

THE STATE IN THE 21ST CENTURY

Ana Célia Castro
Fernando Filgueiras
editors



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The State in the 21st Century

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Ana Célia Castro e Fernando Filgueiras

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CONTENTS

About the authors.....7

Introduction.....17

Innovation systems: from fixing market failures to creating markets.....23

Mariana Mazzucato

The rationale for industrial and innovation policy.....39

Mario Cimoli, Giovanni Dosi, Joseph Stiglitz

Financial Governance After the Great Recession: What Changed and What Didn't?.....57

Jan Kregel

Two successful cases of state investment and a new diffusion model applied to capital flow.....83

Luiz Bevilacqua

Governance Strategies in the 21st Century: Comments on China's New Challenges.....131

Anna Jaguaribe

Energizing industrial development: The role of the state in 21st century greening strategies.....149

John A. Mathews

The role of the state in escaping the middle-income trap: the case for smart industrial policy.....181

Robert H. Wade

**From Exclusive IPR Innovation Regimes to “Commons- Based”
Innovation Regimes: Issues and Perspectives.....209**

Benjamin Coriat

**From catching-up to the technological frontier: challenges for
knowledge governance.....233**

Ana Célia Castro

**Governing Knowledge: Intellectual Property Management for
Development and the Public Interest.....267**

Leonardo Burlamaqui

**Development in unequal societies: Brazil beyond the "golden
decade"291**

Celia Lessa Kerstenetzky

Advances and challenges for social development in Brazil...321

Tiago Falcão and Patricia Vieira da Costa

State Capabilities as a Challenge to Public Policy.....337

Renato Boschi

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A PhD in economics from the University of Sussex, his research deals with development paths, economic growth and its relationship with the productive structure, and international trade. His work examines the interconnections between industrial policy, technological development and innovation. His most important publications include *Learning, Technological Capabilities and Structural Dynamics* (2011); *Innovation and Economic Development: the Impact of Information and Communication Technologies in Latin America* (2010); *Industrial Policy and Development, The Political Economy of Capabilities Accumulation* (with Dosi, G. and J. E. Stiglitz, 2009); and *Institutions and policies in developing economies* (with Dosi, G., R. R. Nelson, and J. E. Stiglitz, 2009).

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INTRODUCTION

Ensuring the conditions for development involves more than simply creating favorable conditions for capitalism. It also involves ensuring governance conditions that create the right incentives so that public and private actors are able to invest and innovate across the different sectors of economy, society, and politics. It also involves creating institutional conditions so that the knowledge generated with innovations and development strategies are conveyed, thus establishing institutional frameworks favorable for economic growth, and the redistribution of generated assets and values.

Based on these premises, this book questions the role of the State in the context of the 21st century, in which the dynamics of the capitalist society is being transformed in scale, associating the development of new technologies, changes in working conditions, the issue of fair redistribution of goods generated, a displacement of power and money centers with governance conditions, and the new roles that the State must exercise. These transformations have altered substantially the economic, social and political contexts in emergent and developed countries, thus demanding new institutional arrays, with the ability to render sustainability to public development policies. Within this context, in the 21st century, the State plays an essential role, not only as a public investor or market regulator, but as an authority that ensures an institutional framework creating favorable, necessary, and sufficient conditions to establish the basis for the development, and conveyance of significant innovations to the sectors of the capitalist economy.

Without this institutional framework enabling a capable, crystal clear, empowered, and efficient public governance, development and innovation policies can hardly prosper, creating measurable and effective results for society. In this book, we have gathered different thoughts on the role of the State in the 21st century. These thoughts go

through the role of the State in the dissemination and the coordination of innovation policies, through industrial policy, state investments, management of knowledge and industrial property, industrial policies, state investment, knowledge management and intellectual property, and through the role of the state itself in the redistribution of goods generated, social policies, and the ability of the State to carry forward development policies. Each of these subject matters, per se, deserves special attention and would entail a range of studies and thoughts. However, the gathering of these texts in this book bears an extensive backbone. No development policy establishes effective and efficient conditions if there is no institutional framework and governance exercised by the State.

It is not a matter of bringing the debate between orthodox and heterodox economists to the core of the book. The thoughts hereby presented are not whether or not the State should intervene in the economy. The thoughts address the institutional framework and the governance of development policies. The purpose of the book lies on the question of the development of capitalist societies under conditions of innovation, expansion, and gradual reduction of disparities. In order to attain this purpose, the thoughts hereby contained are about the systems of public governance that favor this new context of the development policies, i.e. policies of innovation and conveyance of a knowledge that creates and establishes incentives for development.

If presently, innovation is a fundamental precept to make markets move and for development, the State must perform the role of a boosting entity and facilitator of its inherent processes. Given its structure, the State is not innovative in itself. However, it may be a big factor for the development and innovation of the productive chain, and the supply of goods and services to society, through financing, facilitation, and promotion of innovative initiatives. Besides the operation of public banks, the institutional framework promoted by

the State authority is essential to innovation, knowledge management, and the regulatory framework of innovative solutions for society.

Within this context, innovation, changes in industrial policy, sustainability policies, and new technological boundaries should reflect a proposal for wider openness in property, new models of redistribution of wealth and management of capital flows within the context of globalization. Concurrently, it demands new abilities from the State, mainly policies, new governance models, and new action institutional frameworks in society. The challenge of this book is to think about which are the governance milestones necessary and sufficient to achieve development through innovation, knowledge, and redistribution.

The first chapter, by Professor Mariana Mazzucato, deals with innovation policies within the institutional framework of the contemporary State. In face of market failures, the State must not act as the intervener in economy, but as the catalyst for new markets. The second chapter, written by Mario Cimoli, Giovanni Dosi and Joseph Stiglitz, addresses the challenges present in reviewing and restructuring the industrial policy. The institutional redirection of property, as well as capital regimes and flows are essential for development, thus requiring the State to take new stands and governance. The third chapter, by Jan Kregel, deals with financial governance as an essential element for development policies. The changes and responses resulting from the financial crisis did not innovate the governance process. Increasing capital ratios and macro-prudential regulation are tools of the 1970s, thus not able to generate efficient prophylactic measures in crisis situations. In opposition, the fourth chapter, by Luiz Bevilacqua, deals with two successful stories of state investment, associating innovation policies and knowledge management to change and redirect capital flows. The first four chapters focus mainly on governance conditions for development.

The fifth chapter, by Anna Jaguaribe, mentions the case of China. In reviewing its structures of public governance, China has been promoting a shift in the construction of state-oriented capitalism. The Chinese case bets on the future, preserving its political institutions, while innovating its industrial plant, the services sector, and the investment flow. The sixth chapter, written by John Mathews, recognizes that the promotion of green industries, especially in the energy field, is a significant component of state intervention, involving a broad process of bargaining and scale gains. The challenges posed imply rethinking incentive policies based on new institutional arrangements that support innovation and ensure sustainability. The seventh chapter, by Robert Wade, addresses the implementation of intelligent industrial policies. Intelligent industrial policies are those that succeed in promoting and attracting, in the most plural way possible, investments associated with capital gains and intelligence. A targeted industrial policy is not always effective, according to the author, and industrial policies are not miracle solutions. In order to be efficient and effective, an industrial policy must have its performance inserted in both, politics and governance conditions.

The eighth chapter, by Benjamin Coriat, deals with intellectual property rights as the main aspect of public governance and institutional milestones of an innovation policy. Changes in capitalist society and new capital flows require another approach to intellectual property and innovation. The State, prior to stand for citizens, must be a partner of citizenship in the processes of innovation and dissemination of knowledge. Knowledge governance, as Ana Célia Castro states in the ninth chapter, redefines innovation policies. It creates complex structures that redefine concepts and extrapolate the boundaries of given alternatives. In this context, the State must act in partnership and lead innovation processes. Cooperative networks, open innovation processes avoid technological match-ups and ensure better governance conditions towards development. Similarly, Leonardo Burlamaqui

points out that the State must have a strategic action jointly with the intellectual property milestones generated by innovation. Separating profits from innovation, which must be rewarded, but not configured as a monopole - of legally granted property regimes is the focal point of the processes of transformation and development.

The eleventh chapter, written by Celia Kertenetzky, addresses the post-developmental moment experienced in Brazil, and the challenge of development in unequal societies. The key issue in development lies in creating sufficiently inclusive policies in its governance structures, which are capable of reducing inequalities in the flow of economic growth. The twelfth chapter, by Tiago Falcão and Patrícia Costa, deals with the Brazilian experience of social development. In reporting this experience of social development, the authors address the fact that social policies imply growth and economic development, being boosters of change. Finally, the thirteenth chapter, by Professor Renato Raul Boschi, deals with the state capacities necessary to constitute governance conditions for development.

All thoughts hereby presented challenge the issue of development through the construction of governance mechanisms. The role of the State in the 21st century, rather than being an economic propeller or intervener, relies in becoming a partner and a franchisor of a more open development process, based on innovation and on new forms of knowledge, summarizing the conditions of change. The challenge is set, and changes are necessary.

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INNOVATION SYSTEMS: FROM FIXING MARKET FAILURES TO CREATING MARKETS

Mariana Mazzucato

'The important thing for Government is not to do things which individuals are doing already, and to do them a little better or a little worse; but to do those things which at present are not done at all.'

John M. Keynes, *The End of Laissez Faire*, 1926

'The road to the free market was opened and kept open by an enormous increase in continuous, centrally organized and controlled interventionism.'

Karl Polanyi, *The Great Transformation*, 1944

Instead of asking: what benefits [has] this project yielded, it would almost be more pertinent to ask: how many conflicts has it brought in its wake? How many crises has it occasioned and passed through? And these conflicts and crises should appear both on the benefit and the cost side, or sometimes on one—sometimes on the other, depending on the outcome (which cannot be known with precision for a long time, if ever).

Alfred O. Hirschman¹

Beyond market failure

Today countries around the world are seeking 'smart' innovation led growth. And hoping that this growth is also more 'inclusive' and 'sustainable' than in the past (European Commission, 2010). Such a feat requires rethinking the role of government and public policy in the economy—funding not only the 'rate' of innovation, but also envisioning its 'direction'. It requires a new justification of

¹ Cited in Adelman, J. (2013). *Worldly philosopher: the odyssey of Albert O. Hirschman*. Princeton: Princeton University Press, p. 313.

government intervention that goes beyond the usual one of ‘fixing market failures’. It requires shaping and creating of markets. And to render such growth more ‘inclusive’ it requires attention to the ensuing distribution of ‘risks and rewards’.

Complexity theory is relevant here because innovation is (1) a collective process, defined by a *system* of heterogeneous public and private actors, interacting in different ways; (2) it is a fundamentally uncertain process (in the knightian sense) with most attempts ending in failure; and (3) it is a path-dependent, cumulative and highly clustered (wave-like) process, characterised by fat tailed distributions. Unfortunately models of innovation continue to pretend the opposite, i.e. that (1) it is driven mainly by individual genius of ‘entrepreneurs’, at best ‘facilitated’ by the public sector; (2) only characterised by ‘risk’ (see the ‘lottery’ models of endogenous growth theory); and (3) can be modelled as a ‘random walk’ (with little persistence) that statistically appears as a Gaussian process. Understanding the collective, uncertain and persistent nature of innovation helps us to understand the kind of policy questions that we should be asking if we want to achieve smart innovation led growth.

Market failure theory justifies public intervention in the economy only if it is geared towards fixing situations in which markets fail to efficiently allocate resources (Arrow, 1951). The market failure approach suggests that governments intervene to ‘fix’ markets by investing in areas with ‘public goods’ characteristics (such as basic research, or drugs with little market potential) and by devising market mechanisms to internalise external costs (such as pollution) or external benefits (such as herd immunity). Five key sources of market failures - that is, factors or behaviours that result in costs or benefits that are not reflected in the price system – include imperfect competition, information failures, negative externalities, public goods and coordination failures (Mazzucato and Penna, 2014).

Within the mainstream framework, market failure is a *necessary but not sufficient* condition for governmental intervention (Wolf, 1988). The sufficiency results from an assessment that the gains from the intervention outweigh the associated costs due to ‘governmental failures’ (Tullock *et al.*, 2002)—such as capture by private interests (nepotism, cronyism, corruption, rent-seeking) (Krueger, 1974), misallocation of resources (for example, ‘picking losers’) (Falck *et al.*, 2011), or undue competition with private initiatives (‘crowding out’) (Friedman, 1979). Thus, there is a trade-off between two inefficient outcomes; one is generated by free markets (market failure) and the other by governmental intervention (government failure). The solutions advocated by Neo-Keynesians focus on correcting failures such as imperfect information (Stiglitz and Weiss, 1981). Solutions advocated by public choice scholars (Buchanan, 2003) focus on leaving resource allocation to markets (which may be able to correct their failures on their own). While market failure theory provides interesting insights, it is at best useful for describing a *steady state* scenario in which public policy aims to put patches on existing trajectories provided by markets. It is less useful when policy is needed to dynamically create and shape new markets, as in the cases of the Internet, nanotech, biotech, cleantech. There are four key limitations in *Market failure theory*.

1. *Directionality: envisioning and ‘picking’ strategically.* Policies that aim to correct markets assume that once the sources of the failure have been addressed, market forces will efficiently direct the economy to a path of growth and development. Yet, markets are ‘blind’ (Nelson and Winter, 1982; Dosi, 1982) and the direction of change provided by markets often represents suboptimal outcomes from a societal point of view. This is why, in addressing *societal challenges*, states have had to lead the process and provide the direction towards new ‘techno-economic paradigms’ (Perez, 2002), which do not come about spontaneously out of market forces. In

the mass production revolution and the IT revolution, governments made direct ‘mission-oriented’ investments in the technologies that enabled these revolutions to emerge, and formulated bold policies that allowed them to be fully deployed throughout the economy (Mowery, 2010; Block and Keller, 2011). As I show in my recent book (Mazzucato, 2013a), every technology that makes the iPhone ‘smart’ (Internet, GPS, touch-screen display, and SIRI) was publicly funded directly. And even the deployment of most ‘general purpose technologies’ (from electricity to IT) was an outcome of public policy (Perez, 2002). Furthermore, in the IT revolution, and even in the emerging clean-tech revolution, government not only funded the actual technologies (such as mainframes, the Internet, wind and solar power, and fuel cells), but also created a network of decentralized public and private actors (a ‘developmental network state’) (Block and Keller, 2011), provided early-stage funding to companies that risk-averse private finance would not, and devised special tax credits that favoured some activities more than others (Mazzucato, 2013a, 2013b). These facts seem to point to a different analytical problem facing policy makers: not whether the right role is that to intervene or stand back, but understanding *how* particular ‘directions’ and routes can be chosen, and determining how to mobilise and manage activities that can lead to the achievement of dynamic social and technological challenges.

2. *Evaluation: static vs. dynamic metrics.* Market failure theory has developed concrete indicators and methods to evaluate government investments, usually through a cost-benefit analysis that estimates whether the benefits of public intervention compensate for the costs associated both with the market failure and the implementation of the policy (including ‘governmental failures’). However, there is a mismatch between the intrinsically dynamic character of economic development and the static tools used to evaluate policy. The diagnostic tools and evaluation approach based on Market failure theory involves identifying

the sources of market failure and targeting policy interventions on their correction. This entails *ex-ante* considerations about administrative and fiscal requirements and the political-economic consequences of intervention.

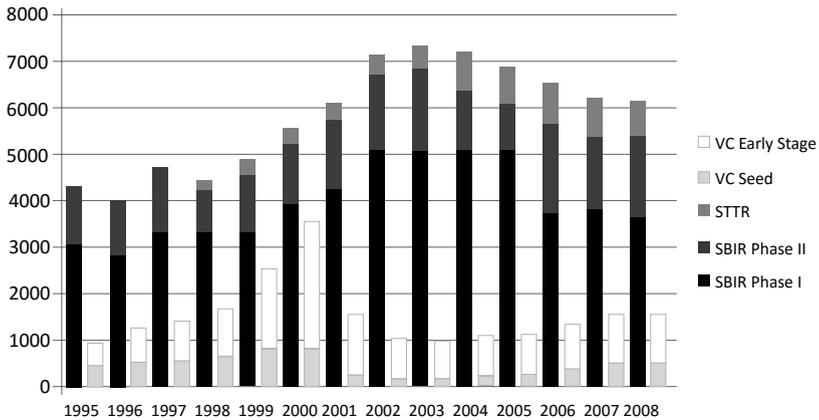
Yet this is a limited toolbox, because it represents a static evaluation of an intrinsically dynamic process. By not allowing for the possibility that government can transform and create new landscapes that did not exist before, the ability to measure such impact has been affected (Mazzucato, 2013a). This then leads to accusations of government 'crowding out' businesses. However, the goal of public investments should be to not only 'kickstart' the economy but to choose directions that "*do those things which at present are not done at all*" (Keynes, 1926). We need *indicators* for such transformative action, in order to avoid investments that are too narrow or directed within the confines of the boundaries set by business practices of the prevailing techno-economic paradigm (Abraham, 2010).

3. Organisation: learning, experimentation and self-discovery. Market failure theory calls for the state to intervene as little as possible in the economy. This view requires has resulted in a trend of 'outsourcing' that often rids government of the knowledge capabilities (for example, around IT) that are necessary for managing change. Studies have examined the influence of outsourcing on the ability of public institutions to attract top-level talent with the relevant knowledge and skills to manage transformative mission-oriented policies (Kakabadse & Kakabadse, 2002). Indeed, there seems to be a self-fulfilling prophecy whereby the less 'big thinking' occurs in government, the less talent/expertise the public sector is able to attract, the less well it performs, the less 'big thinking' it is allowed to do. In order to promote transformation of the economy, by shaping and creating technologies, sectors and markets, the state must organise itself so that it has the 'intelligence' (policy capacity) to think big and formulate bold policies. This does not mean it will always succeed, indeed the underlying

uncertainty in the innovation process means that the state will often fail (Nelson and Winter, 1982; Hirschman, 1967). If the emphasis is on the *process of policy making* (Rodrik, 2013) that can allow the public sector to envision and manage transformational change, then understanding the appropriate structures of public organisations and their ‘absorptive capacity’ (Cohen and Levinthal, 1990) is essential.

4. *Risks and Rewards: towards symbiotic private–public partnerships.* Market failure theory says little about cases in which the state is the *lead investor and risk taker* in capitalist economies through ‘mission-oriented’ investments and policies (Foray et al., 2012). Having a vision of which way to drive an economy requires direct and indirect investment in particular areas, not just ‘creating the conditions’ for change. This requires crucial choices to be made, the fruits of which will create some winners, but also many losers. Figure 1 below shows how much public money has been spent on early stage seed financing through the US Small Business Innovation Research programme. Indeed, precisely because venture capital has become increasingly short-termist, with emphasis on an exit in 3 years (while innovation takes 15–20 years!), such funding has become increasingly important. As have also guaranteed loans for innovative high risk projects. For example, the Obama administration in the US recently provided a direct \$500 million loan to two green-tech companies, Solyndra and Tesla Motors. While the latter is often glorified as a success story, the former failed miserably and became the latest example, used widely by both economists and the more popular treatment in the media, of government being unable to ‘pick winners’. Indeed, the taxpayer picked up the bill (Wood, 2012), and complained. This highlights the need to build a theoretical framework that can help the public sector understand (a) its ‘portfolio’ choices (Rodrik, 2013) and (b) how to socialise not only the risks of those investments but also the rewards. Is it right that the tax payer shouldered the Solyndra loss, yet made nothing from the Tesla profits?

Figure 1 – Early-stage and seed funding awards, SBIR and venture capital



Source: Adapted from Block and Keller (2012)

The question comes down to whether in a market failure framework, the government deserves to retain a direct share of the profits generated from the growth that it fosters. Or put another way, are taxes currently bringing back enough return to government budgets to fund high-risk investments that will probably fail? It is well known that companies that benefit greatly from government investments have been successful in avoiding tax: Google, whose algorithm was funded by the NSF, has been criticised for such avoidance, as have also Apple and Amazon and a host of ‘new economy’ companies. Even if they were not dodging tax, tax *rates*, such as that on capital gains, have been falling due to the narrative that it is a narrow set of agents who are the real innovators and risk takers (Lazonick and Mazzucato, 2013²).

² It was the National Venture Capital Association that in the late 1970s lobbied for capital gains tax to fall from 39.6% to 20% in 5 years (Lazonick and Mazzucato, 2013). Warren Buffett has admitted that such tax changes did not affect investment, only inequality.

Socialising both risks and rewards

This is because innovation is a highly uncertain process; it takes a very long time to develop new technologies, and the effort often ends up in a dry hole. For every Tesla (companies that receive public funding, and become market darlings), there are many Solyndras (companies that receive public funding, and then go bankrupt). For every Internet (technologies funded by government with great success) there are many Concordes (projects funded by government that fail commercially). Indeed Solyndra's recent bankruptcy has been used to talk about government failure, not recognising that if government is to act like a venture capitalist, which it historically has, it will—like all VCs have to—undergo many failures to reach some successes. However, what has not been thought through enough is the way in which to measure success/failure from a government's standpoint, and also how to make sure that, like private VC funds, the state can reap back some return from the successes, in order to cover its losses, and the next round of investments: a revolving fund. This is especially important given the path-dependent and cumulative feature of innovation. Returns arise slowly, negative in the beginning, and slowly building up – potentially to a big pot (eg at the end of the biotech, dotcom and nanotech revolutions). One can think of returns as a cumulative distribution curve, with a slow rise at first, then with a steep increase, followed by levelling off. Unless we understand the collective process of innovation, we risk allowing a narrow group of actors to reap not just the returns proportional to their marginal contributions, but close to the entire *integral* under the curve.

So who gets what? Economists argue that the state already earns back a return for its investments, indirectly via the taxation system. There are three arguments against this reasoning: (1) tax evasion (legal and illegal) is common and realistically will not disappear; (2) taxes, such as capital gains, have been falling over

the last decades, precisely through a false narrative about who the wealth creators are; (3) global movements of capital mean that the particular country or region (e.g. the European Union) funding the innovation might not reap the benefits in terms of local job creation; and (4) while it is of course right to think that investments in the 'basics', such as education, health and research, should not be thought about as earning a return, it is these directed investments at companies and particular technologies that pose a very different problem. If the state is being asked to make such investments (which it undoubtedly has been making and increasingly so, as financial markets have become even more speculative and short-termist), it is necessary for it to cover its inevitable losses when those arise.

Where technological breakthroughs have occurred as a result of targeted state interventions for specific companies, there is potential for the state to reap some of the financial rewards over time, by retaining ownership of a small proportion of the intellectual property created. This is not to say the state should ever have exclusive license or hold a large enough proportion of the value of an innovation to deter a wider spread of its application (and this has never been the case)—the role of government is not to run commercial enterprises, but to spark innovation elsewhere. However, a government should explore whether it is possible to own some of the value it has created, which over time could generate significantly higher value and then be reinvested into growth-generating investments. By adopting 'portfolio' approach to public investments in innovation, success from a few projects can then help cover the losses from many projects.

There are various ways to consider a direct return to the state for its investments in innovation. One is to make sure that loans and guarantees that are handed out by the state to business do not come without strings attached. Loans and grants could have conditions, such as 'income-contingent loans', similar to that of *student loans*. If a company receives a loan/grant from the state, it should be required

to pay back a portion if and when it makes profits above a certain threshold (Mazzucato, 2013). This is not a complicated concept, of course, but it does run counter to some deep-seated assumptions. Currently, with budget deficits under so much pressure, it is no longer possible to ignore the issue.

Apart from income-contingent loans, there is the possibility of the state retaining equity in the companies that it supports. Indeed, this does occur in some countries, such as Israel (through the Yozma public venture capital fund) or in Finland (where SITRA, one of Finland's public funding agencies, retained equity in its early-stage investments in Nokia). To be sure, equity stakes are also retained by state investment banks, such as BNDES (through *BNDESPar*, or 'BNDES Participations'), China Development Bank and KfW, which are two lead investors in the emerging green economy (Mazzucato and Penna, 2014). However, state equity in private companies is often feared in countries like the USA and the UK (and other countries that have copied the Anglo-Saxon model) for fear that the next step is 'communism'! Despite this fear, the most successful capitalist economies have had active states, making the risky investments that resulted in truly technological revolutions (Perez, 2002). We have been too quick to criticise public investments when things go wrong (for example, Concorde or Solyndra) and too slow to reward them when things go right (such as the Internet or Tesla).

Conclusion: a new framework requires new questions

The solutions derived from Market failure theory (downsizing the state apparatus, promoting market-based mechanisms to counter market failures, insulating public agencies from the private sector, etc.) might hold for steady state situations, but not for the situations in which public policy is required for *transformation*, such as those witnessed through the technological and socio-economic missions of the past.

Such missions required an emphasis not on fixing market failures or minimising *government failures* but on *maximising the transformative impact of policy that can shape and create markets*.

Considering the need for government policy to ‘transform’, be catalytic, create and shape markets not just fix them, helps reframe the key questions of economic policy from static ones that worry about crowding out and picking winners to more dynamic ones that are constructive in forming the types of public–private interactions that can create new innovation and industrial landscapes. In this perspective, it is key for government to not just pick different technologies or sectors but ask what it wants from those sectors. In the same way that putting a man on the moon required many sectors to interact, the ‘green’ direction being debated today also requires all sectors to change. Green is not only about wind, solar and biofuels but also about new engines, new maintenance systems, new ways of thinking about product obsolescence (Mazzucato and Perez, 2014). This is not about prescribing specific technologies, but providing directions of change which bottom up solutions can then experiment around. As Stirling (2014) has recently put it: *‘The more demanding the innovation challenges like poverty, ill health or environmental damage, the greater becomes the importance of effective policy. This is not a question of “picking winners”—an uncertainty-shrouded dilemma which is anyhow equally shared between public, private and third sectors. Instead, it is about engaging widely across society, in order to build the most fruitful conditions for deciding what “winning” even means’.*

Government would benefit from adopting a portfolio approach to public investments in innovations, nurturing the explorative, plural, and trial and error aspect of change. This requires thinking not only about technological change in a new way but also organizational change. Building the public agencies of the future with creative, adaptive and explorative capacity.

In sum, to approach the innovation challenge of the future, we must open up the discussion, away from the worry about ‘picking winners’ and ‘crowding out’ towards four key questions for the future should be:

1. Directions. How can public policy be understood in terms of setting the direction and route of change; that is, shaping and creating markets rather than just fixing them? What can be learned from the ways in which directions were set in the past, and how can we stimulate more democratic debate about such directionality?

2. Evaluation. How can an alternative conceptualisation of the role of the public sector in the economy (alternative to *Market failure theory*) translate into new indicators and assessment tools for evaluating public policies, beyond the micro-economic cost/benefit analysis? How does this alter the crowding in/out narrative?

3. Organisational change. How should public organisations be structured so they accommodate the risk-taking and explorative capacity, and the capabilities needed to envision and manage contemporary challenges?

4. Risks and Rewards. How can this alternative conceptualisation be put into practice so that it frames investment tools so that they not only socialise risk but also have potential to socialise the rewards that enable ‘smart growth’ to also be ‘inclusive growth’?

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THE RATIONALE FOR INDUSTRIAL AND INNOVATION POLICY

Mario Cimoli, Giovanni Dosi, Joseph Stiglitz

The evolution of industries¹

A fundamental element in countries that successfully caught-up with the leaders during the 19th and 20th centuries was active government support of the catch-up process, involving various forms of protection and direct and indirect subsidy. The guiding policy argument has been the need of domestic industry in the industries of the day judged critical in the development process for some protection from advanced firms in the leading nations. Alexander Hamilton's argument (1791) for infant industry protection in the new United States was virtually identical to that put forth decades later by Friederich List (1841) regarding Germany's needs. Gershenkron's (1962) famous essay documents the policies and new institutions used in Continental Europe to enable catch-up with Britain. The same story also fits well with the case of Japan, and of Korea and Taiwan somewhat later. In many countries these policies engendered not successful catch-up but a protected inefficient home industry. However, they also were the hallmark during the 20th century of all the countries that have achieved their goals of catching-up.² We need to learn more about the circumstances under which infant industry protection leads to a strong

¹ This paper draws upon M. Cimoli, G. Dosi and J. E. Stiglitz (eds.), *The Political Economy of Capabilities Accumulation: the Past and Future of Policies for Industrial Development*, Oxford University Press (2009) and on successive joint work by the authors. The research leading to this work has enjoyed the long-term backing of the Initiative for Policy dialogue (IPD), Columbia University.

² For a broad historical overview of the role of policies in some now-developed countries, see Reinert (2004).

indigenous industry: the project on which this work draws shed new light on the issue.

These policies obviously angered companies in the leading countries, and their governments, particularly if the supported industry not only supplied its home market but began to invade the world market. While the case made after World War II for free trade was mostly concerned with eliminating protection and subsidy among the rich countries, and at that time there was sympathy for the argument that some infant industry protection was often useful in developing countries, the more recent international treaties that have been made increasingly have been used against import protection and subsidy in countries seeking to catch-up from far behind.

Our belief is that Hamilton and List were and continue to be right that successful catch-up in industries where international trade is considerable requires some kind of infant industry protection or other modes of support.

Table 1. summarizes an exploratory taxonomy of policy interventions, measures and related institutions.

In the last resort, policies and other activities of “institutional engineering” affect together (i) the technological capabilities of individual and corporate organizations, and the rate at which they actually learn; (ii) the economic signals that they face (including of course profitability signals and perceived opportunity costs); (iii) the ways they interact with each other and with non-market institutions (e.g. public agencies, development banks, training and research entities, etc.)

It happens that all major developed countries present indeed relatively high degrees of intervention – whether consciously conceived as industrial policies or not – that affect all the above variables. And this applies, even more so, to the period when today’s developed countries were catching-up with the international leader. What

primarily differentiate the various countries are the instruments, the institutional arrangements and the philosophy of intervention.

The case of Japan is a paradigmatic example of catching-up policies (Dosi, 1984).

Interestingly, Japan appears to have acted comprehensively upon all the variables categorized in our taxonomy above. A heavy discretionary intervention upon the structure of signals (also involving formal and informal protection against imports and foreign investments) recreated the “vacuum environment” that is generally enjoyed only by the technological leader(s). However, this was matched by a pattern of fierce oligopolistic rivalry between Japanese companies and a heavy export orientation which fostered technological dynamism and prevented any exploitation of protection simply in terms of collusive monopolistic pricing.

It is tempting to measure this Japanese experience - notwithstanding, recent, mostly macroeconomic difficulties - with others, on average less successful, such as the European ones, which heavily relied upon one single instrument, financial transfers (especially R&D subsidies and transfers on capital account), leaving to the endogenous working of the international market both the determination of the patterns of signals and the response capabilities of individual firms. Certainly, there are country-specific features of the Japanese example which are hardly transferable. However, that case, in its striking outcome, points at a general possibility of reshaping the patterns of “comparative advantages” as they emerge from the endogenous evolution of national and international industries.

Table 1 – Processes and institutions for policies on technological learning and industrial change

Domains of policy intervention	Policy measures	Related institutions
(i) Opportunities of scientific and technological innovation	Science policies, graduate education, “frontier” technological projects	Research universities, public research centers, medical institutes, space and military agencies, etc.
(ii) Socially distributed learning and technological capabilities	Broader education and training policies	From primary education to polytechnics, to US-type “land-grant colleges”, etc.
(iii) Targeted Industrial Support Measures, affecting e.g. types of firms, etc. – in primis the structure, ownership, modes of governance of business firms (e.g. domestic vs. foreign, family vs. publicly owned companies, etc.)	From the formation of state-owned firms to their privatization, from “national champions” policies to policies affecting MNCs investments; all the way to the legislation affecting corporate governance	State-owned holdings, public merchant banks, public “venture capitalist”, public utilities
(iv) The capabilities of economic agents (in the first instance business firms) in terms of the technological knowledge they embody, the effectiveness and speed with which they search for new technological and organizational advances, etc.	cf. especially points (ii), (iii) and also R&D policies; policies affecting the adoption of new equipment, etc.	
(v) The economic signals and incentives profit-motivated agents face (including actual and expected prices and profit rates, appropriability conditions for innovations, entry barriers, etc.)	Price regulations; tariffs and quotas in international trade; Intellectual Property Rights regimes, etc.	Related regulatory agencies, agencies governing research and production subsidies, trade controlling entities, agencies granting and controlling IPRs
(vi) Selection mechanisms (overlapping with the above)	Policies and legislation affecting Anti-trust and competition; entry and bankruptcy; allocation of finance; markets for corporate ownership; etc.	Anti-trust authorities, institutions governing bankruptcy procedures, etcw.
(vii) Patterns of distribution of information and of interaction amongst different types of agents (e.g. customers, suppliers, banks, shareholders, managers, workers, etc.)	Governance of labor markets, product markets, bank-industry relationships, etc. all the way to collectively shared arrangements for within-firms information-sharing mobility and control, forms of cooperation and competition amongst rival firms, etc. (cf. for example the historical differences between Japanese vs. Anglo-Saxon firms)	

Certainly, the historical experience shows a great variety of country and sector-specific combinations between the types of policies illustrated above. Some subtle regularities nonetheless emerge.

First, a regularity, holding from 19th century Europe and US all the way to contemporary times, is the centrality of public agencies, such as universities, and public policies in the generation and establishment of new technological paradigms.³

Second, and relatedly, “incentives are often not enough”. A crucial role of policies is to affect the capabilities of the actors, especially in the foregoing case of new technological paradigms, but also in all cases of catching-up whereby no reasonable incentive structure might be sufficient to motivate private actors to surmount big technological lags.

Third, market discipline is helpful in so far as it weeds out the low performers and rewards the high performers within particular populations of firms. However, nothing guarantees that too high selective shocks will not wipe out the entire populations themselves, thus also eliminating any future learning possibility.

Fourth, policies - especially those aimed at catching-up - generally face the need to balance measures aimed at capability building (and also at protecting the “infant learner”) with mechanisms curbing inertia and rent-seeking. For example, the latter are indeed one of the major elements missing in the old Latin American experience of import substitution while the former are what is lacking under many more recent “liberalization” policies.

Fifth, historically, a successful catching-up effort in terms of per capita income and wages has always been accompanied by catching-up in the new and most dynamic technological paradigms, irrespective of the initial patterns of comparative advantages, specialization and market-generated signals. Our conjecture is that, *ceteris paribus*, the

³ In particular on the serendipitous impact of public mission oriented programs after WWII see Mazzucato (2013).

structural need for policies affecting *also* the patterns of economic signals (including relative prices and relative profitabilities) as they emerge from the international market will be greater, the higher the distance of any one country from the technological frontier. This is what Amsden (1989) has provocatively called policies of deliberately “getting the prices wrong”. Conversely, endogenous market mechanisms tend to behave in a “virtuous” manner for those countries that happen to be on the frontier, especially in the newest/most promising technologies. This is broadly confirmed by historical experience: unconditional free trade often happened to be advocated and fully exploited only by the technologically and politically leading countries.

The lessons from the past are useful in so far as they apply also to the future. Today, policy making ought to be acutely aware of the fact that future capabilities build upon, refine and modify incumbent ones: hence the policy goal of building *good path-dependencies* (see also Hausmann and Rodrick, 2006). Below is a list of feasible policies that go in this direction.

1. The necessity of nurturing infant industries

Safeguarding the possibility of learning, is indeed the first basic pillar of the *infant industry logic*.

On the incentive side, market signals left to themselves are often not enough and indeed frequently *discourage* the accumulation of technological capabilities in so far as they ought to occur in activities currently displaying significant comparative *disadvantages* and thus also unfavourable current profitabilities. Incidentally note, also, that the existence of financial markets are meagre instruments, if at all, for translating a future and uncertain potential for learning into current investment decisions (more in Stiglitz, 1994; and Stiglitz and Greenwald, 2014). Thus, there are sound learning-related reasons why historical evidence shows that, just prior to industrial catching-up, average industrial import tariffs are relatively low; they

rise rapidly in the catching-up phase, and they fall after a mature industrialization. Indeed, it is during the catching-up phase that the requirement of distorting (international) market signals is more acute, precisely because there are young and still relatively fragile learning infants. Partly it has to do with the fact that many forms of protection entail the *possibility* of learning but not, in the language of Khan and Blankenburg (2009), the ‘compulsion’ to innovate as distinct from the sheer incentive to just exploit a monopoly rent, no matter how inefficient and lazy is the potential ‘learner’ (more on this below). Partly, it has to do with the *conditions of capabilities accumulation and the characteristics of the actors involved*.

After all, even under the best intentions and incentives, industrialization might have rather little to do with the sheer award of property rights and with the establishment of firms as legal entities (cf. Hobday and Perini, 2009). Of course, the legal context does matter and is likely to be a conducive condition. However, this is far from sufficient. In fact, it is quite misleading to think that all over the world there are plenty of sources of technological knowledge just awaiting to be exploited – the lag being due mainly to institutional and incentive-related forces. In fact, irrespectively of the opportunities for the entrepreneurial exploitation of technological knowledge which the ‘international knowledge frontier’ *notionally* offer, the fundamental gap regards precisely the *lack of capabilities* in exploring and exploiting them. ‘horizontal’ policies of education and training, together with the activities of technical support to firms by public institutions can go a long way in the capability-enhancing direction. But even that is not likely to be enough. In fact policies are often bound to get their hands *explicitly* dirty with respect to the nature, internal structure, strategies of few corporate agents themselves.

Fostering the emergence and in a few occasions explicitly building technologically and organizationally competent firms are indeed fundamental infant nurturing tasks.

Needless to say the absence/existence of mature technological capabilities and 'dynamic capabilities' for changing them (cf. Teece, Pisano, and Schuen,1997) in any one country is not a binary variable. However, the distribution is highly uneven. So, one could list several dozen countries which can hardly show any. Other countries do display some technologically progressive organizations in a bigger sea of less dynamic firms. In fact, even the most developed countries present only a fraction of technologically dynamic organizations within a much greater population of firms. (Note that all this applies to both 'high tech' and 'low tech sectors as conventionally defined). In a sense, industrialization has to do with the properties of changing distributions between 'progressive' and 'backward' firms. How do policies affect such dynamic? Dahlman, (2009) reports on China and India, but the historical lesson goes well beyond these two country cases. Policies happened to involve

- (i) state ownership;
- (ii) selective credit allocation;
- (iii) favourable tax treatment to selective industries;
- (iv) restrictions on foreign investment;
- (v) local context requirements;
- (vi) special IPR regimes;
- (vii) government procurement;
- (viii) promotion of large domestic firms.

In a nutshell, this is the full list of the capital sins which the market faithful are supposed to avoid!

There is here again a widespread misunderstanding to be dispelled, which goes under the heading of 'picking-the-winner' or 'national champion' fallacies. Why should governments foster national oligopolists or monopolists in the first place? And how could governments be more 'competent' than market in selecting who is technologically better or worse?

There certainly are unintentional or even counter-intentional outcomes of discretionary industrial policies. Of course, untainted pro-market advocates typically quote among OECD countries the failures of the computer support programmes and the Concord project in Europe as archetypes of such ‘government failures’ to be put down on the table against ‘market failures’. Economists more sympathetic to the positive role of the public visible hand, including us, would find easy to offer the cases of Airbus or ST Microelectronics in Europe, Petrobras and Embraer in Brazil, etc., among many others, as good counterexamples. However, our point goes well beyond this. The ‘picking the winner idea’ basically builds on the unwarranted myth that there are many ‘competitors out there’ in the market, and the government has the arrogance of ‘knowing better’ than the market in their selection. This is often far away from reality in developed countries and, even more so, in catching-up ones. And in fact it happens that the major vehicles of learning and catching-up in all episodes of successful industrialization, with the possible exception of little Singapore, have been *domestic* firms – sometimes alone, sometimes in joint-venture with foreign MNCs -, but rarely MNCs themselves. This holds from German and American industrialization all the way to current China – possibly the case nearest to a two-pronged strategy, both fostering the development of domestic firms and trying to squeeze out of foreign MNCs as much technological knowledge as possible.

Historically, the ‘infant learners’ had to be shielded or helped in the domestic and international markets essentially in their interactions with the more efficient and more innovative firms from ‘frontier’ countries. In these interactions, there is no reason to give up the ‘infant nurturing’ philosophy. On the contrary, it adds to the reasons urging to push toward a more explicit use of the domestic or regional markets as venues of culture of an emerging national industry even when

the latter tends to be squeezed on the international arena between 'advanced productions' and Chinese exports⁴.

2. *Infant industries under the new international Trade Regime*

There is another big novelty in the current organization of international economic relations, namely the regulatory regime stemming from the World Trade Organization (WTO) and the TRIPS agreements (more on them below). The latter ones have implied stronger constraints on what is admissible in terms of subsidies and other discretionary forms of support to firms and industries.

What can be done?

Quite a few things can be done also within the incumbent agreements, full as they are of loopholes and of provisions for exceptions generally put there by the negotiators of developed countries with an eye on their special interests – ranging from dubiously defined 'anti-dumping measures' to national safety and security considerations. Developed countries (in fact, frequently, *the very representatives of special industrial interests* in person, mostly from the U.S., EU and Japan), have been quick in exploiting these provisions. Developing countries have rarely done so, overwhelmed by the power of the money, the political clout, the lawyers' sophistication, the power of blackmail by stronger States. At least equally common has been so far the unawareness of these opportunities for pragmatic management, certainly thickened – we caricature on purpose – by Chicago-trained ministers of the economy truly believing that all problems come from the fact that trade liberalization has not gone far enough, and directors-general of the ministry of trade who had been taught that

⁴ China quickly reduces its absolute disadvantages across the board, in both more traditional productions and in activities based on the newest technological paradigms. And it does so at rates higher than its catching-up in wages (notwithstanding the fast growth of the latter). The outcome is an absolute *cost* advantage in an expanding set of goods including those which were/are central to industrial production of many low and middle income countries.

the Heckscher-Ohlin-Samuelson theorem on gains-from-trade is the last word on the subject. *There are other things that must be avoided at all costs: among them, shy away from 'bilateral' agreements.*

In brief, 'bilateral' agreements are WTO-plus, and, in terms of Intellectual Property Rights, 'TRIPS-plus' agreements, whose bottom line is to close the loopholes/exceptions/safeguard clauses of the original WTO and TRIPS agreements, freezing them in favour of the companies and industries from the developed world. So, a bilateral agreement, most often with the U.S., offers 'preferred country clauses', typically concerning textile exports and the like, which we know do not matter much, if at all, since Chinese exports are more competitive even if one takes away all tariff on the developing country's export. On the other more subtle side, the provisions of the bilateral agreement often involve the unconditional acceptance of the IPR regime imposed by the developed partner and curbs on imports from third countries of commodities produced under the various waivers still contemplated under the WTO. While there are significant and still largely unexploited degrees of freedom unintentionally provided by the current international trade institutions and rules, the straight jacket is likely to remain too tight. As Dahlman (2009) remarks, if China and India "had liberalized from the beginning it is unlikely that they would be the strong economic powers that they have become. To a large extent, some of the strengths of both countries are that they developed strong capabilities before they liberalized". The point applies of course also to the countries which are beginning now their process of capability accumulation. But then the conclusion is that some trade re-negotiation is going to be necessary. It is reasonable for example to switch to a regime whereby the object of multilateral agreement are *average* industrial tariffs as distinct from tariffs that are line-by-line or apply to specific products and sectors.

The system is simpler than the current structure of tariff commitments and would also reconcile multilateral discipline with

policy flexibility since countries would be able subject to an overall average ceiling while maintaining degrees of freedom for discretionary sectoral strategies. In practice it would have the effect of balancing tariff increases and reductions , since a country would need to lower its practised tariffs on some products in order to be able to raise them on others. This would encourage governments to view tariffs as temporary instruments and focus the efforts to ensure that they effectively serve the purpose they are designed for, that is to provide a breathing space for infant industries before they mature and catch up with their counterparts in more advanced countries.

Moreover, within such a logic, the average ceiling itself ought to depend on the levels of technological and economic development, raising as the catching up process is put in motion and falling as industrialization become ripe.

3. A management of the distribution of rents favourable to learning and industrialization

The other side of ‘infant nurturing’ policies discussed above regards the rent distribution profile that they entail. We have already emphasized that offering an opportunity of learning via, say, a temporary trade barrier, does not imply *per se* the incentive to do so rather simply exploiting the rents stemming from the protection. As outlined by Khan and Blankenburg (2009) , successful industrialization policies have all come with rent management strategies providing for *compulsions* for learning and accumulation of both technological capabilities and production capacity. There are three sides to such strategies.

First, on the ‘carrot’ side, policies must be able to transfer resources to the ‘progressive actors’: fiscal policies, subsidies, preferential credits, grants are among the possible means. In fact, fiscal policies are particularly important in the transfer of resources from those activities which benefit from (cyclical or, even more so, trend)

improvements in the terms of trade of natural resources - in the form of export levies, royalties indexed on the final price of the commodities, fines and taxes discouraging environmental damage. Moreover, the construction of industrialization-friendly financial institutions is of paramount importance. Second, on the 'stick' side, governments must have the credibility to commit to developmental rents for periods that are sufficiently long but not too long (of course how long will depend on the sectors; the nature of the technologies; the distance from the international frontier; the initial capabilities of managers, technicians, workers, etc.). In that, of course, the critical requirement is the credible commitment to stop all rent-yielding measures after some time and, in any case, to withdraw them and impose sanctions on firms and industries failing to achieve technological investment or export targets. Third, the nurturing of domestic oligopolists has to be matched by measures fostering competition. There is a general lesson coming from the experiences of Korea, and some decades before Japan, whereby quasi-monopolistic or oligopolistic domestic firms were forced, quite early on, to compete fiercely on the international markets. And, together, above some threshold of industrial development, anti-trust policies are an important deterrent against the lazy exploitation of 'infant protection'.

Indeed, the management of rent distribution in its relation with industrial learning is one of the most difficult and most crucial tasks of any industrialization strategy, as it concerns the overall distribution of income, wealth and political power across economic and social groups.

4. Tight Intellectual Property Rights regimes never help industrialization and sometimes harm it

All catching-up countries – including, to repeat, at one time also the United States and Germany – have done so through a lot of imitation, reverse engineering, straightforward copying. But these activities are precisely what strong property right protection is meant

to prevent. How effective IPR are in achieving this objective depends a lot on the technologies and the sectors but certainly when they are effective they are likely to represent an obstacle to domestic technological learning. Conversely, if IPR protection *may* represent an incentive to innovate in *frontier* countries – a claim indeed quite controversial, not supported by particularly robust evidence (cf. again Dosi et al., 2006, for a discussion) –, there is no evidence that they have any positive effect in spurring innovative activities in catching-up countries. Certainly, successful industrializers at some point start innovating and also patenting, but typically – a century ago as well as today – they fill their patent claim in frontier countries where their strongest competitors are likely to be based. At the same time, the domestic IPR regime has been characteristically weak. The situation, however, has recently changed with TRIPS agreements which have basically extended the tightest IPRs rules of developed countries to all the signing countries, including developing ones, and has been made even worse by the already mentioned bilateral agreements. Further, TRIPS has taken away the possibility of differentiation the regime of protection across products and technologies.

First, it is to *be aware* and never buy the story that ‘IPR are good for development because they are good for innovation’. On the contrary, in many technological areas they are largely irrelevant for both innovation and technological catching-up. In other areas like, in primis, *drugs*, they are definitely harmful for imitation and capability building in catching-up countries (while they have indeed a dubious effect on the rates of innovation in frontier countries). A consequence of such an awareness is also the need of greater efforts to build institutional capabilities and a clear ‘technology acquisition strategy’ to orient negotiations and dispute settlements.

Second, and relatedly, TRIPS agreements contain a series of loopholes, safeguard clauses and exceptional provisions – for example

concerning compulsory licensing – which catching-up countries have still to learn how to exploit.

Third, the most advanced among catching-up countries ought to strive to offer relatively less developed ones appealing regional agreements which could be viable alternatives to the bilateral agreements with the U.S. (and the EU) generally containing IPR provisions even stricter than TRIPS.

Last but not least, also in this case, alike in the trade of goods –already discussed – a new wave of multilateral negotiations are likely to be needed aimed at

- I. reducing the breadth and width of IPR coverage;
- II. expanding the domain of *unpatentability* – from scientific knowledge to algorithms to data -, and,
- III. conditioning the degrees of IPR protection on the relative level of economic and technological development of each country.

After all, the current international IPR regime is largely the response to the special appropriability interest of a small *sub-set* of developed countries' firms – basically Big Pharma and biotech, Microsoft and Hollywood. A reform in the directions just indicated would benefit catching-up countries, but also the first-world consumers, without doing any harm to the overall rate of innovation.

5. The necessary consistency between macroeconomic and industrial policies

As extensively discussed in several chapters of Cimoli, Dosi and Stiglitz (2009) addressing the Latin American experience over the last two decades, there are macroeconomic policies which kill most learning efforts together with most forms carrying the related learning capabilities. Sudden and indiscriminate dismantling of trade barriers can easily do that, especially if it comes together with reckless (non) management of exchange rates, characterized by vicious cycles of appreciation followed by sudden devaluations. And the cycles have

been only amplified by the stubborn refusal to utilize controls over capital movements, especially short-term movements. Blind trust in the ‘magic of the market place’ and the associated lack of fiscal policies and demand management increases output volatility. In turn, the latter, together with the endemic financial fragility of many developing countries’ firms means induced waves of corporate mortality and with that also the disappearance of the capabilities of technological accumulation. And even among surviving firms, behaviours tend to become more short-term and the economy tends to respond more to financial signals than to long term learning opportunities (more on all that in Ocampo and Taylor, 1998; and Stiglitz et al., 2006). The comparative tales of Latin American countries as compared to e.g. Korea or Malaysia, tell the importance of the vicious feedbacks between macro policy shocks prescribed by orthodox recipes and micro dynamics (in Latin America) vs. the virtuous feedbacks between more interventionist and ‘Keynesian’ macro policies and the continuing industrial expansion even under severe financial crises (e.g. in Korea).

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FINANCIAL GOVERNANCE AFTER THE GREAT RECESSION: WHAT CHANGED AND WHAT DIDN'T?

Jan Kregel

The Nature of Financial Institutions

The methods of financial governance depend on how financial services impact the pursuit of government's policy objectives. The traditional approach considers finance and financial services as equivalent to any other good or service provided in the economy; provision is thus subject to the operation of market forces and governance involves augmenting the operation and efficiency of those forces. Indeed, one of the major post-war criticisms of one of the most successful examples of financial governance, the New Deal Glass-Steagall Act, was that it created a monopoly for commercial banks in the provision of insured bank deposits which provided them zero cost funding. Like any monopoly these conditions were considered as market imperfections and thus considered as inefficient and a wasteful misallocation of resources. The wave of deregulation and liberalisation of US financial markets that occurred in the 1980s was based on this argument. In the context of the run up to the recent financial crisis this traditional approach was represented by the Chairman of the Board of Governors of the Federal Reserve System Alan Greenspan who based his approach to governance of the financial system on the idea that market forces limit leverage and risk: "private regulation generally has proved far better at constraining excessive risk-taking than has government regulation." (Greenspan, 2008) An alternative approach, based on the contributions of Keynes, Schumpeter, Minsky and other analysts of

monetary cycles argue that financial institutions and financial services are inherently different from produced real goods and services and the standard conditions for the existence of market supply and demand are not satisfied and are thus inapplicable. In particular, this relates to the absence of any constraints on the degree of leverage and financial innovation that is the basis of the creation of money, liquidity and near-money substitutes, requiring active governance of the process by government regulatory authorities.

It is important to note that representatives of the diverse approaches to governance both as Greenspan and Hyman Minsky agree that the driving force behind the instability of the financial system; they diverge on the most appropriate governance mechanism. For Greenspan “The very nature of finance is that it cannot be profitable unless it is significantly leveraged... and as long as there is debt, there can be failure and contagion.” (Greenspan, 2013) This assessment is virtually identical to Minsky’s view: “Banks are profit maximizing organizations. The return on owners’ equity is $P/B = (P/A) (A/B)$ where P is profits, B is the book value of owners’ equity, and A is assets. Given this profit identity, bank management endeavors to increase profits per dollar of assets and assets per dollar of equity”. (Minsky, 1977: 17) But, Minsky adds an additional factor, that innovation is an integral part of the creation of leverage: “During periods of banking and financial innovation, the supply schedule of credit to business is virtually infinitely elastic. The availability of financing leads to increases in 1) capital asset prices relative to income, 2) the demand for investment goods, and 3) investment activity that is financed. The period in which a virtually infinitely elastic supply of credit exists is transitory, however, for the ever increasing amount of investment that is financed will lead to first an inflation in prices relative to wages and then to a wage inflation.”(Minsky, 1977: 17-9) One of the most important innovations in the recent period has been the use of derivatives: And also here Greenspan’s assessment is based on the

application of market controls: The reason that growth has continued despite adversity, or perhaps because of it, is that these new financial instruments are an increasingly important vehicle for unbundling risks. These instruments enhance the ability to differentiate risk and allocate it to those investors most able and willing to take it. This unbundling improves the ability of the market to engender a set of product and asset prices far more calibrated to the value preferences of consumers than was possible before derivative markets were developed. The product and asset price signals enable entrepreneurs to finely allocate real capital facilities to produce those goods and services most valued by consumers, a process that has undoubtedly improved national productivity growth and standards of living. “ (Greenspan, 1999)

Thus both consider leverage (the excess of the institution's liabilities over owners' equity) as endemic and essential to the operation of the financial system. And both would have accepted Minsky's citation of Henry Simons: “Banking is a pervasive phenomenon, not something to be dealt with merely by legislation directed at what we call banks” The only difference is in how to reign in the operation of competitive innovation and the profit motive with the fact that leverage, which determined the supply of finance, is not subject to equilibration by any market forces. For Minsky “a fundamental flaw exists in an economy with capitalist financial institutions, for no matter how ingenious and perceptive Central Bankers may be, the speculative and innovative elements of capitalism will eventually lead to financial usages and relations that are conducive to instability”

Indeed, Greenspan also appeared to share this view for in the aftermath of the recent financial crisis he recognized the error of his belief in the limits on the creation of liquidity by means of leverage was subject to market forces: “I made a mistake in presuming that the self-interest of organizations, specifically banks, is such that they were best capable of protecting shareholders and equity in the firms.” “Those of us who have looked to the self-interest of lending institutions to

protect shareholders' equity, myself included, are in a state of shocked disbelief." "I've found a flaw. I don't know how significant or permanent it is. But I've been very distressed by that fact." (Greenspan, 2008)

As the greatest financial crisis since the Depression of 2007-8 morphed into the Great Recession of 2009-14 there appeared to be a consensus that the market was not capable of governing finance without a more rigorous set of regulations and supervision. This general agreement led to a series of Reports and measures proposing increased governance of financial institutions and in particular of banks issuing insured deposits serving as means of payment. In the United States the Dodd-Frank Act was introduced, in the United Kingdom the Vickers Report proposed ring-fencing commercial banking deposit taking activities, and the European Union Likannen Report, and the introduction of stronger central regulations in the form of the Single Rule book. Even international organisations were involved, in particular with the upgrading of the Financial Stability Forum, created in the aftermath of the Asian Crisis, to a Financial Stability Board, given broad powers by the Washington meeting of Heads of State and Government after the outbreak of the financial crisis in 2008.

Unfortunately, instead of focusing on the most appropriate measures to ensure stability of the economic system as a whole through enhanced and improved financial governance, much of the newly introduced governance legislation sought to respond to criticism that central banks and government agencies had allowed creditors to escape losses, bankers to escape prosecution and their insolvent financial institutions to be bailed out with government funding, rather than supporting the debtors, in the US households by writing down their underwater mortgages, and the Southern tier countries of the Euro zone by writing down government debts. Indeed, one of the major causes of the transformation of the financial crisis into generalized economic recession and growing unemployment was the asymmetric response to the crisis, supporting creditors and the value

of impaired assets and imposing adjustment on the debtors without pursuing policies that eased their ability to service their debts,

Aside from a number of institutional provisions, such as the creation of numerous committees on the national and international level to monitor financial institution behavior and to warn of impending financial crises and to propose ex ante measures to avoid them, the main remedial measures have been:¹

Regulations (in the US known as the Volcker rule) that restrict proprietary trading by regulated and insured subsidiaries of financial institutions. The intention is to reduce the subsidy to risk-taking created by provision of deposit insurance to the liabilities of these institutions.

Rapid Resolution Authority, including “Living Wills” which provide a procedure for the bankruptcy of very large financial institutions according to a detailed plan of distribution of assets and liabilities (the living wills) to act as a substitute for government rescue and again to reduce the implicit subsidy to banks that are believed to be rescued in the event of insolvency.

Higher Capital ratios -- Enhanced Owners' Equity: to cover anticipated losses from excessive risk-taking and to avoid crisis. The idea is that bailouts can be avoided if PSI requires equity owners to absorb the losses from excessively risky behavior. Unfortunately this approach ignores the fact that a single case of equity write-down would be contagious to other institutions. Finally, the risk weighted capital asset ratios are supplemented with aggregate capital and liquidity ratios, with special supplements for large banks and rebasing the ratios on a more limited definition of capital limited to owners' equity or what is the context is called “loss absorbing” capital.

¹ The measures have been proposed by a number of different bodies such as the Financial Stability Board, the Bank for International Settlements, national governments' regulatory agencies and in the case of the European Union the creation of a Single Rule Book which consolidates many of these measures under the authority of the European Central Bank (cf. Tonveronachi, 2015)

Liquidity buffers -- to ensure a higher share of liquid assets in portfolios to provide a first line of defence in meeting losses from excessive risk taking so that financial institutions can maintain funding by drawing on liquid marketable assets to meet a shortfall in funding in the case of portfolio losses and thus prevent a liquidity crisis from degrading into insolvency.

Stress Tests -- virtually all bank regulators have initiated stress tests to gauge the loss absorbing capacity of capital positions in event of an extreme crisis. The standard is that the bank should have enough capital to absorb losses in a severely adverse economic environment and continue to lend to households and businesses. However, these event scenarios still do not assess the impact of interbank exposures and assume that existing balance sheet structure remains unchanged in response to a series of losses, yet it is precisely these responses to crisis that may well be the major contributing factor in crisis! As a result, these measures technically remain under the rubric of microprudential regulation. Many regulators also limit permission to grant dividends and increases in executive compensation to the successful completion of the stress tests.

It is perhaps unnecessary to note that the reliance on capital as a regulatory device depends on control of principals on their agents and the fact that this does not in general exist in Financial Markets as admitted by Alan Greenspan in "shocked disbelief": "The Agents (Management of Financial Institutions) have no self-interest to protect Principals' (the shareholders') equity".

Amongst the myriad of particular measures that have been proposed by governments in the countries worst impacted by the financial crisis (the Dodd-Frank Act comprises over 800 pages and calls for some 400 additional rules to be written by various financial agencies, plus a series of studies and reports to be produced) the major innovations in financial governance introduced in response to the crisis are in the importance given to macroprudential regulation and

enhanced capital ratios and liquidity buffers. The rest of this chapter will provide an analysis of the effectiveness of these new approaches to financial governance as a means of enhancing the financial system stability and assess how they have improved the operation of the financial system.

The New Role for Bank Capital²

Concerns about bank capital ratios first arose in a special committee in the Bank for International Settlements to deal with risks in the clearing of international transactions following the failure of Herstatt Bank in 1974. It produced two Concordats that sought to allocate regulatory responsibility for banks operating internationally to their home regulatory agency and to provide for global consolidated balance sheet reporting. The rapid rise in international lending produced by the petroleum crisis later in the decade led the Committee to increase focus on the sharp decline in bank capital, and its inadequacy to meet Latin American defaults on syndicated lending. As will be discussed below, it was these concerns that led the Cooke Committee (which was to become the Basle Committee on Bank Supervision) to formulate what it called “macroprudential” regulations. (Clement, 2010).

In essence the Concordat was an international supervisory agreement designed to provide a substitute for an absent international lender of last resort, or better, for the assignment of international lender of last resort responsibility for banks operating internationally. It was the failure of the Concordats to achieve this latter objective that led to the push for international capital adequacy as a second-best substitute. It was given further impetus as a means of providing a “level playing field” for international banks when Japanese banks, with virtually non-existent equity capital, started to dominate the London

² A more extensive discussion of the Basle proposals is in Kregel (2006)

Eurodollar markets to the detriment of US and European banks. The first formal proposal for capital ratios to be applied to banks operating internationally (Basle I), was issued by the BCBS in 1988 for formal approval by national regulatory bodies.

Minimum capital adequacy regulations in various forms in various jurisdictions had existed throughout US banking history, and after the creation of the Federal Reserve were frequently proposed, but never introduced in the post-war period. This was largely due to the dual regulatory structure of National and state chartered banking that characterized the US financial system. It was the rapid expansion of bank lending in the aftermath of the sharp rise in oil prices and US inflation that led Paul Volcker in December 1981 to introduce the first numerical minimum capital adequacy ratio of 5 per cent for primary and 5.5 per cent for total capital.³

The motive behind Volcker's decision was the failure of money supply control to reduce bank lending (or inflation as had been promised by monetarist economists). Banks simply maintained lending margins by raising interest rates in step with inflation and continued to expand lending, irrespective of the level of policy rates, and without any need to raise bank equity. Thus, Wall Street analysts such as Henry Kaufman suggested that a more effective policy of regulatory capital ratios would force banks to raise equity to support their increased lending. If capital markets recognized the increased riskiness of the banks' loan portfolios they would reduce bank multiples pushing up the cost of capital to the point at which banks would no longer find it profitable to lend. The imposition of capital standards at that time was

³ However, the seventeen largest banks operating in international markets were exempt. The official explanation was that they had access to superior liquidity and confidence and thus required less capital –however, as would become evident the following year, the real reason was that they were unable to meet the new minimum requirements, even before the Mexican default. In April 1985 the ratios were increased to 5.5 and 6.0 per cent, despite the fact that in the intervening period Continental Illinois Bank had collapsed with a 5.8 per cent ratio.

also in line with the trend toward deregulation and increasing the role of the market in determining interest rates.

For comparison with the current approach to capital ratios, it is important to recognize that capital adequacy ratios were initially viewed as a monetary policy measure, *not as a regulatory measure to ensure bank solvency*. The point had already been noted by Cooke (1949: 77) who concluded that “a required capital ratio may prove advantageous as a general credit control device”.

Indeed, there seems to have been very little historical support for bank capital as a bulwark for bank solvency. A study of the bank statements of failed and successful Florida State Banks in the period 1922-1928 (the first Florida banking crisis that preceded the 1929 collapse) found that “A comparison of the statements of the groups of failed and successful banks discloses the interesting fact that ... the net worth of the failed banks was a noticeably larger percentage of total liabilities than was the net worth of the successful banks. (12.9 % and 10.4% respectively).” The basic reason was “the larger and more rapid increase of the resources of the failed banks during the boom created problems of wisely investing the added funds”. Rather than increasing their cash holdings, the banks rushed to invest the funds in increasingly doubtful real estate projects. The rapid increase in assets was rewarded by the stock market as an indication of increased future earnings, instead of representing an increase in the volatility of earnings due to the possible overinvestment in real estate in the area (much of which was still under swamp water). The capital market clearly provided no limit on the ability of these banks to expand their doubtful lending practices. A very similar episode took place in the 1980s as savings and loan institutions attempted to grow their way out of the difficulties created by the deregulation of the US financial system.

In theory, the imposition of capital ratios was to increase solvency by giving shareholders incentives to constrain bank

management expansion into excessively risky lending to raise returns. If capital requirements have had scarce success as a constraint on bank lending, it is unlikely that they should have a positive influence on bank solvency. The already cited report of the 1920s Florida real estate crisis presented the traditional view of the role of bank capital noting that “net worth items not only disclose the volume of funds furnished the bank by stockholders, but also measure the amount of shrinkage and loss that can take place among the assets before any loss can fall upon the depositors.” However, it goes on to note “The fact that the net worth was a greater percentage of total liabilities of the failed banks than of the successful, apparently disclosed a sounder and more favourable condition, for it indicated that the failed banks had a relatively larger amount of owners’ investment with which to absorb shrinkages and losses among the assets before the losses could fall upon the depositors.” Yet this did not turn out to be the case. And this is not a view that was limited to the historical experience of the 1920s.

Cooke (1949, 75) noted that “data compiled from the annual reports of the Comptroller of the Currency show that, although their surplus and reserves had been wiped out, national banks which failed during the twenty-five year period from 1920 to 1944 generally had only slightly lower capital-deposit ratios [from 10.6 per cent to 32.3 per cent] at the date of failure than active ones.” She also notes that capital ratios shot up in 1934, as depositors withdrew funds the capital ratio would automatically rise.

A study published in 1995 (cited in Matten, 2000:34) comparing a retrospective assessment of American banks’ capital adequacy measured under the original Basel Accord with the actual soundness of banks measured by the classification by US bank supervisors based on their “CAMEL” scores and actual insolvencies for the period between 1984-1989 showed that more than half of the failed banks in this period and about three quarters of the banks that were rated high

risk problems by their supervisors would have been classified as either adequately or well capitalized under the risk-based capital regime introduced by the Basel Accord.

George Vojta states that “Levels of capitalization appear to have had no direct causal relationship to the incidence of bank failure.” Nor is there evidence to suggest that increasing capital ratios provides increased protection against bank failures. And there seems to be a number of good reasons for this. The first is the precise role to be played by capital in providing stability. Bankers have generally tended to argue that capital is not required to face general losses from their activities. These losses are to be met from current income. For example, a Citibank study covering the period 1962-72 showed that “in no year did after tax loan charge-offs exceed 13.1 per cent of after tax earnings, and that on average charge-offs in that period were 6 per cent of annual earnings. ... Average chargeoffs as a percentage of the loan loss reserve were 3.5 per cent... After tax loan losses averaged less than 0.5 per cent of total capital accounts.” Thus, on average bank losses will be covered through income flows, not met by capital. Indeed, most bankers would argue that capital is meant to protect the bank from abnormal conditions. However, Lucille Mayne (1972) notes “that it is not possible to devise a generally acceptable measure of capital adequacy since the essential function of capital is to serve as a defense against the occurrence of unpredictable events.”

Vojta goes further and suggests that “[t]he capital account of a bank is not adequate to maintain solvency in the event of a major liquidity crisis... Effective defense against ultimate crisis comes from lenders of last resort” that is from the central bank. Finally, Vojta notes that “This does not mean that the government is expected to bail out mismanaged institutions; but neither should financial institutions be expected to be so overcapitalized as to bail out government’s mismanagement of the economy. As a matter of fact and practicality, the economic disaster case should be excluded as a relevant scenario

for capital adequacy purposes.” The clear position of the financial industry is that capital is not an efficient means of providing a defence against abnormal conditions such as a systemic crisis – this is the role of lender of last resort, and is not the relevant factor in dealing with normal losses – these are best dealt with through provisioning out of income and chargeoffs.⁴

But, the current justification for capital ratios has nothing to do with their ability to constrain risky lending activity or to reinforce principals’ monitoring of their agents. It is agnostic about the business model and operating mechanism of financial institutions and simply proposes to set bank capital at a level sufficiently large to cover any conceivable losses without incurring technical insolvency. It is thus also independent of any attempt to mitigate risky behavior or to provide an early warning market mechanism for impending instability.

However, it does rest on the ability to envisage the worst case scenario of systemic losses, supported by the stress tests. And not only is there no theoretical or practical way of measuring this magnitude (this is what value at risk (VAR) was supposed to provide) without being able to predict the innovations that the imposition of capital requirements will generate in financing practices as financial institutions compete for profit.

It has been argued that irrespective of efficiency, the imposition of higher capital ratios is a virtually costless means of reducing financial instability. In contrast to the arguments used in the 1970s when it was considered an instrument of monetary policy it is now argued, on the basis of the Modigliani-Miller theorem, that higher capital ratios will have no impact on bank lending rates (See Admati and Hellwell, 2013). The argument is that in perfect capital markets absent tax distortions, the composition of bank capital between equity

⁴ Vojta, op cit., p. 179. He gives as example the 1969 credit crunch in which “No level of capital would have been adequate to permit affected institutions to withstand general stress of this magnitude.” And “It was only the intervention of the Federal Reserve that avoided collapse of the entire financial system.” p. 173, note 10.

and debt should have no impact on the cost of capital. Aside from the fact that the assumptions required for the validity of this result are never met in real financial markets, and there is no statistical evidence to support the claim (See Cline, 2015), more important it that the argument is based on a static equilibrium result applied to a dynamic disequilibrium adjustment process. In a crisis additional capital would have to be raised in distressed market conditions, and as J. Dimon (2015) has pointed out, in the last crisis “Banks continued to lend freely because effectively they are the “lender of last resort” to their clients as the Federal Reserve is to the banks”. But in the event of a future crisis because of the higher capital requirements JPMChase would be unwilling to accept deposit transfers from weaker banks because of it would require higher capital since additional deposits would incur higher capital charges. In the next crisis “It will be harder for banks either as lenders of last resort or as market-makers to “stand against the tide”.

The result of such procyclical behavior by stronger banks facing additional capital requirements would mean an overall decline in lending and an overall rise in capital costs and borrowing rates in response to crisis. The result of a static equilibrium adjustment process cannot be used to explain the dynamic adjustment of the system to distressed conditions.⁵

Finally, there is no method to adequately measure bank equity as “loss absorbing” capacity. First because capital is an accounting concept and bears no relation to the realizable value of bank assets financed with bank equity. And as both Greenspan and Minsky noted in quotations above, the viability of the financial sector depends on the existence of leverage to produce bank earnings. As noted by Vojta above, and shared by Minsky, the most important element in a financial institution’s stability is the ability of its debtors to generate the cash

⁵ He also notes the negative impact on dealer markets which depend on leverage to fund inventory: “Market depth ... a precursor of liquidity ... of 10-year Treasuries ... today is \$125 million, down from \$500 million at its peak in 2007.”

flows to service their debt, and second to be able to generate sufficient income to meet the market return to capital for it is the search for higher incomes that drives the innovation in financial practices which is at the basis of financial instability and the potential for systemic risk. It is in this sense that bank stability is a question of the operation of the broader macro economy and that has led to the interest in macroprudential regulations.

Macro Prudential Regulation,

As noted above, “macroprudential” regulation is not really a new concept, having been implicitly proposed by Minsky in his early work in the 1960s and 1970s and then independently developed by the Cooke Committee of the Bank for International Settlements, largely under the influence of the work of its then Economic Adviser (subsequently Managing Director), Alexandre Lamfalussy, as he attempted to suggest measures to forestall what he considered to be the forthcoming Latin American debt crisis.

Minsky had early criticized the traditional “micro” approach to bank regulation, in which “The instability of banks and other financial institutions is usually described in term of runs and defaults at particular institutions without a clear explanation of why such strong assets substitution quite suddenly becomes the rule of the day. When conceived in terms of bank runs and defaults, a particular bank fails because of its own, idiosyncratic attributes. Its management has been incompetent or committed fraud. Such a failure may have repercussions on other banking institutions, in that for a time financial markets fail to work normally. This creates transitory refinancing problems for otherwise solvent banks, ... idiosyncratic failures can trigger an epidemic of bank failures, imparting an adverse “depression-creating” shock to the economy.” (H.P. Minsky and Claudia Campbell, 1987: 254-5.” Thus “microprudential” regulation looks ideally at the structure and

comportment of an individual bank, rather than its relations with the rest of the financial system or the overall macroeconomic environment.

In the US, there was a shift away from this approach after the crisis of the savings and loan banks in the 1980s towards a more “risk”-based approach, although the then Chairman of the Federal Deposit Insurance Corporation (FDIC) claimed that the changes “do not reflect a fundamental change in the FDIC’s traditional approach to risk assessment”. She nonetheless noted that examinations were “working to “bridge the gap” that currently separates the “macro” perspective of economics and market trends from the “micro” perspective of bank examinations in ways that will translate data into guidance that examiners can use in assessing and monitoring risks in institutions with differing levels and types of risk exposure. ... The result will be a more effective and accurate assessment of an institution’s ability to manage its risks within a structured framework, which will enhance safety and soundness.” (Helfer, 1996) Despite the clear recognition of impact of macro conditions on micro prudential regulation the approach still placed the emphasis on the examination of the individual institution, rather than on systemic impacts on the entire financial system.

AS noted above, the BIS and its Economic Adviser were stimulated by the sharp rise in bank lending relative to bank capital to push for higher capital standards, but also recognized that they would not be sufficient given the system nature of the forces that were propelling the increased international lending. They thus noted that “Prudential measures are primarily concerned with sound banking practice and the protection of depositors at the level of the individual bank. Much work has been done in this area – which could be described as the ‘micro-prudential’ aspect of banking supervision. [...] However, this micro-prudential aspect may need to be matched by prudential considerations with a wider perspective. This ‘macro-prudential’ approach considers problems that bear upon the market as a whole as distinct from an individual bank, and which may not

be obvious at the micro-prudential level.” (“The use of prudential measures in the international banking markets”, 24 October 1979, pp 1–2, in BISA 7.18(15) – Papers Lamfalussy, LAM25/F67. quoted in Clement, op. cit., p. 61).

According to Ivo Maes (2010), the broad Bank for International Settlements “approach to financial stability, “marrying” the micro and macro-prudential dimensions of financial stability with its emphasis on the macro-prudential dimension, first came to the fore in the Cross Report on innovations in international banking. ... this was the first published official document that used the term “macro-prudential” The Cross Report defined the macro-prudential domain as “the safety and soundness of the broad financial system and payments mechanism” (BIS, 1986, p. 2). ... it focuses on the financial system as a whole, paying attention to the macroeconomic dimension of financial crises. It treats aggregate risk in the financial system as dependent on the collective behaviour of the financial institutions (which contrasts with the microprudential view, where financial institutions are regarded as having no influence on the global situation).

Thus while both Minsky and Lamfalussy provide a similar critique of traditional micro regulation and suggest the importance of formulating regulations that deal with the systemic nature of financial crisis, and in particular, the role of financial innovations as an integral part of the systemic factors that should be covered in macroprudential regulation there is a basic difference in their approach. And that difference lies in the fact that Minsky argued that it was impossible to formulate a coherent approach to macro regulation without and underlying theory of systemic crisis. If micro regulation was grounded in an explanation of the behavior of individual banks, macro regulation would require an explanation of the behaviour of the entire banking and financial system. It was the search for this groundwork theory that led to Minsky’s Financial Instability Hypothesis, developing Keynes’s “foundations of an investment theory of business cycles and

a financial theory of investment in a capitalist economy” (Minsky, 1994:2) to provide the explanation of the cyclical behavior and the systemic interactions that could provide the basis for the formulation of “macroprudential” regulation.

The current approach to macro prudential regulation still lacks this fundamental theoretical grounding. For example, according to Haldane (2014:2) “Since the crisis, financial regulation has become explicitly macro-prudential. This is an expression much-used, but generally little-understood. In a nutshell, it means that policymakers have begun using prudential means to meet macro-economic ends. Those macro-economic ends include tempering swings in credit and leverage – the classic credit cycle. Or, put differently, curbing the credit cycle appears to be an important ingredient of broadly-based macro-economic stability. For Persaud (2009) “Prudential Regulations for the Macro Economy” can be characterized as “A growing consensus around three ideas: Capital requirements need a countercyclical element to “dampen rather than amplify the financial and economic cycle” by “requiring buffers of resources to be built up in good times.” ... Greater emphasis on rules rather than supervisory discretion to counterbalance the political pressures on supervisors. ... rules should include leverage limits liquidity buffers.”

The modern approach thus falls short of Minsky’s view that any macro prudential regulation would require “A more complete description of the instability of an ‘economy with banking.’” Such an approach needs to look behind the runs and analyze the structure of balance sheets, payment commitments and position-making activities. Position-making for a bank consists of the transactions undertaken to bring the cash position to the level required by regulation or bank management. In the position-making view, bank failures do not arise simply because of incompetent or corrupt management. They occur mainly because of the interdependence of payment commitments and position-making transactions across institutions and units.”(Minsky

and Campbell, 1987: 255) Minsky thus went on to recommend and to make formal proposals for a Cash flow Examinations system to Support Macro Prudential Regulations: “Examination and analysis balance sheets based on the view that liquidity is not an innate attribute of an asset but rather that liquidity is a time related characteristic of an ongoing, continuing economic financial institution.” Basic to the idea of liquidity as an attribute of an institution is the ability of the unit to fulfill its payment commitments. Any statement about a unit’s liquidity, therefore depends upon estimating how its normal activities will generate both cash and payments, as well as the conditions under which its assets (including its ability to borrow as an “honorary” asset) can be transformed into cash... Any statement about the liquidity of an institution depends upon assumptions about the behavior of the economy and financial markets. As the assumptions are changed, the estimate of the liquidity of the institutions will vary.

But, in Minsky’s view the error in Macroprudential regulation is the same as that noted above in applying enhanced capital ratios, it is based on an essential static supply and demand analysis when not only is supply and demand in appropriate, it is the static analysis which is an even greater cause of concern.

Dynamic Macro Prudential Regulation⁶

But Minsky’s “new” approach was not only to recognize the cyclical nature of the interactions generated by financing relations within the economic system, it took a much broader approach to regulation: “The supervisory and regulating structure for banking and finance that is in place not only reflects institutional features of the economy stretching back over at least 150 years, it also reflects the understanding, i.e. the economic theory, of how our type of economy works that ruled at the time when the bits and pieces of this

⁶ This section draws on Kregel (2014)

structure was first put in place.” (Minsky, 1994:6) Indeed, this was one of the advantages of Minsky’s proposed cash-flow approach: “The perspective underlying the suggestions was of a dynamic, evolving set of financial institutions and relations. All too often it seems as if the Federal Reserve authorities have been surprised by changes in financial practices. One aim in the design of the examination system was to establish a regular reporting procedure which would force the authorities to be aware of institutional changes that were ongoing, and which furthermore forced the authorities to inquire into how the ongoing developments can be expected to affect the stability of the financial system.” In a subsequent note Minsky gave as example: “One byproduct of the cash flow examination procedure will be more precise knowledge of the relations between the examined institutions and fringe banks. Such a clarification will enable the Federal Reserve to better know what is emerging in financial relations and to be better prepared for contingencies that might dominate as the determinants of its behavior.” (Minsky, 1975:2)

That is, regulation must be institution and theory specific, which is why it must be reassessed frequently in relation to the changes taking place in the financial system. Examination was thus intended to force the central bankers to become aware of ongoing institutional and operational changes in the financial system, something that was clearly lacking in the Fed’s analysis of the recent crisis which has now been revealed to have ignored the mechanics of securitization of subprime mortgages and the role of credit default swaps in the interrelationships between banks and other (fringe or shadow) institutions operating in these markets.

One of the advantages of the use of Minsky’s approach to regulation based on the FIH as the basis for macro prudential regulations is thus that it “explains why regulatory structures eventually become obsolete or perverse. The normal, profit-seeking activities of agents lead to innovation in order to create new sources of profits;

innovation can be in products, process or finance. The search for profits also drives agnates to avoid, evade and adapt to the structure of regulation and intervention put in place to constrain incoherence. In time this undermines the effectiveness of a regime of intervention that “stabilizes the unstable system”. Therefore if regulation is to remain effective, it must be reassessed frequently and made consistent with evolving market and financial structures.” (Minsky and Campbell, 1988: 6) Minsky stressed the point that “As the monetary system, the financial system and the economy are always in the process of adapting to changing circumstances, the quest to get money and finance right may be a never ending struggle.” because what is an appropriate structure at one time is not appropriate at another. Throughout our history the reaction to some ‘unpleasant events’ in banking or finance has been to reform the structure of banking and finance, as well as the structure of government chartering, regulation and supervision of financial institutions. Our predecessors were not fools: ... they knew the institutions of their time well enough so that when legislation changes institution, the new structure succeeded in correcting the malfunctioning, for at least the time being. Such a new structure of payments and financing was apt enough, so that a ‘better’ performance of the economy followed. However the perennial quest for the profits that successful innovators earn, energizes entrepreneurs. New financial and banking institutions and new financing patterns for business, households and government units emerge and their users prosper. Over time the initially apt pattern of regulation and supervision becomes increasingly inept: the inherited structure of regulation and the supervision first becomes not quite right and later becomes perverse. A cumulative effect of the institutional and usage changes that occur is that the institutions which are supposed to contain the endogenous disequilibrating forces of our economy lose much of their power to do so.” (Minsky, 1994: 4-5)

As an example he noted “The shift in position-making from trading in liquid assets in the 1960s to transactions in liabilities in the 1970s” and the “decrease in the margins of safety used to cushion fluctuations in cash flows. As a result, payment commitments have become more closely coordinated with payment receipts so that small changes in conditions can cause a large increase for units (households and businesses who are indebted to banks and banks that are indebted to depositors) to acquire cash by selling assets that may have thin markets.” (Minsky and Campbell, 1987: 255) This leads to a need to sell assets to acquire liquidity which causes a decline in asset prices and a “process that leads to a deep depression”. Minsky thus argued that “The problems today are the result of competition for profits that has transformed an initially robust financial structure into a fragile system and in so doing made obsolete the structure of deposit insurance established 50 years ago.” (Minsky and Campbell, 1988:7)

From this point of view the greatest error committed in the run up to the recent crisis was to allow a major change in the institutional structure of the financial system in the 1999 Financial Services Modernisation Act without any accompanying changes in the regulatory or supervisory structures.

The conclusion, which is just as relevant today, is that “The introduction, in today’s environment of... capital requirements and greater public disclosure of problem institutions ... would make it more, not less, likely that insurance payoffs will be required. In addition, these reforms would increase system instability.” (Ibid.: 253)

What Has Changed?

This chapter has suggested that the two major changes that buttress the increased role of financial governance in the aftermath of the financial crisis and Great Recession are not really new. Both increased capital ratios and macroprudential regulation date back to

the financial crisis of the 1970s and have been in continuous use since then. They do not seem to have been prophylactic in preventing the increasing number and virulence of financial crises since that time. The analysis of the operation of these measures suggests that there is ample reason to believe that they are not particularly efficient in providing governance of the financial system capable of preventing financial instability. As noted, building on Minsky's work, one of the basic difficulties with these measures is that they are not grounded in a solid theoretical explanation of the way the economy with a financial system generates crisis.

One of the most important elements in the failure of these measures is the belief that they are supported by a governance mechanism based on market forces. This was the response to the crisis in the 1930s, as well as the crisis of the 1980s which produced the proposals for capital ratios and macroprudential regulations. The response to the current crisis is no different as can be seen from a recent statement from Alan Greenspan: "An important collateral pay-off for higher equity in the years ahead could be a significant reduction in bank supervision and regulation. Lawmakers and regulators, need to be far less concerned about the quality of the banks' loan and equity portfolios since any losses would be absorbed by shareholders, not taxpayers. This would enable the Dodd-Frank Act on financial regulation of 2010 to be shelved, ending its potential to distort markets — a potential seen in the recent decline in market liquidity and flexibility." Basically the position is that sufficiently high capital ratios will allow the operation of market forces as the only governance mechanism. In this position, we can conclude that nothing has changed in the dominant approach that the most effective financial governance is through the market.

Addendum: An Alternative for Brazil?

Is there an alternative? Real changes in financial governance requires a change in financial structure in order to control leverage. This would involve prohibiting financial institutions from offering means of payment through transferable deposit account, and to have them operated by a government agency, much like the postal savings banks that at one time existed in most countries. This would eliminate the profit driven innovation in the creation of leverage and liquidity in the system. Further, Minsky suggested that “it is worth investigating whether a permanent government Investment bank, such as the Reconstruction Finance Corporation, is a desirable feature for an economy where solvency crises are likely to occur” (Minsky, 1994: 11) This would mean that the degree of liquidity in the system would be driven by the government’s fiscal policy.

This is a real change that could be implemented quite easily in Brazil since it is one of the few countries that has retained a highly successful government development bank. It is perhaps ironic that the bank is currently under threat because it has recently received financing from the Federal budget when this is a major opportunity for increased financial governance and an element of stability in the financial system since it is the government that is levered, not the Bank. National governments can never default on debt issued in their own currency.

Part of the criticism is based on the idea that it provides a subsidy to the Bank’s clients and distorts competition with private financial institutions since the Bank lends at an interest rate that is lower than the rate at which the government itself borrows to fund the Bank. But this is first, a problem of monetary policy and governance of the Central Bank. And secondly it overlooks the subsidies provided to the private banking system whose investment portfolio is dominated by holdings of government debt which allows them to earn returns on

equity in excess of 20 per cent, double the standard in the rest of the world. The reason is, that in addition to the high interest rates due to monetary policy, the government offers its debt with inflation, interest rate and exchange rate guarantees. That is, the debt includes options that cover all the risks of holding the debt, which is already in essence credit risk free, since the government cannot default on the debt. The value of these implicit “options” also represent subsidies to the private banks and a major contribution to the costs of financial stability in Brazil. Any clear comparison of subsidies to the development bank and the private banks must take these subsidies to the private sector into account.

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TWO SUCCESSFUL CASES OF STATE INVESTMENT AND A NEW DIFFUSION MODEL APPLIED TO CAPITAL FLOW

Luiz Bevilacqua

FOREWORD

The initial project regarding the paper to be presented in the “*Seminário internacional Papel do Estado no Século XXI: desafios para a gestão pública*” promoted by the “ Public Management National School (ENAP) and the Brazilian Ministry of Planning, Budget and Management (MP)”, was restricted to the last two topics, that is the impact of public investment on the higher education system and on the technological advances favour the Brazilian agribusiness. Instead of writing an overview regarding the general higher education system and the agribusiness complex we selected two emblematic enterprises proving that making the right choices public investments have a very high return rate.

However meanwhile we closed the basic concepts regarding a new theory dealing with diffusion process. This new theory introduces a second order approach to the dynamics of particles scattering in some supporting medium. The new contribution is the consideration of two simultaneous flows in the same system dividing the diffusion cloud into two fractions. The possibility to work with two simultaneous flows is much more adequate to model population dynamics, infectious diseases with people moving in and out some environment and clearly capital flux. Despite the fact that we have no expertise in economics we dare to present a first essay in capital flux since the results obtained by the new model are quite interesting

and acceptable by the common sense. We are also convinced that it is the obligation of the university to take risks and try to open new roads. The ultimate aim of a genuine research project is to present unexpected results. If in the research output there is no surprise something is missing.

Therefore we decided to make two short reports on the Federal University of ABC in São Paulo, a very successful new university and on EMBRAPA which is a paradigm in the agribusiness complex, following a relatively extended presentation of the second order diffusion theory to capital flux. Besides the economic turmoil affecting Brazil and the international community as well deserves at least some alternative model that could better explain what is going on.

We now address for that new orientation.

1. A second order diffusion model with application in capital flow

1. Introduction

The extraordinary advance in computer technology in the last 30 years together with the demand for integration of several knowledge fields to solve new and challenging problems pushed forth the development of modeling techniques. Initially confined to physicochemical matters modeling was latter introduced to simulate population dynamics, environmental dynamics, epidemics and more recently diseases evolution and social behavior. Particularly the dynamics of economic systems and knowledge transfer belongs to this last theme. Not seldom the mathematical tools were taken from the models used in natural and engineering sciences and adapted to the new fields of knowledge. This type of adjustment works well for simple cases but may fail in more complex situations. Take

for instance the classical diffusion equation in its original form to represent the evolution of contagious deceases or capital flow. The fundamental hypothesis of the classical diffusion theory rely on the assumption that the totality of the material contents, whatever it may be, particles, people, money, moves along a single flow trajectory in a given substratum. This is a rather restrictive hypothesis when we consider infected people moving in and out some environment or capital flow that may occur simultaneously in two opposite directions.

The difficulty is that while acknowledging the limitations of the mathematical tools the demands for new results forces the introduction of rather artificial modifications in the basic governing equation to match some experimental results and observations. The introduction of complementary sources and non-linear terms in the governing equations allows for tuning up the new parameters to match almost all possible observations. Therefore, the validation is restricted to a given circumstance but not concerning the phenomenon itself. If the model together with the parameters estimated for a given data set is applied to a similar problem but with a different input the theoretical prevision could deviate substantially from the real outcome. It is important to distinguish the validation of a particular event from the validation of the subjacent phenomenon. This observation is particularly important when dealing with social and economic modeling.

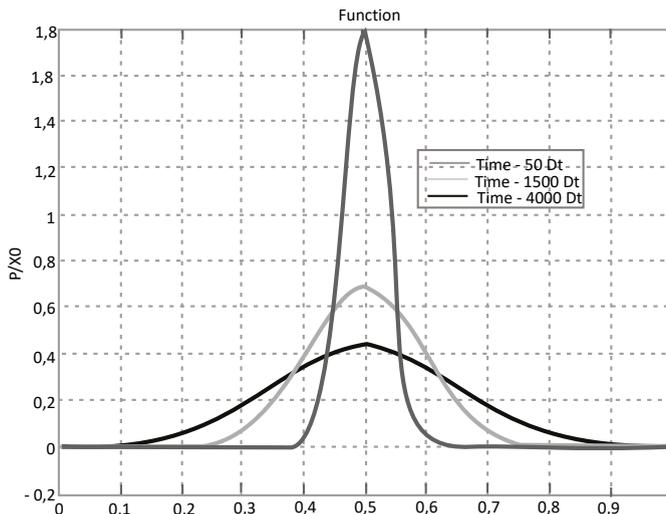
One of the purposes of this paper is to introduce a new diffusion formulation that admits the occurrence of two simultaneous fluxes of the same contents. That is, the same contents, let us say currency, may be into two different “excitation states”, income or outflow, earnings or expenditures, generating two simultaneous flows. Besides, they may change states along the process. The simulation of this kind of phenomenon requires a new governing equation, a fourth order equation. A short presentation of the main steps to derive this new diffusion equation is given in the next section.

2. The classical diffusion framework.

For purpose of completeness it is convenient to make a brief introduction to diffusion processes. The ordered scattering of particles in some supporting medium is called diffusion. Diffusion may happen in a physicochemical process, salt particles disperse in water; in public health problems, malaria spreading in an environment favorable for mosquito reproduction; in a social framework, knowledge transfer in a human population.

The theory associated with the diffusion process was settled in the beginning of the last century. The motivation was the spreading of gas molecules in a confined environment. That is the theory was developed to find out how the particle concentration would evolve in space and time. The basic conclusion was that the particles move from regions where the gas concentration is very high towards rarefied gas regions.

Fig.1 – Evolution of the particle concentration distribution in time and space. For $t=0$ particles are highly concentrated close to $x=0.5$. Particles spread laterally as time increases

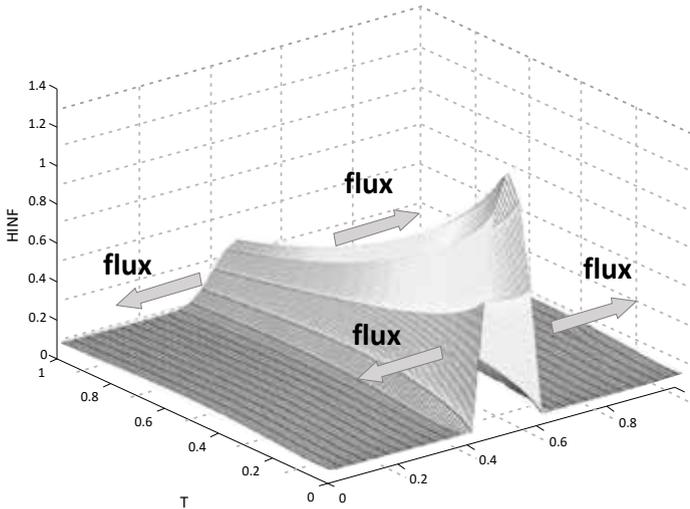


That is nature always tries to homogenize an initially uneven particle distribution provided that the system is free from external perturbations. The analytical formulation of this phenomenon assumes as fundamental hypothesis that the particles flow rate is proportional to the slope (gradient) of the concentration distribution. The direction is clearly from regions of high concentration to regions with low concentration. The modulus of the flow rate is therefore given by (Fick's law):

$$|\Psi_1| = D \left| \frac{\partial q}{\partial x} \right|$$

The parameter D is the diffusion coefficient and $|\partial q / \partial x|$ is the modulus of the concentration distribution gradient. This parameter is related to the interaction between the resistance of the supporting medium against the particles motion and the repulsive force exerted by the particles among themselves. Figure 1 illustrates the diffusion process profiles of particles initially concentrated in a small interval with center at $x=0.5$.

Fig. 2 – Evolution of the particle concentration distribution in time and space. For t=0 particles are highly concentrated close to x=0.5. Particles spread laterally as time increases.



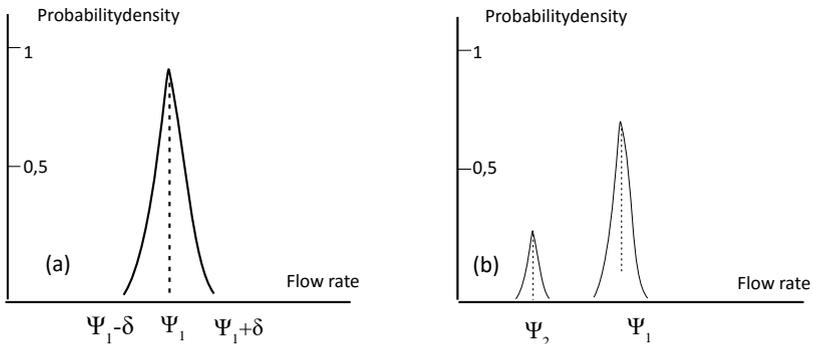
High values of the concentration gradient imply correspondingly high flow rates. Therefore as can be seen in the figure 1 as the process develops the flow rate decreases since the concentration distribution becomes smoother. Using the classical mass conservation principles and the flow rate law introduced above the following equation is obtained:

$$\frac{\partial q}{\partial t} = D \frac{\partial^2 q}{\partial x^2} \quad (1)$$

Careful experimental observations have been made for several types of particle scattering in different substrata. For regular diffusion processes equation (1) has proved to be quite satisfactory. Figure 2 shows the evolution in time and space of a regular diffusion process. The problem arises when there are non expected phenomena taking place in the process, as time delay in particle motion. In these cases the classical equation does not provide a satisfactory solution. To solve the discrepancies between experimental observation and the prediction

of the classical theory some extra terms are introduced to complete equation (1).

Fig.3 – Flow rate probability density function for single flux diffusion (a). Flow rate probability density function for bi-flux diffusion (b). δ very small.



Now the hypothesis that all particles at a given cross-section of the particle cloud move with the same speed is a considerable simplification. What is physically consistent is that the flow rate given by the Fick's law:

$$\Psi_1 = -D \frac{\partial q}{\partial x} \mathbf{i}$$

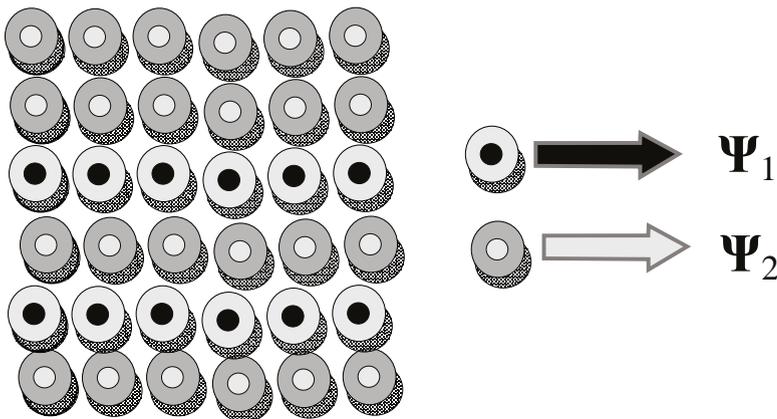
represents the mean value of a flux distribution with a very small deviation from the mean (fig.3a). So the diffusion equation (1) is an approximation that works out

satisfactorily for very small values of δ .

It is not impossible that in some cases the same particle system is split into two sets scattering with different flow rates (Fig. 3b). Beware we are not saying that there are two different species in the same flow, but it is the same species excited into two different energy states. If there were two different species the problem could be solved with two equations of the same order as introduced above, equation (1),

with two different diffusion coefficients D_1 and D_2 and possibly with the inclusion of coupling terms. Therefore, we need a new theory that would allow splitting the particles cloud in the system into two sets of the same nature diffusing with different flow rates. That is the mass flux is divided into two fractions, excited by two distinct flow potentials generating two flow rate vectors Ψ_1 and Ψ_2 as shown in the figure 4.

Fig.4 – Similar particles scatter with different flow rates. Red cells correspond to 2/3 and black cells to 1/3 of the total mass.



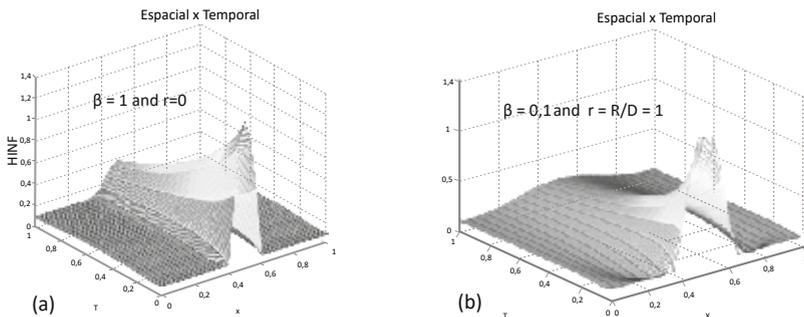
As presented in the next section if we introduce a delay on a certain fraction of the diffusing particles, say $(1-\beta)$ with $0 < \beta < 1$ allowing the complementary set β to scatter according to the classical theory, the following governing equation is obtained:

$$\frac{\partial q}{\partial t} = \beta D \frac{\partial^2 q}{\partial x^2} - (1 - \beta) \beta R \frac{\partial^4 q}{\partial x^4}$$

What we have now is a unique concentration distribution where the particle flux is divided into two distinct portions. Figure 5 illustrates the difference in the response of the two diffusion approaches for a mass concentration input at $t=0$ at the center of the segment $[0,1]$.

The presence of a secondary flux introduces acceleration on the concentration decay while spreading the solution along the x-axis. The behavior of the concentration for the bi-flux theory depends strongly on the parameters β and R .

Fig. 5 – Response to a concentrated distribution at $x=0.5$. (a) Single flux diffusion process, classical solution; (b) bi-flux diffusion process, fourth order PDE.



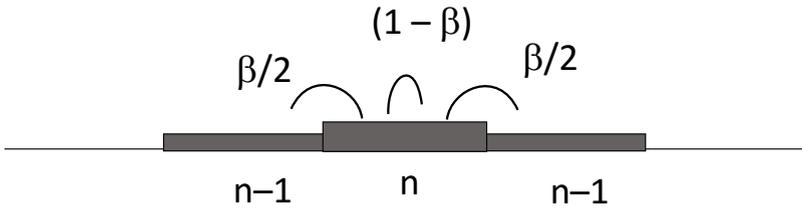
A clear example where this phenomenon is not only plausible but necessary is capital flow. Even in our small universe we all have income and expenses, that is, cash inflows and outflows. It is the same money flowing in two opposite directions possibly with different speeds. The ultimate purpose of this proposal is to show that it is worthwhile exploring the new approach introducing the bi-flux phenomenon in the context of capital flow. The behavior of the economy could be better estimated using the second order flux theory as presented here.

2. An overview of the Second Order Theory

The derivation of the second order theory can be obtained with a very simple discrete model. Indeed, consider a row of cells such that each cell can communicate with the neighboring ones. Let the contents of each cell be partly redistributed to the adjacent cells in

equal portions and partly retained in the cell at each time step. Figure 6 represents

Fig. 6 – Contents distribution considering partial retention



the distribution process for a characteristic time step Δt . The fundamental idea is therefore, to assume that the contents of a cell n at a time t changes at each time interval Δt such that a fraction β is equally redistributed to the right, $n+1$, and left, $n-1$, neighboring cells while the remaining portion $(1-\beta)$ stays temporarily confined in the same cell n . The set of equations derived with the help of the discrete approach representing this distribution law reads:

$$q_n^t = (1 - \beta)q_n^{t-1} + \frac{1}{2}\beta q_{n-1}^{t-1} + \frac{1}{2}\beta q_{n+1}^{t-1}$$

$$q_n^{t+1} = (1 - \beta)q_n^t + \frac{1}{2}\beta q_{n-1}^t + \frac{1}{2}\beta q_{n+1}^t$$

where $0 \leq \beta \leq 1$. Clearly with $\beta=1$ the above equations represent the discrete formulation scheme leading to the well-known second order classical diffusion equation. But with $\beta \neq 1$ a new equation is obtained. After the proper operations and assuming the continuity requirements for the function $q(x,t)$ we get [1] [2].

$$\frac{\partial q}{\partial t} = \beta D \frac{\partial^2 q}{\partial x^2} - (1 - \beta) \beta R \frac{\partial^4 q}{\partial x^4} \tag{2}$$

The fourth order term with negative sign introduces the effect of retention. The coefficient D is the well-known diffusion coefficient and R is a new coefficient that we will call reactivity coefficient. The parameter β is a control parameter expressing the balance between diffusion and retention when both are activated simultaneously. The retention effect reaches its maximum for $\beta=0.5$. Clearly retention cannot be activated without diffusion, that is, while diffusion can take place without retention $\beta=1$, the complementary process, that is, retention without diffusion $\beta=0$ is not possible.

It is remarkable that the discrete approach shows that non-linear terms are not required to represent temporary retention at least for the case of homogeneous isotropic media. This means, as it should be expected, that temporary retention belongs to the class of primary phenomena and, in general, is not a secondary perturbation on the diffusion process as usually assumed for modeling anomalous diffusion.

Equation (2) shows clearly the existence of two different diffusion processes. The variable $q(x,t)$ represents the mass concentration and it is not difficult to see that two distinct velocity potentials come into play one of them corresponding to the second order differential term and the other one corresponding to the fourth order differential term. Particles belonging to the fraction β follow the classical Fick's law, it is the primary flux that will be called Ψ_1 and particles belonging to the fraction $(1-\beta)$ follow a new law, it is the secondary flux that will be called Ψ_2 . Considering equation (1) and anticipating the mathematical structure of the integrand for the mass conservation principle it is not difficult to see that the fluxes are given respectively by:

$$\Psi_1 = -D \frac{\partial q(x,t)}{\partial x} \mathbf{e}_1 \text{ and } \Psi_2 = R\beta \frac{\partial^3 q(x,t)}{\partial x^3} \mathbf{e}_1$$

The physical meaning of the primary flux is well known, namely, the particle concentration distribution tends to smooth out along the

x-axis. The particles move from higher concentration regions toward lower concentration regions. The secondary flux is concerned with the curvature variation of the concentration distribution. It grows with the increase in the curvature. Since increasing curvature means local accumulation, the secondary flux may be interpreted as a process that opposes the growth of local concentration. It is also remarkable that the intensity of the secondary flux increases linearly with the fraction β of particles belonging to the primary flux.

3. Applying the second order theory to simulate simple cases of capital flow.

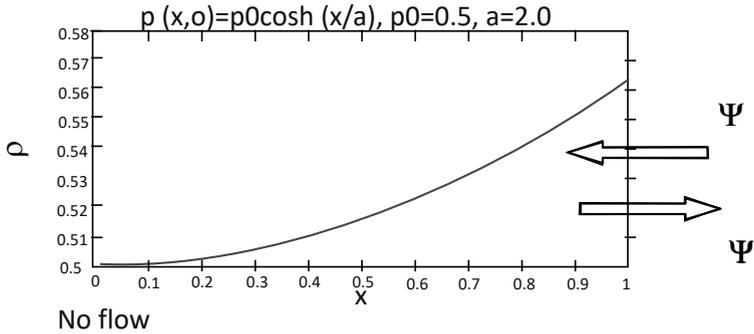
In order to justify the presentation of this proposal it is convenient to show that some basic results match the common sense expectations for simple situations. The questions that certainly can be raised from the following examples could only be answered through a careful investigation effort organized through the convergence of different knowledge fields.

It is important to keep in mind that the present theory is intended to apply the second order or bi-flux theory to typical cases where the classical approach fails to represent the coupled flux. Capital flow is adequate to our purpose. Therefore, we will consider the economic behavior of a small social chain that is the overall response of a relatively restricted economic system.

1. Inflow and outflow in a simple economic chain.

Preliminary analyses have shown that the use of the bi-flux theory leads to simulations that reproduce, at least qualitatively, some of the most important economic states.

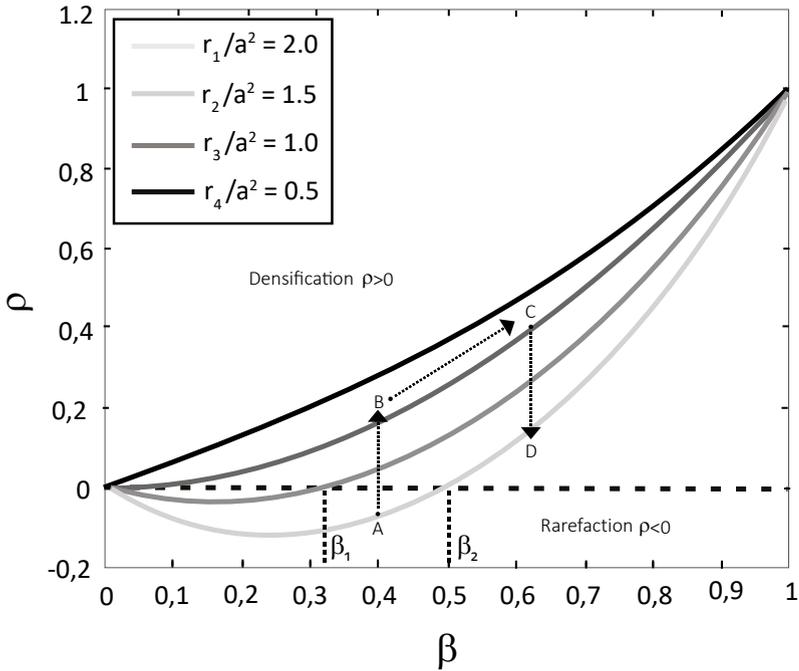
Fig.7 – Profile of aggregated money fluxin an economic chain



Consider the case of some economic chain in the interval $(0,1)$. The resources concentration, that we call $q(x,t)$, vary slightly from the initial point $x=0$, $q(0,0)=0.5$, to the end of the chain, $x=1$, $q(1,0)=0.56$ for some reference initial time $t=0$. The boundary condition at $x=0$ prescribe no flow meaning that it is the end of the chain with no interaction with external agents. At $x=1$ the agents in the chain interact with the outer environment such that the primary flow Ψ_1 is directed inward and a secondary flow Ψ_2 outward (Fig.7).

The solution to this problem with the initial condition $q(x,0)$ given below is very simple.

Fig.8 – Variation of the evolution control parameter ρ with the mass fraction distribution β



Initial condition:

$$\Psi_1 = \Psi_2 = 0$$

Boundary conditions:

at $x=0$ $\Psi_1 = \Psi_2 = 0$ no flux

at $x=1$

$$\Psi_1 = q_0 \left(\frac{1}{a} \right) e^{\rho x} \sinh \left(\frac{1}{a} \right)$$

$$\Psi_2 = q_0 \left(\frac{1}{a} \right) e^{\rho x} \sinh \left(\frac{1}{a} \right)$$

The solution is

$$p(x,t)=q_0 e^{\rho t} \cosh(x/a) \text{ where } \rho = \frac{D\beta}{a^2} \left(1 - (1-\beta) \frac{r}{a^2} \right) r=R/D$$

The parameter ρ controls the time evolution of the diffusion process. Figure 8 shows the variation of ρ with β for some values of the parameter r . Clearly for $\rho > 0$ the process evolves in the direction of assets accumulation $e^{\rho t} > 1$, meaning that the volume of capital inflow exceeds the volume of capital outflow. For the opposite case, $\rho < 0$ and $e^{\rho t} < 1$ the process enters in a recession cycle accumulating losses progressively. Points combining β and r such that ρ vanishes represent stagnation points that may be considered in a different context points of equilibrium. We prefer call those points stagnation points, there aren't gains or losses.

Note that as stated before Ψ_1 corresponds to the primary flux that is, it is assumed to exist independently of Ψ_2 . The subsidiary flux exists, if and only if Ψ_1 is active. This means that spending money is only possible if there is money coming in.

D , R , β and a maybe considered preliminary as defined below.

D : represent the tools to encourage (discourage) investments, high values of D correspond to intensification of the capital inflow rate

R : represents regulations to reduce (increase) the spending time rate, low values of R correspond to contention in the outflow rate that is it tends to decrease the cash outflow rate.

β : this is a very important parameter regulating the distribution between the volume of investments and expenditures. It also controls the outflow rate, if β is small the expenditure rate will fall in the same proportion. It means that if there is no money available payment becomes impossible.

a : may be considered as the length of the connected activities composing the economic chain.

It is important to introduce now the interpretation of the space variable representing the economic chain where the several

agents are distributed. Recall that the first order driving force of any diffusion process is the difference between the concentrations in two neighboring points of the economic string. Following this rule we will divide the economic chain into three segments. E_1 consisting of the economically dominant agents, in the following examples this group is closer to the external environment, $x=1$. E_3 consists of the economically weaker sector, close to $x=0$, and E_2 composed by agents with intermediate impact on the economy.

Just to give an example, suppose a certain economy following a contracting trajectory, that is $\rho < 0$ as represented by point A, $r=r_1$, in the figure 8. Suppose that it is required by the economic authority that the ratio (capital inflow)/(capital outflow) remain constant that is β must be kept constant until the economy shows a positive evolution. This would be possible by reducing the value of $r=R/D$. If D is kept constant because presumably it depends more on fixed external factors the solution would be reducing R , that is, try to negotiate extension of payment terms. This would lead to a point B with $r=r_3$. At this position the economy presents concrete signs of expansion and then it would be possible to attract new capital, that is, increase the value of β to reach the point C. Now if it is convenient to increase R and accelerate the outflow for some reason it would be possible to return to r_1 and still keep the economy in a growing track, point D.

2. The influence of sources and sinks.

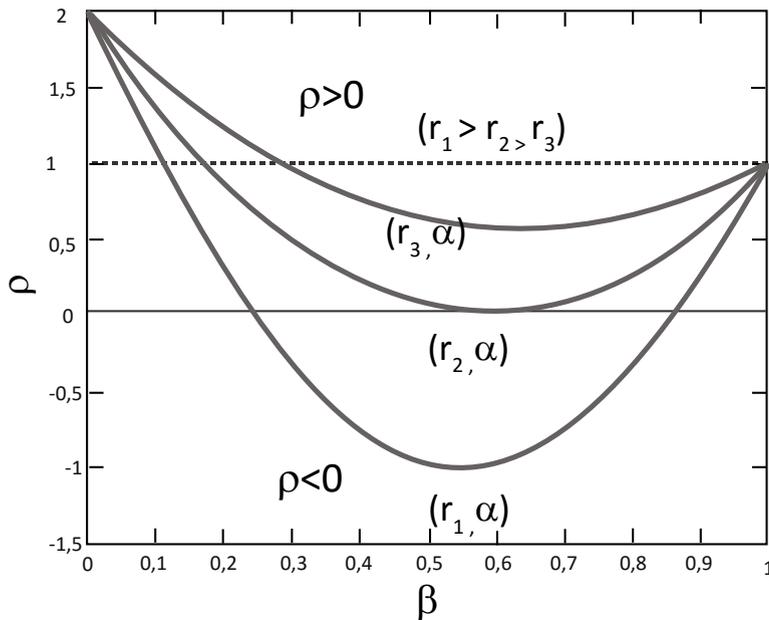
If there are sources and sinks the diffusion equation must be modified in order to incorporate these new factors. Consider a source proportional to the concentration fraction $(1-\beta)$ which corresponds to the capital outflow and a sink proportional to the fraction β which corresponds to the capital inflow. The sources or sinks are not originated from business as usual but require some external agency that lend or borrow money in order to improve the economic output

(sources) or to spare money for future applications (sinks). The new equation reads:

$$\frac{\partial q}{\partial t} = \beta D \frac{\partial^2 q}{\partial x^2} - \beta(1 - \beta)R \frac{\partial^4 q}{\partial x^4} + A(1 - \beta)q - C\beta q$$

The constants A and C define the intensity of the source and the sink respectively. With the same initial and boundary conditions as before we get $\rho = \rho(D, R, a, \beta, A, C)$. With $r = Ra^2/D$, $\alpha = A/Da^2$, $\gamma = C/Da^2$ we obtain the qualitative results as shown in the figures 9, 10, 11 and 12. Figure 9 shows the effect of the inclusion of a source, $\alpha > 0$ and $\gamma = 0$. The theory suggests that there is a critical value of r that overturns the behavior from growth into loss. Therefore injection of capital only turns out to be favorable if the capital outflow is relatively low. For high values of r the economy will be severely damaged. It is also interesting to notice that the action of the external source for $\alpha > 1$ is more effective when outflow concentration prevails over the inflow concentration, β relatively small. This means that injecting money in the economy is more effective if the economic activity is stimulated and people are spending money and taking loans.

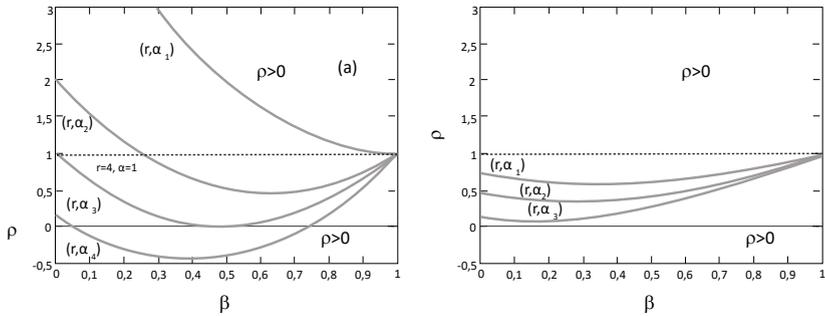
Fig.9 – Influence of the parameter r on the evolution of an economic chain for a given source $\alpha=2.0$. $r_1 = 10$, $r_2 = 5.8$, $r_3 = 3.5$.



Now if r is taken constant and the source intensity α is allowed to vary there are two typical cases. First if $\alpha > 1 + ra^2$, figure 10-a, it is possible to have expressive growth in the economy provided that the source intensity is high enough $\alpha \gg 1$. For very high source intensity the more expressive growth is observed for low values of β . This scenario can be associated with a reduced outflow rate or credit expansion with more flexible rules. If the injection of money is modest it will cause more harm than benefits. For weak sources the economy will grow faster for high values of β , that is, high inflow rates.

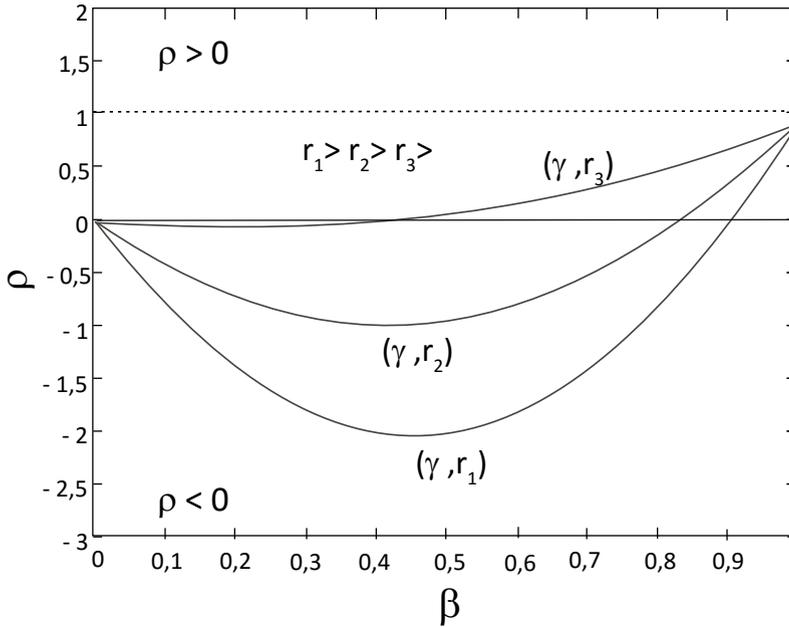
Now it is interesting to observe that for very modest sources $\alpha < 1 + ra^2$ there will always be growth although at very low increasing rate (Fig. 10-b). For this situation the best option is to stimulate capital inflow.

Fig 10 – Influence of the source intensity on the evolution of an economic chain for (a) $r=4$; $\alpha_1=5$, $\alpha_2=2$, $\alpha_3=1$, $\alpha_4=0.1$; (b) $r=0.8$; $\alpha_1=0.8$, $\alpha_2=0.5$, $\alpha_3=0.3$. For this case $\alpha_i < 1+r=1.8$ for all $i=1,2,3$



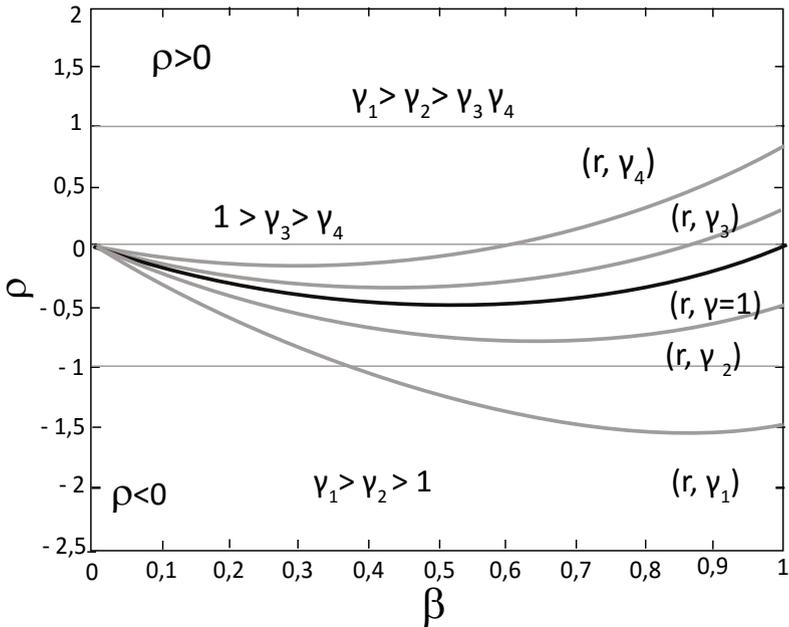
Now if we consider only a sink in the system, $\alpha=0$ and $\gamma>0$, that is we want to spare some money from an expanding economy the situation is much more critical. First for very large values of γ the economy will accumulate considerable losses. The whole system will enter a descendent trajectory. For modest capital subtraction from the system, that is γ small, it would be possible to preserve the growing process provided that r is small and the capital inflow keeps β sufficiently high as shown in the figure 11. Subtraction of money from the economy inhibits the outflow that is spending money and taking loans.

Fig.11 – Influence of the parameter r on the evolution of an economic chain for a given sink $\gamma=0.1$; $r_1 = 10$, $r_2 = 5.8$, $r_3 = 1.5$.



Now if we take a fixed value for $r=2$, the outcome is very critical. For very high extraction of resources from the economic system there will be degradation for all β . If the amount of assets subtracted from the system is modest only the regions where the influx prevails that is high values of β will be associated with growth (Fig. 12).

Fig.12 – Influence of the parameter γ on the evolution of an economic chain for a given $r=2$; $\gamma_1=2.5, \gamma_2=1.5, \gamma_3=0.7, \gamma_4=0.15$



Although the interpretation of the variables advanced here may be subjected to strong criticisms, particularly the meaning of the x variable identified with the structure of the economic chain, the overall response of the model may be identified with real cases observed in the several occasions of strong economic changes.

The results derived from the bi-flux approach are plausible and do not oppose the common sense. The above examples are encouraging. Therefore, it is worthwhile increasing research efforts to obtain an accurate interpretation of the different parameters and select appropriate data to validate the model.

3. Anomalies introduced by the boundary conditions

Different boundary conditions introduce considerable discrepancies on the capital concentration function $p(x,t)$ for small values of t . We show this behavior by using slightly different boundary conditions with the same initial condition. Consider that at $x=0$ there is no flux and at $x=1$ the flux bifurcates into two sections, inflow and outflow. The initial condition is $\Psi_2 = p_0 \left(\frac{1}{a}\right)^3 \sinh\left(\frac{1}{a}\right)$ and the boundary conditions are:

(a) For time independent conditions: $\Psi_1 = p_0 \left(\frac{1}{a}\right) \sinh\left(\frac{1}{a}\right)$

$$\Psi_1 = p_0 \left(\frac{1}{a}\right) \sinh\left(\frac{1}{a}\right)$$

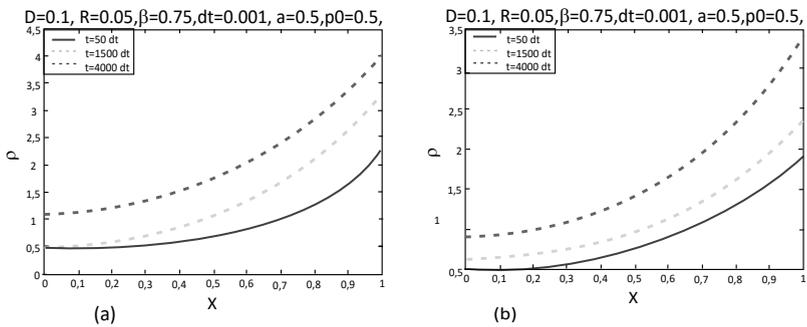
(b) For time dependent conditions: $\Psi_2 = p_0 \left(\frac{1}{a}\right)^3 e^{\rho t} \sinh\left(\frac{1}{a}\right)$

$$\Psi_1 = p_0 \left(\frac{1}{a}\right) e^{\rho t} \sinh\left(\frac{1}{a}\right)$$

Figure 13-a shows the capital concentration variation for three different times. Clearly at the very begin $t=50Dt$ the boundary conditions (a) induce a slight decrease in the capital concentration at the lower end of the economic chain and high concentration increase in the region close to $x=1$, where the in-and outflow are under control. Let us recall that the space variable x represents the economic chain, starting with the weaker economic agents E_3 , x close to zero and ending at $x=1$ E_1 representing economic segment with more decisive power. As shown in the figure 13-a except for the higher sections of the social or economic chain, there will be losses for the segment E_3 and very low economic growth for most of the agents in the segment E_2 just after

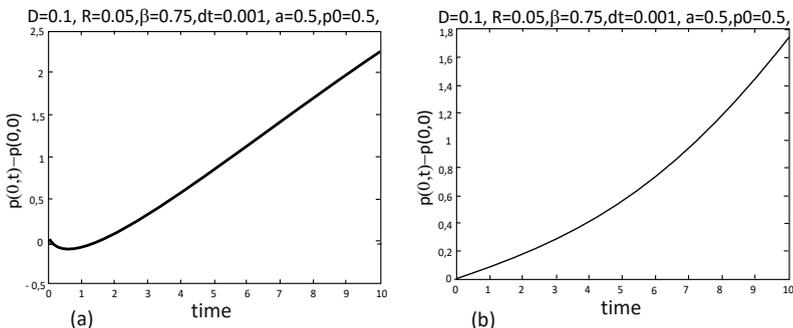
the process starts. As time increases the economy enters a growing phase for all the sections of the chain.

Fig.13 – Concentration distribution for 50Dt, 1500Dt and 4000Dt for time dependent (a) and time independent (b) time dependent boundary conditions.



Therefore the fixed boundary conditions trigger a wrong signalization for the economic evolution if we consider the tendency shown by the initial steps. As shown in the figure 14-a the capital concentration at $x=0$ decreases initially before start growing. This situation could generate panic and social disruption.

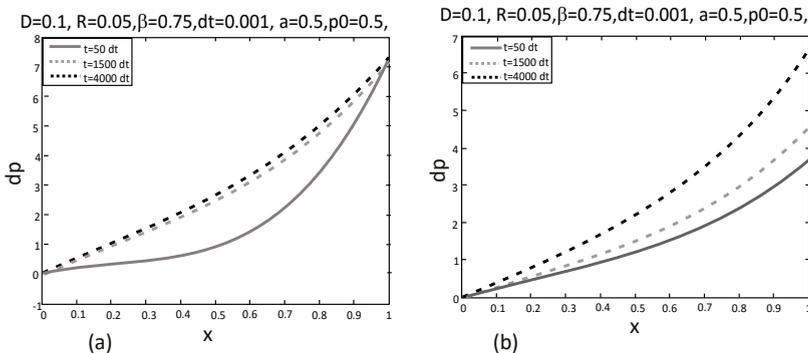
Fig.14 – Concentration deviation from the initial conditions at $x=0$ as function of time, (a) fixed boundary condition, (b) time dependent boundary conditions



Now, for time dependent boundary conditions, that is, if the in- and out flow at $x=1$ follow the evolution tendency signaled by the whole process, all sections of the social chain will benefit from the economic growth as shown in the figure 13-b with no drawback for any section of the social chain, even at $x=0$ as shown in the figure 14-b.

The case of time dependent boundary conditions therefore follows a very regular time evolution as shown in the figures 13-b and 14-b. The first and third derivatives also are monotonic increasing function of x as expected. Recall that the absolute value of the primary flux Ψ_1 is proportional to $|dq/dx|$ and the absolute value of the secondary flux Ψ_2 is proportional to $|d^3q/dx^3|$. Therefore for the case of time dependent boundary conditions the flow rates Ψ_1 and Ψ_2 are well behaved monotonic increasing functions as shown in the figures 15-b and 16-b.

Fig.15 – Evolution of the first derivative of $q(x,t)$ for fixed boundary conditions (a) and time dependente boundary conditions(b)

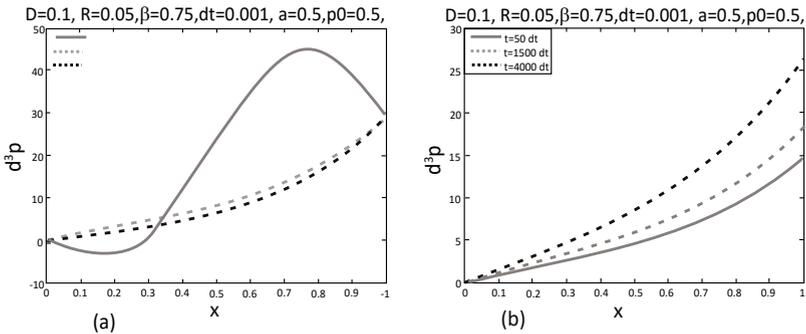


Now the fixed boundary conditions, that is, time independent boundary conditions induce a peculiar behavior that could hardly be anticipate at the very beginning of the diffusion process. The dynamics of the process is particularly intense for $x > 0.5$ that presumably corresponds to the agents with relatively high influence in the economic development. The inflow Ψ_1 intensity and particularly the outflow Ψ_2 intensity are both very high in this section of the chain. We

believe that this parameter is difficult to be directly measured, except for the generalized “sensation” of accelerated capital gains and losses, but with modest impact on the economic growth if any.

The outflow under the conditions imposed in the diffusion process is so high for $x > 0.5$ that, in order to keep the segment E_3 still alive, that is with reduced but still positive resources, there is an inversion in the direction of the subsidiary flow at $x \approx 0.3$ (Fig. 16-a). Therefore for $0 < x < 0.3$, both fluxes, primary and secondary have the same direction. It is a kind of loan coming from the middle segment E_2 toward the lower segment E_3 in the economic scale.

Fig.16 – Evolution of the third derivative of $q(x,t)$ for fixed boundary conditions (a) and time dependent boundary conditions (b)



After the impact at the beginning of the deflagration of the economic dynamics the process reaches the expected behavior with a smooth and monotonic increasing behavior as function of x . Despite the fact that this is only a very elementary model the qualitative divergence in the growth process for the two alternatives presented here are not incompatible with real cases reports. The model suggests that, if the in- and outflow conditions for the economic segment E_1 , with the responsibility of negotiating with external agents – boundary conditions – do not allow for a flexible evolution in time to match the internal demands determined by the natural evolution path, at least in

the very beginning, there will be unavoidable uneven economic growth distribution along the chain. Also, the initial signs do not match the forecast concerning the future economic behavior which presumably is much more positive and optimistic.

The ideas advanced here concerning the socio-economic significance of the new variables need to be carefully discussed. What we intended to show is that the new parameters introduced with the bi-flux theory allow for a much more flexible interpretation of the economic dynamics. The intensity of the secondary flow Ψ_2 for instance is proportional to the inverse of the radius of curvature of the wealth distribution. This means that the secondary flow is directed towards regions with high wealth concentration. This is not an unusual situation.

4. The next steps toward the validation of the theory.

It was shown that the classical theory, which is very useful for simulating simple diffusion processes, is not enough elaborated to deal with more complex processes. The introduction of the second order linear theory, fourth order partial differential equation, allowing for two simultaneous flows within the same diffusion process is adequate to model bi-flux processes as capital flow. This was shown in the preceding section through three particular simulations. The results indicated by the new theory, despite being primarily qualitative, very much agree with the common sense. Therefore we may advance the following statements:

1. The theory is adequate to deal with simultaneous fluxes within a same process.
2. The responses do not contradict the observed and expected outcome.

In other words the results are encouraging and suggest an elaborated version of the model. We consider that future work should look into the following aspects:

1. **Development of the capital flow model.** The questions raised by the previous examples could only be answered through a deeper analysis of the significance of the coefficients D , R , β and a . Therefore it is necessary to select some cases, initially simple cases, to be reviewed under the light of the fourth order theory. Particular attention should be given to the following items:
 - 1.1 Establish a methodology to associate concrete economic data basis with the variables and coefficients introduced in the theory.
 - 1.2 Selection of some cases with reliable data, available and free to be used to test the model.
 - 1.3 Perform a detailed analysis with β as function of time and examine the influence on the answers given by the solution of the equation.
 - 1.4 A key question is to investigate the possibility of the resistivity R to be a function of β . If there is strong evidence supporting this hypothesis the behavior of the solution could be substantially modified to match real cases of economic evolution.
 - 1.5 Explore the significance of sources and sinks, probably associated with loans and debts.
2. **Mathematical analysis.** Given that it is crucial to investigate the behavior of the fundamental equation with the parameters R , D and β as functions of x and t it is inevitable to devote part of the attention to mathematics. Also the addition of sinks and sources and the respective influence on the response is essential. Therefore we envisage the following topics to be considered:

2.1 Development of numerical methods for nonlinear equations of the form:

$$\frac{\partial q}{\partial t} = \frac{\partial}{\partial x} \left(\beta(x,t) D(x,t) \frac{\partial q}{\partial x} \right) - \frac{\partial}{\partial x} \left(\beta(x,t) (1 - \beta(x,t)) R(x,t) \frac{\partial^3 q}{\partial x^3} \right) + \sum A_i(x,t) f_i(\beta)$$

2.2 Analysis of the behavior of the linear fourth order equation with $\beta=\beta(t)$, function of time. Particular attention should be given to the term $\beta(t)(1 - \beta(t))$ that for some particular conditions could lead to chaotic behavior.

2.3 Analysis of the stability conditions of the solution for D and R functions of x . Anisotropic media. Influence of sinks and sources on the stability of the solutions.

2.4 Behavior of particular cases with $R=R(\beta)$ as suggested by the input from the research line 2 above.

2.5 Advanced elaboration of the inverse problem for the fourth order partial differential equation [4] [5].

2.6 If it is possible to associate capital inflow and outflow with two distinct “energy states” a new notion of “entropy” could be introduced in the economy dynamics.

Finally we would like to say that a country cannot remain captive of economic models and indicators that might not represent the dynamics of the real economy. At least some effort should be done to investigate more adequate models that would allow for more efficient economic policies. There are no unique solutions, particularly in socio-economic matters. This is the intention of the present paper.

6. References

We have restricted the references to those dealing directly with the subject of the proposal. Although there is a huge number of papers dealing with diffusion the case of bi-flux for a single particle species could not be found. There are of course several cases where fourth order equations come into play but in different contexts or dealing with non-linear diffusion approaches. References [1] and [2] below contain several citations on classical and anomalous diffusion processes. A representative example of modeling economic behavior with the help of the classical diffusion approach may be found in the famous Black & Sholes paper [6]. Certainly several scholars strongly criticize the Black and Sholes theory while raising doubts about the efficacy of mathematical models in social sciences. This attitude however should not avoid a continuing effort to develop tools helping decision makers to accomplish their rules in society. The key point is not to use models as an infallible tool to take decisions.

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2. A brief report on the creation and the academic output of the Federal University of ABC

1. The new cultural environment

In the last 70 years the world was subjected to amazing changes encompassing the whole spectrum of human knowledge and our way of life. Among several issues we may consider:

1. Global climate changes and the environment
2. Science and Technology boom
3. Sociopolitical and economic issues
4. The open road to the Universe
5. Cultural differences and conflicts
6. What is life? How does our brain work? Who are we?
7. Religion, myths and beliefs
8. A small world- IT
9. The planet earth and self-destruction?
10. Art, artist and mass culture industry
11. Rational and transcended knowledge

All these points are essentials to propose the identity of a university for the XXI century. Particularly the extraordinary progress in science and technology was made possible due to two main factors: advancement in observation: macro- and microcosms and advancement in computer technology and applications. An immediate consequence of these two factors together with the new challenges imposed by the needs of our society was the convergence of disciplines

formerly isolated by strong barriers. The disciplinary convergence has strong impact in the university academic structure. It is necessary to consider, besides reshaping the scientific guidelines, the emerging of new technologies in all fields and the new professions and new options of higher education.

All these new initiatives are coming up very quickly. Then I would say that more than the knowledge era we are living an era of cultural shock. In addition, in times of cultural shock we need to change considerably our attitude towards education. The committee in charge of designing the UFABC project was well aware of these new conditions and the difficulties inherent to the creation of a University that would challenge the traditional academic structure. In any case one important obstacle was not present, namely the academic committees, the faculty senate and all the organized groups that are the guardian of the traditional academic structure. The University would be created from scratch. The obstacles would come from outside. These are not as dangerous as the internal destructive forces.

2. The basic principles

So the Federal University of the ABC was planned considering the conditions imposed by the new cultural environment. The following basic principles were taken as essentials:

1. The traditional university organization is hopeless
2. There is no much time to think and take decisions
3. It is necessary to undertake risks
4. It is necessary to be prepared to make quick changes in orientation
5. It is necessary to challenge traditional rules and fight for new and more flexible statutes adequate to the present times
6. It is necessary to find a suitable “board” to rise above the cultural “shock wave”

7. Anyway it is necessary to be prepared to fall down and get to your feet again

Keeping in mind those challenges the committee started working on the basic academic principles, the cornerstones on which the new University would rest. Although not explicitly appearing in the texts of the implementation committees the academic structure of UFABC was supported by four very basic principles:

Learn rather than Teach

Against the teaching strategies prevailing in the Brazilian culture, it was acknowledged that the University must be a place intended primary to learn rather than teach. This may be apparently easy to implement but it is not. The primary attitude towards the students is that they would learn only what the teacher teaches. The student is considered a passive player in the learning process. The concrete expression of the new attitude was the limitation of number of class-hours per week. It was strongly recommended no more than 15 class-hours per week, 12 being the desirable charge. The students were encouraged to study by themselves and to look for the solutions of new problems autonomously. The education was centered on the following principles:

Fostering creativity – More individual work and fewer classes – Think.

Building self-confidence – To dare and to reduce aversion to risk.

Learning to take decisions and to stimulate entrepreneurship – Less complaints and more solutions.

Together with this new attitude, it was strongly recommended that the sharp boundaries separating the university community into very specific layers (professors, students, technicians, administrators) should be dissolved. It is crucial to build up a new academic community.

Don't pour new wine in old bottles

Interdisciplinary research has come to stay. It is already a successful approach to tackle complex problems. However courses, particularly undergraduate courses follow the classical organization. Departments remain as the fundamental academic units in the university structure. This kind of contradiction confuses the students. It is necessary to break up the departmental structure. Together with breaking down the departmental barriers a reshuffle of the main themes distributed among the classical disciplines, physics, chemist, mathematics, biology, computation should be done. New guidelines more adequate to the new science and new technology should be implemented substituting the old ones. The committee proposed that the new university should be organized with three schools, namely: Natural Sciences and Humanities, Mathematics, Computation and Cognition, Engineering and Social Sciences. The new guidelines would be: Structure of Matter, Energy, Transformation Processes, Communication and Information, Representation and Simulation (Mathematics), Humanities and Social Sciences. The student should have more freedom to select courses and professional options keeping credit requirements for basic courses at a minimum level.

First discover, then publish

Advancement of knowledge rather than thickening the authors' CV should be the focus of publications. The contribution of a scientist is not measured by volume but by the scientific value of the new ideas. The pressure for quantity instead of appreciation for quality delays the advancement of science and technology. Also this fundamental idea should support the performance evaluation in the academic career.

Finally the UFABC ultimate declaration of identity was settled as follows

The main commitment of the UFABC toward society is to **recover the appreciation for scientific learning**, to show the beauty inherent in the mysteries of nature and hidden in a mathematical object. It was founded on the assumption that knowledge is not only a means to response to market demands but **above all to the enlightenment of the human spirit**.

The project of UFABC is sustained by the **freedom to explore new paths** that will lead the University closer to its **original and universal purpose**: to discover, to invent and to think critically. The education system, more than ever, should encourage students to make **their own choices, to take risks, to accept challenges and to think creatively**.

The UFABC is committed to the above principles that will guide the university to accomplish its mission contributing effectively for the educational enhancement of our Nation.

3. The implementation

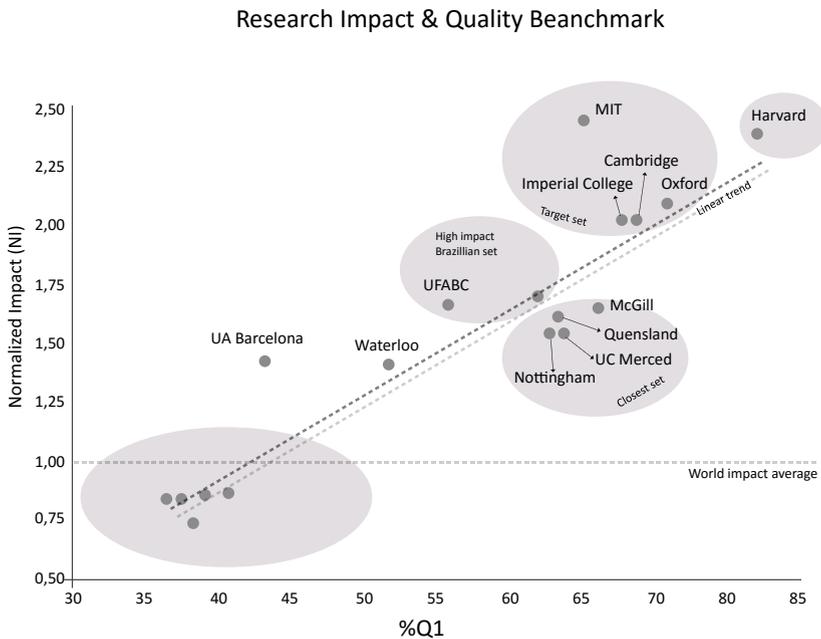
The UFABC was founded according to the above principles. The first five years were difficult partly due to the resistance to accept a new education project. Our society is acquainted to follow well established educational paths. Any deviation raises suspicious attitudes most of the time assuming that education would deteriorate if the students would be free to make their own choices. High school teachers, parents and also most of the academic community did not approve the new educational project. The high school students were discouraged to apply for the new university. The local unions and community associations criticized strongly the new project. Newspapers independently from their ideological option opposed the basic educational principles and the orientation proposed by the university for the new professional careers.

So the first five years were very difficult for the faculty and the UFABC leaders. Fortunately the young professors joining the university were highly qualified and committed with the project. Graduate courses started simultaneously with undergraduate courses so that the

professors joining the university could continue their research work. Collaborative agreement, frequently very informal, were established with other universities allowing for the continuation of research projects of the new faculty joining the university.

After 10 years the UFABC is now showing that the effort was worthwhile. The academic output of the university is being recognized internationally as shown in the figure 1. It is the best Brazilian university considering the criteria of high-quality publications, normalized impact factor, overall excellence and internationalization. Certainly the volume of publication is still less than other older Brazilian universities.

Fig. 1 – Scientific production at UFABC, quality of journals vs impact, SIR GLOBAL 2013, Scimago LAB



According to the Ministry of Education evaluation process, the UFABC is distinguished as one of the 20th best universities in Brazil among 2000. The UFABC belongs to the select group with the highest possible score. In 2013 this recently founded University conquered

the first place in the education performance for the bachelor courses: Chemistry and Mathematics and the engineering courses: Material Science and Engineering and Environmental Engineering.

The former UFABC student Thiago Alencar who obtained the undergraduate degree in Aerospace Engineering in 2011, was honored with the **“The Theodore W. Hissey Award”** sponsored by the IEEE. It was the second Brazilian to receive this prize. He wrote a letter to the UFABC faculty finishing with the following words:

“I would like to dedicate this prize to the (UFABC) professors and share my achievements accomplished in last few years expressing my high appreciation for the Bachelor degree project that I finished and has made a big difference not only my academic life but also in my education as a citizen, besides the several opportunities that this pioneering and audacious academic project has opened in my life. I owe a great deal for being what I am now to my former professors who even facing so many difficulties believed in the interdisciplinary pedagogical proposal of the Bachelor program and that fight constantly to keep the university mission faithful to its original principles, preparing courses, doing research, advising students to become highly qualified professionals with critical thought concerning their role in society.”

The ranking of Brazilian Universities organized by the newspaper “Folha da São Paulo” distinguishes the UFABC as the Brazilian university more involved in international cooperation. The UFABC leads the rank in the item “Internationalization”.

In May 2015, the prestigious British newspaper “The Guardian” published an article under the title: The Federal University of ABC (UFABC).

The first paragraph reads:

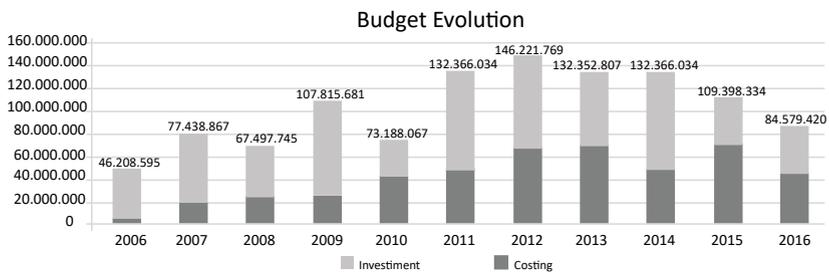
“President Lula may have drawn much of his power base from the unions he represented in local industry, but in the creation of the ABC region’s Federal University he has paid back that loyalty. Shaking off the image of closed-off laboratories, conservative approaches and

reluctance to change, UFABC is proving the shining example of what a public higher education in Brazil can become”.

This is a remarkable recognition of the high level that Brazilian higher education can reach. Unfortunately the Brazilian media do not emphasize the histories of success, the disaster and misconduct have the priority.

Finally the recent choice of the São Bernardo do Campo county as the headquarters of the Swedish aircraft factory SAAB to produce fighters for the Brazilian Air Force has closed the overall purpose of the UFABC. The UFABC certainly played an important role in the SAAB’s decision process. The unions that 10 years ago had a suspicious attitude towards the UFABC role in the industrial enhancement of the region are now asking for more investments on education and training for the region. Even the fostering of graduate courses in the region entered the list of the union demands.

Fig 2. – Evolution of the UFABC annual budget. The 2016 FY is estimated



So it is very clear the extraordinary benefits that this new university with a revolutionary academic project, at least for the Brazilian standards, has brought not only for the local society but also for the national education system. In fact, after the success of UFABC other Brazilian universities are trying to reorganize their curricula to be more effective in the modern world. Now how to measure the impact on the economy brought by the quality of higher education is not an easy task. In any case, it is commonly accepted all over the

world that education plays a key role in the economic and industrial development. The public investment in higher education has been severely cut in the last two years. The figure 2 shows the recourses allocation to UFABC since its creation. It is imperative to recover the initial investment pace. The UFABC is now living a very productive cycle. Discontinuation will severely damage the scientific production and education for the future. With 562 professors, 12000 students 23 undergraduate courses and 23 graduate courses, with high academic evaluation and honored with more than 100 academic awards the UFABC is still in expansion phase particularly regarding laboratories and infrastructure. It would be a disaster to abandon such a singular initiative, which is bringing a renovation wave for the national higher education, with unquestionable success recognized internationally.

We avoid introducing references. Complementary information can be obtained from the University homepage. Several dissertations have focused the UFABC project and evolution. We believe that a close follow up of the UFABC development will be extremely useful to analyze the factors that could influence the growth or the decay of a university in the Brazilian federal system. Finally it is important to mention that this August the number of graduate students in UFABC has reached the digit 1000.

3. A short report on role of EMBRAPA in the Brazilian agribusiness.

This section is a short account on the EMBRAPA role in the Brazilian agricultural complex. It is only to remind how worth is State investments. EMBRAPA's history and development trajectory has been well written by several authors [1] [2]. So it is not our purpose to summarize EMBRAPA's history but to show in brief numbers how important this Institution has been to the Brazilian economy and agricultural science and technology.

EMBRAPA, Brazilian Agricultura¹ Research Corporation, a research section of the Ministry of Agriculture, Livestock and Food

Supply was created in 1973 as the government's response to the challenge of modernizing agriculture to face the new and challenging problems of the modern world. This institution was given the mission of coordinating the Brazilian Agricultural Research System, integrating the actions of several Brazilian institutions involved with agricultural research. It was also within the EMBRAPA's scope to promote a more effective international cooperation.

Although EMBRAPA has been playing an excellent role in the development of the Brazilian industrial complex I would like to remind the contribution of a scientist who migrated to Brazil in the fifties and is an example for all our academic community: **Dr. Johanna Döbereiner**. Against the opinion of several well recognized scientists who sustained that working with bacteria to fix nitrogen was good only for theoretical purposes, with no practical application, she pursued her research and proved that she was right. Their opponents sustained that only the nitrogen fertilization could be effective to improve soybeans production. After strong discussions, involving Brazilian and mainly foreign scientists who were skeptical about her theory, she proved that she was right. This was possible with her breakthrough contribution showing that nitrogen fixation could be done introducing *Azospirillum* and other bacteria that could be useful to Brazilian soil following the discovery of nitrogen fixation bacteria in different species of vegetables, mainly grasses as corn and sugar cane. Dr. Döbereiner contribution is an extraordinary example of self-confidence, intellectual independence, courage to face new and challenging problems and passion for scientific research. Her discovery played a decisive role in EMBRAPA effort to adapt soybeans in the northeast of Brazil. Dr. Döbereiner proved that science is extremely useful to push technological development. It is important to say that investing in science has always been one of the most important of the EMBRAPA's priorities. In an interview for BBC Brazil, researchers in the field of agriculture were unanimous to declare that the most important contribution of EMBRAPA was the

development of technologies that allowed for the correction of the soil acidity in the Northeast Brazil making possible the adaptation of plants coming from different biome. Before 1970 the Northeast region was irrelevant as a player in the agribusiness, nowadays this region contributes with almost 50% of the country's production.

Among the main actions characterizing EMBAPA's priorities we may quote [2]:

- The planning team includes people with economic and social sciences background that contribute decisively for the Institution's program. The Institution priorities are well defined and followed along the execution.

- The research is focused on the agribusiness as a whole. The purpose is to develop a system not a specific technology. The technology is part of the package.

- Departments were abolished and research units were created such that each unit could work out solutions more adequate to the requirements of the respective region.

It is also important to mention that EMBRAPA has an international outreach program. As stated in the EMBRAPA homepage the LABEX was created to "promote scientific and technological cooperation with other countries". To accomplish this target," Embrapa launched a program to set up virtual laboratories abroad, which seek to ensure Embrapa's physical presence outside of Brazil. The concept of virtual laboratory entails sharing laboratory space and infrastructure with partner institutions."

EMBRAPA is a shining example that investing in technology is really worth it. As written in the Social Report 2014:

The Social Profit/Net Revenue ratio in 2014 was of 8.53. In order words, each Brazilian real invested was returned to Brazilian society multiplied by 8.53. The returns from Embrapa's investment in the 106 technologies monitored and assessed since 1997, the year of the Social

Report's inception, also indicate high yield and an average internal rate of return (IRR) of 39.4%.

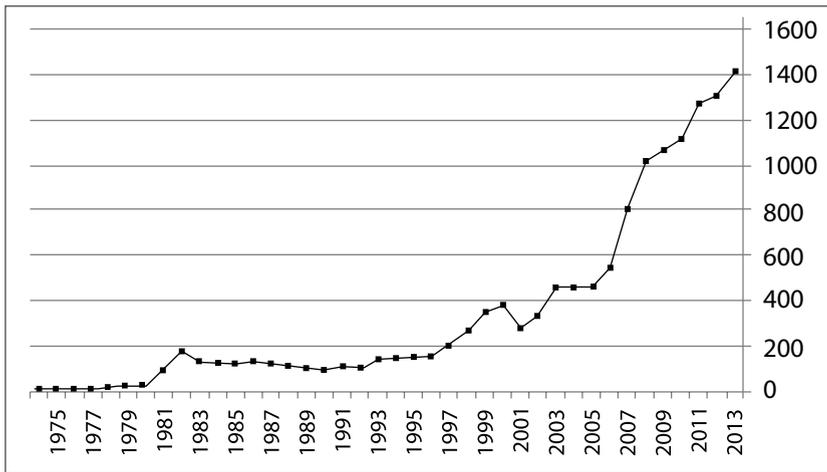
In 2014, 66,255 new jobs were created. This is a baseline figure, as it refers to new jobs generated by the 106 technologies assessed in this report. Since Embrapa has developed and transferred thousands of technologies, products, and services to Brazilian society throughout the course of its history, such impact on the number of jobs created each year is certainly much higher.

The ongoing research is contributing continuously to the growth of the country. We may highlight the following initiatives as stated in the Social Report 2014:

- Mato Grosso do Sul Fishing Control -SCPesca/MS, which enabled the management and the conservation of fish stocks in Pantanal.
- Technology developed to reduce deforestation and to guarantee milk production in the Amazon region.
- SuplementaCerto App, a code which helps farmers decide on cattle feed during draughts.
- INPE-Embrapa Partnership in land monitoring in Amazonia extended to Cerrado.
- Booroola mutation program that expands sheep meat production in Southern Brazil.
- Draught-resistant cashew clone that generates wealth growth in Piauí semiarid.
- New gene bank that broadens Embrapa's contribution to food security in the planet.
- Embrapa's new website intended to increase the potential of technology transfer.

It is also important to mention that in 2014, EMBRAPA was distinguished with 70 awards and honors. The growing contribution to scientific development is clear from figure 1.

Fig. 3 – Scientific publications in indexed journals according to Web of Science Period 1974 a 2013.

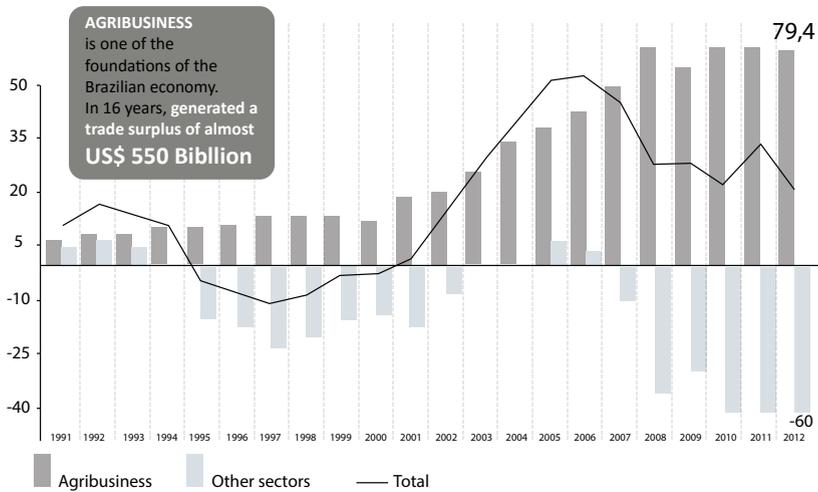


Among the new research topics the Amazon rain forest is attracting the attention of some of the researchers. The main focus is to invest in the adaptation of some species to be introduced in the region keeping inviolate the sustained environment requirements. This initiative could enhance the production of typical fruits of the Amazon region and push forward the exportation to other Brazilian regions and to other countries. It is also to mention some initiatives in the field of genetic improvement, which fall outside of the investment priorities of the private sector. If EMBRAPA is successful in these projects it can raise the institution to a competitive status with the private sector and reach very good position in the market provided that it can create a business sector.

Among the several contributions that EMBRAPA has brought to the national development we would like to highlight two points. The first concerns the extraordinary impact in the economy. Between 2002 and 2012 the exports by the Brazilian agribusiness sector was multiplied by seven. The contribution of the agribusiness export is essential to keep positive the Brazilian commercial balance. As

seen from the figure 2 in 2012 the Brazilian exports coming from agribusiness activities reached 79.4 billion USD overcoming several times other activities and keeping positive the commercial balance exports-imports.

Fig. 4 – Trade balance and contribution of the agribusiness.



The second point refers to the contribution of EMBRAPA to the increase of the Brazilian agricultural and cattle production. It is impressive as can be seen from the figure 3. Particularly remarkable is the increase in the soybeans production reaching the level of almost ten thousand percent in the period 1965/2005.

Fig. 5 – Performance of the Brazilian agribusiness 1965-2005 in tons

Year	1965	1975	1985	1995	2005	Var. % 1965/ 2005
Sugar Cane	75.852.864	91.524.560	247.199.472	303.699.488	420.120.992	453,9
Soy Beans	523.176	9.893.008	18.278.592	25.682.636	52.700.000	9.973,1
Corn Grain	12.111.921	16.334.516	22.018.176	36.266.952	34.859.600	187,8
Orange	2.285.524	6.313.171	14.214.307	19.837.212	17.804.600	679,0
Rise	7.579.649	7.781.538	9.024.555	11.226.064	13.140.900	73,4
Tabacco	248.182	285.934	410.474	455.986	878.651	254,0
Wheat	585.384	1.788.180	4.320.267	1.533.871	5.200.840	788,4
Beans	2.289.796	2.282.466	2.548.738	2.946.168	3.076.010	34,3
Meats	2.420.782	3.589.592	5.898.738	12.807.517	19.919.135	722,8
Milk	6.857.813	10.054.500	12.572.830	17.126.100	23.455.000	242,0

Fonte: FAO, 2006.

In a recent report [4] the following guidelines were proposed to steer EMBRAPA's research effort. The following themes were selected following the input of the production chains that allowed the identification of the most important technological challenges in the several agribusiness activities. The selected topics are:

- Natural resources and climate changes
- New science: biotechnology, nanotechnology and geotechnology
- Automation, information technology, and precision agriculture
- Sanitary safety of agricultural products and productive chains
- Production systems

- Agro-industrial technologies of biomass and green chemistry
- Safety measures for food, nutrition and health.
- Markets, policies and rural development

Finally, we would like to call the attention about the evolution of EMBRAPA's budget in the last 15 years [4]. After a critical phase encompassing the period 1995- 2003 when the institution budget decreased drastically from 1.38% to 0.73% of the gross domestic product (GDP) of the agribusiness sector there was a partial recovery to reach the level of approximately 1,0% of the agribusiness GDP (Fig. 4).

Fig.6 – Evolution of EMBRAPA's budget as a fraction of the gross domestic product corresponding to the agribusiness activities

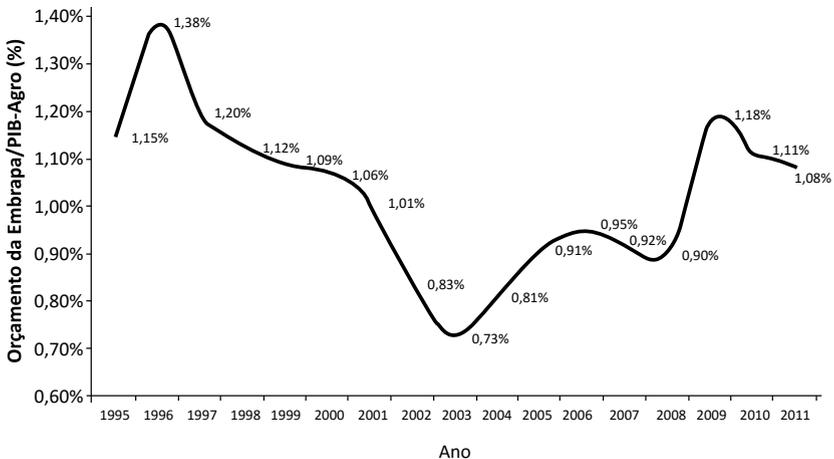
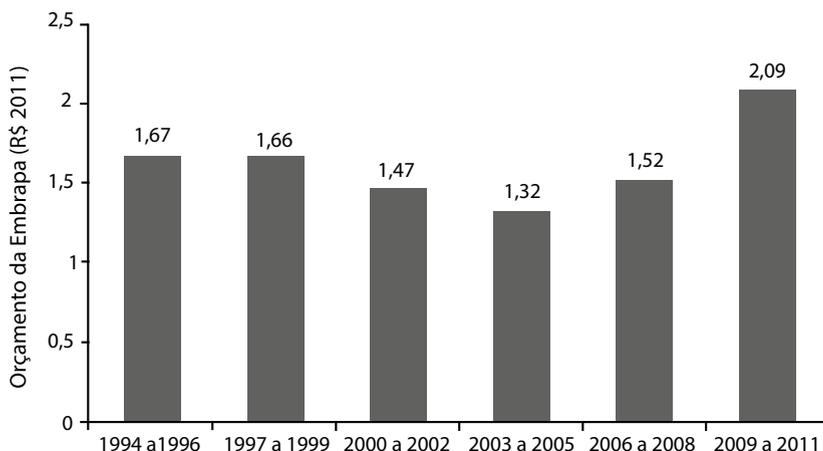


Figure 6 displays the institution budget in the last 15 years. Recently there was an increase in the amount allocated to EMBRAPA by the Federal Government. It is clear that this institution deserves the maximum support from governmental investment agents. The return of the investments to compensate the imbalance of the export-import.

Fig.7 – Evolution of EMBRAPA’s budget in R\$ billions.

The return of the investments to compensate the imbalance of the export-import relation justifies this policy. It is very important to sustain the effectiveness of institutions like EMBRAPA in the middle of temporary turmoil affecting the national and global economies. We believe that it is one of the most important activities of the economic authority to define priorities in difficulty times. EMBRAPA has proved to bring unique contribution to Brazilian economy, agricultural science and agribusiness, it must be preserved.

This was a very short account on the EMBRAPA’s role in the Brazilian agribusiness industry. There are several papers and books on EMBRAPA’s history and role in Brazilian economy that the reader could easily access. The main conclusion is that public investment is worth, provided that, the people involved are competent and able to think independently, the problems are challenging, and the targets are well defined. EMBRAPA is one of these.

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GOVERNANCE STRATEGIES IN THE 21ST CENTURY: COMMENTS ON CHINA'S NEW CHALLENGES

Anna Jaguaribe

Introduction

China now faces the dilemma of transforming its growth model, based on an economy with global ties in all commercial, industrial, and service sectors. Due to the extremely comprehensive political geography of its investment portfolio, a slowdown in its growth, market fluctuations and changes in the composition of its GDP produce global shock waves. The fact that China's economic growth has been quite steady over the past three decades at 10% a year also contributes to this shock effect.

After more than thirty years of economic internationalization and accelerated catching up, China's economy enters a new stage and confronts economic imbalances and disarticulations stemming from its rapid growth, as well as significant changes in the global economy.

The New Normal and New Silk Road policies are strategies designed to meet the challenges posed by the economy and the new international scenario. Such policies bet on the sustainability of the Chinese economic model dynamics, i.e. the effectiveness of a combination of global market economy and state presence in key sectors and investments. These policies also rely on China's international consolidation without hegemonic struggles. In this case, international consolidation is connected with increased trade, investment and political understandings in Asia, serving as a model for inter-regional relations.

The dynamics of domestic and foreign policy are mutually supportive. They are instruments designed to facilitate the progression from catching up to becoming an innovation economy. They seek to sort out persistent social and economic problems in a different global context, without the advantages that characterized the early stages of economic reform in China.

The New Normal policy is not only a strategy for fiscal rebalancing, reform of the financial and administrative systems, but also a market development policy which relies on innovation as a new driver of growth.

China's new growth model implies a slowing economy and demands transformation in the dynamics of trade and public investment. This new context brings uncertainty to the international market as it changes the income profile of those who depended on China to drive national growth.

The slowdown in China's growth has been interpreted by many observers as the end of an exceptional process of modernization and a test to national strategies linking state and market in the dynamics of growth. On the positive side, this slowdown is considered part of the historical slowdown of Asian countries with fast catching up, such as Japan, Korea and Taiwan. On the negative side, the slowdown in growth and turbulence in the process are seen as the ultimate test to prove that state intervention hinders the proper functioning of market internationalization.

This paper argues that what is currently taking place is more than a process of normalization of Chinese economic growth patterns. New policies actually seeking to manage new growth levels result from a particular model of governance and a unique process of modernization. Their success does not depend on the impossibility of combining strong state presence in a globalized market economy, but on the congruence between policy and means and the existence of predictable and adequate governance practices and institutions.

The New Normal policy seeks to facilitate progression from a catching up policy to an economy driven by the domestic market and innovation. Such is a complex movement requiring special training and institutional dynamics which are often contradictory. In the case of China, it is an ongoing process, with several possibilities of development for the future. The aims are escaping from the potential pitfall of secondary innovation, advanced technological density and global integration for the economy. At stake is the ability to create institutions and governance mechanisms to enable this progression.

The rise of China has transformed the global scenario for the development of emerging economies and the sustainability of developed economies. With its consolidation, China has shattered various development models. The road China follows today has been modified by its own success and the currently available options of reform are products of such circumstances. Thus, China and its circumstances are both the exception and their own rule. This paper discusses the transformation underway, seeking to highlight issues that remain to be clarified in the Chinese strategy to become an innovation economy.

The New Chinese Strategies: the New Normal and the Silk Road

In the past 35 years, China has grown on average 10% per year and transformed its economy into a global manufacturing center, a global meeting point for the supply chain of the economic industry. Among the various elements characterizing this achievement are: long-term strategic planning, high rate of investment and savings, a financial system composed of public banks that facilitate not only large investments in infrastructure, but also credit for major state companies, and the competitive dynamics of global insertion of emerging Chinese companies.

After more than three decades of economic internationalization and accelerated catching up, the international conditions which facilitated the country's growth, the drivers of the economy, have slowed down. Globalization changes, as well as the internal conditions that had facilitated economic growth in China: demographic curve, low-cost labor and energy, and pent-up demand.

This rapid growth has brought significant fiscal imbalances and financial barriers. The stimulus policy adopted as anti-crisis measure in 2008 further accentuated a marked trend for debt and overinvestment on the part of provincial governments. The new policy seeks to address fiscal challenges, internal financial weaknesses, and decreased margin of benefits from public investment.

Despite the centralized nature of strategic planning in China, the decision-making process allows great freedom of action to regional governments. Increased investment in regional administrations was fundamental for the dynamics of Chinese growth and was implemented through several combinations of incentives. Particularly relevant to the creation of new industrial plants were tax and financial incentives using resources from the sale of communal lands. The end of additional revenues from land sales contributed to trigger a spiral of financial debt and fiscal deficit in the regions.

They also reduced the margin of benefits from public investment. After decades of investment in infrastructure, the Chinese economy is now less capable of absorbing new investments in infrastructure and construction and state companies in the industry currently have excess capacity.

Post-2008 credit injection reinforced speculative trends in stock and construction markets, thus contributing to a new level of debt and bubbles in the stock market. The Shanghai stock market crash is an example of such imbalances.

The aim of the New Normal

The New Normal policy announced by Xi Jinping is aimed at achieving lower rates and higher quality in growth. An economic model underpinned by public investment and exports is replaced with a model focused on services, domestic market, and innovation with an emphasis on green economy. The aim is to rebalance the fiscal system, solve the debt spiral of regional governments and reform the financial system by making bigger and better credit opportunities available to the private sector. It seeks to encourage the service sector and domestic consumption, undersized in the export-oriented manufacturing economy. The aim is to boost green economy through investment and innovation in alternative energy, gradually disassociating China's energy matrix from coal. The new policy is accompanied by a significant administrative reform aimed at achieving more transparency and less bureaucracy in public governance, thus contributing to the fight against corruption.

In 2015, the Economic Conference of the Central Committee of the Communist Party of China explained the new economic policy as a strategy with nine goals. They are: promoting the domestic market; eliminating barriers to investment by stimulating the withdrawal of savings for investment; seeking new comparative advantages in production besides low wages; increasing the quality of industrial production and services; focusing on innovation; stimulating new markets with transparent incentives - disconnected from land sales and special tax advantages; shifting to a low-carbon economy; improving the risk management system in credit and construction markets; and a macroeconomic policy suitable to the post-crisis global economy (HU ANGANG, 2015).

Nevertheless, the new policy is also a reading of medium- and long-term opportunities for China. It can be assumed that both internal and external advantages that have benefited China's

catching up have disappeared or changed in such a way as to require a thorough review of the economic axes. Only a new strategy may reverse internal imbalances and be proactive in forging external circumstances that will favor growth.

The New Silk Road

The new economic strategy comes attached to new international initiatives, including the Silk Road Policy, which, albeit designed at the regional level, has important global implications. New international initiatives have different dynamics with multiple synergies. Their pillars are: outward direct investment (ODI); creating new multilateral funds and financial platforms dedicated to investment in infrastructure; and expanding regional and inter-regional trade agreements. They come accompanied by an exchange rate policy to facilitate the internationalization of the Renminbi.

As of 2005, China has begun a steady expansion of its foreign investments, in such a way that outward investment (ODI) is almost equal to investments in China (FDI). Growth is exponential, from 12.26 billion dollars in 2005 to 117.76 billion dollars in 2014. The globalization of investments was at first driven by the pursuit of comparative advantages for the export industry and by an interest in securing the natural resources needed for economic growth.

As of 2012, foreign investment in China has become an instrument for the global integration of all economic sectors. Both large state-owned companies and the private sector invest outside China. The purchase of Smarterfield by Shuanghui as well as investments of Beijing Genomics and Shanghai Wang in the lithium battery industry are examples of this new wave of Chinese foreign investment.

The second foundation of the international policy is the creation of new multilateral funds. Over the past two years, China has launched a series of new multilateral funds, with funding ranging from 50 to 100

billion dollars. The new funds are dedicated mainly to investments in infrastructure.

The new Asian Infrastructure Investment Bank (AIIB), the New Development Bank BRICS (NDB), the Silk Road Fund, and the New Financial Platform of the Shanghai Cooperation Organization are some of these initiatives. AIIB has the participation of major European and Asian countries, as well as Brazil. The participation of countries from outside the region and the multilateral design of initiatives both help them go beyond the Asian context and change the perspective from which we look at global economic relations. Such are innovations in the international architecture that anticipate major changes in inter-regional policy. They will no doubt have significant effects on the political dynamics of Breton Woods multilateral institutions.

The third pillar of the new foreign policy is the expansion of regional and inter-regional trade agreements. In this context, negotiations for the establishment of a free-trade area between China, Japan and Korea and the proposal of a Free Trade Area in Asia, discussed at the 2014 APEC Summit in Beijing, are particularly relevant. Such an activism in trade policy is even more significant in view of the stagnation of global WTO negotiations. All these initiatives – which increase the complexity and intensity of the Chinese international insertion – respond to Asia's changing geopolitics and increasing competition for influence between China and the United States in the Pacific.

The New Normal policy and new international financial initiatives in China are concerted in that they reinforce the pursuit of new economic opportunities. Both policies are inspired by an assessment of possibilities, conditionalities and trends in the global market and China's position within this context.

Zha Daojing argues that this is not the first time China adjusts its development path by linking external and internal factors. Its entry into the World Trade Organization in 2002 was an equally significant

choice. In 2002, change was meant to conform its growth path to international market governance standards. Today, conversely, it is China that must be more proactive in the management of international economic governance (Zha Daojing, 2015).

The new Silk Road policy, although apparently not linked to innovation or green economy, paves the way for international opportunities in a dull global economy. The World Bank estimates that Asia would need about 30 trillion dollars for new investments in infrastructure. The creation of the new Asian multilateral funds allows for expansion in large-scale investments in areas where China – and particularly large Chinese companies – are today at the technology frontier. They provide opportunities at a time when marginal gains in national infrastructure investments are falling and Chinese companies have excess capacity (Xue and Qiao, 2011).

From the commercial point of view, these new funds consolidate ties and partnerships in the region by adding a financial dimension to the policy of new and wider trade agreements and the promotion of a free-trade area for the entire Asia.

From the geopolitical perspective, the new funds inaugurate a new architecture for a multilateral policy that advances and expands the institutional universe of Breton Woods where China remains poorly represented. A new political frontier arises in the multilateral world.

Context and Challenges

So far reforms initiated by the Xi Jinping administration have had success, but also faced significant challenges. China's growth leans toward lower averages than anticipated and the current expectation is for a growth rate below the targeted 7% for 2015 and 2016.

With regard to the reorientation of the drivers of the economy, the service sector advances as planned, nearly reaching parity of

growth with the manufacturing sector, from 43% of the GDP in 2010 to 48% in 2014.

Fiscal reform proceeds with the imposition of greater discipline in regional spending, cuts in extra-budgetary programs and reorganization of bank and regional government debts. Kroeber estimates that regional government debts amounting to two trillion dollars are being restructured with long-term securities (Kroeber, 2015). It is worth noting that debt recycling strategies were very successful in the 1990s, when the program to restructure state-owned companies was started.

As for financial reform, new rules on deposits and liberalization of bank credit are making the credit market more liquid and contributing to the establishment of new businesses. The promotion of the Shanghai free trade area (FTA) and the future expansion of this policy to other geographical areas are an important part of the financial reform. The FTAs are intended to make transactions in foreign currencies more flexible within their respective areas, in effect working as a small-scale opening of capital account. An administrative reform is promoted concurrently, and it facilitates investment by using a negative list. In this system, a negative list indicates investments and areas to be excluded or disfavored, thus suppressing the requirement for prior approvals and investment controls by central authorities.

The New Normal policy is the result of an already-changed China, as the current structure of gross domestic product indicates. Nonetheless, that does not mean it faces fewer challenges. The unfavorable international context in which a low-growth global economy weakens export economies and increases competition for additional value does not facilitate fiscal and financial adjustments.

The recent devaluation of the Renminbi and major swings at the Stock Exchange in August 2015, as well as construction market fluctuations, all point to weaknesses inherent in the national system of credit, savings and investment.

The government had approved changes in China's exchange rate since 2005, as part of a program to unpeg the Renminbi from the dollar and make it more flexible. However, sharp fluctuation and government intervention have fueled concerns that the long-run policy would not suffice.

That is also true for fluctuations in the stock market. It is clear that, in China, the stock market is too small in relation to the economy. One estimates that only between 7-9% of the population participates in the stock market, which explains why recent major disruptions have only had limited effect on the real economy. Nevertheless, government inputs and outputs in the stock market point to the importance that the Chinese administration attaches to economic credibility and disruptions entailed by the economic adjustment.

The stock exchange and the transition to tax rate flexibility are relevant for the future as they are steps in the financial market opening policy. The reform and reorganization of the financial sector depend on financial reforms envisaged for large companies, more dynamic private enterprises in China, and increased public trading of state-owned companies. Likewise, exchange rate stability is essential to curb capital flight, which increases with economic fluctuations. Nevertheless, it is important to distinguish between recent troubles in Chinese exchange rates and stock exchange and the longer-term policies for reorganization of domestic demand and strengthening of the innovation economy.

The Role of Innovation

China's new growth strategy focuses on increasing aggregate domestic demand and capacity for innovation and green economy to act as growth drivers. Such complex objectives have different timeframes. The slowdown of the export economy and increased domestic demand do not necessarily go hand in hand. Both innovation and the green

economy are strategies with long-term results which also depend on the development and nature of markets and policymaking institutions.

International observers have explained China's slowdown as a natural trend of the Asian growth model. Korea, Taiwan and Singapore have had significant drops in growth rates after the consolidation of their industries. From this perspective, the New Normal would be – more abruptly – the beginning of the end of China's exceptional development.

However, what we see today is beyond normalization of growth and redressing of economic imbalances. It results from the transformation of China's GDP, the evolution from a manufacturing economy to a service economy that has been growing since 2010 and will be sustained in the long term by continuing and increasing urban transformation and by China's further international integration.

The transformation of skilled labor, the expansion of the middle classes, the extension of higher education, and the globalization of scientific production in China all support a qualitative change in social organization that sustains the service economy and a move towards international integration of production.

This new policy is also a government strategy, resulting from reflections in the academy, the party and the government on new global and national challenges, the role of innovation, and the Chinese innovation system.

Scientific and technological development and, in particular, the importance given to innovation, have always been the unifying axis of economic strategies in China. Investments in science and technology are constant in its reform programs and catching up comes along with the creation of companies. This distinguishes China from other Asian countries and other transitions to a market economy. Long-term investments in science and technology reached 2% of GDP in 2012, emphasizing applied research and R&D at the company level.

The current composition and technological density of the Chinese industrial structure result from well-designed strategies matching priorities and time-bound instruments. Particularly relevant are: the strategic plan that points to sectors, knowledge platforms and, later, strategic industries to be favored. The use of foreign direct investment as policy and technology transfer instrument, coexistence and productive exchange with multinationals and a practice of controlled trial prior to the adoption of technology projects for various industries. Added to these instruments is a credit policy that encourages investment while also encouraging competition in the internal market.

Chinese companies have used internationalization and the pursuit of global competitiveness as business growth strategy. Xue Lan describes the industrial reform in China as a three-stage process. Until the mid-1980s, the transformation of companies and diversification of the industrial fabric were stimulated by external examples. In the late 1990s, industrial diversification became associated with Chinese integration into the global economy. Since 2006, the global integration of industry and the economy have been driven by domestic capabilities (Xue, 2015).

This constant pursuit of global integration has allowed Chinese companies to take secondary innovations to a new strategic frontier. In a study on industrial strategies of selected Chinese companies, Adriano Proença identifies two interesting modes of action of the private sector: identifying insertion gaps – “modules” in supply chains where market domain can be established in a competitively sustainable manner, and identifying and entering major innovation projects by large state-owned companies (Proença 2011).

Since 2004, China’s industry and technology policy has gained particular depth, a consensus on goals, and strong inter-ministerial coordination, which leads many analysts to view China’s technology policy as a new “industrial-technological” paradigm (Naughton 2012, Chen Ling 2012, Heilman 2013). This emerging consensus has partly

resulted from discussions at the academic and governmental levels on the limits of technological benefits from the participation in value chains of the electronics industry. The conclusion was that the innovation economy in China would require a new strategy for the building of capabilities and deepening of knowledge platforms.

The 2006 Medium- and Long-term Plan for Science and Technology and the 2011 Twelfth Five-Year Plan are policies resulting from this important debate. The Medium- and Long-term Plan identifies knowledge platforms – the so-called mega-programs –, and establishes a policy for the development of these areas. The Twelfth Five-Year Plan complements this program by pinpointing strategic industries emerging from the mega-programs. Estimates are that 22.6% of the spending in the science and technology budget – which today amounts to 2% of China's GDP – is associated with mega-programs and strategic industries (Chen Ling, 2015).

The strategic sectors and industries selected by the Twelfth Plan have become subject of various regional pilot programs. Duplication of investment and spending is undoubtedly part of the cost of this piloting exercise to select winning technology choices, but also a greater marketing guarantee.

Chen Ling (2015) notes that, unlike other countries, the implementation of industrial programs in China has an important gap between the design and implementation phases. The consultation process preceding the preparation of industrial plans is very broad, which gives the plans an indicative character. Technology choices result from a long journey of experimentation and pilot projects at the regional level. Such was the path leading to the adoption of technology models for high-speed train, electric vehicles, high-voltage transmission network, and the choice of generation III nuclear reactors.

It is not yet possible to give a comprehensive assessment of the investment in mega-programs and strategic industries. The most frequent criticism of Chinese programs is that they are excessively top-

down and impositive, tending to separate the dynamics of markets, government-owned companies, and megafunding.

Nevertheless, the Chinese industrial fabric is currently complex and globalized. The policy of stimulating the market while maintaining investment capacity and consolidating state-owned companies in key sectors remains part of the economic growth and internationalization strategy around new axes.

Major innovation projects require permanent and dynamic funding to minimize the risks of innovation, while facilitating ventures when they have to be undertaken. Leading private companies operate with unique dynamics of investment and, especially, risk. The interaction between public and private sectors, state-owned and small and medium, national and global enterprises takes place differently from the early stages of catching up. Synergies exist as well as competition, and financial and economic regulatory institutions must reflect such a complexity.

Intensifying the innovation economy also requires freedom of experimentation and flexibility to allow organizational, financial and technological innovations to combine in different ways. This surge of creativity was the driver of the first stages of the creation of Chinese companies – the 1980s' era of creative capitalism, which, according to Yacheng Huang (Huang, 2008), was the real transformation in the Chinese market. All these variables bring an additional burden to the state. Difficulties recognized by the Xi Jinping administration highlight the need to recalibrate state capacities of promotion, regulation and standardization.

China has a wealth of research and support institutions that work dynamically in mediating between basic research and the market. There is a culture of experimentation and marketing. The multiplying funds and financing schemes that arise as shadow banking point to obstacles and limits in the financial system, but also to a proneness for business.

As noted, the New Normal policy reaffirms the centrality of innovation in China's economic strategy and advances reform of the national innovation system. Major independently managed thematic funds are being created, although under government auspices, for the areas of mega-programs, basic research, applied research, human resources and marketing in small and medium enterprises.

The new Silk Road policy will undoubtedly multiply the global possibilities for Chinese enterprises, thus contributing to internalizing value chains and increasing the technology intensity of leading Chinese companies. The bet is on the capacity of the national innovation system to develop important links between the market and the public sector, while linked to global knowledge networks.

In this new, much more complex industrial stage with diversified and often competing demands and in a new, much more competitive international environment, will it be possible to maintain consensus on funding, goals and technological objectives? Will the policy instruments designed for intensive catching up be suited to China's new stage of growth?

Approach and Questions to Be Answered

So far the success of the Chinese catching up has been based on a political approach with a number of key elements: strategic planning, long-term view on the global integration of the Chinese economy, consensus built around goals and institutional coordination between the Ministries of Finance, Trade, and Science and Technology. Besides these features, there is availability of resources. The implementation of programs is facilitated by the availability of large reserves, fast-increasing international investments, and a national budget that went from 10.8% of GDP in 1995 to 22.6% in 2012.

The new Chinese policy is a long-term commitment to the sustainability of the Chinese economic governance model. It seeks to

balance the relationship between the state and the market by adapting to new challenges. Such an adaptation is not without difficulties. The progression to an innovation economy is complex and less suitable to the structured agreements of the past, as it depends on policies and capabilities which differ from the catching-up models. Contradictions are inherent in the process. It requires a risk culture, trial and error, as well as institutional structures to guarantee this innovative space. Campaigns, organized consensus and win-win situations become more difficult and less efficient.

In many respects, China's national innovation system is already successful. It has been able to steer a transition from command economy to market economy and brought Chinese research and industry to various innovation frontiers. The system consists of specialized meritocratic institutions with multiple synergies. Funding for the national innovation system is consistent and its members participate in global knowledge production chains. There is constant exchange between universities, research centers and companies involving scientific communities around the world. The number of research centers within companies and international research laboratories based in China is rapidly growing.

In trade, China has developed its own business culture with important synergies in Asia, thus upholding its mercantile tradition. The success of the Alibaba business platform and Xiaomi low-cost smartphones are witness to China's commercial inventiveness and the ability of the Chinese industry to read the global market and anticipate demand. This agenda will undoubtedly be reaffirmed with the New Silk Road policy.

In this context, the question arises: which are the success metrics for the future? Will the technological frontier be in all areas? Will technological primacy follow the American model? Technological establishment in selected areas like Japan and Germany

or the application of new knowledge to domestic problems: strategic innovation?

The consolidation of an innovation economy depends on a culture of innovation that is not restricted to commercial success, or products and processes. Rather, it is defined by the ability to inquire and think differently, beyond pre-established schemes, to find synergies between different fields of knowledge. This was one of the important traits of the Silicon Valley dynamics. Such qualities are carefully cultivated by the American system, although in its case security considerations are the main driver of the pursuit of technological supremacy.

However, when we examine the new global geopolitics of production, as modified by the rise of China, the examples above seem limited. The increasingly evident separation between technological agenda and military agenda and the relevance of the public assets agenda and China's unique development issues have very significantly changed the scope of options and priorities for innovation.

There is a long list of innovation priorities linked to processes and solutions to problems outside the proprietary axis and which may develop into a decidedly Chinese national innovation system. The public assets agenda associated with China's development conditions, particularly green economy, is immense and rich in developments that go much beyond the Asian space.

The bet on green economy and the beginning of a debate on sustainable cities in China are examples of potential areas of innovation in the system. The Chinese model of innovation management, which feeds into the state-market dynamics in economic management, has features that favor the management of knowledge advancement in the field of public assets. Consistent funding, long-term vision associated with economic growth, experimentation capacity, and a global network of knowledge platforms.

China has so far shown particular skill at restructuring its economic policy and maintaining growth while making bets consistent

with the preservation of its model of political management. The question is whether governance reforms undertaken today will ensure such a flexibility for corrective action in the future. Will the bets be too disparate to promote a consistent economic strategy?

As Wu Ji Liang argues, growth and progress depend on a good relationship between innovation and institutions. The capacity of the Chinese governance system to change course and identify mistakes has been relevant to the success achieved so far. The diversity of goals at stake for the coming years will no doubt require even more flexibility, experimentation in governance, and bets for the future.

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ENERGIZING INDUSTRIAL DEVELOPMENT: THE ROLE OF THE STATE IN 21ST CENTURY GREENING STRATEGIES

John A. Mathews

Introduction

There was a time when industrial development and energy were discussed in separate categories. The prevailing orthodoxy, which governed the “East Asian Miracle” of Japan’s industrialization, followed by that of Korea, Taiwan and Singapore, was that integration with the world’s fossil-fuel economy represented the optimal path forward. Grow rich with coal and oil, and then diversify – this was the formula. It worked because as a group, the East Asian “tigers” could not put too much strain on fossil fuel supplies. But in the 21st century, as giants like China and then India and Brazil and South Africa are moving along the industrialization pathway, their energy choices are becoming critical – for themselves and the world.

Let us call these the BICS countries, as opposed to the BRICS – leaving out Russia which is a special case through continued dependence on fossil fuels. The BICS countries have a population numbering 2.7 billion (around a third of world population of 7.3 billion), and at this scale the pathway to industrialization cannot ignore the means through which the process unfolds. If the BICS countries were to follow the “Business as Usual” pathway, with its strategy of exploiting access to fossil fuels wherever they can be found and are politically/economically available, they would run into serious geopolitical tensions well before the fuels ran out.

The western countries as they industrialized were able to tap resources from around the world, via colonialism and imperialism, while they exploited their own coal and oil reserves without any sense that they might be finite. And carbon emissions with their deleterious planetary climatic impact were not considered a problem. Obviously enough, these conditions do not apply today.

The emerging industrial powers, led by the BICS countries, have to invent a new development model that will enable them to bring ten times as many people to the rising income levels enjoyed by industrialized countries, while having to respect much tighter constraints on resources and fossil fuel usage. Without a “circuit breaker” this challenge does not add up – the BICS countries would be trying the square the circle. The result would be heightened geopolitical tensions leading to war, revolution and terror, quite apart from ecological damage of unimaginable proportions.

But there is a circuit breaker – and it is green development. Its core is green growth. In their various ways, the BICS countries are all pursuing some variant of green growth alongside the fossil-fuelled and resource profligate model of development. This is their feasible pathway to industrial development. When one reflects on the issues involved, what other pathway is there?

The positive future-oriented scenario is one in which these countries maintain their focus on and commitment to green development, because of their overwhelming national interests in doing so. The sceptical view is that they are doing too little, too late to reverse their previous fossil fuelled trajectory. Our scepticism is reinforced by the carbon lock-in that still prevails in the West. The US for example (pace President Obama’s 11th hour efforts) is fixated on its ‘energy revolution’ involving coal seam gas and shale oil – fossil fuels that have only become accessible in the past decade because of technological developments, and which as high cost businesses now appear to be doomed because of falling oil prices. Japan is still focused

on nuclear, despite Fukushima – with all the cost over-runs and delays entailed. And the EU remains divided between the renewable energy optimism of Germany, with its remarkable *Energiewende*, and the fossil fuel/nuclear hard line of the UK, Poland et al.

Moreover the efforts of the BICS countries to promote renewables and low-carbon development are not supported internationally – even with all the rhetoric on carbon reductions emitted under the Kyoto process. In place of promoting diffusion of clean and low-carbon technology, the industrialized countries are actively seeking to impede it through trade sanctions. China for example has been ‘punished’ for promoting its solar PV industry by other countries, led by the US, the EU and Japan, in imposing counter-tariffs on solar PV imports and causing great disruption to China’s PV industry. In India attempts to grow a solar PV industry in emulation of China, utilizing local content requirements, feed-in tariffs, tax breaks and other tools from the industrial strategy toolkit, are also being hindered by trade actions brought to the WTO.

Central to these developments and pathways is the role of state agencies and institutions. Price-guided mechanisms will not prove to be sufficiently robust and sufficiently rapid to effect the transition needed, to meet either the needs of the 21st century industrializing giants or of the world as a whole. Indeed, it is the role of public institutions and national governments in driving this new, green phase of world industrialization -- where Brazil, India and China are such key players -- that is proving to be fundamental. The issue is: what strategies are open to states as they seek to guide and shape the unfolding greening process which promises wealth and sustainability?

Development strategies in the 21st century: New roles for the state

Energy is not just any other commodity (oil, coal, gas) or any other process (conversion, transmission) or piece of infrastructure (grid, smart grid, high speed rail). It is in fact fundamental to modern industrialization; it lies at the core of the process of modernization that we call industrialization.¹

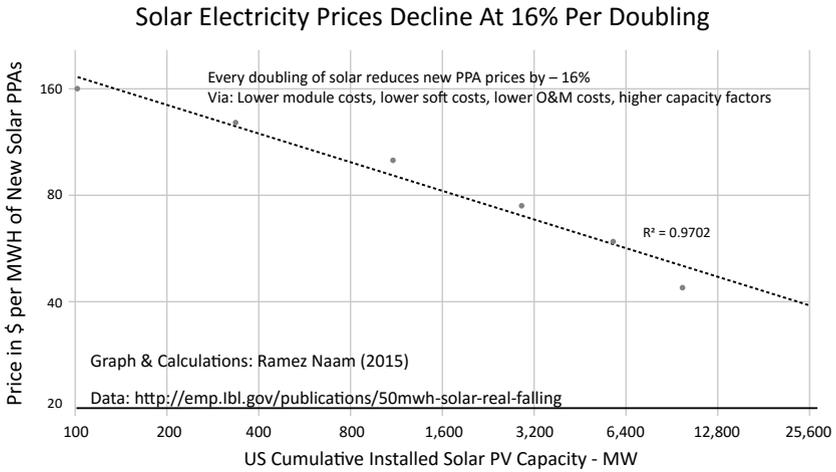
Yet energy was conspicuous by its absence in the literature on conventional industrial development strategy. There was capital, and labor and land (e.g. land reform). But where was energy? It was just assumed that energy would be supplied by fossil fuels – as it had been in the west’s industrialization. So in the 20th century Japan built a mighty energy system to power its manufacturing system, all based on fossil fuels and then nuclear. Likewise in the cases of Korea and Taiwan and until recently, Singapore. All are locked into energy systems that prioritize fossil fuels and nuclear – although it is true that Korea is making efforts to liberate itself via its green growth strategy. All were locked into the incumbent energy system; but beyond this, they made leapfrogging progress in “doing” fossil fuels better than the advanced countries. Singapore for example established itself as an indispensable hub for the oil industry – oil markets (the Singapore oil price index), oil refining, transport and petrochemicals.

It is falling costs which are the fundamental drivers of the global transition. The most recent analyses find that new solar PV installations are comparable in cost to fossil fuelled power plants, and falling at a rate of 16% for every doubling of capacity. The evidence is provided in Fig. 1.²

¹ My own contributions on these matters are listed in References, including Mathews (2007-2014; Mathews and Reinert 2014; Mathews and Tan 2011-2015; Mathews, Hu and Wu 2015.

² See Ramez Naam, ‘How cheap can solar get? Very cheap indeed’, *Energy Post*, 21 August 2015, at: <http://www.energypost.eu/cheap-can-solar-get-cheap-indeed/>

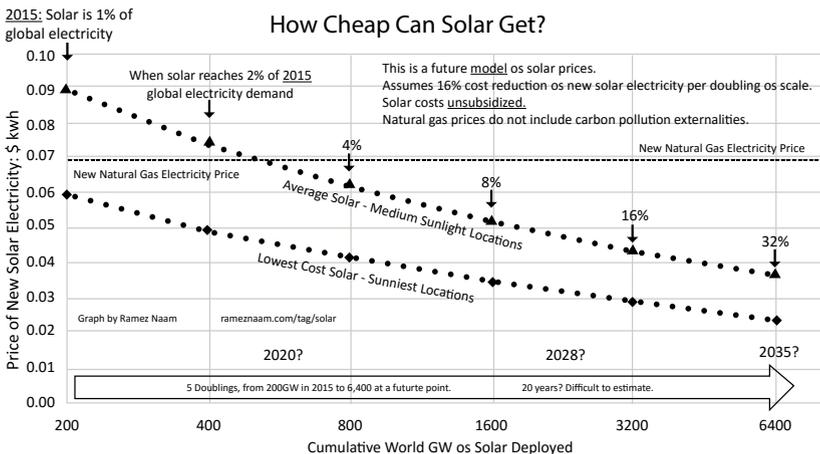
Fig. 1 – Solar electric energy costs declining



Source: Naam 2015.

At this rate, the cost of solar will continue to plunge, and will be well below the costs associated with burning fossil fuels before 2020 (Fig. 2). At this point an industrializing country would be well advised to study closely its options regarding energy, and evaluate the costs of going with renewables as opposed to fossil fuels and nuclear.

Fig. 2 – Future trajectory of solar PV costs

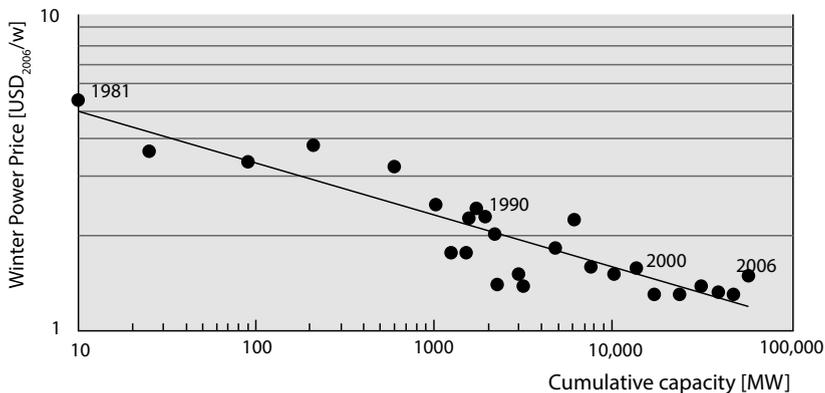


Source: Naam 2015

The chart indicates that the world could pass the 1000 GW mark of solar PV power (the first terawatt) by 2020. This is entirely plausible. Already China has an official goal of 100 GW by 2020, and India has now matched that goal. There are extensive rooftop solar programs in Europe and the USA, and Japan seems poised to join the process. So the 1 TW mark is actually likely to be passed before 2020 – perhaps in just five years’ time. By then the generating cost of new solar PV installations should be somewhere between 4 and 6 cents per kWh (or \$40 to \$60 per MWh) – cheaper than even the cheapest brown coal. This is how fast the renewables revolution is unfolding.

A similar story can be told for wind power. Consider the learning curve for wind power, which demonstrates a clear cost reduction potential out to 100,000 MW (or 100 GW – a level already achieved by China) – as shown in Fig. 3. The levelized cost of wind power has been falling at a rate of 14% per year as cumulative production experience and scale of market grows.

Fig. 3 – Learning curve for wind power



Source: Fishedick et al., 2011, p. 847

It is the rapidly falling costs of renewables that is the fundamental feature of the greening process. There can no longer be any doubt that clean and renewable energy technologies are now, or will shortly be, lower in cost than the fossil fuels that they replacing. This amounts

to a fundamental sociotechnical shift (Mathews 2013). It challenges countries to revise their developmental strategies and challenges companies to craft new business models that take advantage of the plunging costs of renewables.

There are important reasons for this that go beyond the contingencies of one technology or another. All renewable energy devices – wind turbines, solar PV cells, CSP lenses and mirrors – share the characteristic that they are all the products of manufacturing. And this is what connects renewables fundamentally to industrial strategy. As Hao Tan and I put it in our article published last year in *Nature*:

‘... unlike oil, coal and gas, the supplies of which are limited and subject to geopolitical tensions, renewable-energy devices can be built anywhere and implemented wherever there is sufficient water, wind and sun.’ (2014: 166)

What we meant by this is that manufacturing is the very special process where increasing returns (reducing costs) can be generated: as the scale of production increases, so the unit costs decline. This has been understood by every mass production entrepreneur, from Henry Ford onwards. It is now understood by Chinese, Indian and Brazilian entrepreneurs who are scaling up production of renewables devices and installing them at ever higher capacities, to reduce costs and drive market expansion. In this way, renewables are becoming central to the industrialization process, because they involve manufacturing, learning curves and market expansion linked to cost reduction.

These features are not found in fossil fuel extraction and utilization. On the contrary, all fossil fuel extraction, from coal mining to oil and gas drilling and now right up to extraction of coal seam gas via hydraulic fracturing, involves a relentless process of diminishing returns (or long-run increasing costs). (Fossil fuels are going through a price deflation at the moment, but this is unlikely to continue indefinitely.)

Because renewables devices are always the products of manufacturing, they can in-principle be produced anywhere. This is fundamentally why renewables provide energy security – because a country can build its energy security through building manufacturing systems that can operate independently of the vagaries of supplies (and prices) of fossil fuels. No wonder China, India and Brazil are turning to renewables as fast as is technically and economically possible. And as they do so, they drive down costs even more, and provide further incentives for market expansion and entry by presently under-developed countries into the industrialization process.

This is a virtuous cycle. It was blocked by fossil fuels and their infrastructure controlled by the developed world. But greening processes unblock the process. That is why it is so fruitful – and why green development is the culmination and likely next chapter in a process of global industrialization.

Let us now review how in their different ways all the BICS countries are participating in this vast energy transition – and through doing so, are raising their income levels to achieve their long-sought goal of becoming middle-income countries.

Renewable energy national strategies: the BICS countries

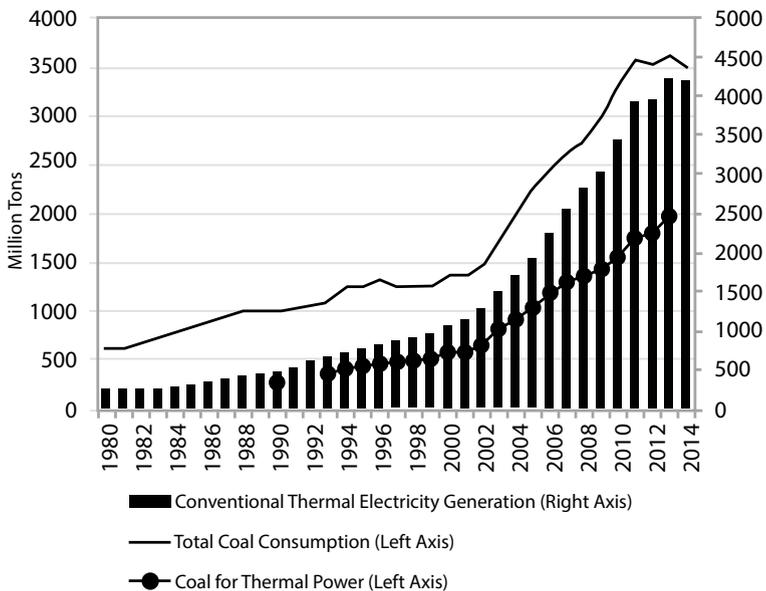
China

In just the past decade China has emerged as the world's renewable energy superpower – building up world class renewable energy industries (wind and solar farms in the vanguard) and renewable power manufacturing industries (wind turbines, solar modules and cells) as well as major infrastructure projects including a strong and smart grid, EV recharging networks and a national high speed rail network. All this as it has continued to expand its coal-fired energy system as engine of its vast manufacturing system – although it

is true that China has been curbing its coal consumption over the past two years, not just in relative terms but in terms of absolute levels. The peaking of China’s coal consumption, followed by a peaking in its carbon emissions, could be about to occur much earlier in China than predicted.

Like rising industrial powers before it, China has initially relied on fossil fuels, and coal in particular, to drive its manufacturing engine. The rapid increase in coal consumption, that took off after China joined the WTO in 2001, is clearly seen in Fig. 4.

Fig.4 – Chinese thermal power generation and rising coal consumption up to 2014



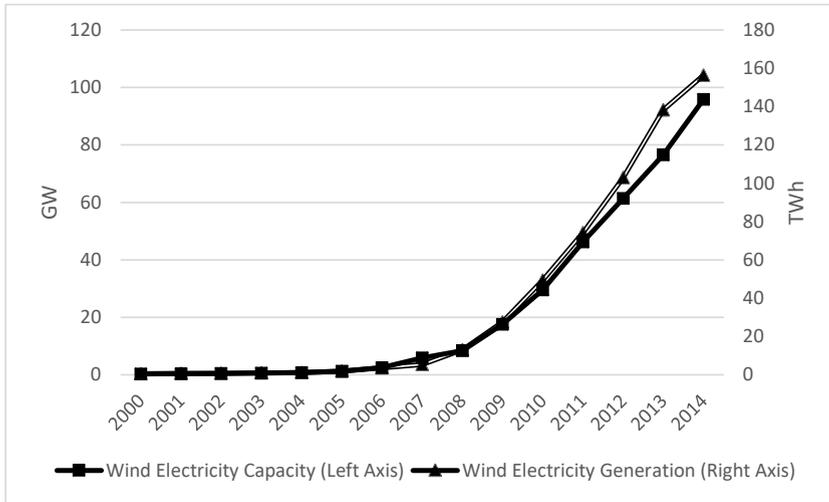
Source: Mathews and Tan (2015)

Fig. 4 also indicates that China is now taking active steps to curb coal consumption – as a step towards remedying the shocking air and water pollution that has struck Chinese cities.³ The complementary

³ For a discussion of China’s possible ‘Great reversal’ in terms of coal consumption, see the article from Hao Tan and myself posted to *Asia Pacific Journal: Japan Focus* on August 26 2015, at: <http://japanfocus.org/-Hao-Tan/4365/article.html>

actions taken by the Chinese government are that a new green energy system is being created, at a rate of advance that promises to eventually overtake the ‘black’ coal-fired energy system. The results of actions taken to build a wind power industry are shown in Fig. 5.

Fig. 5 – China’s wind power generation, 2000-2014



Source: Mathews and Tan (2015)

It is China’s building of wind power and solar PV systems at a scale never previously thought possible that is driving the cost reductions that are now making renewables accessible to all – including India, Brazil and SA.

China’s judicious use of local content requirements was the key to its successful creation of a wind turbine manufacturing system – as widely acknowledged.⁴ Some experience was generated by the *Ride the Winds* program of the late 1990s, and the formal LCR provisions were then imposed from 2003, both by the tendering system for nationally approved projects, where the scoring included clear LCR criteria, and by wind farm projects approved by the National Development and Reform Commission (ND&RC) and likewise contained a graduated

⁴ See discussions by Kuntze and Moerenhout (2013) and by Gandenberger et al (2015).

LCR provision. Following complaints at the WTO by the US, the schemes were discontinued in 2009 – but only after they had done the job of helping Chinese firms to enter all the stages of the wind turbine manufacturing value chain, and ensuring that the leaders like Goldwind, Sinovel and MingYang were on the way to becoming global leaders.

India

From a slow start, India is now determined to become a world leader in green energy and green development. It is doing so not just because of concerns over climate change, but for reasons to do with energy and resource security and the building of an energy platform that will supply both domestic markets and export business as well.⁵ India is using a full panoply of industrial strategies to achieve these ambitious goals, from market promotion measures including tax breaks and feed-in tariffs to industrial promotion such as local content requirements being attached to foreign direct investments (albeit attracting some opposition at the WTO, particularly from the USA).

The most ambitious program is the National Solar Mission, which in July 2015 was upgraded with a new goal of seeing 100 GW of solar power installed in India by the earlier date of 2019 – where 40 GW would be rooftop solar and 60 GW would be medium- and large-scale grid-connected solar power projects. These are extremely ambitious targets, upgraded from the original target of 20 GW by 2021-22 that had been announced in 2008 and amended in 2010. Indeed it puts India on a par with China in terms of specific solar PV targets, where China has a well-known target for solar PV of 100 GW by 2020 (at the conclusion of the 13th FYP) – although there have been rumours floated in the press that China is about to double its 2020 target for solar to

⁵ For discussion of India's greening strategies, see for example Mattoo and Subramanian (2012) or Johnson (2015).

200 GW as part of the 13th FYP (<http://cleantechnica.com/2015/07/26/china-2020-solar-energy-target-200-gigawatts-rumor/>).

With the election of the Narendra Modi government in 2014, the stage was set for further detailed promotion of renewables and greening of the Indian economy generally. Modi himself has reiterated the point that his government's central goal will be to ensure 24/7 power for all Indians – and since coal is subject to supply and price fluctuations, the best way of delivering on such a promise is through promotion of renewables. The fresh targets announced are backed by administrative and financial commitments. The July 2014 budget of the Modi government had a provision for a doubling of the tax on coal, which would raise an extra \$1.1 billion to fund clean energy projects. Green energy companies were at the same time offered a 10-year tax holiday to get themselves firmly established.

The next anticipated move is for the Indian government to announce a National Wind Mission (NWM) to replicate the success so far of the National Solar Mission (NSM). Some reports indicate that the NWM will also set a target of 100 GW wind by 2022, and that it will be backed by comprehensive policy promotion encompassing tax breaks, facilitation in securing land and local permits, as well as promotion of the wind power manufacturing value chain in India (at present largely dominated by Suzlon). The essence of these RE Mission programs (NSM and probable NWM) is that they provide investment certainty and real incentives for developers based on a clear understanding of what manufacturers and wind/solar farm developers need. The projects represent a substantial initiative on the part of the Ministry of New and Renewable Energy (MNRE), itself a major institutional innovation, designed to create fiscal and monetary space for RE development separated from the influence of fossil fuels.

Current levels of RE capacity in India are (at March 2015): wind power capacity 23.4 GW; solar PV capacity 3.7 GW and total RE capacity 35.8 GW. The ambitious NSM and (probable) NWM targets

would have to see an extra 10 GW of solar and 10 GW of wind capacity being added each year between now and 2020. This in itself can be viewed as a major industrialization effort.

The LCR provisions of the NSM are quite explicit – and no doubt provide a template for what can also be expected under the probable NWM. The NSM was launched by the Singh administration with comprehensive national development goals being made clear (Johnson 2015). Three phases were envisaged, allowing for policy learning along the way. Phase 1 was the pilot phase, with a first batch of bids being commissioned in January 2012 and a second batch in January 2013. Phase 2 was designed to build on the achievements of Phase 1, when a more extensive value chain would be created in India, directly supporting a further 3 GW of solar development and leveraging a further anticipated 6 GW from the private sector. Phase 3 was envisaged as the final scaling-up of the program, with 10 GW being expected to be installed over five years. This aspect has been drastically upgraded to reach the new 100 GW target by 2019.

The provisions covering LCRs in the NSM were designed to avoid WTO entanglements, in particular having a state-owned entity being the purchaser of the solar energy generated and thereby being nominally in compliance with the WTO Government Procurement Agreement (GPA). Even the name of the program, namely the NSM Procurement Program, emphasized this aspect and signalled India's strategy if required to defend the program in Geneva. Nevertheless the United States has objected to the LCR provisions on grounds that they create trade barriers to exports of US RE products and technology (which is, after all, their goal). In fact the US has lodged two successive objections and the case is now moving through the WTO procedures. Indian observers were holding out hope that there could be a cooling off or even a settlement reached at the US-Indian Summit of Feb 2015 when President Obama visited the Indian capital with a strong trade retinue; the outcome (if any) has not yet been made public.

But it is clear that India has not allowed this hiccup to curb further LCR provisions being inserted into Phase 2 batch 2 of the program, and there is open speculation that the anticipated NWM will likewise contain strong LCR provisions. India is clearly serious about building its RE industry and creating manufacturing industries to support both solar and wind power development on a large scale – and it is not about to let some scrapping at the WTO in Geneva block its ambitions.

Brazil

Brazil has been pursuing an industrialization strategy that is lifting tens of millions of its citizens out of poverty.⁶ Brazil has been traditionally a green energy source country, with much more emphasis on hydro power than most, and greater emphasis on sustainably grown sugar cane-sourced ethanol as liquid fuel. But in the last five years it has been ramping up its renewable power sources generally, to enhance its energy security – e.g. making the country’s industry less prone to brownouts and power rationing because of droughts that reduce hydro capacity (as in the worst drought on record in 2014/2015).

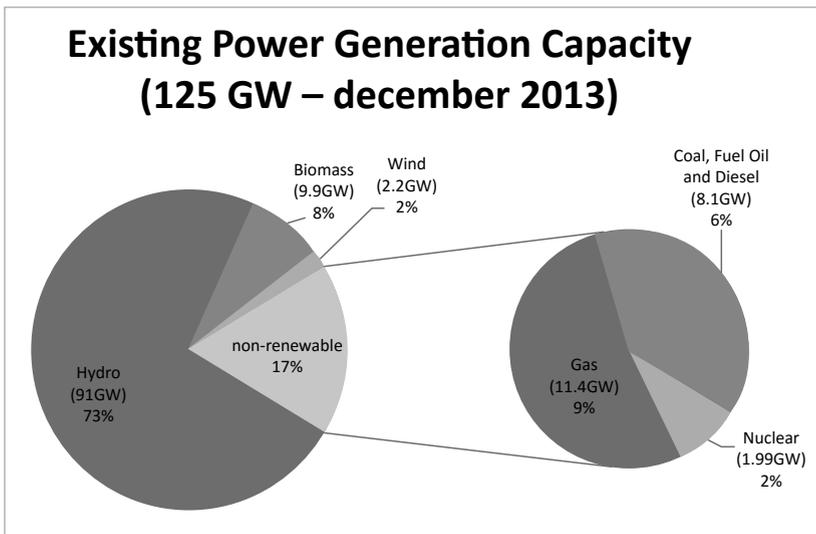
At the same time Brazil has been enhancing its energy security in terms of oil, through its offshore “pre-salt” oil discoveries and the government’s determined efforts to play a role in utilizing the exploitation of these offshore oil deposits to build an offshore oil industry – centered on state-owned Petrobras. Brazil became independent of oil imports in 2006, and since then has become a major oil and gas producer in its own right, earning export dollars and saving vast sums in terms of substitution of imports.

Brazil has one of the largest renewable energy components of its energy system of any country in the world – with renewables accounting for 83% of generating capacity, largely based on hydro (comparable to Norway). Since 2009 it has been ramping up wind and

⁶ On Brazil’s strategies of industrialization generally, see for example Castro (2008) or Schutte (2012).

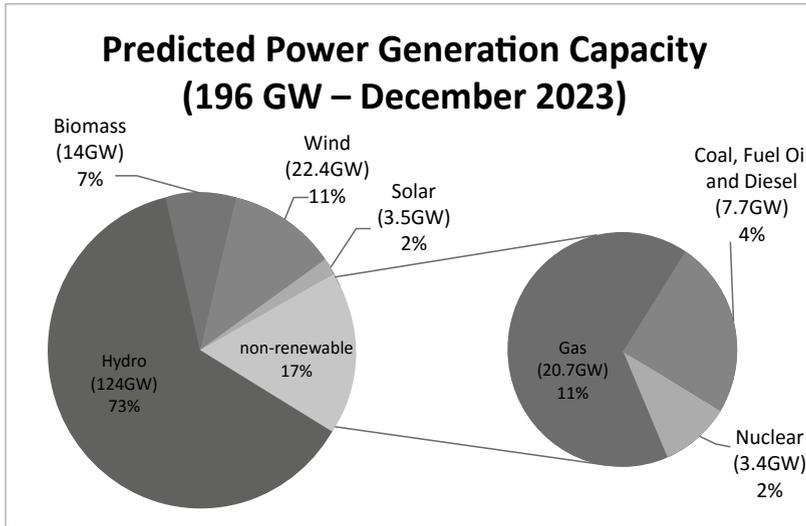
solar PV power as well, so that by 2015 wind power had grown to 6 GW (4.5% of generating capacity) and is expected to reach around 24 GW by 2023 (under the rolling 10-year energy plan maintained by the Ministry of Mines and Energy). Electric generating sources from water, wind and solar (WWS) are expected to grow from 103.2 GW in 2013 to 164 GW by 2023 – meaning that Brazil would be the world’s fourth most significant deployer of renewable energy systems on the planet (after China, the US and Germany) and comparable to India. It is anticipated under the 10-year plan that wind will grow at an average of 2 GW per year, to reach 24 GW by 2023 (11% of the total) and solar to reach 3.5 GW (2%), which with hydro reaching 124 GW would mean WWS would account for 164 GW by 2023. With biomass contributing 14 GW (7%), the 83% contribution from renewables is expected to be maintained (Figs. 6 and 7).

Fig. 6 – Brazil’s existing electric generating capacity (2013)



Source: Ministry of Miner and Energy, 2013.

Fig. 7 – Brazil’s anticipated electric generating capacity by 2023



Source: Ministry of Miner and Energy, 2013.

Brazil maintains a 10-year rolling target for all energy sources, which in itself is an important institutional innovation and a measure reflecting strong state leadership in the renewable energy sector. The latest version is the 2023 plan, updating the 2013 energy mix. This 2023 target has Brazilian wind and solar accounting for 13% of all generation capacity, and hydro accounting for 65% -- i.e. WWS sources accounting for 78% of Brazil’s generation capacity, and the balance (thermal, nuclear, and biomass) accounting for 22%.⁷

In June 2015 Brazil and the US issued a joint declaration on climate goals, with Brazil committing to protect forests and ramp up

⁷ Hydro is expected to grow at an average rate of 3.3 GW per year, expanding from 91 GW in 2013 (73% of capacity) to 124 GW by 2023, and 63% of capacity. Wind is expected to expand at an average rate of 2 GW per year to reach 22.4 GW in 2023, up from 2.2 GW in 2013; while solar is expected to reach 3.5 GW by 2023, up from a negligible amount in 2013, and expanding at an average rate of 350 MW per year. Total WWS capacity in 2013 reached 93.2 GW (hydro 91; wind 2.2; solar PV negligible) while WWS sources are expected to reach 150 GW by 2023 (hydro 124, wind 22.4 and solar PV 3.5 GW).

its use of renewable energy. Both Brazil and the US have committed to achieving 20% of their electricity from wind and solar by 2030 – i.e. from non-hydro sources.

The role of the state in creating this 21st century energy infrastructure in Brazil has been critical. The Ministry of Mines and Energy has maintained a strong emphasis on building up renewables capacity (with its foundation in manufacturing of wind turbines and solar cells and their value chains) even while supporting the country's existing minerals exploitation and export systems and the emerging offshore oil industry (despite problems of corruption that have surfaced at Petrobras). The series of New Energy Auctions have been responsible for creating wholly new wind power and now solar PV power contracts based on Power Purchase Agreements at costs amongst the lowest in the world.

Brazil has utilized a smart combination of strategies to enable it to catch up in renewables and build its own renewable power industries. These strategies include **guaranteed power purchase agreements** (PPAs) and **power-contract auctions** to boost the market for renewables, as well as the use of indirect local sourcing requirements not imposed through the trading system (where they would attract attention from trading partners, above all the US) but instead indirectly through the financing mechanism, operated by the National Development Bank BNDES. In 2011 the Brazilian (Lula) government took the important initiative of publishing a 10-year plan for energy development, creating targets that have underpinned investment certainty.

BNDES has been central to the renewable energy industry creation. The bank amended its approach to granting loans to the wind power industry in 2012, announcing that developers that utilize BNDES loans to build wind farms would have to source wind turbines and their components locally by the year 2016. In August 2014 BNDES announced similar plans for the solar PV industry. For dominant

technology crystalline silicon PV panels, this program would proceed through three phases, culminating in all cells being produced locally by 2020. For thin-film solar cells there are two phases with all module assembly having to be carried out in Brazil by 2018.⁸

South Africa

While South Africa is not in the same league as the BIC countries in terms of its energy transition and its economic potential, there are good reasons for including it in this analysis because it is grouped with Brazil, India and China in Goldman Sachs-inspired analyses of emerging markets, and because it is party to the launch of the BRICS- countries' newly launched infrastructure investment bank (the New Development Bank, launched formally in Shanghai in July 2015: <http://in.reuters.com/article/2015/07/21/emerging-brics-bank-idINKCNOPV07Z20150721>). Moreover it is seriously addressing renewable energy issues from the perspective of industrial strategy. South Africa starts from the difficult position that it has traditionally been a highly energy-intensive industrial country with a strong dependence on coal. Its electricity generating system has been highly centralized and coal-fired; moreover the electric power market is dominated by a quasi-monopoly in the form of Eskom, responsible for more than 95% of the electricity generated in South Africa.

Against this backdrop the post-Apartheid ANC government (ascending to power in 1994) has been seeking to set a different direction. There were some false starts in promoting renewables, with the launch of a Renewable Energy Policy White Paper in 2003 that set modest targets for renewables for 2013 – but not including any solar PV

⁸ This extremely effective program is also quite transparent. In December 2014 BNDES published its *Perspectives on Investment* report for the next four years (2015 to 2018), outlining where it would be placing priority for investments. http://www.bndes.gov.br/SiteBNDES/bndes/bndes_en/Institucional/Press/Noticias/2014/20141203_estudo.html

or wind power. Next, following the Copenhagen Summit of 2009, the SA government issued a Renewable Energy feed-in tariff (REFITs) policy, but considerable uncertainty surrounded the commitments made and no contracts were actually signed. These could be considered learning steps.

In August 2011, following a lengthy national debate, the South African government launched the Renewable Energy Independent Power Producer (REIPP) Procurement Program, which established a bidding process for renewable energy projects beyond the traditional thermal (coal-fired) generating sector. The new program was designed to encourage the emergence of independent power producers to break the Eskom monopoly, by providing a certain amount of protected market for the renewable sector. The principal target set under the program is for generation of 10 TWh of renewable energy. Complementary targets set under the REIPP included 3.7 GW of renewable energy capacity to be installed by 2016 – including 1.8 GW of onshore wind capacity, 1.5 GW of solar PV capacity and an initial 200 MW of concentrated solar power (CSP). The targets were raised in 2012, when the government called for an extra 3.2 GW of renewables capacity to be added by 2020. While small in comparison with thermal generating in South Africa, and tiny when compared with similar targets in China, India and Brazil, these goals nevertheless represent first steps towards a genuine transformation (greening) of the South African energy sector and pathway towards a new model of industrialization.

In November 2011 the South African government embarked on a public tendering process to accelerate uptake of renewable energy projects, calling for three rounds of tenders which attracted bid of nearly 4 GW of capacity sweetened by 20-year power purchase agreements (PPAs) with Eskom. The bids came from both domestic and foreign companies, and were backed by serious finance – Chinese bids backed by \$2 billion in funding from the Industrial and Commercial Bank of China; US bids backed by \$2 billion in funding from the Ex-Im

Bank; and African bids backed by a loans facility of \$1.1 billion provided by the Development Bank of Southern Africa, approved in 2012.

The public bidding process has achieved significant cost reductions in renewable energy, but has also enabled the SA government to impose LCRs that have been ratcheted up, from modest requirements in 2012 to 35% in the next round (much of which foreign investors were able to meet through construction costs) and rising to 40% in the most recent round (and 45% for CSP projects). Developers are in practice required to reach a 65% local content threshold in order to build a 'social and economic score' that can win contracts. So far there appears to be no international negative response at the WTO to these LCR provisions, which have a clear industry-building mandate rather than being protectionist. Some foreign countries have also been induced to sign financial assistance packages that clearly pave the way for involvement by their national firms – as in the case of a Danish loan that was followed by Vestas winning contracts. All this represents important activities on the part of the SA state.

In April 2015 the SA Dept of Energy announced the results of its fourth Request for Proposals under the REIPP procurement program (issued July 2014), which resulted in 13 proposals being selected as preferred bidders, adding up to 1.2 GW of installed capacity and investment of R23 billion (US\$ 1.7 billion) – mostly going to the Eastern Cape and Northern Cape provinces. That brought total committed private sector investment under the program since 2011 to R168 billion (US\$ 12.6 billion). The winning bids averaged R619/MWh (US\$46.50/MWh, or 4.6 US cents per kWh) for onshore wind and R786/MWh (US\$59/MWh) for solar PV – very much in line with the best results obtained in other parts of the world. The process of closing each bid involves negotiation of a Power Purchase Agreement between the bidding IPP and Eskom and finalization of an Implementation Agreement between the IPP and the Department of Energy. The contracted PPA involves a price that lasts for 20 years, indexed to the

CPI. Foreign funding accounted for 28% of investment commitments, with local content rising to 65% (from 38% in the first round, 53% in the second and 54% in the third). The Department counts this as an economic success for the program, contributing significantly to SA's industrial development and greening.⁹

Following initial acceptance of LCRs in Round 1, the bidders for Round 2 were asked to identify components of fulfilling their contracts that would involve local content – with a focus on manufacturing wind turbine blades and towers, PV modules and inverters and metal structures for PV plants. In Round 3 the definition of local content was further clarified, with as much emphasis on production of components along the value chain as on final product.¹⁰

Wind farms are now proliferating in South Africa, providing enhanced energy security and a growing market for wind turbine products as well as local employment for workers who would otherwise remain unskilled and unemployed. The Cookhouse wind farm for example is the largest built so far in Africa, with 66 2-MW turbines spinning to generate power at 138 MW; it started feeding power into the grid at the end of 2014. The wind farm is partially owned by a Community trust, which channels its profits from the farm to health and education projects. Wind energy costed at less than 5 US cents per kWh means that the farm generates power at around half the cost of coal. Eskom itself founded one of the first wind farms, the Darling farm located in the Western Cape; it was basically a pilot project founded in 2008 and involving just four turbines. Now there are farms like Sere and Dorper, both rated at 100 MW and under construction. (It needs to be pointed out that these 100 MW wind farms, impressive as they are, are only 1% the size and capacity of the giant 10 GW wind farms being built in China.)

⁹ SA Dept of Energy presentation on Bid window 4, Preferred Bidders' Announcement under the REIPP Procurement Program, 16 April 2015, at: <http://www.ipprenewables.co.za/#page/2183>

¹⁰ See Eberhard et al (2015) for an evaluation of these LCR provisions.

The LCR provisions have been successful in creating components firms along the value chain. So far there is one final wind turbine producer, I-WEC, founded by two South African engineers in 2009. I-WEC (standing for Isivunguvungu Wind Energy Converter), offers a state-of-the-art 2.5 MW wind power system, with a design licensed from the German wind turbine engineering firm Aerodyn Energiesysteme GmbH. The company has partnered with the local heavy engineering firm DCD Dorbyl (now a shareholder in I-WEC) to boost its engineering capabilities and with the German wind turbine design company from which I-WEC has licensed its current 2.5 MW turbine. (The same German company has partnered with MingYang in China ...) I-WEC claims that its first energy converter already has 70% local content, while some critical components have to be sourced from foreign specialist suppliers.

Complementing the wind power projects, South Africa's solar farms feature both solar PV and concentrated solar power projects located in desert areas. The Sishen solar energy facility came online in December 2014, rated at 94.3 MW peak; it can generate 216 GWh electrical energy in a year, from 320,000 solar PV modules. Complementing the solar PV projects are those based on mirrors and lenses – concentrated solar power (CSP) projects. The 100 MW Redstone CSP plant will be the first such facility in Africa, featuring Solar Reserve's molten salt energy storage technology allowing the plant to generate power day and night. Another CSP project is the 100 MW Kathu Solar Park which will be equipped with molten salt storage allowing power to be generated for 4.5 hours after sunset. The field of mirrors as envisaged for the Kathu solar park is shown in Fig. 8.

Fig. 8 – Kathu Solar Park (announced)

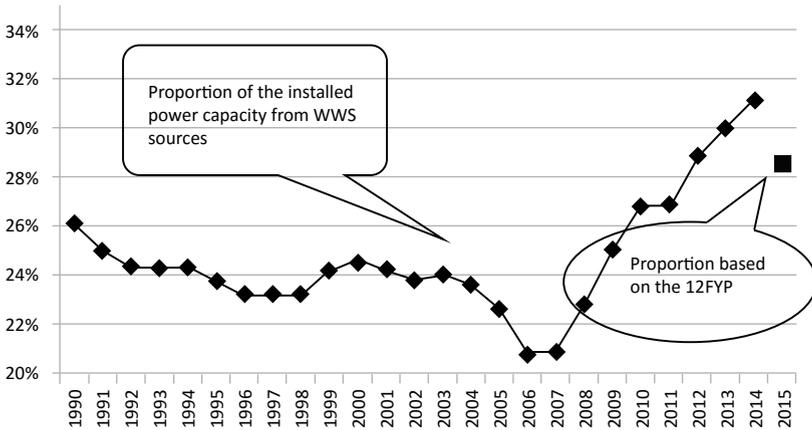


Source: Businessstech.co.za

Global ramifications of integrating renewables into industrial development strategies

Evidently the BICS countries are all embarked on major transformations of their energy sectors with a clear target of raising their dependence on renewable sources, mainly water, wind and solar, and reducing their dependence on fossil fuels (and nuclear – not discussed here). The case of China will have to stand for all four major industrializing powers, in terms of its clear change of direction, as shown in Fig. 9.

Fig. 9 – Proportion of installed power capacity from renewable sources (hydro, wind and solar): 1990 -2014, and 2015 target based on the 12th FYP



Source: Mathews and Tan 2015

What then have been the international ramifications? We have seen that local content requirements (LCR) provisions have been very successful in promoting BICS countries’ green industries, and they have correspondingly become the focus of more and more acrimonious trade disputes, thus potentially curbing the global uptake of green technologies. In this way promotion of green industry and trade is coming to be viewed as a relevant “industrial policy” in the 21st century – and demanding in turn a reform of trade rules to accommodate its specific character.¹¹

The rash of current disputes over promotion of green industries and products dates back to the action taken against Ontario’s Feed-in-Tariff (FiT) provisions coupled to Local Content Requirements (LCRs), which despite their success in helping to build an effective renewable

¹¹ See Wu and Salzman (2014) and Bigdeli (2014) for reviews of the case law; Rodrik (2014) for the economic significance of the turn to ‘green industrial policy’; and Pegels and Luetkenhorst (2014) for an analysis of the related industrial shift in Germany known as the *Energiewende* (‘energy transformation’).

energy system in the province and reducing carbon emissions, were made the subject of complaint by Japan and deemed WTO-incompatible by an Appeal Board in 2013.¹² There have been actions taken against China's promotion of both its wind turbine industry, through LCRs, and its solar PV industry through local subsidies and tax breaks (in separate actions brought by the US and the EU); and against India's National Solar Mission which was designed to bring India up from being a laggard to being a leader in transitioning to a clean energy future (an action brought by the US). Meanwhile China has itself brought cases at the WTO against US state-level LCRs and local subsidies; the US, in turn, has responded to domestic pressures and imposed anti-dumping and countervailing duties (AD and CVDs) on two occasions against Chinese PV imports, to which China has retaliated by imposing CVDs on US exports of such products as PV cell-making equipment and silicon exports.¹³

According to scholars of trends in world trade, this constitutes a serious outbreak of trade disputes that stem from the imposition of green industrial policies by both advanced and developing states, in a bid to accelerate the uptake of clean energy systems and reduce carbon emissions.¹⁴ The impact is felt by the states targeted by these trade actions, and more widely by the warning sent out to other states that they too will be targeted if they proceed to impose green industrial policies.

Yet it has to be pointed out that if countries are going to seriously tackle the challenge of decarbonizing their energy systems, they will need to employ some form of green industrial policy, and utilize one

¹² See WTO, Canada: Measures relating to the Feed-in Tariff program, Implementation notified by respondent, 15 June 2014, at: https://www.wto.org/english/tratop_e/dispu_e/cases_e/ds426_e.htm

¹³ See the discussion by Charnovitz and Fischer (2014); Bigdeli (2015); and on Indian implications, Kent and Jha (2014) and Johnson (2014).

¹⁴ See in particular Bigdeli (2014); Rubini (2012); Low, Marceau and Reinaud (2012); Kuntze and Moerenhout (2013); Cosbey and Mavroidis (2014); and Wu and Salzman (2014).

or more of the various industrial strategies involving subsidies, low-interest loans, tax breaks and above all FiTs and LCRs which have proven themselves to be powerful means, when employed judiciously, to build new cleantech value chains and producers of cleantech products. It is not a question of allowing newly industrializing countries like China and India to build renewable energy industries that will then destroy such industries in already developed countries. Rather, it is a question of promoting the diffusion of cleantech industries and encouraging the planting of such industries in countries around the world, subject to WTO oversight to ensure that competition remains reasonable and does not become predatory.

Short of comprehensive reform of world trade rules (unlikely under current conditions) there are promising ways forward. Governments interested in promoting their green interests and expanding trade could make local content requirements a subset of public procurement arrangements for green goods, utilizing government-owned entities for the purpose (as done by India). These arrangements stand a chance of surviving challenge at the WTO, and would have demonstrable ripple effects in the rest of the economy.

Countries that already possess the great public asset of a national development bank (like the BNDES in Brazil) have the option of pursuing local content requirements put in practice entirely through the domestic finance system, and by-passing the trade system altogether. Indeed the Brazilian model of building renewable energy industries through judicious use of targeted loans from the national development bank, offering lower interest rates for finance to domestic companies which meet local content requirements (and offering the same rates to foreign firms if they enter into joint ventures in Brazil, where the domestic partner is the one that applies for the green finance), combined with public (reverse) auctions that drive down costs of renewable energy as they enlarge the market, seems

to be optimal for emerging/developing/industrializing countries in the second decade of the 21st century.

Concluding remarks

Recognizing that promotion of green industries is already a major component of active state intervention in transforming fossil fueled-economies, and that trade promises to play a major role in the development of green industries around the world, the scope for a 'grand bargain' between the parties involved would seem to be clear. Yet recognizing that progress on these issues is slow (e.g. the UNFCCC has been hosting talks on developing a global accord on reducing carbon emissions for close on two decades) the prospects for resolution are not encouraging -- yet sentiment on these matters could shift rapidly, particularly if the Paris Conference of the Parties to be staged in December 2015 is successful. A possible line of advance would be for a set of products or processes to be identified as contributing to decarbonization of energy systems, and for which the WTO could provide exemption from the usual constraining rules of free competition. A candidate authority to make such an identification would be the United Nations Framework Convention on Climate Change (UNFCCC), which is calling the world to Paris in December 2015. The purpose of the exemption – the first to be recognized by the WTO since its inception – would be to allow countries to use such exemptions (for a designated period, say five years) and utilize provisions such as LCRs to build their own green industries. This would be a 21st century WTO-compatible green industrial policy.

There is an alternative way around WTO constraints, namely utilization of the provisions on government procurement combined with LCRs for renewable energy and green industry development, as

applying to some nominated public entity or entities.¹⁵ There is the Indian precedent, involving a government-owned energy company – but it is complicated by the action being taken against India’s green LCRs by the United States.¹⁶ This Indian experience provides a tentative model for other countries, because the public procurement provisions of the WTO are the ones that are least disciplined and subject to WTO case law.¹⁷ The way this could be accomplished is that countries looking to promote their green industries in a forceful manner that is probably WTO-compliant would be advised to (1) create a public entity in the energy space that can act as driver of the green transformation (e.g. a public entity that purchases green electricity); and (2) ensure that the actions of the created public entity comply with the provisions of the GPA, and perhaps set out exemptions for goods that are designated as “green goods” where LCRs might be applied.¹⁸

In this author’s opinion the best strategy of all, and the one that makes optimal use of state action in the 21st century, is the Brazilian threefold approach. First, investment uncertainty is reduced through the government creating and maintaining a rolling ten-year plan for

¹⁵ On the international political economy of government procurement measures and the WTO, see Weiss (2005).

¹⁶ One of the arguments used by the Indian government in defending its LCR scheme from the attack by the United States is that it has been administered by a public power producer, the National Thermal Power Corporation (NTPC). Now there are oddities here worth noting. India is utilizing the “public procurement” defence – and yet it is not a signatory of the WTO Government Procurement Agreement, which nominally regulates public procurement between the parties. And the NTPC is a coal-burning entity, not a renewable power company.

¹⁷ See Thurbon (2014) albeit without specific reference to the GPA. Resort to the public procurement provisions of the WTO as a means around interdiction of LCRs is also canvassed by Kuntze and Moerenhout (2013).

¹⁸ The Government Procurement Agreement of the WTO is a set of principles applying to procurement procedures by national and sub-national public entities. Many of the general principles of the WTO are subject to exemptions concerned with government procurement, provided the country concerned has signed up to the minimum principles outlined in the GPA – principles which are themselves also subject to exemptions. Israel for example is a signatory but specifically exempts many products that are purchased by public entities concerned with health and security matters. See Weiss (2005).

the build-up of the renewables market; even if the individual forecasts turn out to be wrong (which they probably will) the important effect is to create a sense of direction. Second, the services of the state-owned development bank are utilized to provide green financing, with a preference for local content reflected in favourable interest rates, available to domestic firms either acting alone or in JVs with foreign partners (particularly technology partners). Such an arrangement where LCRs are effected entirely through the domestic finance system and not through trade or investment, stands the best chance of surviving any potential attack via the WTO. Third is a state-mediated (reverse) auction system where companies are allowed to bid for renewable energy contracts and costs are forced down through a competitive bidding scheme. This threefold approach combines finance with cost reduction and enhancement of investor certainty in an optimal manner – addressing the triple nexus of **market**, **finance** and **cost**. This approach provides a robust justification of a creative role for the state in the 21st century task of greening the world's industrial systems.

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THE ROLE OF THE STATE IN ESCAPING THE MIDDLE-INCOME TRAP: THE CASE FOR SMART INDUSTRIAL POLICY

Robert H. Wade

For a few years after the start of the North Atlantic financial crisis in 2007-08 it looked as though countries of the BRICS and MINTS and whatever others global investors choose to put into their acronyms shared a buoyant economic future “decoupled” from recession in the West. How different things now look, Brazil being Exhibit A. Through 2015 Brazil has featured almost daily in western media reports for the wrong reasons – captured in the *Financial Times* editorial titled “Brazil’s terrible fall from economic grace” (14 September). The editorial reports, “The economy is in a mess. Brazil’s worst recession since the Great Depression will see the economy shrink by as much as 3 per cent this year, and 2 per cent in 2016. Public finances are in disarray...”.

Standing back to take a longer view, we see that between 1950 and 2010 Brazil spent the first 7 years as a “low-income” country and the next 53 years as a “lower-middle-income” country. Lower-middle-income is here defined as a per capita GDP of between PPP\$ 2,000 and \$7,250 a year (about \$5.50 to \$20 a day, in 1990 purchasing power parity [PPP] dollars).

Many other Latin American and Caribbean countries have also, like Brazil, spent over 4 decades between 1950 and 2010 as lower-middle-income countries and remain in that category today: the list includes Bolivia, Brazil, Colombia, Ecuador, El Salvador, Guatemala, Jamaica, Panama, and Peru (Felipe et al. 2010).

Indeed, just about all Latin American countries and Middle East countries had reached the lower-middle-income range by the 1960s or 1970s, and most remain in or just above this range today.

In contrast, Japan, Taiwan, South Korea, and China zoomed through the lower-middle-income range in less than 2 decades en route to the upper-middle-income range, and then, for the first three, the high-income range.

The Southeast Asian countries come between these speeds: Malaysia and Thailand spent almost 3 decades in the lower-middle range before rising to upper-middle (where they remained as of 2010, when the data set ends). Philippines spent more than 3 decades before rising to upper-middle. Indonesia spent the 25 years before 2010 as lower-middle; before that back to 1950, as low-income.

Causes of the wealth of nations

These numbers highlight the Adam Smith question, of what determines the relative wealth of nations, or relative GDP per person or per working hour. The young Smith gave the following answer:

“Little else is required to carry a state to the highest degree of opulence from the lowest barbarism, but peace, easy taxes, and a tolerable administration of justice, all the rest being brought about by the natural course of things” (1755).

Though Smith himself qualified it in *The Wealth of Nations* (first edition 1776), present-day economists continue to endorse it as basically correct. The renown professor of economics at Harvard Gregory Mankiw – author of a leading economics textbook and former chair of the Council of Economic Advisors – said in the *Wall Street Journal*, 2006, that

“Adam Smith was right when he said ... [the above statement].”

The renown British economist Timothy Besley and the renown Swedish economist Torsten Persson (a long-time member of the

selection committee for the Nobel Memorial Prize in Economics) take the Adam Smith statement as the epigraph to their 2011 book *Pillars of Prosperity*.

The core mechanism, in today's neoclassical parlance, is that a free market (with peace, fair taxes and reasonably effective enforcement of law and order) incentivizes finance and people with human capital to move from places where these factors are abundant to where they are scarcer, bringing recent products, processes, and technologies. This keeps generating economic growth in the poorer area until it has roughly caught up with the richer area (allowing for differences in climate and geography) – provided the processes are not blocked by government and special interests.

This mechanism presents the world economy as an open system. All countries could, conceptually, become equally “developed”, just as all runners in a marathon race could, conceptually, run abreast. Inherent (non-governmental) segmentations in the world economy, unequal exchange, cumulative causations, are not part of the vision.

On the other hand, pioneers of post Second World War development economics -- such as Nurkse, Rosenstein-Rodan, Myrdal, Singer and especially Prebisch -- emphasised fundamental differences in economic structure between developed and developing countries; and some of them located the development process in the context of a hierarchical “center-periphery” structure, where the center was the West and the periphery was developing countries, and economic development in the periphery was fundamentally affected by relations with the center (Fischer 2015).

“Peripherality” conferred some development advantages, they thought, somewhat in line with neoclassical thinking; especially advantages in terms of technology diffusion – or imitation -- from rich to poor countries, enabling the latter to use advanced technologies without having to bear the cost of innovation. But mostly peripherality conferred disadvantages, quite unlike the metaphor of a marathon

race. If anything, the metaphor could be development as a mountain race, where lead runners throw down ropes and ladders to help *some* of the laggards – think East Asian capitalist countries after the Second World War – but increasingly over time, especially after the end of the Cold War, erect obstacles to lagging runners – think the Uruguay Round.

These pioneer development economists thought that the “free market” – even when well fortified by human rights and rule of law – could cause countries to become locked into a production structure which constituted a low-income equilibrium trap, because *price signals are good for marginal resource allocation changes but not for the major production upgrading and diversification reallocations necessary for sustained development*. Hence the state in the peripheral country *could* play a major role in overcoming the disadvantages of peripherality and capturing the advantages; and so too *could* international institutions (eg commodity agreements, World Bank loans). The pioneers recognized that “could” is not the same as “would”.

The positive developmental role of the state was the reigning consensus in the sub-discipline of development economics until the ascendance of neoliberal development economics in the 1980s. Neoliberal economics calls for a substantially stronger role of the state than did classical liberalism (a la Adam Smith); but a role to restructure economy and society so as to maximize the scope for “market freedom”, as distinct from steering resource allocation. It puts “exchange” at the center of the development process, not “production”, in line with the neoliberal vision of society (individuals, corporations and governments) as the nexus of exchanges (or contractual obligations), rather than repositories of production capabilities. The only legitimate production role of the state is to “correct market failures” – and maybe not even correct market failures, because the inefficiency costs of

government corrective intervention often exceed the inefficiency costs of uncorrected market failure.

The difficulties of rising to high-income status

If we look at the big picture of growth performance over past decades, we see striking and under-noticed evidence which lends credibility to the now “heterodox” views of pre-neoliberal economists.

Here are three stylized facts.

- “How many *non-western* countries have become developed in the *past two centuries*?”. The answer – even stretching the categories of non-western, developed, and country – is less than 10.
- A World Bank study (2013) identified 101 countries in 1960 as “middle-income”. Of those 101, only 14 reached “high-income” by 2008.
- Branko Milanovic (2005) classified countries into four bands of GDP per head. At the top are the “rich countries” of the West plus Japan, down to Greece or Portugal. Next are the “contender” countries (those with the best chance of making it into the ranks of the “rich”), down to two thirds of the income of the bottom rich country. Milanovic traced movement across two time periods, 1960 to 1978, and 1979 to 2000. He found that less than 15% of the contenders at the start of each period rose to the rich category by the end of the period; moreover, a *majority of the contenders in both periods fell into a lower income category* by the end of the period. On the other hand, few of the “rich” countries at the start of each period fell into a lower category by the end.
- It is as though the rich countries have been held up by forces analogous to magnetic levitation, and the countries below the rich held down by forces analogous to gravity.

Evidence of this kind says that sustained economic development is very difficult, contrary to the spirit of Adam Smith and neoclassical/neoliberal development economics; and suggests that the difficulties arise not just for features *internal* to each country (eg low scores on rule of law, or “inward” rather than “outward” orientation of trade and investment policy) but from features of the international economy and patterns of peripheral integration into it.

The middle-income trap: how real?

The idea of hierarchical center-periphery relations as the global context for development has been rendered more specific with the idea of the middle-income trap (MIT). The phrase seems to have originated in a 2007 World Bank book by Indermit Gill and Homi Kharas, *An East Asian Renaissance: Ideas for Economic Growth*. But they mention it on only two pages in an almost 350 page book, and say little more than,

“In the absence of economies of scale, East Asian middle-income countries would face an uphill struggle to maintain their historically impressive growth. Strategies based on factor accumulation are likely to deliver steadily worse results, which is a natural occurrence as the marginal productivity of capital declines. Latin America and the Middle East are examples of middle-income regions that, for decades, have been unable to escape this trap” (18).

The implication is that middle-income countries or regions may experience slower long-run growth than either low-income countries (reaping high returns from simple factor accumulation, like raising the ratio of investment to GDP) or high-income countries (reaping high returns from innovation and economies of scale).

A strong piece of evidence is provided by IMF researchers (Aiyar et al., 2013). They examine the frequency of “growth slowdowns” for a large set of countries divided into low, middle and high income – using 15 plausible definitions of the “middle-income” range; and define

growth slowdowns by a complex formula based on extended deviation downwards from the extrapolated growth path at the earlier faster rate. The bottom-line result is clear: middle income countries have more frequent growth slowdowns than low or high income countries. See figure 1. (Robertson and Ye 2013 confirm Aiyar et al's conclusions using a somewhat different measure of relative income.)

A second measure of the MIT is time spent in the middle-income range, or more specifically, the lower-middle-income range. We saw earlier that, in 1950 to 2010, regions and countries show substantial variation, from less than 2 decades in the case of four East Asian countries to over 4 decades for many Latin American and Caribbean countries, including Brazil.

A slightly different measure is country income levels expressed as a percentage of US real income. Figure 2 shows these numbers for countries in East and Southeast Asia from 1950 to 2006. We see the early take-off of Japan, from 20% of US income in 1950 to reach 50% of US income by around 1965; and the later take-off of Taiwan and then South Korea from 10-15% of US income in 1950 to 50% by around 1995. Then come Malaysia and Thailand, which by 2006 had reached only 30% of US income. Below them come Indonesia, Philippines and Vietnam, still at around 10-15% of US income in 2006. It is plausible to say that Malaysia, Thailand, Philippines and Indonesia have been caught in a middle-income trap.

However, Lant Pritchett and Larry Summers (2014) argue that there is no close correlation between *level* of country income and growth slowdowns (contrary to the IMF researchers Aiyar et al. 2013). They find a close correlation between *fast pace of growth* and subsequent sharp slowdowns, regardless of income level.

The dominant tendency in growth patterns, they say, is regression to the global mean. Specifically, episodes of "super-fast" growth (6% per year or more) lasting more than 15 years are uncommon. China set the world record by 2010 (end of data), when it had experienced

super-fast growth for each of the previous 33 years. The only countries which come close are Taiwan, 32 years (1962 – 94) and South Korea, 29 years (1962 – 91).

Pritchett and Summers use these results to challenge “Asiaphoria”, the presumption that the center of gravity of world economy is shifting rapidly to China and India, based on extrapolating China and India’s fast growth far ahead. An example is the OECD report *Looking to 2060: Long-term Global Growth Prospects* (2012), which forecasts per capita growth from 2011 to 2020 at 6.6% for China and 6.7% for India. Such forecasts overlook the dominant statistical pattern, regression to the mean. That China had already set the world record for length of super-fast growth by 2010 makes its sharp slowdown after 2012 (to 2015 and continuing) not surprising.

My conclusion is that the middle-income *trap* is not well supported empirically if taken to mean *a specific average income threshold* (eg \$10,000) at which a country will -- with high probability -- experience a sharp growth deceleration followed by prolonged semi-stagnation (Im and Rosenblatt 2013).

But if we use the idea in a looser metaphorical sense to mean that countries in a broad middle-income band (divided into lower- and upper-middle) have a higher probability of experiencing sharp slow-downs and sustained lower than average growth for a decade or more than low- or high-income countries, then it is “real enough” to be taken seriously by national policy makers and international development organizations – always remembering that income alone (whether level or pace of growth) is not determining, as can be seen in the earlier figures of *regional* variation.

Moreover, both Aiyer et al. 2013 and Pritchett and Summers 2014 could be right: sharp growth slowdowns and extended low growth in the broad middle-income range may be caused – in the proximate sense – by both *middle-income level* and by *fast pace of growth* followed by regression to the mean.

Mechanisms of the MIT

The *how* question -- how to escape the MIT – depends on the answer to the *why* question – why (some) countries are caught. The literature suggests several mechanisms. One strand says the causes are too little investment in education and too little “good governance”; so the escape route is more investment in education and more reform of governance. We need not spend time discussing this argument, because it is too obviously largely false (see Kanchoochat and Intarakumnerd 2014).

Here are several more plausible causal mechanisms for the MIT.

Diminishing returns to inter-sectoral reallocation

One MIT mechanism is diminishing returns to inter-sectoral resource reallocation, as follows. Countries in the low-income range can grow fast on the back of (a) cheap labor, (b) transfer of resources (including people) from low-productivity agriculture to higher-productivity manufacturing and (some) services in cities, (c) investment to GDP ratios rising from low to medium, and (d) simple imitation of more sophisticated technology. But as a country’s average income continues to rise, these sources of growth yield diminishing returns.

Export structure

A second mechanism relates to the sophistication and diversification of the production and, specifically, the export structure. Jesus Felipe and co-authors (2012) compare countries which spent more than the average time in the lower-middle-income range with countries which spent less time than average and moved up into the upper-middle-income range. They find that the former have a significantly less *sophisticated* and less *diversified* export structure than the latter. With reference to the same comparison at the upper-

middle-income level, they test only for the diversification of export products, and find that countries which spend more than the average time in the upper-middle range have significantly less diversified exports and those that spend less time than average in the upper-middle-income range have significantly more diversified exports. In the same vein, Imbs and Wacziarg 2003 find that per capita income is positively correlated with a *more diversified* production structure until a turning point at around \$20,000 in today's dollars, far above the normal range of "middle income"; above this, income per capita is positively correlated with production specialization.

The findings of Jan Fagerberg and co-authors make a qualification to the argument about the importance of diversified export structure (2007). They find, across a large set of countries, that countries which in 1980-82 had a relatively high proportion of their exports from four categories of goods (ICT, pharmaceuticals, instruments, other machinery) enjoyed higher subsequent GDP growth to 2000-02 than countries with less of their exports from these industries –for the reason that these four categories experienced the fastest growth of world trade of products (defined at the 3 digit SITC classification). So countries which specialized relatively more in these four product categories had a high level of "demand competitiveness", in Fagerberg et al's phrase.

Foreign ownership and glass ceiling

A third mechanism is the difficulty of countries whose manufacturing sector is dominated by foreign-owned firms and dependent on technology imports face in transitioning to one controlled by local managers and with substantial local technology development. Kenichi Ohno (2009) calls this a "glass ceiling".

Global value chains and lock in

Fourth, participating in “global” manufacturing value chains (which in fact are mostly “regional”) can lock a country into low value-added manufacturing activities – which take on economic qualities similar to low value-added commodities. Without vigorous state action to counter this lock-in a country’s firms may be blocked from upgrading to higher value-added items within given product categories or jump a different set of manufactured products with higher value-added (UNCTAD 2014; Paus 2014; Kaplinsky 2000).

Brazil again

Figure 3 shows the dramatic fall in the share of manufacturers in Brazil’s exports between 2000 and 2014, and the increase in the share of commodities like iron ore, oil seeds, petroleum products and meat. Between 2002 and 2011 commodities rose from 28% of Brazil’s total exports to 48%; manufactures fell from 55% to 37%.

Between 2003 (start of the Lula government) and 2012 Brazil’s exports to China increased by an astonishing 30 times. As of 2010 China became Brazil’s biggest trading partner, displacing the US. In 2010 80% of Brazil’s exports to China comprised just three commodities: crude oil, iron ore, and soybeans. At the same time, 98% of Brazil’s imports from China were manufactured goods. Most of the elaborate costumes worn for Brazil’s *carnivale* are now made in China.

In the light of the above findings about the tendency of middle-income countries with relatively undiversified and unsophisticated production and export structure to get stuck in the middle-income range, these trends are disastrous for Brazil. Without reversing the specialization in commodity exports induced by Chinese demand over the 2000s the economy is likely to remain in the middle-income range for a long time.

Southeast Asia

For Southeast Asia, Shahid Yusuf and Kaoru Nabeshima, in *Tiger Economies Under Threat* (2009), say the following:

“Unlike the original East Asian Tiger economies, the Southeast Asian Tigers [including Malaysia, Thailand, Philippines, Indonesia] have yet to build the indigenous capacity to design, to innovate, and to diversify into new and more profitable areas with good long-run prospects, and very few of their firms have created regional – much less global – brand names.... More disquietening is the sparseness of backward links from MNC operations, which would signify progressive industrial deepening, as has occurred in Korea and Taiwan [China], and as is already under way in China. This lack of backward links means that domestic value-added in manufacturing remains low. Moreover, none of these countries has nurtured large and dynamic producers of tradable services” (10).

With reference to Malaysia they say:

“Malaysian industry appears to be sliding down the technological slope, and incentives for workers to improve their skills are weakening” (26).

This is striking, given that Malaysia has a large concentration of foreign-owned firms (especially on the island of Penang) producing “high tech” products. But they are “cathedrals in the desert”, not much integrated into the domestic economy.

Another MIT mechanism: the debt trap

We have identified four mechanisms of lock-in to the middle-income range, all related to production: diminishing returns to simple inter-sectoral resource transfer; lack of diversification and sophistication of exports; largely foreign-owned manufacturing sector; and passive integration into labor-intensive parts of regional value chains.

As well as these, there is the “foreign debt trap”. From the 1970s till today western international organizations and development economists have urged developing country governments to adopt a strategy of “economic growth with foreign borrowing” (Bresser Pereira et al., 2008, 2014). The rationale is that more foreign borrowing permits a higher rate of domestic investment than less foreign borrowing. Advocates of the foreign borrowing strategy tend to downplay the dangers of the country overborrowing in relation to ability to repay -- overborrowing because the foreign loans can easily be used to raise *consumption* rather than investment and generate a “feel good” sentiment in the population at large, or because the foreign borrowing is at variable interest rates and the US Federal Reserve hikes its interest rates in response to US conditions, multiplying the debt burden for developing country borrowers.

When developing countries fall into a debt trap they become vulnerable to the West’s “Washington Consensus” conditionalities, which generally include abandoning a proactive state role in trade and industry. At the time of the East Asian financial crisis of 1997-99 IMF officials asked their World Bank colleagues to send them lists of conditionalities they at the World Bank wished to impose on the crisis countries, saying that this was a golden opportunity. The combined IMF and World Bank conditionalities on the emergency loans to South Korea, Thailand, and Indonesia went far beyond measures related to getting out of the crisis, into a privatization and market liberalization agenda that the organizations and the western states which run them had long wanted. Hence the crisis is widely known in the region as “the IMF crisis”.¹ A leading American figure in setting the IMF’s and World Bank’s conditionalities in emergency loans to

¹ For the inside story of the East Asian crisis of 1997-99 see Blustein 2001. I worked at the World Bank at the time of the crisis. See for example Wade 1998a, 1998b. The Chiang Mai Initiative was established by the ASEAN plus Three countries to provide themselves with a means of by-passing the IMF in future crises. See Wade 2013a, 2013b.

East and Southeast Asian countries in the debt crisis of 1997-1999 explained, “If we can’t get them when they’re down we’ll never get them” (personal conversation, 2000).

In short, many but not all middle income countries have rates of long-run growth too low to bring them into the high income category within five or so decades of entering the middle income category. Countries in this “trap” experience a pattern of volatile growth, which itself reflects (1) relatively low “production capabilities” (hence the idea of a “middle capabilities trap”: Paus 2014) as seen in relatively undiversified and unsophisticated export product composition; and (2) relatively frequent and/or severe foreign debt crises.

Escaping the MIT by upgrading the production structure

If we agree that transformation of production structure (coupled with managed rather than free integration into international financial markets) is the crux of economic development, the question becomes how to transform the production (and export) structure in the direction of more sophisticated and more diversified products.

This brings us to the contentious subject of “industrial policy” (IP). The mainstream (since the ascendancy of neoliberal economics in the 1980s) has said that selective industrial policy is either ineffective or net harmful; this is crucial for the identity of neoliberal economics, which is unified around antagonism to the planned economy and a vibrant welfare state. A small band of dissidents has argued to the contrary.

Below I review some of the main debates about IP, including both “why (or whether) IP?”, and “how”.

I take it as given that IP is about targeting specific industrial sectors to raise their productivity and relative importance; or more broadly, targeting sectors across industry, agriculture and services so as deliberately to change the economy’s production structure. In contrast, mainstream economists commonly prescribe

policies to strengthen certain *functions* which will raise productivity “horizontally”, or across the board, not limited to specific sectors (such as R&D subsidies, or special access to credit for small and medium enterprises); and sometimes refer to these horizontal policies as acceptable industrial policies, as contrasted with unacceptable vertical, sectorally selective policies.

But the framing of “horizontal or functional versus vertical or sectoral ” is largely meaningless. Almost all state policies beyond basic education and health impact some sectors more than others. Their selective impacts should be planned for.

Fixing market failure, or more?

The mainstream “market failure” approach to industrial policy and public investment posits a trade-off: the inefficiency costs of leaving market failures unattended versus the inefficiency costs caused by government intervention to correct market failures. The policy conclusion is that state “intervention” can be justified in sectors where (1) the market fails (the necessary condition), and (2) the costs caused by the intervention are less than the costs of leaving the market failure unattended (the sufficient condition). A sectorally-targeted role beyond fixing market failure is unjustified. The practical question is how to identify and measure the costs of “market failure” and “government failure”.

Mainstream economists tend to presume that the above two conditions greatly restrict the legitimate scope for government intervention. But others emphasise the pervasiveness of information and coordination externalities as causes of market failure. Externalities mean effects external to the decisions of uncoordinated private profit-seeking actors.

Information externalities mean that a private entrepreneur has limited incentives to invest in experimenting and innovating, because if the project succeeds others can imitate without paying

the experiment costs, while if the project fails the entrepreneur bears the costs (“socialized benefits and privatized costs” is not a recipe for successful capitalism). So desirable experimentation, self-discovery and R&D investment by entrepreneurs will be socially sub-optimal.

Coordination externalities imply that investment is hampered if upstream and downstream investments are not made more or less simultaneously – especially when economies of scale are large, such that costs of production per unit fall steeply as output rises.

These external effects can justify a proactive role of the state in one way or another bearing some of the risk (“socializing” risk). Commonly, though, the state fails to design the contract so that it gets a financial return on its “interventions” when these help to generate private sector profit, as does a venture capitalist. Commonly, the state bears the costs and the private sector reaps all the financial gain (Mazzucato 2013).

But this debate – whether the state should limit interventions to situations of clear market failure – can go round and round till the cows come home. It is difficult to resolve empirically or theoretically, because the terms of the debate – costs of market failure, costs and benefits of “correcting” – are so elastic. Advocates of different positions on the role of the state can draw the boundaries of externalities where they will.

Moreover, advocates of the market failure approach tend to downplay the big historical fact that from the beginning of capitalism the state has not only “fixed market failures” but also *created and shaped* markets, often by deploying non-market resource allocations – as analysed by Keynes, Schumpeter, Rosenstein-Rodan, Polanyi, Gerschenkron, Prebisch, Minsky and more.

Industrial policy within or also beyond existing comparative advantage?

Closely related to the debate about market failure as the test of appropriate “government intervention” is debate about how far the state should go in “leading” the market rather than just “following” the market. “Following” means the state placing bets to support investments which private profit-seeking actors would want to do anyway, helping them to go further and faster than otherwise (Wade 1990a). It means the state promoting some activities ahead of others, but within the limits of the economy’s existing “comparative advantage”. “Leading” the market means the state pushing resources into activities that the private sector would not undertake without sizable state assistance.

Exhibit A of leading the market is South Korea’s POSCO (formerly Pohang Iron and Steel Company), initiated in 1968 as a largely state-owned enterprise against the emphatic advice of the World Bank and the US government, which said that steel was not in Korea’s comparative advantage (radios were). By the late 1980s it was the fifth biggest steel producer in the world.

Justin Yifu Lin, the former chief economist of the World Bank, advocates a “following the market” industrial policy, with some protection and investment support for selected sectors, but only for products and technologies within the economy’s *existing* comparative advantage (with perhaps a few pioneering exceptions). Over time, he says, the growth of these targeted activities will endogenously change the economy’s endowment structure, and hence its comparative advantage.

“The best way for a developing country to achieve sustained, dynamic growth is to follow comparative advantage in its industrial development and to tap into the potential of advantages of backwardness in industrial upgrading” (2012: 397).

Notice that the justification is not to do with politics – the (alleged) inability of most developing country governments to “lead” the market effectively. It is that limiting industrial policy to promotion of activities within the economy’s existing comparative advantage is the *best* path, even for the most high-capacity government.

This is strange, for both empirical and theoretical reasons. Empirically, there is plausible (though always contestable) evidence that the now developed countries effectively adopted promotion measures during their industrialization which “stretched” comparative advantage rather than stay within its limits, however defined. There is also plausible evidence that the most successful developing countries in the post-Second World War period – including Japan, Taiwan, South Korea, Singapore and Israel – also pushed far beyond their comparative advantage at any one point in time (Wade, 1990b, 1992).

The standard retort of neoliberal development economists (and of modestly heterodox ones like Justin Yifu Lin) is: “ah, but they stayed within their *dynamic* comparative advantage, if not within static comparative advantage”. But the criteria for “dynamic” comparative advantage are even fuzzier than for static comparative advantage, and the retort easily becomes a tautology.

In any case, the extent to which the now developed countries and the unusually successful post-war developing countries listed above complied with criteria of comparative advantage has been debated between Lin and Ha-Joon Chang (2009). My conclusion is that the evidence favors Chang: the historical evidence can justify a state in promoting activities that lie beyond or “stretch” (like a rubber membrane) present comparative advantage. I leave the issue here (Wade 2011).

The theoretical basis for the comparative advantage prescription is even weaker than the empirical basis. Comparative advantage theory is fundamentally flawed, and it is amazing that it has been taken as the foundation of mainstream development economics for decades. It

assumes, as a *necessary* condition, perfect competition in all markets in all the relevant countries. If there is not perfect competition in some markets in some countries the theory gives no solution. Also, the theory assumes a raft of “*no’s*”: no externalities; no increasing returns; no factor mobility between countries; and no technical change.

Policy instruments

Another focus of debate concerns policy instruments (Wade 2003). “Price” instruments like tariffs and selective subsidies are relatively easy to implement; but constrained by WTO rules and, as a broad generalization, arguably more vulnerable to corruption than non-price instruments. However, the fact that WTO rules make certain instruments “prohibited” does not mean that a government which uses them will be punished. Governments which consider their national interest to have been damaged by the actions of another government have to bring a case to the WTO’s Dispute Settlement Mechanism. This is typically a cumbersome and costly process, and it is by no means automatic that a government which uses a “prohibited”, let alone “actionable” instrument will be penalized (Aggarwal and Evenett 2010; Wade 2003).

The other big point is that plenty of scope remains within or on the edge of WTO rules for non-price instruments. These include:

- Coordination of investments via (1) entry regulation, (2) investment cartels, (3) negotiated capacity cuts.
- Policies to achieve economies of scale, such as (1) production licensing conditional on production scale, (2) state-mediated mergers and acquisitions.
- Regulation of technology imports, such as screening for import of obsolete technology.
- Regulation of FDI, via (1) ownership restrictions, (2) local content requirements, (3) technology transfer requirements, (4) mandatory worker training.

- Export promotion, via (1) subsidies, (2) loan guarantees, (3) marketing support, (4) national campaigns to persuade producers it is their “national duty” to export, supplemented with prestigious export prizes.
- Government allocation of foreign exchange, prioritizing imports of capital goods and discouraging imports of luxury consumer goods (Kanchoochat and Intarakumnerd 2014).

Another key instrument in the capitalist East Asian cases was publicly funded R&D, aimed (in the early decades) at domesticating and disseminating foreign technologies in priority sectors. For example, the Taiwan government established the Industrial Research and Training Institute (ITRI), with a staff of some 10,000 by the early 1980s. One of its institutes was the Electronics and Service Organization (ERSO), with a staff of around 700. ITRI was matched on the military technology side by a parallel organization, which had around 20,000 staff by the early 1980s – and whose R&D spilled over into civilian uses. Taiwan at that time had a population of around 19 mn, and GDP per head about 40% that of the United States (Wade 1990b).

Whatever the instruments, the general principles for the design of incentive systems suggest – and capitalist East Asian experience confirms – that assistance must be given against performance conditions and built-in monitoring against benchmarks (such as price and quality of competing imports); and with clear exit mechanisms, such as sunset clauses. More specifically:

- Support a relatively small number of sectors at any one time; and target fiscal investment incentives at new products or products at the top performance end produced in country, with automatic retargeting as more than a few producers become able to meet the standards.
- Think of export promotion and import replacing as “two wings of the same bird”, complements rather than substitutes. Schemes such as duty drawbacks can be used

to protect exporters from import protection. See Wade 1991 for an account of the nuts and bolts of Taiwan's duty drawback scheme.

- Use protection not to insulate domestic producers from international competitive pressure but to *buffer* them – for example by limiting protection to a certain period within which protected producers must reach close to the price and quality of imported substitutes (Wade 1993).

How to establish an effective industrial policy agency

Cross-country evidence suggests some rules of thumb for how to create and sustain effective agencies -- “islands of excellence” or “pockets of effectiveness” -- even in a surrounding bureaucratic swamp (Roll 2013).

- The top of government must be committed to the mission of diversifying and upgrading production structure.
- The agency director must be appointed by the top.
- The appointment should by-pass normal, patronage criteria – probably against a lot of elite opposition.
- The director will come from *outside the inner elite*. This makes the director less vulnerable to the “*insider's dilemma*”. A director from inside the inner elite will be under strong pressure to appoint inside-elite staff (including adult children of the inner elite), which risks staffing the agency with less-than-competent people and opening the director to attack for running an ineffective agency. On the other hand, if the director does not staff from the inner elite the agency may be rendered ineffective by attacks from those spurned.

- Initially the director has *weak* political ties to the top political authority; but once appointed must develop *strong* ties to the top, for defence of the agency.
- The director must protect the autonomy of the agency by manipulating connections to politicians, firms, unions. Autonomy is not the same as “separate” and is not fixed in law. *Autonomy is relational.*
- To make sensible decisions on “directional thrust” the agency must engage in dense dialogue with the private sector (and state-owned enterprises). In this way the agency can protect itself against the always-ready charge that it is “picking winners” (or in the vocabulary above, “leading the market”). In the dense dialogue the distinction between leading and following the market becomes blurred.
- Dense dialogue with the business sector poses the acute question of the integrity of agency staff, which relates to remuneration. The Singapore solution is worth copying: set senior public service salary grades by explicit comparison with the nearest equivalents in the private sector. For example, set the remuneration of the top civil servant in a certain agency as the average of the remuneration of the top five executives in the nearest private sector jobs, so that as the latter’s remuneration rises, so does that of the top civil servant; and so on down. This has to be combined with severe sanctions against civil service corruption.

Conclusions

Economic development from “barbarism” to “opulence” is not an inherent process of a capitalist economy, and Adam Smith was quite wrong to say that “all the rest [is] brought about by the natural course of things” – as he himself would be first to admit looking back

from today. Apart from China and Taiwan, no national economy has grown at more than 6 percent a year for 30 years or more. Others have managed 6 percent or more for 15 years or so, only to experience a protracted growth slowdown. Sharp growth slowdowns seem to be more frequent among middle income countries than either low or high income countries. Most strikingly of all, few – less than 10 -- non-western countries have become developed in the past two centuries. There does seem to be something analogous to a “glass ceiling”, resulting from both internal political economy and the hierarchical structure of the world economy.

Sectorally targeted industrial policy can help, and was effective in East Asia. But it is anything but a silver bullet – more for political rather than narrowly economic reasons. Once industrial diversification and upgrading incentives of various kinds become available, potential beneficiaries have incentives to “fish the government for fools” -- to take the money and run, to press for trade protection and subsidies with no performance conditions or ones easily fudged.

Exhibit A is again Brazil, where regulations promulgated for the car assembly industry in 2011 included local content requirements fudged in a way that allowed foreign-owned assemblers to include expenses for marketing, public relations and lobbying; and which required a mere 0.5% of gross revenues to be spent on R&D, far less than the industry spends in other countries. Thanks to measures like these, plus substantial trade protection, the car assemblers have enjoyed profit rates of around 10%, three times the common rate in the US market. Similarly in electronics. The Taiwanese-owned company Foxconn has established factories in Brazil and in return received subsidies amounting to 10-15 % of the retail price, enabling imports to be undercut; yet the (real) value-added in Brazil is small, because most is in imported components.

It is easy to see why industrial policies like the Brazilian ones just described are a mistake; and also why implementing ones that are

well designed can be politically and administratively difficult. But it bears repeating that the neoliberal or Washington Consensus package is unlikely to yield upwards convergence, because convergence is often blocked by market, property, and political forces to protect the hierarchical structure of the world economy, including those which produce the “middle income trap”. Well designed and well implemented industrial policies are a necessary but not sufficient condition for a country to zoom through the middle income range, unless it happens to be sitting on diamonds or other natural resources in high and sustained demand. END

Figure 1 – Frequency of growth slowdowns at different middle-income ranges (Aiyer et al 2013)

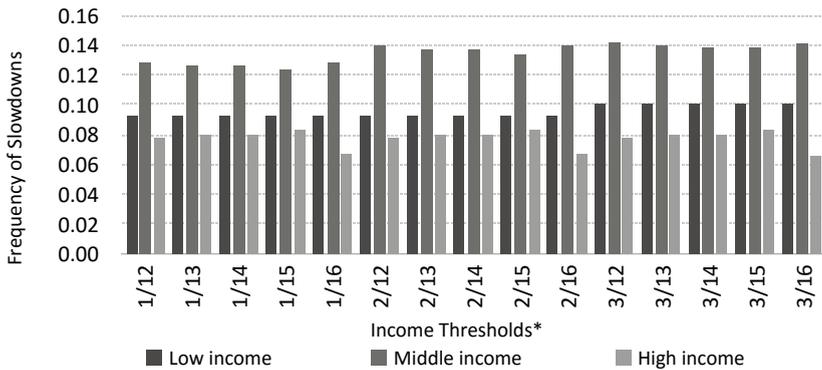
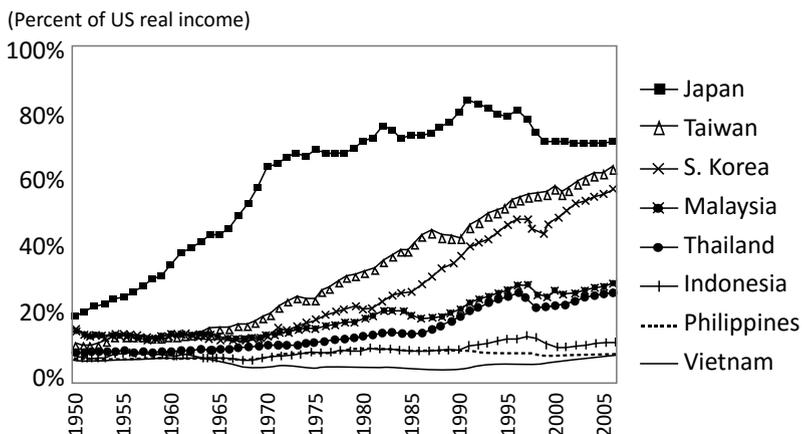


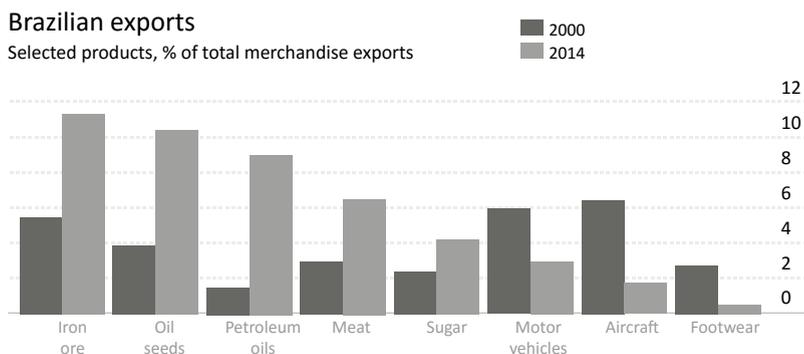
Figure 2 – Different Speed of Catching Up



Sources: Angus Maddison, *The World Economy: A Millennium Perspective*, OECD Development Centre, 2001; the Central Bank of the Republic of China; and IMF *International Financial Statistics* (for updating 1998-2006).

Note: Per capita real income relative to US as measured by the 1990 International Geary Khamis dollars.

Figure 3. Brazilian exports, selected products % of total merchandise exports, 2000, 2014



Source: Unctad

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FROM EXCLUSIVE IPR INNOVATION REGIMES TO “COMMONS- BASED” INNOVATION REGIMES ISSUES AND PERSPECTIVES

Benjamin Coriat

Introduction

Even if this thesis has triggered a series of debates and controversies, it is now accepted that our economies can be characterized as «knowledge¹ based” where intellectual property rights (IPR) systems play a crucial role. If IPR systems, envisaged here as specific institutional arrangements around R&D and innovation activities, deserve attention, it is because at the same time : i) they mark the frontier between what are patentable vs. non-patentable matters, thus defining the frontier between the world of “open” vs. restricted access to knowledge; ii) they embed a series of incentives to innovate thus contributing to fix key characteristics of the “innovation regimes” under which the economic actors behave; iii) finally, because - as it has been stressed - IPR systems have experienced dramatic changes in the last 30 or 40 years, deeply impacting the classical routes and channels followed by R&D and innovation policies (Coriat and Orsi 2002, Jaffe and Lerner 2004). The importance of the changes that have affected IPR regimes is such that they could be characterized as contributing to the implementation of “a new enclosure movement” (Boyle, 2003), an enclosure that this time encloses, not land, but ideas and knowledge.

¹ For a detailed analysis of different types of «knowledge commons» see Hess and Ostrom (2007). On this issue one can also refer to Madison M. J., Frischmann B. M., Standburg K. J. (2008). In Coriat (2012) and (2015), we have tried to define the similarities and differences between “natural resource based commons” and “knowledge commons”

In this paper, after briefly reviewing how IPR systems have evolved, we draw attention to new institutional arrangements, known as “commons” (or to be more precise “*knowledge commons*”) that can be analyzed as institutional innovations allowing to overcome the limits introduced, through IPR systems, with the recent extension of exclusive rights on knowledge and basic research.

In order to better understand the importance of such knowledge commons, the paper is organized as follows.

1. The first section is dedicated to the presentation of the so called “open science” principles and to the traditional role played by the type of IPR systems that prevailed after the Second World War, up until the mid-1970s. We show how the open science system has given rise, during that period, to an “innovation regime” that was very conducive to the requirement of the growth of the firms

2. The second sections shows how, beginning in the 1980s, this innovation regime was eroded by a series of “displacements of frontiers” provoked by a new series of IPR laws and court rulings which finally, have altered the characteristics of the classical open science system. If some of the large firms of the new emerging sectors (especially in Biotech and Information Technologies) have benefited from these changes of the IP regime, we argue that in many cases the new regime has resulted in important threats and obstacles to the creativity of a large variety of communities of innovators

3. In the third part we focus on the initiatives taken by different communities of innovators in reaction to the limits and shortcomings posed by the new enhanced IPR Regime. We examine how, under the name of “commons”, a series of new entities were established. Based on the sharing of information and cooperation between the actors at the origins of the commons, these new entities (often defined as “*knowledge commons*”) have given rise to new innovation regimes whose key feature is that they are grounded not *on competition and*

exclusive IP rights, but on cooperation and the shared benefits of the products of cooperation.

IPRs in the age of corporate capitalism: “the open science” principles and the classical economic foundations of patent regimes

During the period following the Second World War, which is also the “thirty glorious” era of so-called “fordist” accumulation regime, a well-defined type of IPR regime which proved to be very favourable to innovation prevailed both in the USA and in Europe. This IPR regime known and codified under the name of “open science” is based on well-defined principles. According to this vision, the open science systems are composed of two complementary worlds:

i) the world of “open science” as such, characterized by the following traits:

- basic research² mainly performed in universities and public labs is largely publicly funded; the result of this type of research, published in academic journals is made freely available to the community of innovators;
- the quality of the publications is guaranteed by a system of “peer reviewing”: the specialists of the concerned fields by authorizing the publication of given results provide at the same time a sort of “guarantee” on the scientific quality of the paper accepted for publication;
- the system is driven at the same time by cooperation (the scientists can benefit freely from the works and discoveries of their colleagues) and competition: the race to be the “first to publish” on a given issue (a position recognized by the date of publication in academic journals according to

² The content and meaning of the notion of « basic research » which are key to the understanding of the organization of the open science system are defined below. On this topic see the seminal Nelson (1959) paper

the so called “rule of priority”), has proved to be a powerful incentive inside the community of scientists.

ii) the world of the “kingdoms of technology” ;

- the other complementary world is constituted by the so called “kingdoms of technology”; in this world the discoveries are patented; thus, against a commitment to disclose the content of the discovery and make it free to be copied some years later, the patent owner is granted a right to exploit the benefit of its discovery under a temporary monopoly;
- this world, in opposition to the previous one, is a world where the actors (mainly: firms) seek to exploit rents based on the temporary monopolies granted to them; profit seeking is here the incentive driving the activity of the firms

This type of institutionalization of science (Merton, 1973 Dasbugta 1999), was not born in a day. It is the result of a long history of trials and errors but also of conflicts and compromises between the different actors involved in the process of production of knowledge³. But it is not an overstatement to say that the foundations of this regime were posed on the occasion of a series of reflections and debates that followed the publication of the Bush report (Bush, 1945), and the discussion it raised on the crucial role of basic science and fundamental research in the process of economic growth (Nelson, 1959). In this sense, It took a long time to have these principle fixed. They are the result of both theoretical efforts and of historical contingences.

To really understand the issues at stake, it is necessary to refer to Arrow’s contributions on the role of basic science. Since his seminal article (Arrow, 1962), it has been recognised that an economy composed of private, decentralised agents in competition is constantly under the threat of under-

³ See our Coriat and Weinstein (2012) paper where a historical perspective is given on the establishment of the system.

investment in research. This is due to the indivisible nature of good "information", including the products of research. Because the investment to produce new products is at the same time costly and risky, most firms would prefer to let their rivals invest first and stay in a position of "free rider" to benefit from the innovation without having invested for it. In these conditions, granting inventors with patents, (in other words a "temporary monopoly" to exploit their inventions), is intended to provide a sufficient incentive for private firms to invest in research activities⁴. Fundamentally, therefore, the purpose of patents is to compensate for so-called "market failures", while at the same time curbing monopolies and restrictive or discriminatory practices⁵, which would deprive the public of the benefits of inventions. Hence, an "optimal" patent system must find the right balance between two opposing requirements: - the incentive for innovation on the one hand, and its diffusion at a reasonable cost on the other.

According to this view (that, until recently, used be to the dominant one in economic theory and public policies), all patenting systems should be governed by considerations of social welfare. While guaranteeing the incentive to innovate, such systems must limit the social cost of the protection granted to innovators by restricting the rights conferred on patentees⁶.

Another key principle at the heart of IPR regimes concerns the definition of "patentable objects", that is to say define the "frontier" which separates information and knowledge which can be patented from that which cannot. On a purely theoretical level, the search for

⁴ Let's recall that a patent is classically defined as the exclusive but temporary right to enjoy the proceeds of an invention – including the right to prevent from competitors from using it.

⁵ What competition law formalizes as "abuses of a dominant position".

⁶ Note that all patenting systems demand something in return. The inventor must reveal the contents of his invention, so that society can benefit from the new knowledge and other players can develop it further or invent around it. In accordance with this principle, patenting systems have always required a written description of the invention as a condition for the granting of the patent.

this frontier has stimulated, particularly in the United States, certain observations of crucial importance concerning the status of basic research. Following on from the work of Nelson (1959), Arrow, setting out a principle that would be subsequently a key reference in the field, stressed the need to distinguish basic research from other research activities. He argued that because it occupies a very “upstream” position in the R&D process, the specific purpose of basic research is to provide *common knowledge bases*, in other words *multiple-use inputs* for other research activities. The results of basic research are characterised by the fact that they can only be used for future advances in research or for the development of new products. Consequently, as any private appropriation of the results of basic research would work against the fruitful development of innovation, by impeding their use, Arrow contended that all researchers should have free access to these results, in the interests of public welfare.

In this approach, long recognised as the authority in the matter, a patent is seen *as a constituent element of a frontier between “upstream” and “downstream” research activities*. Only patents on downstream research products are considered capable of playing a positive role in the encouragement of innovation. On the contrary the results of “upstream research” mainly obtained in universities and other academic institutions largely through public funding, should be freely and publicly disclosed and made available to the community of researchers.

It has to be noticed that both systems possess their own incentives to create and innovate. The point is obvious as regards the patent system. The (temporary) monopoly granted to the patent owner is a solid ground to extract financial rents. In the business world, the search for seeking monopoly rents is obviously a powerful motive to innovate. But even if it is less obvious, incentives are operating also on the other side of the system. Here “the rule of priority”, *i.e.* the recognition for an author to be the first to publish on a given issue, is

indeed a powerful incentive and reward. It provides to the beneficiaries reputation among the peers thus maintaining vivid emulation in the community or researchers. More than that, it should be mentioned that “reputation” apart from the honours it will bring, can also be at the origins of financial benefits (in terms of accelerated professional careers, rewards and prizes granted by different knowledge societies).

Finally, considered as a whole, the open science system with its two sides (the world of free access to scientific results, and the world of “secrets” and patents) has given rise to a specific innovation regime that proved to be very conducive to innovation activities⁷.

The system was all the more efficient that it spreads along with the extension of what was characterized as “managerial capitalism”. The rise of the large “M” firm described by Chandler (1990, 1992), is a constitutive part of the “open science system”, since, most applied research (destined to be patented) was carried on inside the specialized laboratories of the large “M form” firms. As Schumpeter (1911/1934) noted on his side, the installation of *specialized research labs* inside large firms is typical of the last stage of capitalism he describes in his famous book. Thus the articulation of “publicly funded” research in large universities and public research institutions *mainly dedicated to basic research on one side, with applied research mainly carried on in the private labs in large corporations* and destined to be patented on the other side, were the basis of the specific innovation regime that imposed itself after WWII until the mid 1970s.

To conclude on this point, it should be noted that the principles of “open science” (characterized by free access to basic knowledge and patents granted to the sole inventions whose utility is clearly established), proved to be very conducive to the creation and diffusion of innovation during the period that started after WWII and lasted until the mid 1970s. This period was one of the

⁷ For an exhaustive presentation of the word of « open science », one can refer to Dasgupta and David, (1994) and to Merton’s seminal works

most spectacular in the history of capitalism in terms of growth and other economic performances, a period marked also by a continuous flow of innovations. In the domain of pharmaceuticals for instance, this period is known as the “golden age” of the industry. It is during that period and under the regime of open science, that the larger number of new molecules and drugs were conceived and marketed. (Orsenigo, Dosi, Mazzucato, 2005)

The 1980s: “displacement of frontiers”, alteration of the open science principles, extension and strengthening of exclusive IP rights

Beginning with the late 1970s and 1980s however, some dramatic changes took place. The changes were so rapid and deep, than in less than 25 years a largely modified IPR was regime was established (Coriat and Orsi, 2002). The new regime first appeared in the USA, and so it is on the changes that took place in this country that we must focus on. As we will show, the new regime was installed by the means of a number of institutional changes whose origin is at the same time “political” (new laws emanating from the Congress of the USA) and jurisprudential. A number of key courts rulings, regarding IPR disputes were delivered. In a country marked by the tradition of the *Common Law*, these rulings of course played a major role for the enforcement of the new regime.

Legal changes

A series of changes of a legal nature were first introduced to open up the area of patents (and more generally IPR) to new players. In practice, these were the universities and research laboratories, authorised by the new legislation to file patents on the products of their research, even—and this is the noteworthy point—when the research in question is publicly funded. This step was taken in 1980

with the passage of the Bayh-Dole Act, which introduced a series of complementary arrangements. On the one hand, it authorised the filing of patents on the results of publicly funded research⁸. On the other, it opened the possibility of transferring these patents to private firms in the form of *exclusive licenses* or creating joint ventures with such firms in order to take advantage of the knowledge thus transferred. This created the opportunity for such joint ventures firms either to trade these licenses or to make use of them to create marketable products. A massive increase in the number of patents registered by university labs followed (Jaffe, 2000)⁹.

The transformation introduced by the Bayh-Dole Act was decisive. In fact, until this law was passed, the prevailing doctrine in the area of patents had a considerably different orientation which, consistent with the economics of research as analysed by Arrow and Nelson¹⁰, attempted to compensate for the market shortcomings resulting from the ‘public interest’ nature of scientific information. The Bayh-Dole Act broke with this practice and the doctrine underlying it. With the introduction of the possibility of attributing the results of publicly-funded research in the form of *exclusive licenses to private firms*, the very foundations of the incentive to innovate through public grants lost both its meaning and its bases in the theory of well-being.

⁸ It has to be noticed that the practice of patenting results from publicly funded research did exist before the Bayh-Dole, but only in well defined and restrictive conditions. The passing of the Act opened the way to the generalization of such a practice.

⁹ An indicator of the involvement of universities in patenting activity during the 1990s and the early 2000s is given by their spectacular increasing licensing revenue. According to a survey on this issue : “ Beginning in 1991, university licensing revenue chiefly from patents increased nearly three times, passing from \$200 millions to \$550 millions in less than a decade” (Merill et al, 2004). However closer examination reveals that the large majority of this revenue is concentrated in few biological inventions and is captured by a small number of institutions. “The top 10 universities patent holders accounted for 66 % licensing revenue in 2000” (id).

¹⁰

The effects of the Bayh-Dole Act were all the more profound that they took place in a context of general and dramatic changes of doctrine regarding patents and IP protection, largely fuelled by a series of key new court rulings that have largely modified the prevailing jurisprudence.

New Court Rulings: software programs and living entities as patentable matters

The changes introduced by the new court rulings covered numerous issues, but the essential change consisted in enlarging the scope of patentability to cover objects which had not previously been included or were explicitly excluded from it¹¹.

Two main areas are concerned here: computer software and living organisms. In the first, this development was reflected by the authorisation to patent *algorithms corresponding to the simultaneous use of mathematical equations*. In other words, elements of ‘generic’ knowledge currently used by the community of software programmers and designers were now patentable. The 1990s were thus to see the patentability of the famous “business models” for sales methods or financial services.

As a consequence of these changes the granting of software and Internet patents surged. «... [from 1992 to 1997] ... the USPTO granted 750 internet patents » But it is mostly after 1998 that the granting of such patents soared. More than 4000 patents were granted in 1999, and nearly 57000 in the year 2000, mainly to software developers and to ICT companies. Between 1995 and 2000 the rate of increase of internet was estimated at 1 515 %» (I. Liotard, 2004). It has to be noticed too, that during the same period many Internet companies were promoted on the basis of the financial markets’ evaluations of

¹¹ For a detailed presentation of the modifications, see (Jaffe, 2000; Jaffe and Lerner 2004) and (Coriat and Orsi, 2002).

their intangible assets, which took the form of patents and other IPR on computer methods.

But the change was most radical and heavy with implications in the *life-sciences* field. Here, the breach was first opened by the well-known Chakrabarty ruling allowing General Electric to patent a micro-organism and this decision was the first in a long series which ultimately led to the patentability of genes and partial gene sequences. In the United States today, more than fifty thousand patents on gene sequences or partial gene sequences have been granted or filed, thus *opening up the way to a veritable commodification of scientific knowledge* (Orsi 2002; Orsi and Moatti 2001). In numerous cases, moreover, the patents granted cover not inventions of recognised utility but a wide range of future applications. By granting patents on basic knowledge itself (the input of future inventions), American courts have protected not only the inventions described and disclosed but also all the potential and virtual ones which might be derived from the use of patented knowledge.¹²

The changes in the IP regime on living organisms offer an exemplary demonstration of the process leading to the erosion of the distinction between ‘discoveries’ and ‘inventions’. In the past, this border clearly separated two worlds: that of the production of knowledge (constituted as the world of “open science”) and that of the commercial exploitation of these discoveries (the world of innovation) where industrial firms confront each other, as previously stated in section 1 of this paper.

¹² In this respect, American jurisprudence broke with prior doctrine, for the precise description of the invention concerned in order to demonstrate its practical utility had been an essential criterion of patentability. In 1997, however a court decision (*Regents of the Univ of Cal v Eli Lilly and & Co*) has stated that simply describing a method for isolating a gene or other component of a sequence of DNA is not sufficient to show possession and the complete sequence or other identifying features must be disclosed to have a patent granted. It is however too soon to evaluate the practical effects of such a tentative to put limits to the granting on genes on so called research tools (more on this issue in Merrill et al 2004)

To sum up, it can be argued that this period has witnessed something like a “displacement of borders” inaugurating an era of privatisation of the scientific commons (Orsi 2002). This unprecedented situation is denounced by many important and influential sectors of the scientific community but also by private-sector innovators¹³.

At a more theoretical level, we must observe that, in line with the “revolution” achieved by the theory of property rights in other domains of economic theory (and mainly regarding the theory of the firm), these changes on the IPR doctrines and practices marked the primacy of the idea that the granting of *exclusive rights*, (i.e. “right to transfer” and or alienate) should be enforced as a way to promote efficient market for knowledge¹⁴. (More on this point in Coriat and Weinstein 2012)

The new regime did produce some positive effects for a certain class of firms. Basically the beneficiaries of the system were the large firms of the IT sector on the one hand, and the new biotech firms that make profits by selling property rights on the other hand. Elsewhere we have argued that these changes have opened a space to what can be named a new type of “science-based firms” (Coriat et al 2003)

As a result of these changes it can be argued that the classical “Innovation regime” based on open science principles has been largely eroded. The displacement of frontiers that happened in the world of patents has made available to business activities a series of domains that were previously governed by the rule of open science and free access to inventions and discoveries.

¹³ This point is developed below.

¹⁴ This view is strongly defended by proprietary rights theorists. For a systematic plea in favor of implementing *exclusive* property rights as a mean to strengthen market efficiency see A. Alchian (1978 and 1993)

The rise of “Knowledge Commons” as alternatives to the ongoing process of privatization of knowledge

The limits and shortcomings of the regime that emerged from the ruins of the classical Open Science System are numerous and have regularly been denounced. One of the most careful and exhaustive critical assessments of the new IPR regime was achieved in 2004 by the powerful National Research Council of the American National Academies. The conclusions published by Merrill and al (2004) confirm on numerous points the anxieties expressed by the scientific community, and the authors foster a series of reforms aiming at setting the granting of patents on more solid grounds. These conclusions come to strengthen those already made by a series of many influential academics who plead for a return towards more balanced forms of protection, leaving more space to the principles of open science (Heller and Eisenberg, 1998; Rai, 2000; Rai and Eisenberg, 2003; Nelson, 2004)¹⁵.

Indeed the process of privatization of knowledge (presented in section 2) strengthened the idea that the scientific community was likely to face a “tragedy of the anticommons”, a notion coined to mirror the earlier opposed thesis formulated by Hardin (1968). The assumption behind the vision proposed by Heller and Eisenberg (1990), is that the abuse of exclusive rights established by IPR over discoveries or inventions have finally raised a series of new obstacles to the production and circulation of knowledge, thus damaging the process of innovation itself. Since, in many cases there were obstacles posed to free access to “upward” knowledge (to paraphrase Arrow’s words), inventors were in danger to be confronted with a situation where the bits and pieces of knowledge they need to gather to pursue

¹⁵ Even more critical arguments against the system, asking for the suppression of IPR were also launched on the public scene. See the plea by Boldrin and Levine (2008) “against intellectual monopoly”.

their own research activities, are protected with patents, creating more or less artificial barriers, hammering their capacity to innovate¹⁶.

It is in such circumstances that different types of initiatives were launched and soon spread out among the community of scientists. The goal shared by the actors at the origin of these initiatives was to find a way to re-open a space for free and open access to basic scientific resources, and to re-establish more cooperation in a world where competition had spectacularly increased. An important point here is that, whilst pursuing their basic goals (re-install the conditions of open science) the actors were encouraged to promote a series of institutional and judicial innovations that finally gave rise to new modes of production of innovation. It is this family of new entities designed to restore free and open access and cooperation that, during the 1980 were designated under the name of “knowledge commons”. In this sense it can be argued that just as the history of natural-resource commons is linked to that of the “enclosure movement” (Hardin 1968 and for a critique of this view Ostrom,1990), the history of knowledge commons is inseparable from the “second enclosure movement” (Boyle, 2003) that took place in the last decades of the 20th century. To be sure, it is first and foremost in order to overcome the limits posed by the new regime of the 1980s that new modes of producing innovation came into existence.

The route towards the establishing of these new modes is not unique: initiatives were taken at different levels and in different domains¹⁷. But there is no doubt that what has been done under the

¹⁶ A detailed presentation of these changes and the threats they pose for the scientific commons can be found in Coriat and Orsi (2002). On this point, see also Nelson (2004).

¹⁷ To overcome the limits posed by the extension and the strengthening of copyright laws, a movement based on “Creative commons” was also launched in the early 2000’s. The organization created for that purpose has conceived several [copyright-licenses](#) known as [Creative Commons licenses](#) free of charge to the public. These licenses are designed to allow creators to communicate which rights they reserve, and which rights they [waive](#) for the benefit of recipients or other creators. Creative Commons has been described as being at the forefront of the [copyleft](#) movement,

egis of the F/LOSS (Free/Libre and Open Source Software) movement was the first successful tentative at very large scale, to introduce new modes of production of innovation. As such F/LOSS can be considered as the locus of the most archetypical “Knowledge Commons”.

The F/LOSS movement was not successful only in its specialized domains (i.e. producing a series of software through new practices based on free and open access to the source codes). It was also successful *in the design of major judicial and institutional innovations that surpassed the sole world of software and opened a space for other types and categories of innovations*. These are the reasons why we have chosen to focus here on some of the achievements of the FLOSS movement. The FLOSS movement can be regarded as an “archetype” of the new commons-based innovation regime.

Without drawing a complete picture of the history of the FLOSS movement, one must recall that in the beginning, the first «free» software were the result of initiatives taken by professional developers to bypass and counteract the privatization and the enclosure of software that began to take place in the late 1970s¹⁸. Initially, in the 1960s and early 1970s, clients had to pay for the hardware, *the software being provided for free*, as «public goods». And software were produced in a cooperative way by developers sharing and associating their skills. As stated by B. Gates in his famous «Letter to the Hobbyists»: in the early days of the industry «Hardware must be paid, software is something to share”¹⁹. It is only after many years of battle, after the extension of

which seeks to support the building of a richer [public domain](#) by providing an alternative to the automatic “all rights reserved” [copyright](#), dubbed “some rights reserved. In 2008, there were an estimated 130 million works licensed under Creative Commons. As of October 2011, [Flickr](#) alone hosts over 200 million Creative Commons licensed photos. (information gathered on wikipedia website)

In the same way a movement to establish “open publishing” principles against the “cartels” that was formed by the publishers of the professional academic journals, began to spread

¹⁸ For the history and an analysis of that period see Stallman (2002) Mangolte (2015)

¹⁹ **B Gates “Letter to the Hobbyists (Feb 3, 1976)**

copyrights and patents to mathematical algorithm that software were sold as «commodities» and marketed as such.

It is in reaction to these changes in the world of software that certain professional communities of developers involved in the maintenance of large systems decided to produce their own tools, renewing with the tradition of openness and cooperation that prevailed at the origin of the business.

To do so, in the course of their activity, they had to design their own tools and institution to protect their inventions and to guarantee their maintenance in the public domain. Thus, through the FLOSS foundation, emerged a series of legal innovations. Among them a key institutional innovation was the GPL-GNU license that guarantees the cumulateness of progresses through free access to information and innovation.

If the world of free software can be analyzed as a world of “commons” it is because, like natural resource based commons²⁰ it is constituted of specific entities based not on exclusive property rights granted to one owner or proprietor but on the distribution and allocation of different attributes of property rights allocated to different stakeholders. To put it in another way, in the world of FLOSS (just as in the world of natural resource based commons: fisheries and so on ...) *property rights takes the form of a « bundle of rights »*²¹. In the case of software one can distinguish three types of basic rights : i) rights to use the soft; ii) rights to duplicate and transfer it to third parties; iii) rights to have access to the source code, to modify it and to create new versions of the same basic soft.

Whether the developers using the latter right are obliged (or not) to reintroduce in open access the result of their works is a question of

²⁰ On this issue and for a comparison of natural resource based and knowledge commons see our paper: Coriat (2011) available at <http://www.mshparisnord.fr/ANR-PROPICE/documents.html>

²¹ The notion of «bundle of rights» is discussed in details in Schlager E. and Ostrom E. (1992). See also Orsi (2015) in Coriat (ed) (2015)

design of the licenses attached to the soft. In the same way, whether the developer (who has created a new version of an existing soft available in free access) is authorized (or not) to seek a commercial benefit from his work, and under which forms and conditions this benefit can (or cannot) be taken, is also a question of design of the license attached to the use of the soft. In fact, with the launch of these innovative licenses, began a process of institutionalization of new modes of producing innovation through shared access and the constitution of «communities of innovators» (Von Hippel). Thus there exist a series of different licenses providing different possibilities.

One of the licenses designed at that time, introducing the notion of «copyleft license» played a key role in the history of knowledge commons and can be regarded as a «constitutive rule» in this field. According to the rule attached to the copyleft principle: the developers interested in a given soft have a right to access the database and source code, they can work on the information withdrawn to develop new applications, propose solutions to existing errors or bugs, install new and more efficient routines ... but, doing so implies that they accept the constraint to share their innovations on the public domain (i.e. the domain of open and shared access).

Even if the design of such licenses is of crucial importance to fix the way users will access the products of developers, and the conditions for further development of existing products, the point will not be discussed here. It suffices for us to highlight the fact that the legal regime attached to these softs is at the origin of a completely different regime than the one organizing the world of private and exclusive property rights that resulted from the spread of copyright and patents on software.

If we concentrate on the mode of production of innovation that is at the basis of the new commons based innovation regime, some remarks can be made. One here must observe that by defining the type of «rules» embedded in the different licenses, the communities

of innovators gathered in the F/LOSS movement were able to initiate a powerful process whose originality lies in key principles:

i) It is first of crucial importance to note that the different types of licenses opening access to shared databases of information *do not imply any «absence of property»*. On the contrary the new license designed under the aegis of FLOSS contribute to delineate spaces of «common» and shared property. Like natural-resource commons, *knowledge commons are not based on an absence of property rights, but on another form of use and distribution of the different types of rights attached to Intellectual Property Rights*. Here, like in the case of natural resource based commons, much depend on the type of “bundle of rights” deployed among stakeholders. (more on this in Coriat ed, (2015)

ii) **Incentives**. The new commons-based innovation regime relies on incentives of a different nature that the ones attached to the classical exclusive IP rights. Here the incentives to join the community are based on the fact that joining the community allows the newcomer to benefit from the creativity of the other participants and stakeholders at the condition that the newcomer in the community accepts that the others can also benefit from his/her own creativity.

- As regards the internal « dynamics » that takes place inside the community of developers, it has been argued than one specificity of the process of creation is that it is based on “horizontal” interactions between developers, rather than on a vertical and hierarchical division of labor. Raymond (1999) after having analyzed the form of cooperation adopted in the Linux project found a de-centralized “bazaar” model, which he set off against the traditional corporate approach of hierarchical, small-circle development which he dubbed the cathedral style ». (F. Lehman, 2004)
- This « horizontal » and decentralized way of conducting the developments tasks, opens up original ways of resolving the

« conflicts » that can arise in the course of the development process. In the FLOSS world « ... there is always the option of a split, or fork. The terms of FLOSS licenses make forks possible; both halves will be able to continue their work with only a loss in numbers and skills, but without having to rewrite any code (...). Temporary forks are also a way out of major conflicts, giving both parties the chance to implement their ideas, and allowing for the project to be reunited under a more successful course of action (F. Lehman, id)

Finally a remarkable achievement of the F/LOSS movement lies in the fact that through private contracts the constitution of a public domain guaranteed as such can be achieved. If the knowledge put in common is covered by a copyleft license then: as stated by Stallman himself, *«anyone can add but no one can withdraw information and appropriate for private use»*. It has to be noted however that the variety and flexibility of available licenses makes it possible also for developers and innovators to use an open-source database, to protect their inventions. In the first case we are in the world of “free” software and innovations, in the second case we are in the world of “open source” developers. We are dealing here with institutional constructs guaranteeing free access and free use of the innovations generated by the commons, but only to those who accept the rules of the game.

To conclude

Two series of remarks deserve attention

1. Even if we have concentrated our analysis on one “category” of innovators (the F/LOSS community) there exists a wide variety of such commons based innovators. In the same way as it has been argued, there are a number and a large variety of types of “licenses” guaranteeing different levels of access and rights to withdraw and/or develop the information

gathered in given commons. Hence, more work is needed to better understand what is at stake. In this paper, we merely aimed to draw attention on an emerging process and provide some initial elements of analysis for practices capable of renewing the core of innovation activities.

2. A second remark concerns the role that the state can play to favor the spread of the new innovation regime. To face the new challenges we would argue that in addition to its classical function (fund public research and universities, define strategic R-D priorities, design the right IPR laws and patent systems...), the state has to play new roles, assuming the objective of being *an enabler and facilitator of the new innovation regime*. Identifying the right stake holders, guaranteeing the sharing and distribution of the different rights among stakeholders in a given knowledge commons (and/or community of innovators), contributing to the definition of the rules of the game, contributing to the definition of the appropriate « governance structure » and governance mechanisms of different types of knowledge commons... are new tasks for a State that will have to act not “on behalf” the citizens, as it previously did, but as a *partner*. The new commons-base innovation regime clearly implies for the State to behave differently: less on “*behalf of*” the citizens (and the communities of innovators) but “*together with*” the citizens.

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FROM CATCHING-UP TO THE TECHNOLOGICAL FRONTIER: CHALLENGES FOR KNOWLEDGE GOVERNANCE

Ana Célia Castro

“Perhaps a crux of success or failure as a society is to know which core values to hold on to, and which ones to discard and replace with new values, when times change.”

Diamond, J. COLLAPSE. How societies choose to fail or succeed. 2005.

Theoretical and conceptual framework

The first challenge to this reflection regards the updating (*aggiornamento*) of the concept of technological *catching-up*¹,

¹ Convergence or *catching-up* is defined as technological parity or equivalence to state-of-the-art international standards. It is a process that tends to occur in a concentrated form within a given time range, and it is accompanied by high rates of economic growth, with increased productivity and international competitiveness for the sectors and companies involved. In addition to the concept of historical *catching-up*, there is the concept of technological *catching-up*, with which we will work in this paper. The most important reference texts for studies on catching-up are: Gerschenkron (1962); Abramovitz (1986); and Hikino & Amsden (1994). See also Nelson, Mazzoleni, Cantwell, Bell, Hobday, Von Tunzelmann, Metcalfe, Henry & Odagiri (2005). Two recent theses on the subject can also be cited: Bastian (2008) and Rego (2014). Antonio Barros de Castro was the author responsible for the introduction of this approach to interpret Brazilian industrial development as a process of *catching-up*, instead of the prevailing interpretation in the ECLAC tradition, synthesized in Tavares (1973), who describes Latin American industrialization as an import substitution process. On this topic, see Castro and Proença (2001) and Castro (2003). The collection of papers presented by Castro at the National Forum can be seen in Velloso (*Antonio Barros de Castro. O Desenvolvimento Brasileiro da Era Geisel ao Nosso Tempo*). The article *Renegade Development: Rise and Demise of State-led Development in Brazil*, in Smith *et al.* (1993), takes a step forward and discusses the role of conventions and shared beliefs in the interpretation of the most recent period in Brazilian economy. The latest version of this article is in Castro and Castro (2012).

given the new context of the 21st century. In synthesis, the following reflections could be suggested.

As opposed to the recent past, there does not seem to be a single technological path while a higher standard is not established. The concept of secondary innovation², which describes how countries test and pursue different technological trajectories, following their vocations and capabilities³, makes the concept of catching-up indefinite – catching-up with what? It seems that a roadmap to be followed by sectors and countries is no longer available. If there were such a path, it would not necessarily be up to the countries with higher *per capita* income to hold up to the “less developed” “the mirror of their own future”.⁴

The so-called “superior” technologies must also meet objectives outside the traditional universe of technology. Considerations on sustainability, saving/not wasting resources, not harming human and

² Based on Dosi's (1982) notion of technological paradigm and technological trajectories, secondary innovation sheds new light on the topic. Before the technological standards of an industry/ product/process are consolidated, developing countries may explore alternative routes according to their capabilities. A company may purchase a technology from a developed country, absorb knowledge gained via technology transfer agreements with companies from developed countries and enhance it, thus exploring new trajectory possibilities. See Wu, Ma and Xu (2011).

³ The concept of dynamic capabilities was introduced by Teece (1998), but its roots lie in the literature of the Resource-Based View. Dynamic capabilities translate into market sensing and sizing abilities, alluding to the Schumpeterian sources of competitive advantage, which may be considered a consequence of unique innovations. Innovations, in turn, help understand other organizational and business processes of integration, learning, reshaping and transformation, positioning (location), enforcement capability (“assessment”), reproducibility and imitability of the organizational process. The Resource-Based View has its precursors in Penrose (1959) and Chandler (1977) and emphasizes the competitive advantage related to the ownership of scarce, but relevant and difficult to imitate, assets, such as knowledge. See Foss (1997), *Resources, Firms, and Strategies: a reader in the Resource-Based Perspective*, which concentrates the main contributions of this literature.

⁴ Marx (1867), *Capital*, cited in this paper according to the Marx (1968) edition: “Los países industrialmente más desarrollados no hacen más que poner delante de los países menos progresivos el espejo de su propio porvenir” (Prologue to the First German Edition, 1867, p. xiv). China is perhaps the greatest example of *leapfrogging*. On this theme, see Proenca, Habert, Aredes, Camargo Jr. (2011).

animal health/life, fulfilling social inclusion objectives, respecting/taking into account traditional knowledge of cosmologies rooted in tradition are involved in the definition of which technologies a society will reckon superior in the present or near future⁵.

Another important line of thought recognizes a change in the way of doing science which impacts knowledge governance, in that it redefines the forms of coordination within and outside companies, thus far a privileged locus for innovation⁶. Concepts such as open innovation⁷, user innovation⁸ and the existence of innovation

⁵ If this is taken to be true for certain industries, in the case of agriculture, such requirements or demands become even more compelling. The outlook on agriculture seems to mirror the existence of at least three tensions currently present in Brazil: a perspective of the social movements – which is markedly ideological – on the agrarian restructuring movements, in which the issue of unequal access to resources is more important than its use; a productivist point of view – related to agribusiness – emphasizing average income of farming operations; and an understanding derived from sustainability, environmental protection, low use of fossil fuels, agroecology, which may or may not be accompanied by cosmologies which emphasize religious and spiritual dimensions, present, for example, in movements like Pachamama (Mother Earth, divinity related to the earth, fertility, the mother, and the feminine) or in shamanic traditions which have been valued and studied by traditional science itself.

⁶ In *Capitalism, Socialism and Democracy*, Schumpeter (1947) identified the "domestication" of innovation within enterprises – subordinating the introduction of innovations in the economy to a reduction in the differential rents of technologies still in use – as one of the causes for the overcoming of capitalism: not for its failures, but precisely for its successes.

⁷ "We propose the following definition of open innovation, in hopes of unifying future work in this area: open innovation is a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with each organization's business model. These flows of knowledge may involve knowledge inflows to the focal organization (leveraging external knowledge sources through internal processes), knowledge outflows from a focal organization (leveraging internal knowledge through external commercialization processes) or both (coupling external knowledge sources and commercialization activities)" (Chesbrough, 2006, p.xxiv). The latest publication on the advances of the "open innovation" approach is Chesbrough, Vanhaverbeke and West (2015).

⁸ Baldwin and Von Hippel, 2011:1400 and Von Hippel, E. *Democratizing Innovation*. MIT Press. 2005. The concept of "user innovation" was proposed by Von Hippel (1988, 2005, 2010) and has had increasing adherence in the business world, especially in the development of applications launched by mobile and information technology

platforms, knowledge networks and markets⁹ have been absorbed by the literature on innovation but need to be reconsidered in the assessment of technological catching-up process. In fact, processes that involve knowledge, learning and innovation have been deeply renewed.¹⁰ Such changes take place not only happen in companies, universities and research institutions responsible for innovation.

New types of organizations, hybrids composed of markets and corporate networks – knowledge networks and markets – are emerging. In these new types of organizations, knowledge is both the intellectual property of a company and fragmented across multiple entities in the network. It is also incorporated in intangible assets,¹¹ whose value is commodified in different forms and in emerging market structures¹² (BURLAMAQUI; CASTRO; KATTEL, 2013, p.xiv).

companies. A case in point is Shaumi, a Chinese company adopting a business model that relies on followers ("fans") to test the launching of new applications/products, which engenders its own market of potential customers. A more recent publication can be cited on the advances of the "user innovation" approach: Chesbrough, Vanhaverbeke and West (2015).

⁹ The OECD has circulated a document entitled Knowledge Networks and Markets for discussion by experts. For more information, see <http://www.oecd.org/innovation/inno/knm.htm>.

"Knowledge networks and markets are arrangements which govern the transfer of various types of knowledge, such as intellectual property, know-how, software code or databases, between independent parties across the economy. The OECD's KNM project studies existing and emerging knowledge allocation mechanisms and their impact on knowledge creation, dissemination and use. The assessment of the economic significance of KNMs informs an evidence-based approach to science and innovation policy making" (OCDE, 2013, p. 2).

¹⁰ "The changes alluded to are the products not only of new technological regimes, such as described in Coriat and Weinstein (2002), but, especially, the result of changes in institutions, organizations, and governance structures that accompany them" (BURLAMAQUI; CASTRO; KATTEL, 2012, p. xvi).

¹¹ Possas (1999) draws attention to "the presence of intangible assets, based on experience, knowledge, relationships established, image created" (Possas, 1999, p. 120).

¹² "New types of organizations, hybrids composed of markets and corporate networks – knowledge networks and markets – are emerging. In these new types of organizations, knowledge is both proprietary and fragmented across multiple entities. It is also incorporated into intangibles assets, whose value they seek to seize. (Teece 2002) These intangible assets are marketed under different forms in emerging market structures" (Burlamaqui; Castro; Kattel, 2013, p.).

However, not all knowledge can be appropriated – it can also move freely in research networks and innovation cooperatives, such as open databases, genetic code mappings, *wikipedias*, and under agreements based on “*creative commons*” and “*science commons*”, which seek alternative intellectual property regimes, with major implications for knowledge governance. In this sense, knowledge creation and diffusion are ahead of policy and regulation, which have not kept pace with changes in the fast-paced real and virtual world of innovation. The implications for the catching-up process seem to not have been enough discussed or clarified.¹³ An unforeseen result, one might suggest, is that technological catching-up is in fact a never-ending process, in which innovation may arise from changing architectures in denser institutional arrangements, and therefore may not constitute a clear goal to be achieved, while *leapfrogging* is always a possibility that collaborative innovation may or may not reveal.

R&D activities are thus increasing the connectivity and development of technology platforms that facilitate management activities dispersed in firms and more distributed innovation networks¹⁴, therefore involving a larger number of different entities. This new organization of innovation, it seems, would have advantages and could prove more efficient than centralized/hierarchical alternatives, as it can mobilize more substantial and more dispersed resources for innovation. In this sense, competition between alternative technology routes – adopted by countries when conducting the so-called secondary innovation – may be enabled due to a reduction in the bureaucratic costs associated with centralized research and development processes. Such alternatives, as suggested by the OECD document, need a “strong glue” that allows for denser

¹³ Emphasis on this point is justified by the fact that innovation platforms coordinated by Embrapa are the object of this work.

¹⁴ Eric Von Hippel was the first to propose the term “distributed innovation” to describe a system in which innovation is the result of interaction between producers, users, and even rivals.

knowledge flows among players. This knowledge governance structure, the document suggests, would be the so-called knowledge networks and markets, as widely discussed above.

Knowledge networks and markets could be defined as (not necessarily) soft infrastructures and instruments/mechanisms that facilitate the development of innovation clusters, based on the concepts of open innovation and marketing of inventions by universities (in the Brazilian case, these would be the Technology Innovation Centers – NITs – under the Innovation Law)¹⁵. These are arrangements governing the transfer of various types of codified knowledge, such as patents, know-how, code and databases, among others, which flows among independent parties and facilitates accessibility, usability and marketing. Participants in knowledge networks and markets are universities, firms (particularly start-ups), government agencies, and even individual researchers or innovators (using a very broad concept of innovation).¹⁶

Knowledge networks and markets - KNM may be characterized, first, by their objectives: circulate (share and negotiate) intellectual property rights, whether on patents, databases, research results from virtually connected teams, proprietary material in general, knowledge, secrets, among others; arrange the joint production of new knowledge, as such contracts are complex and difficult to monitor; circulate (share, negotiate) existing knowledge, which may depend on setting up the markets in which these negotiations will take place.

¹⁵ / See Lei de Inovação, Lei nº 10.973, of 2 December 2004. Available at http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2004/lei/l10.973.htm.

¹⁶ This concept does not apply only to innovations in the "more conventional" sectors. An application which may not have yet been considered for the concept of KNM in creative economy could be the business model introduced by the YouTube platform to "monetize" the uploads of videos and other products made available on the web. See the excellent presentation of this business model by Pedro Misukami, from the Center for Technology and Society, Fundação Getulio Vargas, Cultura Digital e Novos Processos de Intermediação. There is a presentation by the same author on the new Brazilian Internet legal framework at https://www.youtube.com/watch?v=qiOd_owiv6w

On the supply side, KNM include monetary incentives (including public funding), reciprocal access, reputation or contacts, public interest. On the demand side, KNM enable different conditions of access: restricted (like clubs, or research networks); open access, but through payment; open and free access, like in Wikipedias and Scielo, for example.¹⁷ Governance can take place at the micro level (of companies and organizations participating in consortia), the meso level (of network and market-type structures), and at the macro level (mechanisms/instruments governing the production, use, circulation and appropriation (rights, protection) of knowledge).¹⁸

Industrial and technological policies (favoring innovation); regulation of competition; intellectual property regimes – resulting from the activities of patent offices –; the Judiciary, which deals with the litigation of intellectual property; and the diplomatic corps of a country that operates in global governance organizations with some degree of influence or freedom to modify the international legal apparatus of intellectual property (IP) and/or competition regulation are institutions involved in the new ecology of innovation and its governance.

Thus, the concept of knowledge management was impoverished by this tangle of dimensions, actors and policies. The term knowledge

¹⁷ Other relevant criteria to think of a KNM typology would be: who are its members and how they interact, what are the governance mechanisms or how coordination takes place within the KNM.

¹⁸ It seems convenient to distinguish two more recent concepts of knowledge governance. The first, focusing on the company, may be attributed to Nicolai Foss and other researchers following this line, and is described in Foss and Michailova (2009). Another consideration was explored in the abovementioned book by Burlamaqui, Castro and Kattel, where knowledge governance refers to policies and regulations that encourage the production, circulation, diffusion/use and protection of knowledge. Thus, it is a concept located in the macro dimension. In this regard, the very judgment on knowledge benefits from a distinction between general – restless, ungovernable – knowledge, as described in Metcalfe, and organizational knowledge, which, even when uncoded, is shared by the company/organization and may thus be coordinated. See also Tsoukas (2005) and Tsoukas and Mylonopoulos (2004).

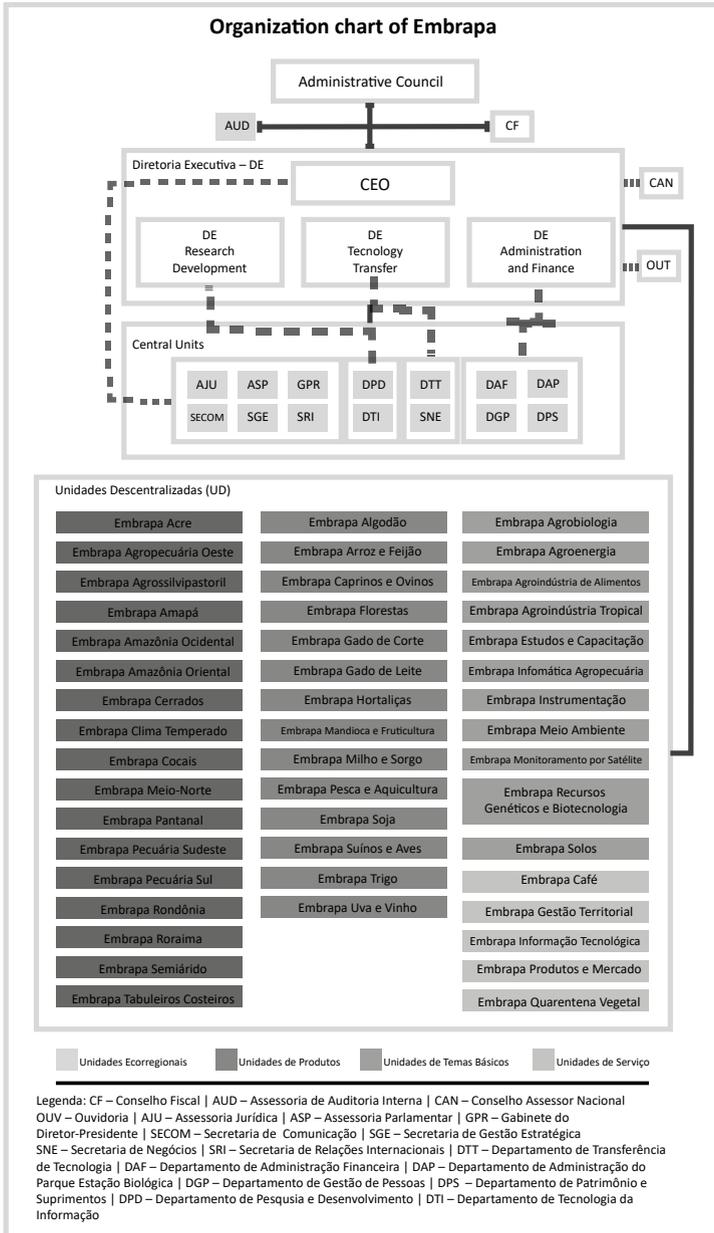
governance seems more adherent to the multiple realities of the knowledge economy, including not only its scientific and technological frontier, but also the subtleties and complexities of creative economy, for example. Similarly, organizational knowledge cannot be strictly managed, because dynamic capabilities may lead technological trajectories to different paths, which were not necessarily expected. In this sense, although fundamental for envisaging frontiers, paths and trends, technology prospecting cannot comprehend windows of opportunity that companies seek and will seek to take advantage of, and which appear unexpectedly.

Before examining the knowledge platforms coordinated by Embrapa, one should mention the following research results from the years 2012 and 2013, when interviews with Embrapa's directors were conducted.

It could be said that there was a shared belief or structured consensus: Embrapa believed to be at the technological frontier of low-carbon tropical agriculture; besides, the corporation believed it was able to set that frontier. In this sense, internal, national and international institutional arrangements, strategic design, research infrastructure, new research units that had recently been inaugurated, virtual laboratories abroad (LABEX), organization in macro programs, the whole governance of internal knowledge, reinforced that very understanding, that very intelligence. The research evaluation methodology itself required new metrics which would be able to reveal the dynamics of such an agriculture. Tensions between social inclusion, productivist (high -yield farming), and sustainability objectives, seemed to be entangled under the same strategic direction: low-carbon tropical agriculture. Embrapa performed technology prospecting and trusted its leadership over countries with similar agriculture.¹⁹ The organizational structure was as shown in Figures 1 and 2.

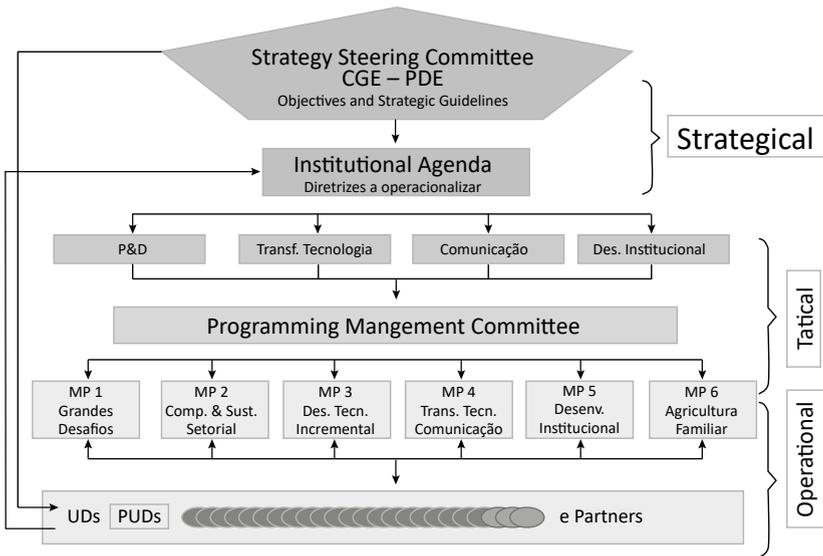
¹⁹ The same cannot be stated today, but there is not enough evidence to say otherwise.

Figure 1 – Embrapa’s organizational chart, 2012



Source: Embrapa, 2012.

Figure 2 – Embrapa’s internal organizational chart, 2012. Macro programs



Source: Embrapa, n/d.

Knowledge governance – coffee, soybean, and sugar cane²⁰

Embrapa has played the role of a catalyst by placing Brazil at the frontier of low-carbon agriculture. As we know, leadership at the new agricultural frontier is a hard place to keep. The forms of organizing research point to different ways of doing science and technology. Collaborative knowledge platforms are the main example, and Embrapa has governance (coordination) of some notable experiences (i) the Network of the National Research Project of the Eucalyptus Genome (Rede Genolyptus); (ii) the Brazilian Coffee Research and Development Consortium (CBP&D/Café or Consórcio Café), which gathers more than

²⁰ According to data from MAPA, the Brazilian coffee crop was of 49.15 million bags (2013/2014); the sugar cane crop for the same year was 633.7 million tons (making Brazil the top producer of the product in the world); and the soybean crop in 2013/2014 was of 30,173 million tons.

sixty different institutions²¹; (iii) and the Citriculture Defense Fund (Fundecitrus), just to mention a few but successful experiences.

The Brazilian Coffee Research and Development Consortium (CBP&DC), coordinated by Embrapa Café, has a larger institutional political organization and was established in 1997. The National Consortium for Soybean Genome Studies (Genosoja) is newer, coordinated by Embrapa Soja, and was founded in 2007 in order to identify and functionally characterize the soybean genes that act in the physiological processes of the plant. The consortium is a form of organization adopted by Embrapa to establish partnerships with other national and international public and private institutions, as a means to keep knowledge governance with regard to soybeans. To some extent, both these consortia hold knowledge governance in these sectors, in which Embrapa is a major reference.

Unlike other crops with historically marked presence of Embrapa, the Corporation did not have a thematic unit dedicated to research on sugarcane until recently, when the Embrapa Agroenergia unit was created with sugar cane, among other crops, as one of its biggest bets. Embrapa has therefore established a partnership with the Inter-University Network for the Development of the Sugarcane Industry (Ridesa), aiming to expand the activities of Embrapa Agroenergia and strengthen its research. Ridesa is similar in design to technological consortia, as it gathers material and intellectual resources as well as infrastructure for research on the sugarcane crop in the country. Ridesa was established in 1991, and its coordination is carried out by the Universities that compose it, in a public institutional arrangement.

²¹ As regards coffee and soybean, there are TCs coordinated by Embrapa through its Embrapa Café and Embrapa Soja units. These consortia are different from their objectives to the combination of public and private actors, which implies different knowledge governance conditions for research in these sectors. The coffee TC has unique composition and has given rise to the Embrapa Café unit, which has coordinated the consortium for about fifteen years. The soybean TC has emerged more recently, from an initiative by researchers from the Embrapa Soja unit, having a more precise goal, namely the mapping of the soybean genome.

Coffee Technology Consortium²²

The Brazilian Coffee Research and Development Consortium brings together over 50 research institutions and is coordinated by Embrapa. It emerged in the mid-1990s in response to the challenges faced by the crop due to market opening, with the expiration of the terms of the International Coffee Agreement (ICA) and the extinction of the Brazilian Coffee Institute (IBC). The creation of the institution was considered an innovative proposal because it aimed to integrate the execution of research activities on the coffee crop – something new at the time –, and it was initially composed of ten founding institutions²³. Soon after the creation of the consortium, Embrapa Café was created as a decentralized unit which would be responsible for coordination of research demands among participating institutions. The Coffee Program Support Service (*Serviço de Apoio ao Programa Café*, SAPC) was founded on August 30, 1999, in Brasília, and became known by the synthetic name Embrapa Café. More than a corporate management institutional arrangement, a network research platform was being established, as well as a structure able to build consensus

²² The TC aims to aggregate the human, laboratory, physical and financial resources of institutions for the design and execution of research activities in all areas of the coffee production chain and comprising the main Brazilian coffee producing states: Minas Gerais, Espírito Santo, São Paulo, Paraná, Bahia, Rondônia, Rio de Janeiro, Pará, Acre, Amazonas, Goiás, and Distrito Federal. Research developed by the TC covers the entire production chain, from the production and processing to trading and consumption, including consumer health. See <http://www.sapc.embrapa.br/>. See also ISSN 1678-1694 Novembro, 2012 Sistema de Gestão do Consórcio Pesquisa Café: Governança Corporativa, at <http://ainfo.cnptia.embrapa.br/digital/bitstream/item/86766/1/Sistema-de-gestao.pdf>

²³ Agricultural Development Company of Bahia (EBDA), Agricultural Research Company of Minas Gerais (Epamig), Agronomic Institute of Campinas (IAC), Agronomic Institute of Paraná (Iapar), Institute for Research, Technical Assistance and Rural Extension of Espírito Santo (Incaper), Agricultural Research Company of the State of Rio de Janeiro (Pesagro – Rio), Federal University of Lavras (UFLA), Federal University of Viçosa (UFV), as well as Embrapa and MAPA.

through efforts to coalesce the different interests at stake, in a field of utmost importance in Brazilian agribusiness.²⁴

The Brazilian Coffee Institute, created in 1950, was extinguished in 1990 and institutions working with coffee felt the need to ensure continuity of ongoing research activities. The interest of these institutions stimulated the creation of the Coffee Policy Deliberative Council (CDPC) in 1996, a collegiate body linked to MAPA with the purpose of approving policies for the coffee sector.²⁵ The Coffee TC is an unprecedented and unique experience in the country and abroad integrating traditional scientific, educational and rural extension institutions for knowledge generation and technology transfer, integrated with the various segments of the coffee agroindustrial chain. According Mirian Eira, a researcher at Embrapa, the consortium represents institutions

gathered by a pluralistic, democratically participatory model, with coordination at the national level and with decentralized execution. The result of this union is hundreds of research and technology transfer activities, in which more than a thousand professionals are involved, including researchers, teachers, extension workers, students, scholarship holders and interns. All research work is geared to the needs of customers – coffee producers, trade, government and end consumer. This targeted research effort has expanded the basis of the evolution of the Brazilian coffee business (EMBRAPA, 2012).²⁶

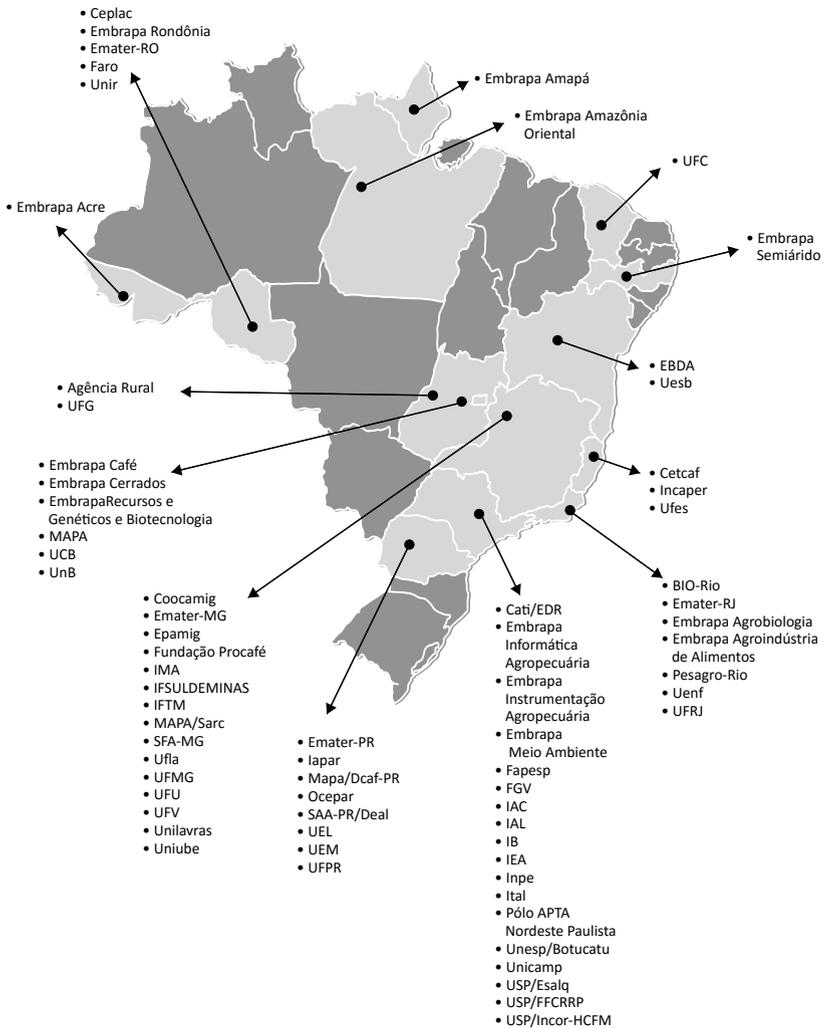
²⁴ In the 1950s, the first institute having coffee as its sole mission was created: the Brazilian Coffee Institute (IBC). Created with the objective of defining the policy for the sector, coordinating and controlling strategies from the production to domestic and foreign trading, the IBC provided financial and technical support to coffee production and promoted studies and research on coffee cultivation and economy. The institute managed the Coffee Economy Defense Fund (Funcafé), established in 1986 with funds from quotas of coffee export contributions. The fund financed production and new research on the coffee crop.

²⁵ The council aims at making public policies concerning the production, trade, export and marketing, as well as establishing an agronomic and market research program to provide technical and commercial support to the development of the coffee agro-industrial chain (EMBRAPA, 2012).

²⁶ The consortium is responsible for the design and implementation of the National Coffee Research and Development Program, which supports projects and mobilizes about 1,300 researchers and extension workers. This program works as science and technology arm of MAPA and of the Coffee Policy Deliberative Council.

Embrapa Café is in charge of the coordinated strategic management of the research program, with the goal of supporting technological innovation and, as per its official document, the sustainable development of the Brazilian coffee production chain. Resources for research and coordination come from Funcafé.

Figure 3 – Institutions participating in the Coffee Research Consortium



Source: www.consorciopesquisacafe.com.br.

The implementation of the consortium has allowed to establish formal and effective channels of scientific and technological exchange between consortium institutions through systematic dynamics. The TC has replaced an informal and individual model with an institutionalized and collective research model for greater benefits for the coffee industry. Since the establishment of this institutional arrangement, funds from sources external to Funcafé have reached 50% of total fund resources.²⁷

The consortium has had several achievements in terms of technology for the coffee sector, including:

- genetic improvement, cultivars with high-yield and high-quality potential;
- biotechnology studies, gene mapping based on DNA markers and characterization of nucleotide modification markers, from the database of the Coffee Genome Project. The project raises Brazilian coffee production to a leading position in coffee genetics research worldwide;
- multiplication of materials of high agronomic value in bioreactors, evaluation of field conditions, biofactory with large seedling production capacity;
- forestation of coffee farms: characterization and assessment of technologies for usage, practice and management of forested coffee agricultural systems, ecophysiological, edafic and phytotechnical impacts of shading, impact of intercropping on sustainability, evaluation of cultivars, organic materials, and plants as nutrient sources in fertilization for the sustainability of coffee agroecosystems.
- irrigated coffee production: improvement of the irrigated coffee production system, definition of technologies for the use of

²⁷ In 2011, Funcafé provided to the national coffee sector funds amounting to R\$ 2.44 billion to finance the upgrading and boost productivity in coffee cultivation, processing and export; research development; promoting domestic and foreign markets, as well as the livelihood of rural workers (EMBRAPA, 2012).

irrigation, fertigation in different production systems, competitiveness and sustainability;

- organic coffee production; design of a standard system for the production of organic coffee, evaluation of unusual coffee fertilization management systems, focus on nutrition, health and soil protection;

- Conilon coffee production technologies; enhancement of the production process and cultural practices to increase coffee productivity and sustainability;

- sizing of the coffee plantations, geoprocessing technologies, encouraging geographical indications, denomination of origin, so as to promote the sustainability of coffee production in various territories;

- climate change: studies on potential strategic technology solutions to maintain productivity and mitigate the effects of climate change on coffee production;

- nematode control: studies on the genetic variability of nematodes and establishment of crop management practices with biological control in infested coffee producing areas.

It is important to note that these actions are focus on the fields of biotechnology, ecophysiology, biotic stress response, genetic improvement, disease prediction system, and harvest improvements. They also emphasize sustainability issues, such as climate changes, pest bioecology, development of sustainable production systems, water use optimization. A third emphasis not shown on the above list of priorities, but reported in other sources on the consortium, refers to the demand side, including, on the one hand, the importance of beverage quality, as expressed in *gourmet* coffees, and, on the other the effects of coffee on human health – both positive effects, such as reduction in depression and coronary disease rates and the prevention of degenerative disease, and negative ones, derived from excessive consumption.²⁸

²⁸ file:///C:/Users/Anacelia2/Downloads/Cafe-e-saude-humana.pdf. "Few people know that coffee is a nutraceutical (nutritional and pharmaceutical) beverage, richer in minerals than sports drinks, containing vitamin B (niacin) and caffeine,

Embrapa Soja and Genosoja²⁹

The National Consortium for Soybean Genome Studies (Genosoja) has formalized Brazil's participation in the International Soybean Genome Consortium – ISGC, formed in 2007 by 25 research groups from different parts of the world, including countries like the US, China, Japan, Korea and Brazil.

Genosoja is led by Embrapa Soja, funded by CNPq, and involves more than nine institutions in the country. The Brazilian consortium aims to act as a national counterpart to the ISGC, thus contributing to studies adapted to the tropical reality. More specifically, it aims to deal with mechanisms that will improve the conditions for development of the plant in Brazil, thereby ensuring resistance to diseases and drought, among others.

Commercial production of soybeans began in Brazil in the 1960s, when producing this crop became an option for the summer, after the wheat crop, contributing to increased swine and poultry production. In the 1970s, the upsurge in soybean prices in the world market and the flow of the Brazilian crop during the American off-season required investment in technology to adapt the crop to Brazilian conditions. In

which is safe in the existing dose of 3 to 4 daily cups (up to 500 mg/day), which stimulates attention, focus, memory and school learning. Besides, coffee contains chlorogenic acids, natural antioxidants which, in the appropriate roasting process, forms quinides, which help prevent depression and its consequences (smoking, alcoholism, drug abuse and suicide). (...) Daily and moderate coffee consumption by adults can also help fight depression, the fourth cause of death in the world today, but which will become the second by the year 2020, according to information from the World Health Organization (WHO), after myocardial infarction. Therefore, a good way to avoid depression and its consequences, as well as myocardial infarction, is the adoption of daily and moderate coffee consumption..."

See also 24 ENCAFE, Encontro Nacional das Indústrias do Café, at <http://www.abic.com.br/publique/cgi/cgilua.exe/sys/start.htm?sid=279>, on the effects of coffee in the prevention of degenerative diseases.

²⁹ Information presented here was collected from the website of CNPq Research Groups Directory (<http://dgp.cnpq.br/buscaoperacional/detalhegrupo.jsp?grupo=00925014BKW6DN>).

1975 the Embrapa Soja unit was created in Londrina, Paraná, which was dedicated to the “tropicalization” of the soybean, allowing the grain to be planted in low-latitude regions. The result was a revolution in the world soybean market, which has made Brazil one of the largest producers of this grain, currently only behind the United States.³⁰

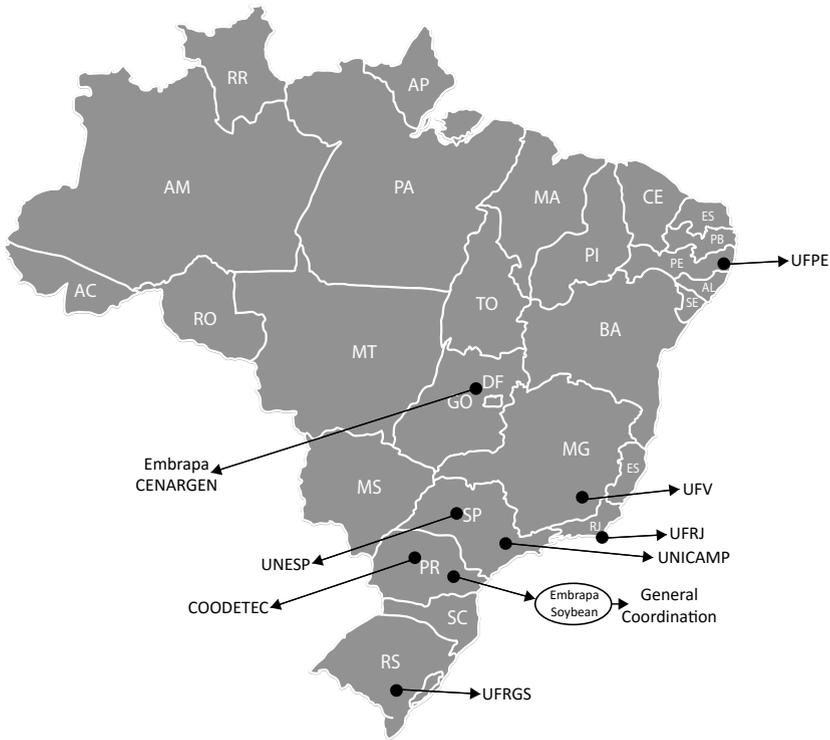
Embrapa Soja is a national and international reference in soybean research, and has developed pioneering technologies such as soil and fertility management. It has introduced biological nitrogen fixation by *Rhizobium*³¹; appropriate crop management for the different Brazilian ecosystems; integrated management of pests and weeds; biological control of the soybean caterpillar and the green stink bug, the most common pests attacking the crop; among others (EMBRAPA SOJA, 2012).

³⁰ “The importance of certain structuring agroindustrial chains that functioned as drivers and showcase for the process – like those of soybean, orange and poultry, whose consequences far surpass the effects of catching-up – must be highlighted. Soybean expansion in the 1970s is a case in point, which promoted land redistribution and enabled medium and small producers in the south of the country, mainly through the production of soybean and wheat in the same crop calendar. In addition to allowing effective catching-up with the United States and Argentina, it moved the agricultural frontier toward the center-west and center-north, and thus dramatically increased the Brazilian production potential. It managed to solve technological problems created by the extension of the border, cheapened production and pressed for the creation of an intermodal transportation network, resulting in cost reduction. Research on the Brazilian soybean emphasized biological nitrogen fixation in the soil, which reduced the use of fertilizers and made its continued expansion sustainable. Through the articulation of grain-bran-oil and grain-feed-meat chains, it contributed for the industry to offer more diverse and sophisticated food, not just more competitive, which was able to meet the new demands of consumers (functional foods, transgenic versus traditional versus organic food). In this sense, it enabled increased international competitiveness of the agri-food system. Finally, the development of new soy products and processes (soy ink, biodiesel, traceability, labeling) indicate its technological frontier” (CASTRO, 2007, p. 297). On the catching-up of agriculture and competitiveness of the agroindustrial chain of soybean, see Castro, A.C. (1996, 2009, 2010, 2011, 2012).

³¹ Döbereiner, Johanna – A Importância da Fixação Biológica do Nitrogênio para a Agricultura Sustentável, 1990, Embrapa CNPAB researcher in Seropédica, was a pioneer in research on nitrogen fixation by *Rhizobium* found in legumes, like soybeans. This characteristic of Brazilian soybeans not only affords it leadership in research, but, above all, results in unprecedented savings in “inside-the-gate” production costs.

The Genesoja Consortium was established in 2008 and comprises a specific research group in CNPq, gathering more than 50 researchers.³²

Figure 4 – Institutions participating in the Soybean Genome Consortium



Source: www.scielo.br/scielo.php?pid=S1415-47572012000200001&script=sci_arttext#fig1

³² Among the institutions participating in the Genesoja TC are: Embrapa Recursos Genéticos e Biotecnologia (Cenargen, Brasília, Distrito Federal), Universidade Estadual de Campinas (Unicamp, Campinas, São Paulo), Universidade Estadual Paulista Júlio de Mesquita Filho (Unesp, Botucatu, São Paulo), Universidade Federal de Pernambuco (UFPE, Recife, Pernambuco), Universidade Federal do Rio Grande do Sul (UFRGS, Porto Alegre, Rio Grande do Sul), Universidade Federal de Viçosa (UFV, Viçosa, Minas Gerais), Universidade Federal do Rio de Janeiro (UFRJ, Rio de Janeiro, Rio de Janeiro), as well as a private partner, namely Cooperativa Central de Pesquisa Agrícola (Coodetec, Cascavel, Paraná).

The Genosoja Consortium aims to facilitate the exchange of information, technology and knowledge generated for the soybean crop, benefiting not only the members of the consortium, but also the entire scientific community conducting research on the soybean crop, which is the main commodity of Brazilian agriculture. Among the objectives of the project is the identification and functional characterization of the soybean genes involved in important physiological processes of the plant³³. In this sense, the studies of the Genosoja consortium aim to better understand the molecular mechanisms of the plant, seeking to enable the development of technologies that will lead to new alternatives in addressing the main problems limiting the exploitation of the crop, such as biotic and abiotic stresses, by means of studies with structural and functional genomics, transcriptomics and proteomics.

According to the coordinator of Genosoja, the consortium is a national arm of the international soybean genome consortium, which gathers Brazilian, American, Korean, Chinese and Japanese researchers. In this sense, it places Brazil in the high-end soybean research circuit. The genetics of soybeans, with approximately 66,000 genes, has been sequenced by the United States. However, very little is known about the function of each gene, and the challenge for the international consortium is to learn about these functions. Therefore, participating in this international consortium allows Brazil to be linked to numerous labs around the world researching the genes and characteristics of soybean, taking local specificities into account.³⁴ Even before the establishment of the Genosoja Consortium, a consortium for the study of soybean rust had been created by the Ministry of Science and Technology (MCT), with the support of MAPA. When the Technology Platform for the Study of Soybean Rust was created, involving

³³ Resistance to diseases, specifically Asian soybean rust and nematodes, drought tolerance, nitrogen fixation and grain quality.

³⁴ "Genosoja will be very important for the development of new cultivars related to these characteristics, not only for the members of the consortium, but for the whole scientific community working with the soybean crop, as all data generated will be made available to the public after the end of the project" (AGRONLINE, 2012).

phytopathology, genetics, and biopathology, the consortium received funds from FINEP (Financier of Studies and Projects) from 2004 to 2010. After accomplishing the genetic sequencing of the soybean, the challenge has become the knowledge and mapping of gene functions, based on Brazilian and international research.³⁵ After identification of the genes linked to characteristics for the improvement of soybean production, research now aims to select some of these genes to pursue better understanding of the molecular mechanisms that can enhance soybean production. The Genosoja Consortium is divided into its components, including the management and handling of different aspects of the soybean genome (BENKO-ISEPPON; NEPOMUCENO; ABDELNOOR, 2012):

I. Project management – responsible for organization, meetings, integration, and research reports.

II. Structural genomics – includes research on physical genomic architecture, analysis and sequencing of gene-rich regions, comparison with other wild relatives of the Glycine genus, synteny studies and indication of important regions for resequencing, identification of single-nucleotide polymorphisms (SNP), which are important for mapping and marker-assisted selection.

III. Transcriptomics – comprises the largest research group, responsible for approaches to different expression profiles, using strategies to access transcripts under different biotic (Asian soybean rust: *Phakopsora pachyrhizi*, CPMMV: *Cowpea mild mottle virus*, nematodes: *Meloydogyne javanica* and *Pratylenchus brachyurus*) and abiotic (hydric stress) factors. Strategies used: a) subtractive cDNA; b) SuperSAGE; c) microRNA libraries; d) cDNA sequences of roots infested with the nematode *M. javanica* compared to stressed control.

IV. Proteomics – profile of soybean protein, low protein mass and identification of peptides and protein-protein interactions.

³⁵ The Genosoja Consortium began with CNPq funding resources amounting to R\$ 6 million, plus R\$ 2 million in counterparty funds from Embrapa, through the Embrapa Network for Soybean Genome Studies (Regesoja).

V. Expression assays (transgenics) – considering results of transcriptomics and proteomics: valuable genes are being transformed.

VI. Bioinformatics – Genosoja database, tools integrating project data, comparison with sequences available in public databases of other research projects.

Figure 5 – Functional organizations of the Genosoja consortium



Source: www.scielo.br/scielo.php?pid=S141547572012000200001&script=sci_arttext#fig1.

If, on the one hand, Genosoja has a specific role within genetics-based research on the soybean crop, for which it gathers different Brazilian research institutions, on the other hand it is coordinated by Embrapa Soja, which keeps numerous other partnerships in soybean research. In this context, Genosoja is included in a broader collaborative knowledge platform, managed by Embrapa Soja.

Ridesa³⁶ and Embrapa Agrobionergia

The Brazilian Federal Government has a minor role in the field of sugarcane, especially after the termination of the National Sugarcane Improvement Program (Planalsucar)³⁷, in the early 1990s, when its activities were absorbed by Ridesa (FURTADO, 2008)³⁸. Ridesa is a successful example of networking for the technological advancement of sugarcane seed production. The public-private partnership involves more than 300 companies producing sugar, ethanol and energy, as well as nine Brazilian federal universities.³⁹

Ridesa was established in 1991,⁴⁰ located in areas of operation of Planasucar coordinations, from which it absorbed staff and headquarter and experimental station facilities, including university professors.

³⁶ Information from the website <<http://www.ridesa.com.br/?pagina=home>>.

³⁷ The National Sugarcane Improvement Program (Planalsucar) has had as many as 30 experimental stations throughout the country, making significant contribution to the improvement of sugarcane productivity in the Northeastern states (FURTADO, 2008).

³⁸ It is clear, however, that the main sugarcane research center in Brazil is the Sugarcane Technology Center (*Centro de Tecnologia Canavieira*, CTC), which is a private institution. To learn more about this institution, as well as other groups investing in research in the sugarcane industry, see Vieira Júnior, Buainain, Silveira and Oliveira (2009).

³⁹ Because Ridesa is exclusively devoted to research on sugarcane, it is the interest of Embrapa Agroenergia to establish a partnership with this network to enhance its research focused on sugarcane.

⁴⁰ Initially through an agreement signed between seven federal universities: Universidade Federal do Paraná (UFPR), Universidade Federal de São Carlos (UFSCar), Universidade Federal de Viçosa (UFV), Universidade Federal Rural do Rio de Janeiro, Universidade Federal do Sergipe (UFS), Universidade Federal do Alagoas (UFAL), and Universidade Federal de Pernambuco (UFPE).

Planalsucar and now by Ridesa – have good market, and estimates are that they are grown in more than 50% of the area with sugarcane crops in the country, representing up to 70% of the planted area. Data presented by Ridesa (2012) shows the breadth of technological results achieved in the context of research on the sugarcane crop and the importance of partner institutions.⁴²

Embrapa Agroenergia

The resumption by the Brazilian government of research on sugarcane through EMBRAPA is a recent development taking place in the context of a paradigm shift for the Corporation, namely gearing its research to the production of biomass for energy, not only food, production⁴³. This new orientation is due to the current scenario of energy shortage, caused by the end of the fossil fuel era due to a reduction in oil, coal, and natural gas reserves (EMBRAPA AGROENERGIA, 2008, p. 7).

In 2006, MAPA launched the National Agroenergy Plan and established guidelines for public and private actions to generate knowledge and technologies for sustainable agriculture for energy production and the rational use of renewable energy. Thus, it stimulated the creation of Embrapa Agroenergia, under the name

⁴² The germplasm bank is located in the Serra do Ouro Flowering and Crossing Station (UFAL), in the municipality of Murici, state of Alagoas. It gathers over 2000 genotypes including cultivars used in the country, clones and different species imported from different sugarcane producing regions in the world.

⁴³ According to Rufino (2006, p. 82), , since its establishment in 1974, so as not to duplicate actions and dilute existing resources, Embrapa has not included in its program research on coffee, sugarcane and cocoa, since these crops had their own research institutes, respectively, the Brazilian Coffee Institute (*Instituto Brasileiro do Café*, IBC), the Sugar and Alcohol Institute (*Instituto do Açúcar e do Alcool*, IAA) and the Executive Committee of the Cocoa Crop Plan (*Comissão Executiva do Plano da Lavoura Cacaueira*, Ceplac), linked to the Ministry of Industry and Commerce. With the extinction of these three institutions for political reasons, in 1991, and also considering its administrative and financial commitments, Embrapa did not take over the duties of knowledge and technology generation for these three production chains.

National Center for Agroenergy Research (*Centro Nacional de Pesquisa de Agroenergia, CNPAE*)⁴⁴.

In the Brazilian agroenergy scenario, the sugarcane crop is a major focus of research. According to Embrapa Agroenergia (2008, p. 23), competition with other institutions working for the improvement of this crop may inhibit the advancement required for the expansion of its agribusiness. Among the opportunities for technological cooperation, the company proposes to establish, in partnership with its units, Ridesa and other institutions, the conceptual basis for the consolidation of a new public program for the improvement of sugarcane in the country (Embrapa Agroenergia, 2008, p. 26). The organization of an institutional arrangement promoting closer links between institutions working with sugarcane in Brazil and optimizing their research is, at the moment, a great challenge to be overcome.

Considering the issue of sugarcane, there is strong demand for the creation of a specific unit within Embrapa, which is also expressed in debates of the Sectorial Chamber of Sugar and Alcohol, mostly from Northeastern groups.⁴⁵ A fact that has pushed for the demand is that Alagoas is the only Northeastern state that does not have an Embrapa unit and where Ridesa's germplasm bank is located. During our interviews, we have observed that there is no actual mobilization

⁴⁴ According to Embrapa Agroenergia (2008, p. 9), the National Center for Agroenergy Research (CNPAE – Embrapa Agroenergia) was established by Board Resolution No. 61 of 24 May 2006 (BCA No. 25 of 29.05. 2006) as a unit of Embrapa's decentralized structure, for the development and promotion of innovation and technology transfer. These technologies advance towards sustainability and competitiveness for agroenergy chains. This is the 41st Decentralized Unit of Embrapa, and its 38th Research Center, fitting into the category of thematic center and operates throughout the national territory. Embrapa Agroenergia involves four working platforms: Ethanol, Biodiesel, Energy Forests and Byproducts and Waste Materials, whose concern is to promote the improvement of raw materials, processes of biomass conversion into energy, and the forms of energy obtained, thus ensuring scientific and technological competitiveness and integration of Embrapa's responsibilities.

⁴⁵ The Brazilian union of sugar producers has recently ceded an area next to UFAL for extension of Embrapa's existing experimental field. This field is currently linked to Embrapa's Coastal Tablelands unit, in Sergipe, and is within the area belonging to UFAL, in the capital city of Alagoas.

within the Company for this to occur, given that the units prioritize the cross-sectionality of research topics, which does not point towards the building of another product-focused unit.

Table 1 – Characteristics of the TC and network institutional arrangements for soybean, coffee and sugarcane in Brazil

Characteristics	Soybean	Coffee	Sugarcane
Research-oriented institutional arrangement	Genosoja/Embrapa Soja	Coffee Technology Consortium/Embrapa Café	Ridesa
Year of creation of the consortium or network	2007	1997	1991
No. of institutions involved	9	+ 50	9
Public institutions involved	Embrapa Soja, Embrapa Cenargen, UFV, UFRGS, UEP, UFPE, Unicamp, UFRJ, UFPR	EBDA, Epamig, IAC, Iapar, Inca-per, Pesagro-RJ, Universidade UFLA, UFV, Embrapa and MAPA	UFPR, UFSCar, UFV, UFRRJ, UFS, UFAL, UFPE, UFG and UFMT
Private institutions involved	Coodetec (Casca-vel, PR)	-	300 companies in public-private partnerships
No. of Brazilian researchers involved	50	1300	-
Scope	National and international Genosoja project	National and international	National
Coordination	Embrapa Soja (Londrina/PR)	Embrapa Café (DF)	Alternated between the institutions involved
Institutional mechanism for the debate of policies for the sector	Sectorial Chamber of the Soybean Productive Chain	Coffee Policy Deliberative Council	Sectorial Chamber of the Sugar and Alcohol Production Chain

Source: Prepared by Sílvia Zimmermann.

Preliminary Conclusions

It can be considered that Brazil is at low-carbon tropical agriculture frontier and Embrapa has played a central role in this process. The historical path which, since the 1950s, has led the country from technological catching-up to its current position at the knowledge frontier was not the object of this work. By taking a position at the technological frontier, the country weighs the risk and benefits of defining its own frontier. Knowledge governance in the knowledge networks and markets has been decisive for the attainment of this position in technical terms. This is the case of the coffee, soybean and sugarcane innovation platforms, which are institutional arrangements favoring innovation.

These complex structures redefine old concepts like technological catching-up: there is no longer a roadmap to be followed, and leapfrogging is the only alternative; leading countries may be peers/partners; the concepts of secondary innovation, open innovation and cooperative networks are new ways of delivering innovation, which contributes to the deconstruction of the concept of catching-up.

There is still great uncertainty regarding what may be considered “superior” innovation, as tensions must be accommodated between formerly foreign goals in the innovative territory (e.g. social inclusion and sustainability). Another understanding derived from this discussion is that this depends on strategic choices, as well as on the conditions to implement them.

In a recent article in compared state capabilities, which compared the institutional architecture of science and technology in Brazil and China, the conclusion was: “the existence of a structured consensus on which sectors should receive incentive from the entrepreneurial State, where the technological frontier lies in these sectors, and which countries have reached it, depends on: *i)* the backing of institutions capable of carrying out prospective and retrospective studies actually considered in the decision-making process; *ii)* undertaking

of continuous technology prospecting, subject to periodic review processes; *iii*) ability to take conflicts of interest into account, but also to neutralize them in the building of structured consensus; and, finally, *iv*) a deep-rooted and effective financial system for innovation. Two conditions seem essential for coordination of national modernization processes: structured vision for the future and state capabilities for their implementation. This does not refer to a continuum of skills or capabilities, but to a range of decision-making processes on long-term strategies, as well as coordination in the design and implementation of technology policies” (Castro, 2015, p.3).

In order to examine decision-making processes, it is paramount to consider: the relationship between decision makers and funders – research institutes, think tanks, universities, and others – or the institutional backing of strategic decisions; whether or not there is an effort towards a prospective view of technology; governance structures and power relations, where possible; and conventions, shared beliefs and consensus behind visions for the future and influencing the path taken and choices made.

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GOVERNING KNOWLEDGE: INTELLECTUAL PROPERTY MANAGEMENT FOR DEVELOPMENT AND THE PUBLIC INTEREST

Leonardo Burlamaqui

Introduction¹

*“The field of knowledge is the common property of mankind.”
Thomas Jefferson*

The core point of this paper is the hypothesis that in the field of intellectual property rights and regulations, the last three decades witnessed a big change. The boundaries of private (or corporate) interests have been hyper-expanded while the public domain has significantly contracted. The paper tries to show that this is detrimental to innovation diffusion and productivity growth. (cf. Brown-Keyder 2007; Boyle 2008; Rodrik 2011 and Burlamaqui and Cimoli 2014 for similar lines of reasoning). The paper develops the argument analytically, fleshes it out with some empirical evidence and provides a few policy recommendations on how to redesign the frontiers between public and private spaces. The result would be a more open, democratic and development-oriented institutional landscape in the fields of knowledge creation and appropriation. This “Knowledge Governance”, analytical perspective developed here proposes a framework within which, in the field of knowledge creation, diffusion and appropriation, the dividing line between private interests and the public domain ought to be redrawn. The paper’s key goal is to provide reasoning for a set of rules, regulatory redesign and institutional coordination that

¹ This paper is an outgrowth of recent papers published by the author (Burlamaqui: 2009b, 2014 and Burlamaqui and Cimoli: 2014).

would favor the commitment to distribute (disseminate) over the right to exclude.

In 2005, Mark Blaug made a prescient, remark in that matter:

“It never occurred to anyone before, say the 1980s, that such disparate phenomena as patents for mechanical inventions, industrial products and processes (now extended to biotechnology, algorithms and even business methods), copyrights for the expression of literary and artistic expressions in fixed form and trademarks and trade names for distinctive services, *could be generalized under the heading of property rights*, all conferred by the legal system in relation to discrete items of information resulting from some sort of appropriate intellectual activity”. (Blaug 2005, 71-72, italics added)

For the purposes of the arguments in this paper, there are two crucial elements implicit in Blaug’s statement. First, that, as recently as in the seventies, the balance between private interests and the public domain was completely different from what it has become today. Second, that what became codified, and largely accepted, as intellectual property *rights* was, until then, understood as a set of *rules and regulations* issued by the state, granting temporary monopolies to corporations in very specific cases. Recent history seems to back both Blaug’s statement and my hypothesis. Until the 1970s, United States patents were seen as monopolies (a term with distinctly negative connotations at that time), not rights. In fact, in some areas of economic activity, it would have been possible to say that upholding the validity of IP was the exception rather than the rule (Brown-Keyder 2007, 159). This was reflected in IP law as well as in competition or antitrust law. In copyrights, the term under United States law was 28 years.

The early 1970s witnessed several dramatic changes. In 1974, a trade act allowed the Federal Trade Commission to bring sanctions directly against countries whose products were seen to hurt United States interests. In 1975, copyrights were expanded to over 70 years from the death of the author, and for corporate owners, to 95 and sometimes even 120 years (Brown-Keyder 2007, 158; Boyle 2008, ch.

1). In 1979, Section 301 of the United States trade law was amended to “allow private parties to take significant and public steps to enforce international trade agreements” (Brown-Keyder 2007, 160). In 1988, the Justice Department rescinded guidelines for antitrust prohibitions on certain kinds of licensing clauses. This removed IP licensing from antitrust scrutiny. Finally, with the enactment of the WTO in 1995, the TRIPs agreement quickly became the linchpin of United States trade strategy. By then, private corporations had vastly expanded their enforcement power and global outreach, while the public domain had significantly contracted.

From a knowledge governance perspective, the critical question is this: *When does extended protection cease to work for generating Schumpeterian profits and become a base for rent-seeking and rent extraction.*² There is no good theoretical answer to this, but recent data on declining R&D expenditures correlating with the maintenance of handsome profits in big pharma seems to emphasize its relevance (cf. “Supply Running Low.” *Financial Times* 10 February 2011). As an alternative to the “strong IPRs” mainstream approach, new insights and evidence are beginning to appear. Besides the already cited studies, a few papers and books are laying the ground for a very different way to understand the complex interactions among knowledge production, appropriation and diffusion. Examples include Jerome Reichmann’s work, the comparative and interdisciplinary research led by Richard Nelson, Akira Goto and Hiro Odagiri on intellectual property and catching-up and the collection of essays edited by Fred Block and Mathew Keller on the role of the US government in technology development (Reichmann et alii: 2014, Odagiri et Alii: 2010, Block and Keller eds: 2011).

However, notwithstanding the valuable contributions by this emerging body of research, the main analytical question remains largely untouched: How should government-issued intellectual property

² See Arnold Plant’s point below on that matter.

rules and regulations interact with publicly funded R&D research and competition policies³, in order to help craft and govern socially inclusive development strategies? It appears there is no coherent analytical framework to address that interaction.⁴ However, those links are central to any meaningful discussion of dynamic competition, knowledge accumulation and diffusion, and sustainable development in a global context today.⁵

This paper aims to contribute to answering that question. Section II lays the ground rules by linking knowledge production and dynamic competition with intellectual property issues from the perspective of the dynamic efficiencies and inefficiencies that are bound to appear. It will become clear that the existence of dynamic inefficiencies opens up a considerable space for public interest based “knowledge governance” policies and regulations. Section III further develops the previous framework by linking competition and technology policies with intellectual property. Special attention is given to how competition policies should link publicly funded R&D to intellectual property rules issues under a Knowledge governance approach.. Section IV concludes the paper by suggesting some broader theoretical and policy implications of that approach.

³ A much less catchy label but one that reveals their real nature much better than “rights.”

⁴ This does not imply a shortage of work discussing specific issues in what is called “the economics of intellectual property rights.” See Menell (1999) for an excellent survey on general theories of IP. A very interesting review acknowledging the under-researched nature of the theme can be found in Dixon and Greenlough (2002). The shortcomings of most of that work are, from my perspective, the result of its concentration on “data,” “measures” and “testing,” with little attention paid to the theoretical framework within which they are conducted.

⁵ From an evolutionary perspective, evolution should not be confused with progress (a very common mistake), but as a process, it should definitively be understood as entailing increasing complexity.

Knowledge production, dynamic inefficiencies and the role of knowledge governance

In the context of Schumpeterian competition, intellectual property rules and regulations (IPRs) – patents, trade secrets, confidentiality contracts, copyrights, trademarks and registered brand names – became powerful, strategic weapons for generating sustained competitive advantages and, especially, Ricardian rents (cf. Schumpeter: 1934, Plant 1934).⁶

From an entrepreneurial perspective, patents and other IPRs are extremely effective means to reduce uncertainties and therefore *can* contribute to igniting the animal spirits and long-term expectations through building temporary monopolies around products, processes, market niches and, eventually, whole markets (Nelson 1996; Burlamaqui and Proença 2003). However, the word *temporary* is crucial here because of creative destruction; as Schumpeter (1994, 102) stated long ago, “A monopoly position is in general no cushion to sleep on.”⁷

The Chicago Law and Economics framework claims that in the absence of robust legal protection for an invention, the inventor either will have less incentive to innovate or will try to keep his invention secret, thus reducing, in both cases, the stock of knowledge to society as a whole (Landes and Posner 2003, 294). From that perspective, patent law itself supposedly internalizes the goal of promoting the

⁶ Having said that, it is striking how little has been written about the crucial and complex connection between Schumpeterian competition and IPRs. We include ourselves in that loophole. In that regard, legal theorists such as Landes and Posner and Benkler are clearly ahead, in the sense that they are already doing the reverse – using Schumpeterian concepts and insights to deal with IPRs (cf. Landes and Posner 2003, Benkler 2006).

⁷ However, a strong IP regime is precisely the kind of “institutional innovation” that can help to build that cushion. Addressing this problem is one of the core issues of the knowledge-governance approach.

diffusion of innovation.⁸ It requires, as a condition of granting a patent, that the patent application disclose the steps constituting the invention in sufficient detail to enable readers of the application, if knowledgeable about the relevant technology, to manufacture the patented product themselves. Of course, anyone who wishes to replicate a patented product or process legally will have to negotiate a license with the patentee (Jolly and Philpott 2004, pt. 1; Landes and Posner 2003, 294-295).

Moreover, any reader of the patent application will be free to “invent around” it, to achieve the technological benefits of the patent by other means without infringing on the patent. Translated to evolutionary economics jargon, the requirement of public disclosure creates a situation of “incomplete appropriability” for the patent holder. That links directly to Schumpeter’s insight on the temporary nature of monopolies: incomplete appropriability allows for the possibility of technological inventiveness and borrowing from publicized information, both of which foster creative-destruction processes that are the main challengers of established monopolistic positions. Thus, if carefully used, intellectual property rules *can be* sources of dynamic efficiencies that can help to *ignite* the Schumpeterian positive-sum game represented by falling costs, falling prices, positive margins (achieved through market power) and increased consumer welfare.⁹

Those are the basics, but the picture gets much more complicated as we examine the details. When we dive into the depths of the relationship between innovation and IP laws and regulations, considerable space opens up for dynamic *inefficiencies* to emerge and, therefore, for the introduction of governance considerations and for the emergence of a knowledge-governance approach. Consider the following six points.

First, as Sir Arnold Plant, an almost forgotten analyst in the field, observed in the early 1930s,

⁸ Reference here is to American patent law.

⁹ From here on, I will label this “Schumpeterian positive-sum game” as the “Schumpeterian package.”

“In the case of physical property, the institution of private property makes for the *preservation of scarce goods*. ... In contrast, property rights in patents and copyrights make possible *the creation of scarcity* of the products appropriated. ... *the beneficiary is made the owner of the entire supply of a product for which there may be no easily obtainable substitute.*” (Plant 1934, 65-67, emphasis added)

In sum, intellectual property regulations can easily give rise to dynamic inefficiencies such as cumulative monopoly power to extract rents from a given consumer base, notwithstanding the fact that they *can* at the same time create the conditions for the expansion of productivity and wealth and the generation of Schumpeterian profits.¹⁰ That in itself leaves ground for knowledge-governance-oriented initiatives to enter the scene¹¹, as we will see shortly.

Second, the broader – and stronger – the IPRs, generally, the less the patentee’s competitors will be able to benefit from the patent by “inventing around,” or innovating on the shoulders of, the patent (or copyright) holder. Broad IPRs are thus bound to exacerbate the dynamic inefficiencies that Plant and others have observed. Accordingly, especially given the complexity and diversity of patents and other IPRs, a one-size-fits-all prescription seems ill-advised. From an analytical point of view, the articulation between competition policies and IPRs is a much needed development¹², especially if the former’s goal is *innovation diffusion and delivering the Schumpeterian package, not innovators’ protection per se*.

Third, the practice of *strategic patenting*, that is, the proliferating business strategy of applying for patents that the company has no

¹⁰ Or, in a more technical way of saying it, the expected (negative) impact on future incentives for competitors to compete (innovate) and future consumer welfare (see Anthony 2000, sect. IV.)

¹¹ On policy prescriptions, institutional building, institutional coordination and regulatory redesign.

¹² We will use the term “competition policies” rather than “antitrust” here because of the outdated connotation of the latter. We will not discuss “trust-busting”, but a much more subtle and complex set of behaviors, institutions and policy tools.

intention of using, or exploiting, solely to prevent others from profiting from the innovation (cf. Varian, Farrel and Shapiro 2004, pt. 2; Landes and Posner 2003, ch. 11). Obviously, this is a major source of dynamic inefficiency. It has the effect of shifting resources from true innovative activity to litigation (or from labs to courts). It drastically increases the costs of patent prosecution and litigation and, therefore, of innovation. Such strategic patenting constitutes a paradigmatic example of what Baumol has called “unproductive entrepreneurship.” Baumol notes:

“... [a] variety of roles among which the entrepreneur’s efforts can be reallocated ... and some of those roles do not follow the constructive and innovative script conventionally attributed to that person. Indeed, at times the entrepreneur may even lead a parasitical existence that is actually damaging to the economy. (cf. Baumol 1993, ch. 2, 25; see also ch. 4)”.

Evidently, this task of “reallocation of entrepreneurship” (from unproductive roles to productive ones) is a *knowledge-governance* matter and one that goes far beyond the common notions associated with industrial and technology policies.

Fourth, IPRs have a central role in the “digitally renewed economy”, as Paul David would label it, (Cf. David in Brynjolfsson and Kahin 2002, 85). In so-called “new-economy industries”, intellectual property, rather than the products and processes in and of themselves, is a firm’s primary output or asset. Overlapping innovations, rapidly falling average total costs, zero marginal costs, strong network externalities and, therefore, fierce “standards battles” and “lock-in” situations are the hallmarks of new-economy industries (Shapiro and Varian 1999; Best 2001; De Long 2000; Brynjolfsson and McAfee: 2011). These industry-structure characteristics might be seen as generating speeding waves of creative destruction and, thus, potentially more (not less) fiercely competitive challenges to incumbents. Although there is an element of truth in that picture, creative destruction in a world of increasing returns of scale, fast learning and “winner-takes-all” markets does not mean anything close to some idealized form

of “perfect competition” or perfectly contestable markets. Rather, it merely brings the replacement of one, or a few, dominant firms by others, such as the replacement of Fairchild by Intel, of Ciba and Geigy by Pfizer and Novartis, of Wang and Compaq by Dell and Samsung, of IBM by Microsoft and Lenovo and of Microsoft by Google and Apple.

In other words, in the new economy, firms’ abilities to combine first-mover advantages with trade secrets, patents, copyrights, brand loyalties and network externalities may afford them secure long-lasting monopolistic positions despite their low rate of (radical) innovations and not because of it.¹³ The outcome is, once more, the danger of replacing Schumpeterian profits with rent extraction and Schumpeterian competition with zero-sum game exclusionary practices. From the perspective of delivering the “Schumpeterian Package”, there is an obvious role for knowledge governance here in restoring the balance between private interests and the public domain (cf. Boyle 2008, Ch. 8-10). However, the normative policy framework within which it should take place is far from certain. I will revisit it in the next section.

Fifth, if we understand knowledge production as a cumulative, and increasingly globalized¹⁴, process in which cutting-edge knowledge and expertise rest on previous innovations, and if we conceive of patents and IPRs, in general, as *fences* erected to protect those previous innovations, we get a very different outcome. It is

¹³ See Landes and Posner’s (2003, 395-396) somewhat reluctant recognition of that point. The case of Microsoft itself can be used to illustrate the point. The lack of breakthroughs – technological innovations or radical quality/price improvements – is notoriously known in Microsoft. It is well known that the “Windows” model was copied from Apple’s user interface – which itself was a second-hand theft from Xerox PARC – as well as the tremendous lack of perception, by the company, of the Internet potential until the success of Netscape became obvious. It is also known that the differences between the versions of Windows and Office that I am using right now, although “new”, display very pale improvements in relation to their 1998 predecessors.

¹⁴ In the sense of its increasingly geographical dispersion, but not denoting any sign of broader inclusion or democratic orientation.

not difficult to perceive, depending on the institutional design within which IPRs are handled, the tension and potential trade-off between private interests and the conception of knowledge as a global public good. This is the so-called argument of the “second-enclosure movement” or “information feudalism,” which is now the subject of intense debate (cf. Drahos and Braithwaite 2002, Boyle 2003 and 2008, Evans 2005, Technology Review 2005). According to Evans (discussing Boyle’s ideas),

“There are really two halves to the second-enclosure movement. The defensive side focuses on intensifying the enforcement of protected monopoly rights to exclude others from using information that has been defined as private property. The offensive side of the agenda involves taking information that has been considered part of “nature”, or the common, cultural and informational heritage of humankind, and transforming it into “private property”. If both halves are successful, the “second-enclosure movement” would constitute a *global re-distribution of property* comparable to the eradication of the commons that ushered in agrarian capitalism in Western Europe 300 years ago”. (Evans 2005, 2; emphasis added)

Once more, we encounter strong forces of *global* dynamic inefficiencies, presenting an opportunity for knowledge-governance-oriented policies to step in.

Sixth, to the question “where do knowledge and innovations come from in the developed nations?” a very large part of the answer would include: publicly funded R&D, government contracting to buy things from the private sector that do not exist and using the WTO to help open up markets for those innovations abroad (Block 2008, Weiss 2008, 2009). In the case of the United States, armed with an annual procurement budget of US\$450 billion – more than 1 trillion if states are included – the state plays a crucial role in governing the way knowledge and innovations prosper in the United States (Ruttan 2006; Weiss 2009). Furthermore, according to some recent studies, the United States government played a decisive part in the development of virtually all general-purpose technology, from interchangeable parts

and mass production to DARPA and biotech (cf. Ruttan 2006, Weiss 2007, Block 2008, Block and Keller 2011).¹⁵

Let me rephrase this point: If we conceive R&D as “turning money into knowledge” and innovation as “turning knowledge into money,” why should governments (i.e., public money) heavily subsidize the former and almost completely retreat from participating in the latter?

Last, the institutional structure – or institutional design – within which the knowledge-production appropriation and diffusion apparatus is enforced is central for understanding its performance. We refer here not to the rules, as such, but to their legal enforcement apparatuses, the state structures by which they are supported and the sort of public bureaucracies available to administer the R&D and IP systems. Jaffe and Lerner’s (2002) thoughtful and provocative work on the recent changes in the United States patent system provides the background for our discussion, which will draw on the relationship between the institutional design of the United States patent system and the problems it creates for the promotion of innovation and “productive entrepreneurship” .

All six issues discussed above illustrate how the interaction between Schumpeterian competition and hyperextended intellectual property rules and regulations can give rise to dynamic inefficiencies that risk the delivery of the “Schumpeterian Package” and call for knowledge-governance interventions to restore the balance between private interests and the public good (or public interest).

Knowledge governance: Bringing the public domain back in

Knowledge governance (KG) is a broad concept embracing different forms of governance mechanisms influencing the production, dissemination and appropriability of knowledge. The “knowledge-governance approach” is an emerging approach that

¹⁵ DARPA is the Defense Advanced Research Projects Agency, the central research organization of the United States Department of Defense. Its most radical innovation was the Internet (known first as ARPANET).

cuts across the fields of knowledge creation and management, innovation and competition policies and state capacities. KG deals with how the deployment of governance mechanisms influences knowledge processes, such as sharing, retaining and creating knowledge. As an analytical perspective, it encompasses intellectual property rules and regulations but supersedes it, drawing on those aforementioned fields and disciplines in order to design the contours of a new knowledge ecology. KG's main goal is to design, support and implement public interest oriented governance mechanisms, as well as organizational and business models which are alternatives to the instituted intellectual property regime we now have (Burlamaqui 2009b). Within the knowledge governance approach, the general rule should be the promotion of innovation (not the innovator) and the assurance of its widest diffusion. This implies, simultaneously, promoting and regulating entrepreneurial success. Promoting *and* regulating is a crucial link here. Together, they address both the private (profit seeking) and the public (innovation-diffusion and technological-upgrading) sides of competition policies and their respective institutional designs.

This policy and institutional-design package was, in fact, the core of the Asian state-centered developmental strategy. Nowadays, it remains alive and well in East Asia. In Singapore, it is evident in the country's twin government-sponsored initiatives. On "biomedical sciences" and on "work restructuring," where market-shaping and institutional coordination are the core elements (Pereira 2008). In China, it is clearly present in the 12th five-year plan for 2011 to 2015, finalized last April. The plan highlights the importance of the "magic seven" industries: (1) energy saving and environmental protection, (2) next-generation information technology, (3) biotechnology, (4) high-end manufacturing, (5) new energy, (6) new materials and (7) clean-energy vehicles. The plan's objective is to "shape" them in order to raise their share from 3 percent to 15 percent of the economy by 2020.

None of those countries labels their government-sponsored initiatives as knowledge governance, but it is quite clear that this is what they really are: going much beyond “industrial policy” or “intellectual property”, they reach the key interactions between knowledge and markets ... and shape them from a public-policy/public-interest perspective.

From a normative perspective, knowledge-governance policies should use market-shaping devices in order to design policies to manage creative-destruction processes. These policies would seek to shape markets in order to reduce dynamic inefficiencies and increase dynamic efficiencies coming from Schumpeterian competition, a form of competition that, now, overuses intellectual property rules as one of its core weapons. From the perspective of firms, knowledge-governance policies should not be about preventing “market power” but about curbing its excesses: “unproductive entrepreneurship” and “rent extraction”.

Within a knowledge-governance framework, the main policy concerns should be to mitigate structural inefficiencies and to increase access. Plant argued that patents can make the beneficiary “the owner of the entire supply of a product for which there may be no easily obtainable substitute”, (1934, 30) a troubling claim. A clever, but not radical, innovation (for instance, market-niche dominance by Post It® notes from 3M) should not raise major concerns among policy-makers dealing with competition issues. However, what are the implications of a proprietary general-purpose technology cornering the market? For instance, a new genetic-engineering research tool or a particular DNA sequence)? Then Plant’s point would hold completely, and the granting of a patent would create a substantial monopoly for the owner – and potentially prevent others from exploiting it – thus slowing the diffusion of a potentially radical innovation with obvious negative impacts on productivity growth.

In cases like those involving general-purpose technologies, IP rules and regulations should be much more rigorously examined and carefully constructed. A possible “tool” for dealing with them would be for the government to claim a *golden share* in the IPR system (especially patents and copyrights), by which it would be able to convert a property right previously granted into a general public license¹⁶, as well as to profit from its dissemination¹⁷.

In sum, radical innovations – and, especially, general-purpose technologies – should be subjected to a special IPR regime in which the government’s golden share should be able, if needed, to “shape” the market toward a more competitive institutional design (away from too secure – or broad – monopolies).¹⁸ A legitimate, and fair, reason to do so is that, as already mentioned above, according to some recent studies, the US government played a decisive part in the development of virtually all general-purpose technology, from interchangeable parts and mass production to DARPA and biotech (cf. Ruttan 2006; Weiss 2007 and 2014; Block 2008).

¹⁶ That is, a *legally enforced* temporary monopoly.

¹⁷ Meaning the ability to recover his costs, establish a robust competitive advantage and enjoy a sizable profit stream, but not the ability to exclude others from using and inventing around his innovation or protecting its diffusion. Taking as an example the Microsoft case, the battle should not be about “breaking” the company. The golden share would allow the government to force Microsoft to publish its source code. An open code would quickly get cleaned up and improved, consumers would benefit and new entrants would probably arise helping ignite the innovation race and dislodging Microsoft from its monopoly position while preserving the company’s market power and ability to innovate.

¹⁸ As a clever reader, you should, at this point, be asking “How can an innovation – or innovation cluster – be defined as radical before it ‘matures’ though a process that evidently takes time?” The answer is simple: it cannot. The proposal here is for public sources of funding and regulatory bodies, through the golden share or via special provisions similar to those behind the rationale for issuing compulsory licenses, to retain the *option* to classify an innovation cluster as a strategic general-purpose technology for potentially delivering “massive wealth creation.” As such, those technologies would be treated similarly to weapons of mass destruction, but for inverse reasons. And that placement would happen ex-post, not ex-ante.

Given both the complexity and diversity of knowledge-production regimes and R&D funding, a one-size-fits-all prescription for knowledge appropriation (IPR rules) is not the best way to handle the matter. The 20-year length of a patent (or the terms of copyrights and registrations) is not a “scientifically established outcome” (Landes and Posner 2003). It is, rather, a convention – that is, a (lobby-based) institutional-legal construct that, as such, can very well be questioned and changed.¹⁹ Alternatively, consider this broad guideline for knowledge-governance policies: the length and breadth of patent protection, as well as innovations protected by copyrights, such as software, should be directly linked to the expenditures in R&D, made by applicants in the development of a technology and inversely correlated with their market power.²⁰ Thus, big research budgets (in terms relative to the firm’s size) would, in principle, qualify better than “historical accidents” to earn legitimate protection. Conversely, “global players” would enjoy less legal protection than “garage outfits”, given that the same legal contract would grant cumulative and increasing returns in the former case – reinforcing dominance – and, often, the ability to serve debt in the latter. Instead of one

¹⁹ As a matter of fact, a century ago, copyrights lasted for 14 years – and could be extended another 14 if the copyright holder petitioned for an extension. Today, corporate copyrights last for 95 years, and individuals retain copyrights for 70 years after their deaths. There was nothing “scientific” to back these changes but rather the powerful lobby of the entertainment industry. As for patents, the reader bear in mind that both in Switzerland (between 1850 and 1907) and in the Netherlands (between 1868 and 1912), industrialization occurred without enforcement of patent laws (cf. Schiff 1971).

²⁰ R&D expenses as a percentage of the applicant’s sales or assets could become a metric. That would require a close monitoring of R&D evolution within firms. Assuming that those R&D-intensive industries are also the ones bearing more fixed and sunk costs, plus near-future planned expenses tied to the “birth” of an innovation or technology, should be in the contract granting the rights and their actual production of the enabling mechanism to conclude the exam. Otherwise, patent pending would be a sort of “reasonable doubt” proviso.

size fitting all, we would have something like – paraphrasing Rodrik – “many recipes under the same rule”.²¹

As for the source of dynamic inefficiencies referred to above as *strategic patenting*, it should be dealt with in the same way David Ricardo suggested landlords should be addressed²²: earned but unused patents should be classified like fertile but uncultivated pieces of land in an environment structurally constrained by scarcity. They should be taxed, and progressively so. After an initial “launching period,” each year of idleness in the commercialization of the patent should give rise to a severe fine, the exact amount of which should be left to specialists in the field but could very well be an increasing percentage of the patentee’s sales or assets. Does this sound rigorous? Yes, it does, but patents and IPRs are legally conceded monopolies and matters of public interest.²³ They are too important to be left to private law firms to design and to corporations to govern.²⁴

²¹ A very difficult emerging theme here is the protection to be given to traditional knowledge: DOC (Denominazione de Origine Controllata certifications that grant monopolies based on regional know-how and capabilities, like champagne versus sparkling wines) issues and related others. I acknowledge its importance but do not deal with that in this paper.

²² The parallel here would be between the example given by David Ricardo of the unique fertility of a piece of privately owned land, which would generate increasing revenues to its owner, regardless of efforts to improve the land’s productivity, and the stream of revenue generated from a patent regardless of whether its owner keeps innovating.

²³ In that sense, they are very similar to the financial industry and especially to the banking sector.

²⁴ Google offers a striking example on that matter: it has just bid US\$900 million for the patent portfolio of [Nortel Networks](#), the Canadian telecom-equipment maker, as part of a strategy to defend itself against patent litigation. The amount of money involved signals how fierce the patent wars have become, particularly in Silicon Valley, where even the largest and most powerful companies, like Google, are besieged by dozens of patent-infringement suits. It also underscores Google’s frustration with the state of the patent-reform legislation in Congress. Though Google could potentially use some of the technology in the Nortel patents in future research, the company said it wanted to buy them to defend itself against patent litigation. By building a large portfolio of patents, Google keeps them out of competitors’ hands. It also hopes to dissuade other companies from suing it, either because Google holds similar

Additionally, the kind of approach to the governance of knowledge I am pointing to should have as its core principle the discouragement of the sort of unproductive entrepreneurship that Baumol highlighted more than three decades: A type of legal entrepreneurship that turns law firms into very big and profitable corporations but with zero impact on the economy's real productivity. It would, in sum, help to trigger the "relocation of entrepreneurship" – from courts back to labs – as claimed by Baumol (1993 and 2002).

Another key point outlined in Section II above relates to the relationship between the "digitally renewed economy" and intellectual property issues, and particularly to the risk of winner-takes-all market outcomes (cf. Varian et al. 2004; Carlton and Gertner 2002). Knowledge-governance policies here should pursue, very aggressively if needed, public enforcement of standards development, cooperative-standards setting, the stimulation of (instead of restriction on) joint research ventures and other forms of research coordination and venture capital financing to multiple sources of experimentation (Block and Keller 2011). The aim should be a "less kind, less gentle patent system," as Jaffe and Lerner (2002) put it, in which patents are much harder to acquire and easier to share.

Also of concern is the recent wave of IPR expansion and its connection to a potential "information feudalism" or "second enclosure movement." This movement is analyzed by "progressive IP lawyers", software programmers and a sizable number of social and natural scientists of various extractions as a recipe for global monopoly, one that is likely to stifle innovation at the same time as it concentrates wealth (see Moglen 2003, Benkler 2003 and Burlamaqui and Cimoli: 2014). A number of commentators have called for an alternative to this second enclosure, an alternative they term "the new commons".²⁵

patents to the ones they might sue over or as deterrence – if you sue me, I will sue you (*NYT* 5 April 2011).

²⁵ A "commons" is a piece of land over which people can exercise certain traditional rights in common, such as allowing their livestock to graze upon it. Older texts use

As Evans (2005, 3) has aptly put it, this alternative is “attractive both because of its distributional implications and because of its potential for raising the rate of innovation and value creation”. From a knowledge-governance perspective, the basis of the new commons comes from a redefinition of “ownership”: from the focus on the right to exclude to the focus on the commitment to distribute (disseminate).

The key idea here is that once property rights are redefined along the lines pioneered by the open-source software movement, a much more egalitarian redistribution of intangible assets and a more powerful rationale to foster innovations will be able to emerge. This rationale is one that unfolds from the characteristics of the networked information economy – an economy of information, knowledge and culture that flows over a ubiquitous, decentralized network.

In that environment, as Benkler remarks, productivity and growth can be sustained in a pattern that differs fundamentally from the industrial economies of the twentieth century in two crucial characteristics. First, network based knowledge creation can play a much more important role than it could in the physical economy. Individuals and teams working cooperatively alongside firms can make a difference in the creation of innovative solutions and productivity gains (Benkler 2003, 1 and 2006).²⁶ Second, decentralized production and distribution networks, whether market-based or not, can similarly play a much more important role by increasing the diversity of ways of organizing production and consumption and, therefore, by increasing the sources and possibilities for multiple forms of experimentation.

the word “common” to denote any such right, but more modern usage is to refer to particular rights of common and to reserve the name “common” for the land over which the rights are exercised. By extension, the term “commons” has come to be applied to other resources that a community has rights or access to.

²⁶ And, he adds, one can clearly observe this behavior by noticing that most of what we do on the Internet runs on software produced by tens of thousands of volunteers, working together in a way that is fundamentally more closely related to a community than to a hierarchical big corporation standing alone.

This is clearly a global issue and – because of its global scope, and also because of the under-theorized relationship between innovation, competition policies and intellectual property rights – a very difficult one to handle. It will certainly require the active involvement of governments in encouraging and assisting the development of open-source systems to move society toward more general-public-licenses-oriented IPR regimes. It will also require international cooperation – both very turbulent matters from a power-politics perspective. Nevertheless, the recent decisions by IBM and Nokia, for example, to put part of their patents into the public domain suggests that there is perhaps more room to maneuver than the skeptical analyst might expect.

Conclusion

The knowledge-governance-oriented policy-institutions framework I have proposed would be flexible and pragmatic and have creative-destruction management and maximum expansion of access to knowledge as its main goals. In its innovation- and competition-policies dimension, it would *not* be anti-bigness per se, but anti-unproductive entrepreneurship (Baumol 1993 and 2002); pro-efficiency but not libertarian (in the “Chicago School” sense of letting the market, almost always, take care of its own problems); and, especially, pro-cooperation, leaving room for business networks to thrive and for state-sponsored administrative-guidance initiatives. It would also engineer policies toward the development of multiple sources of experimentation and allow room for industrial and technology policies without jeopardizing its own core theoretical foundations.

In its intellectual-property dimension, it should *not* point to a one-size-fits-all institutional design and should *not* pursue the maximum protection of monopolistic rents, as both the US PTO and the WTO seem to be doing. It should search, instead, for the minimal

common denominator, allowing for institutional and technological diversity and space for distinctive developmental strategies (Boyle 2004, 2008; Rodrik 2011). It should take into account the asymmetries in the distance to the “development frontier” among countries and regions, echoing Joseph Stieglitz’s wise remark that “Intellectual property is certainly important, but the appropriate IPR system for an emerging country is different than the IPR system best fitting already developed nations” (Stiglitz 2005).²⁷

From an evolutionary perspective, the key issue to deal with is how to separate innovation-rooted profits, which should be rewarded but understood as temporary (their continuity dependent on continuous innovation), from legal monopoly-granted rents, which should be eliminated or, at least, closely monitored and curtailed.

None of these policy prescriptions will be achieved without a huge dose of “strategic state action”; and most of them will require a high degree of state capacity as well as international treaties redesign (such as the GATS ²⁸ under the WTO). This is an uneasy task; nonetheless, the expected result, to which this paper intends to make a small contribution, would be a theory/policy framework linking, conceptually, innovation and Schumpeterian competition to competition policies and intellectual-property-rights management, which will allow room for a more open, democratic and development oriented knowledge ecology.

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²⁷ One of the main reasons for that, although certainly not the only one, is that the big pharmaceutical companies perform obscene price discrimination among nations (cf. Varian et al. 2004, 52) and almost always refuse to engage in poor and emerging countries’ public policies oriented toward health care.

²⁸ General Agreement on Trade in Services.

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DEVELOPMENT IN UNEQUAL SOCIETIES: BRAZIL BEYOND THE “GOLDEN DECADE”¹

Celia Lessa Kerstenetzky

Introduction

This article aims to analyze the relationship between development and inequality in the context of recent Brazilian experience during the period I call “golden decade” – Brazil’s auspicious entry into the twenty-first century.

The larger premise is that intense and enduring inequalities are symptoms of underdevelopment. The more specific premise is that Brazil is a case in point, and therefore it is urgent to understand the native pattern of growth, permeated by deeply iniquitous while structuring social relations. However, instead of investigating these relationships, the text explores the exception – the golden decade experiment, in which growth was combined with an unprecedented degree of equity and democracy in the history of developmental projects in the country –, seeking to shed light on choices, elements of success, and unseized opportunities that may signal necessary rerouting for future public action.

Among the conditions determining recent achievements, I use the intersectional concept of “redistributive growth” to highlight policies to increase the purchasing power of the poorer population, particularly increasing the value of the minimum wage and targeted

¹ The author acknowledges the comments during her lecture given at the international seminar *The Role of the Nation-State in the 21st Century*, organized by ENAP and held in September 2015 in Brasilia. She also thanks Jaques Kerstenetzky for perusal and shrewd suggestions, and Elisa Monçores and Graciele Guedes for their help in research on public employment.

income programs. Among the untapped opportunities are policies for the fair equalization of opportunities, notably the decisive expansion of public social services and progressive taxation. Regarding the latter, interest lies not so much in the fiscally responsible funding function of equalizing policies, but in their capacity to limit the growing (and already very high) appropriation of national income by high-income strata and correct the strongly regressive character of the main source of government revenue, i.e. taxation.

Finally, it should be noted that this is an essay, whose main purpose is suggest paths to assess the possibilities of public action for development in its most elevated sense in the country.

The text is divided into four sections, in addition to this introduction. In the first section, I suggest the problematic relationship between development and inequality as a framework to critically reflect on Brazil's experience of development in recent decades. In the following section, the Brazilian golden age is documented, highlighting the experiment of increasing the value of the minimum wage, and previously unpublished research results are presented. Such results reveal that the minimum wage was the most important factor in reducing income inequality in Brazil, precisely as it gained value in real terms. Within this section, I propose the category "redistributive growth" in seeking to shed light on what was attempted and, to a significant extent, accomplished in the country. In section 3, I analyze the darker side of the golden decade: the bet that was not made on the steady expansion of services and progressive taxation, which is still incipient in the country, laying bare the asymmetrical character of the social contract of the 1988 Constitution: the pact of rights was not accompanied by a pact on taxation. In the following section, I explore the potential of these interventions in terms of growth through redistribution. In the final section, I evaluate the qualitative leap required for a full-scale model of redistributive growth, implying

integration of increased social opportunities and progressive taxation into the set of development policies.

Development and inequality

If substantial and lasting economic inequalities are distinctive traits of underdevelopment, development interventions must confront them.

According to a robust and growing set of studies, the negative influence of inequality is evident in several dimensions of development. In fact, research associates inequalities with weak democracies, unsustainable growth, low social trust, high levels of relative and absolute poverty, unequal access to opportunities and low social mobility, health and education deficit, high levels of corruption, and weak government (KERSTENETZKY, 2002; JENCKS, 2002; O'DONNELL, 1999; AGHION *et al.* 1998; OSTRY *et al.* 2014; ESPING-ANDERSEN, 2015; WILKINSON, PICKETT, 2009; ROSE-ACKERMAN, 2004; ROTHSTEIN, 2011).

The sources of enduring inequalities are reasonably mapped. Charles Tilly (1999) highlights opportunity hoarding and economic exploitation due to monopoly ownership of valuable assets as two critical mechanisms producing and reproducing such inequalities; Thomas Piketty (2014), singles out the rent-seeking impulse of capital-wealth as the driving force of the "great divergence"² and inheritance as the main mechanism of its perpetuation. Celso Furtado (1974), in analyzing the history of development in less developed countries such as Brazil, coined the word *underdevelopment* to designate a certain pathology inherent to the developmentalist model, which drives and is driven by inequalities.

Nowhere seems entirely immune to them. According to a thoroughly documented historical research in Piketty (2014),

² The great pro-concentration force would be a persistent divergence between return of capital and output growth rates.

capitalism, the globally widespread economic system, inexorably concentrates income and wealth.

If so, an appropriate measure for development must capture the “loss” caused by inequality. A modest but effective indicator is the Inequality-Adjusted Human Development Index (IHDI), which adjusts the Human Development Index (HDI) – a combination of per capita GDP and achievements in education and health – for an average of inequality in these three dimensions.

As expected, all 144 countries for which information is available have their HDI reduced when adjusted for inequality³. However, this is more or less so depending on the country. In fact, if we compare the ranking of countries according to IHDI with the one based on HDI, it can be noted, for instance, that the United States loses 16 positions, while Sweden goes up three positions, Finland, nine, Norway remains first and Denmark keeps its position. Among the emerging countries, Brazil falls 16 positions (like Chile), behind Argentina (four positions down) and Mexico (13 down). Such a variation can largely be explained by a more or less effective welfare state.

The Brazilian situation is particularly worrying: it is the seventh economy in the world, and goes down to 79th in HDI and 95th in IHDI (the biggest drop among high-HDI nations) (UNDP 2014). In terms of income inequality, Brazil is among the 13 highest Gini indices in the world (WDI 2014). In fact, decades of growth have not reduced a consistently high inequality, except when, as in the decade ending in 2013, inequality reduction was an explicit objective guiding public policy (Table 1, Attached).

³ According to the UNDP website: “The average global loss in HDI due to inequality is about 22.9 %—ranging from 5.5% (Finland) to 44.0% (Angola). People in sub-Saharan Africa suffer the largest losses due to inequality in all three dimensions, followed by South Asia and the Arab States and Latin America and the Caribbean. Sub-Saharan Africa suffers the highest inequality in health (36.6%), while South Asia has the highest inequality in education (41.6%). The region of Arab States also has the highest inequality in education (38%), Latin America and the Caribbean suffers the largest inequality in income (36.3%)”. See <http://hdr.undp.org/en/content/inequality-adjusted-human-development-index-ihdi>. Retrieved on August 29, 2015.

The golden decade in Brazil: democracy, growth, equity

From my perspective, the golden decade was different in the political commitment to endogenous social policy efforts—a commitment that was widely favored by the international economic situation.

Usually viewed as cost and advocated solely for social justice and equity reasons, social policy was designed and promoted within a new framework, as “pro-growth” (see, e.g., CASTRO *et al.* 2011). In fact, some evidence of what international literature called an efficient redistribution paradigm – policies such as public education and health, as well as government transfers would have contributed to a reduction in the Gini coefficient concurrent with growth – has been found in IPEA simulations (Table 1, Attached).

Brazil is far from a pioneer in something Northern European and East Asian countries had already deliberately pursued; it sought it simultaneously with other Latin American countries; but was somehow unique, especially for the role played by the minimum wage. Particularly interesting are the pioneering aspects of the experiment – led here as in other Latin American countries by a center-left coalition – in the recent history of the country itself.

In order to examine the Brazilian experience in its economic, social and political intersectionality, I propose the concept of “redistributive growth”. This would be a form of growth having redistribution as input and equity as a guide. Redistribution would occur through regulatory intervention (labor market policies), government transfer payments (contributory and non-contributory transfers) and public service provision (public health and education), as well as through progressive funding of social policies. As for equity, it would be revealed by the impact of such interventions on average inequality, as measured by the Gini index, or – perhaps more appropriately – by the higher growth rates of the bottom five tenths of income distribution in relation to the top five tenths.

Although incompletely, the Brazilian experiment illustrates a process of redistributive growth, including regulatory interventions in the labor market and government transfer payments. As widely documented, the flagship was domestic mass consumption (Table 2, Attached), encouraged by an increase in household income (and access to credit). The latter, in turn, was stimulated by labor market policies (raising the real value of the minimum wage and formalization of employment) and government transfer payments (rural social security, the Continuous Cash Benefit, the Bolsa Família Program, unemployment insurance, and salary bonuses) (KERSTENETZKY, 2012, 2014, 2015). Between 2003 and 2010, the average GDP growth rate was over 4% and the Gini index fell more than five percentage points. Between 2011 and 2013, the growth rate dropped 50 percent (still driven by consumption), but the Gini index fell yet another percentage point.

In this process, some pessimistic forecasts have not come true. First, income programs, even when non-conditional on work, have not diminished the economic participation of beneficiaries (MDS/IPEA 2014 presents a literature review). The increased value of the minimum wage has not entailed an increase in unemployment or informality; on the contrary, unemployment and informality fell continuously. It was concurrent with a general improvement in the labor market: increased employment, a decrease in poor-quality jobs (notably, agriculture and housekeeping services), increased participation of women and non-white people in the market, increased education and increased average labor income (QUADROS, 2014; BRITO, 2015). Raising the value of the minimum wage has not caused an agglutination of workers in income ranges below the minimum wage (BRITO, 2015); the minimum wage got closer to the average salary (BRITO, 2015) and tended to become in fact the *minimum* wage. Finally, the main targeted income program, the Bolsa Familia program, has done less to reduce inequality than the minimum wage (Brito 2015).

Recent research results help clarify the distributional impacts of the policies adopted in Brazil (BRITO, 2015). As previously noted, in a preliminary comparison between the redistributive effects of a targeted policy – the Bolsa Família program – and those of another policy which, although not universal, is at least cross-sectional –raising the value of the minimum wage – for the period from 2006 to 2011, the minimum wage policy prevailed. Its contribution to reducing the Gini index was three times higher than the Bolsa Família Program (32% versus 10%). This explains why, although this program is very marginally redistributive, the scope of impact of a higher-value minimum wage is greater, including not only workers who are paid the exact amount of a minimum wage, but also those whose salaries are somehow indexed according to the minimum (just below or just above it), and especially every beneficiary of constitutional government transfers, also indexed according to the minimum. Thus, while just over 15% of the workers are paid the statutory wage floor, more than 60% of the retirement pensions in the general social security system have the minimum amount. Similarly, it indexes constitutional welfare, the Continuous Cash Benefit, and is also the floor for unemployment insurance and salary bonuses.

The same study (BRITO, 2015), covering the period from 1995 to 2013, estimated the total effect of increasing the value of the minimum wage in nearly three quarters of the total decrease in inequality as measured by the Gini coefficient (72.4%), most of it due to social security (37.7%), while the labor market contributed 26.3% and the cash benefit (BPC) represented 8.4%. This may still be an underestimation, as it does not take into account the so-called lighthouse effect, i.e., the signaling effect of the minimum wage on compensation in its surroundings, either by informal indexing, or because the minimum wage is explicitly used as cash value.

In this context, two points are specially relevant. First, it should be noted that indexation of transfer payments according to the

minimum wage, together with its wage floor function, is part of a range of regulatory interventions in Brazil⁴ anchored in the classical principle of the social minimum, i.e., the Government guarantee of a certain level of welfare to all citizens, whether through transfer payments, or via labor market regulation. The policy of raising the value of the minimum wage, another regulatory intervention, is intended to recover its historically depreciated real value in order to achieve the constitutionally fixed amount. Thus, it seeks to effect the link between the minimum wage and the social minimum.

Second, the policy to increase the real value of the minimum wage has apparently created a favorable political economy to its support, which would be doubtful in the case of expanding the Bolsa Família program with equivalent redistributive effectiveness. In other words, the strong impact on distribution stems from its expressive improvement, reaching all income levels below the median income and not only individuals eligible to income programs (in fact, a significant number of them is not even contemplated), which would favor political support for the policy. Overall, the relative impact of one targeted policy versus another cross-sectional one in the Brazilian experience corroborates stylized facts known from other countries and experiments with social welfare schemes, where universal policies achieve better redistributive effects than targeted policies by reason of scope (number of beneficiaries, extent of political support, budget) (KERSTENETZKY, 2012).

The golden decade: the other side

However the golden decade also had a darker side. Several problems could be mentioned, such as leakage of part of domestic consumption to imports and less favorable evolution of the Brazilian industry, which was facilitated by an appreciation in the exchange rate

⁴ The suggestion of reckoning these policies as regulatory is in Evans and Frase 2015.

and ultimately by policies geared to stabilization. I will focus on the issues that most directly affected the pace and future prospects of redistribution.

First, the expansion of employment mainly occurred in sectors like construction, trade and personal services⁵. Although the jobs created have been mostly formal and ranging up to around two minimum wages, such labor markets are not very stable, with little perspective of professional development and not requiring much qualification or schooling. Industrial employment shrank not only because of a sluggish domestic industry, challenged by imports of consumer goods from countries like China, but also because, realistically, one cannot generally expect the industry – however successful – to generate the jobs needed to absorb the additions to the labor force.

Besides, despite any income gains or social mobility, of no less importance are the so-call consumption gaps, i.e. unsatisfied social needs due to pent-up demand or insufficient supply issues (KERSTENETZKY, 2015). I refer mainly to deficits in necessary consumption, i.e. consumption of goods and services necessary to achieve a minimally decent standard of living, which could be summarized by the condition of being above the poverty line. This is despite welfare policy. Calculations performed using the 2012 National Household Sample Survey (*Pesquisa Nacional por Amostragem Domiciliar*, PNAD) showed that 16% of Brazilians do not have sufficient resources to feed themselves adequately (according to the criterion of amount of nutrients established by the Ministry of Health) or to cover essential expenses (housing, clothing and transportation) (KERSTENETZKY, MONÇORES, 2014).

Another consumption gap to be considered is discretionary consumption, where spending exceeds basic needs and is usually associated with middle-class status. A survey on consumption habits of

⁵ According to Arbache (2015), the service sector accounts for more than 72% of employment in Brazil and in recent years has accounted for 83 of every 100 new jobs created.

socioeconomic Class C, which has expanded significantly in the golden decade, shows that this pattern still makes it very different from the “classic” middle class, and thus it is not appropriate to call it “the new middle class”. Most citizens in this segment still have consumption habits similar to those of economically vulnerable families (Class D), and lack the economic security that characterizes the middle class (KERSTENETZKY, UCHÔA, VALLE SILVA 2015).

Another space to be conquered concerns public consumption, that is, goods and services provided by the government and consumed individually by citizens, such as education, health, culture and other services. In Kerstenetzky (2015) I explain:

“Public consumption is defined by a system of national accounts such as government expenditure with the provision of collective and individual goods and services for families and other institutional actors. Besides the collective consumer goods and services that cannot be individualized and adequately provided by the market, such as public administration in the broad sense, that is, the provision of security and justice services, there is individual public consumption. This includes the goods and services which could be purchased by families “or for which it is possible to identify the receiver of each good or service” but are provided by the government as social transfers in kind and which effectively represent an increase in the final consumption of households, not restricted to income perceived in the market or via government cash transfers. Typical goods and services in this expenditure are education and public health, but it also includes “the supply of food, medicines, educational materials, culture, etc.” Along with the direct consumption of households (depending on their available income, a sum of market income and government net cash transfers, such as pensions and social benefits), this free provision of goods and services contributes to the quality of life standards that Brazilian families can achieve.” (p. 11 and 12).

Tables 3, 4 and 5 illustrate the case of education, showing how heavily underprovided public education is in the country, with low participation of young people in high school or (mostly) in higher education, and young children in early childhood education, as well as various deficits regarding professional development, compensation and provision of teachers (Tables 3 and 4). We can also observe some symptoms of educational inequity, precisely in the ultimate equalizing institution; there are significantly disparate levels of schooling between the white and the nonwhite, the rich and the poor in the country (Table 5).

Third, this public consumption gap corresponds to the insufficient growth rate of public social services which could potentially equalize opportunities (Tables 6, 7 and 8). In fact, the share of public consumption in aggregate demand has shrunk over the period under review (Kerstenetzky 2015). Health has lost participation in federal government spending, and education, after a significant growth, has come to a halt since 2012 (Table 6). The level of spending is much lower than projected in the Second National Education Plan (*II Plano Nacional de Educação*). In an international comparison, Brazilian per capita spending in both sectors is behind, even according to Latin American standards (Tables 7 and 8).

Fourth, despite an ongoing increase in the tax burden since 1995, reaching 35% of GDP in 2014, progressive taxation has not advanced. Progressive taxation is still incipient, making the tax burden regressive.

The notoriously regressive indirect taxes account for more than half of the tax burden in the country (51%), while direct taxes represent only 18%, an anomaly in international terms (Chart 2). The only progressive tax is income tax. However, its maximum rate is among the lowest in the world (27.5%), significantly lower than the ones implemented by all similar countries in Latin America (Chart 4). Distributed profits and dividends are exempt from tax; the total income tax is less than 30%, versus an average of 43% for OECD

countries (GOBETTI, ORAIR, 2015). As a result, the very rich pay 6% of income tax, whereas the upper middle class, for instance, pays twice as much (*idem*). Besides, incidence analysis reveals even more disturbing anomalies in distributional terms: the burden of indirect taxes is twice as heavy among low-income households than for households with higher income levels (PAYERAS, 2010; 21% for those who earned up to 400 reais and 10% for those who earned more than 6,000 reais)⁶. Zockun (2015) estimated the tax burden for those who earn up to two minimum wages at 48% and 26% for those earning more than 30 minimum wages. The total impact could not be distributively innocuous: indirect taxation nullifies the progressive effect of direct taxation in Brazil, increasing the Gini index (PAYERAS, 2010).

It is not difficult to conclude that social policy is being disproportionately funded by its main direct beneficiaries. In other words, the social contract of taxation took an entirely opposed path to the social contract of rights underlying the 1988 Constitution. Notably, soon after the promulgation of the 1988 Constitution, the maximum income tax rate was reduced from 45% to 25% (SOUZA, 2014). A few years later, in 1995, distributed profits and dividends would be exempted from tax. Estimates are that, had the pre-1995 rates prevailed, these taxes would yield a revenue of around 50 billion reais in 2015 – more than half the tax effort the country must make to meet the 2015 primary surplus target (GOBETTI, ORAIR, 2015).

Brazil is, in short, a country where rich families pay nearly no taxes. The importance of this fact could be more realistically appreciated when the first calculations about inequality of income and wealth based on income tax records came to light, following the publication of *Capital in the Twenty-First Century*, by Thomas Piketty. This new source

⁶ Tax fairness in this case would require at least an equal tax burden for different income groups. Inequality stems primarily from the fact that the poor consume all their income while the richest spend only a fraction of what they earn. This "unfair" situation could be ameliorated by different rates for different consumer goods. China, for example, although it does not levy a tax on wealth, has introduced a tax on the consumption of luxury goods.

of information has shown that inequality in the country is even higher than previously thought and, with regard to the concentration in high incomes, it may be *growing* in recent years.

In terms of income appropriation, the richest 1% has the equivalent to 25% of income; the richest 5%, in turn, have the equivalent to 50% (MEDEIROS *et al.* 2014). As for the appropriation of wealth, the top 1% of taxpayers concentrate 30% of the total declared wealth (O GLOBO 2015; IRPF 2015). Against the compression of inequality between the income levels from the first to the ninth tenth of distribution, the share of the top 1% grew between 2006 and 2012 (MEDEIROS *et al.* 2014). It is worth noting that the income of high-income taxpayers is underreported. Therefore, the picture described is by no means exaggerated.

Potential of services⁷ and taxation to sustain redistributive growth: the international experience

International literature describes the typical experience of the most socially balanced countries as marked by an expansion of employment and income that, while serving social needs, expands the productive and creative capacity of the workforce (LINDERT, 2004; MYRDAL, 1973). In 1973, in a lecture to commemorate the 20th anniversary of BNDES, Gunnar Myrdal read a short paper suggestively titled "Equity and Growth" in which he encouraged Brazil and other less developed countries to explore the path that joined egalitarian reforms (social public goods) with increasing productivity. He said: "the importance of the type of reforms ..., where the quest for greater equality is indissolubly linked with that of higher productivity." (MYRDAL, 1973, p.47). The catching up of Nordic countries in the 1960s

⁷ Some of the ideas presented in this study regarding the expansion of social services with redistributive growth and development were discussed in Kerstenetzky 2012 and later in Kerstenetzky 2014a and 2014b.

proved, in fact, a leap forward, but did not attract followers in the tropics at the time.

The history of development in Northern European countries like Sweden records a revolution in public services, with emphasis on high-quality universal education, an egalitarian policy which dramatically impacted the intersectoral composition of the economy and the structure, composition and dynamics of employment. The revolution in the labor market raised public employment to an equivalent to 35% of the total, most of them for women, with economic participation reaching unprecedented levels (BERGQVIST; BJARNEGARD; ZETTERBERG, 2015). These jobs were supported by a universal system of high-quality child care and early childhood education institutions (ESPING-ANDERSEN, 2015) which further stimulated it with the addition of jobs in new service segments. According to some estimates, female employment would have reduced the risk of child poverty in these countries by three to four times (ESPING-ANDERSEN, 2009; RAINWATER; SMEEDING, 2003). In general, the pursuit of greater equality via universalization of opportunity had short- and medium-term economic returns (generating jobs and income and increasing production capacity), and probably impacted intergenerational equity (upward social mobility opportunities) to an even greater extent than the intragenerational one (see ESPING-ANDERSEN 2015).

On the other hand, public jobs have proved to be of higher quality in terms of professional skills, compensation and social protection than jobs generated in the segment of consumer services, which boomed in countries with low labor market regulation. Thus, it constitutes a more interesting option within the sector that has generated most jobs, i.e., the service sector. Moreover, they had negatively correlation with income inequality, suggesting a potential direct redistributive effect that must be further investigated⁸.

⁸ The correlation coefficient between the percentage of public employment and the Gini index was minus 0.71, based on data in OECD 2015. See Chart 3, Attached.

In international literature, several studies have related services, especially lifelong learning, with innovation (HUO; STEPHENS, 2014; BOYER, 2012). Countries like Denmark, which has a strong educational system based on the principle of lifelong learning, starting in early childhood, have recorded high percentages of (mainly private) spending on innovation. In contrast, countries like Brazil, with relatively high public spending on innovation, insufficient investment and poor educational results, have very low participation of the private sector and therefore underinvest in innovation. In general, affordable, high-quality health and education services are commonly associated with the productive and creative capacity of the workforce.

One consequence of the focus on social services is changing the pattern of consumption and production toward public consumer goods. The ratio between private consumption and public consumption in economically prosperous and socially balanced "Service States" is 1.6 (NORDEN, 2015). In Brazil, the ratio is more than the double, 3.4. The gap suggests paths to explore toward a consumption pattern that simultaneously satisfies social needs, manages equity and promotes growth, increasing productivity and environmental sustainability, as public social goods generally spare natural resources.

If one focuses exclusively on equity aspects, contemporary literature on welfare states indicates that among the most redistributive are those which invest proportionately in high-quality public social services. Within this segment, we should highlight care services, which are multifunctional: among others, they promote gender equality and important intergenerational redistribution impacts. Early childhood education, for instance, helps reduce the transmission of inequality across generations. (ESPING-ANDERSEN, 2009, 2015; HECKMAN, HOCHNER, 2000). Studies have shown that preschool years are essential to determine the life opportunities of individuals, emphasizing the role of families and pointing to household income inequality, as well as inequalities of opportunity,

as keys for explanation. In fact, the countries with the lowest levels of income inequality are the ones with the lowest levels of child poverty and the lowest income elasticities between parent and children generations. They are also the nations where children of parents with little education have the best chances of achieving higher levels of instruction: the chances are three to four times higher among Nordic people than among Germans or Americans (ESPING-ANDERSEN, 2015). Typical policies of universalist welfare states, including transfer payments and services, especially early childhood education, are usually associated with lower inequality of income and education between generations.

The redistributive impact of such services is considerable even in less developed countries like Brazil. Lustig *et al.* (2013) suggest that public spending on education and health in the country reduces inequalities in final income more effectively than cash transfers. It is possible that large redistributive coalitions, including the middle class, increase access and the quality of services, a fact that has been repeatedly observed in the European experience (JUDT, SNYDER, 2012; PIERSON, 2006; ESPING-ANDERSEN, 1990), maximizing the long-term effects inequality reduction.

Regarding progressive taxation, its importance is well documented in the so-called Great Compression of income inequality, which took place in rich countries in the post-war period (PIKETTY, 2014). Progressive income tax gained prominence at the time⁹. In the same post-war period, following the international trend, the maximum income tax rate in Brazil jumped from 20% to 50% between 1945 and 1947, reaching 65% in the early 1960s. Not surprisingly, after 1964, the rate fell and stabilized at 50% throughout the rest of the decade (SOUZA, 2014), when inequality – as measured by the Gini index – grew more than 10%.

⁹ The maximum rate reached 83% immediately before Thatcher, and 70% immediately before Reagan in England and the USA, respectively (cf. Piketty 2014).

Progressive taxation is the basis of the most redistributive modern welfare states (OECD 2015). Moreover, progressive taxes such as the wealth tax (also called net worth tax) have been adopted in countries with cyclical taxation issues. In recent years, Spain is a case in point. This tax, in particular, can be used to limit the accumulation of wealth, mostly inherited, and thus control the excessive detachment of the richest 1%, as suggested by Piketty (2014). According to Piketty, a small annual rate would control such an accumulation, inciding on the high rate of return that wealth yields in capitalism. This additional revenue could be used, for example, to reduce public debt, to finance social investment items, or to make the tax burden more progressive.

Contrary to what is often stated in Brazilian public debate, a wealth tax is not rare in the world. In Latin America, it is levied in at least four countries: Argentina (*impuesto sobre los bienes personales*), Uruguay, Colombia (*impuesto al patrimonio*) and the Dominican Republic. In Europe, it is present in several countries, including France, Norway, Luxembourg, Switzerland, Iceland and Spain. In other regions, it is collected in India, Algeria, in many Islamic countries, and Suriname (NASCIMENTO, 2015a). However, if we consider wealth tax incorporated in other taxes, such as progressive property taxes (and broadening the scope of what is considered property) or a surcharge on the already progressive income tax, we may conclude that a significant number of countries collect such a tax, including South Korea, South Africa, Costa Rica, Peru, Morocco, as well as several European countries, Canada and Australia (NASCIMENTO, 2015a).

Taxes on distributed profits and dividends, which do not exist in Brazil, are charged in almost all OECD countries (GOBETTI, ORAIR, 2015). Not levied on companies, they have no impact on investment but reduce household income inequality.

Finally, as inheritance is the main source of wealth (cf. PIKETTY, 2014), progressive taxes on inheritance or gifts are essential mechanisms for the socialization of wealth as recently proposed

by Anthony Atkinson (2015). While researching the influence of education on the income of the richest people in Brazil, Medeiros & Galvão (2015) found no significant relationship between education and high income, similarly to the findings of Piketty (2014) for the United States: according to the authors, the rich are not rich because they are more educated. While these findings on the one hand weaken meritocratic arguments on the accumulation of wealth, on the other hand, democratizing the access to wealth would create opportunities for new productive investments, a subject that is further explored by the growing economic literature on efficient redistribution.

Revising the model of redistributive growth?

In view of the current state of services and progressive taxation in the country, and considering the potential of such interventions for the promotion of socially balanced growth, it is possible to identify new responsibilities for public action. If the purpose is to grow while meeting social needs and promoting social balance, these interventions should be seen as development policies in their own right.

The documented underprovision of social public services is a welcome opportunity for intervention. A measure of the current intervention deficit is, for instance, the public employment gap in the country (Chart 1): it corresponds to nine percent in comparison with the average of OECD countries and 23 percent in relation to the service states of Northern Europe (OECD 2015). In this scenario, several possibilities are missed in fields such as: provision of high-quality public social services, as reported in the previous section; more and better jobs (in social services, largely to replace those created by the personal service and construction industries), greater gender equity, greater production capacity, higher probability of innovation, better sustainability results, more cohesive and less unequal societies. It is also worth mentioning the expected effect of social investment

policies like early childhood education and the creation of a national care system.

The gains expected from the introduction of progressive taxation are also expressive as demonstrated by the gap that separates Brazil from equivalently or more developed countries. The gap in maximum income tax rate has a variation around eight percent (compared to the US) and more than 30 percent (of Northern European countries are taken as reference). As for the tax on profits and dividends, considering the overall taxation on profits (retained and distributed), our distance from OECD countries is 13 percentage points (GOBETTI, ORAIR, 2015), since distributed profits are exempt from tax in our country. Our tax on urban property is not progressive and the tax on rural property is virtually non-existent, since relevant information for its calculation are self-reported and evidently distorted (GUANZIROLI, 1996), representing in 2013 no more than 0.02% of the GDP, despite the extremely high concentration of land ownership in the country (land Gini over 0.8).

The potential gains must be assessed taking into account not only present circumstances, but also the current crisis and the need for fiscal adjustment (which could be mainly tax-related, so as not to endanger precisely the gains of the golden decade, obtained from social policy). Also worth considering:

- 1) the need for additional social investments to expand classical services (like education and health) and other, more modern ones (like a national care system, which is essential for an aging population not to reverse the increased economic participation of women, who are in charge of most caregiving activities;

- 2) the opportunity to improve the progressivity of the tax burden to finance such investments and contribute to minimizing post-tax inequality, thus avoiding the paradox of a progressive spending funded by a regressive tax that nearly compensates it;

- 3) the persistently high income inequality, especially the one that resists the usual social policies, such as concentration of income and

wealth at the top of income distribution, unchanged by any mobility below. The problem of the top of the distribution concentrating an overwhelmingly disproportionate share of income could have no more appropriate mitigating mechanism than some form of progressive taxation, as implemented in countries mindful of the socially harmful effects of excessive concentration of wealth.

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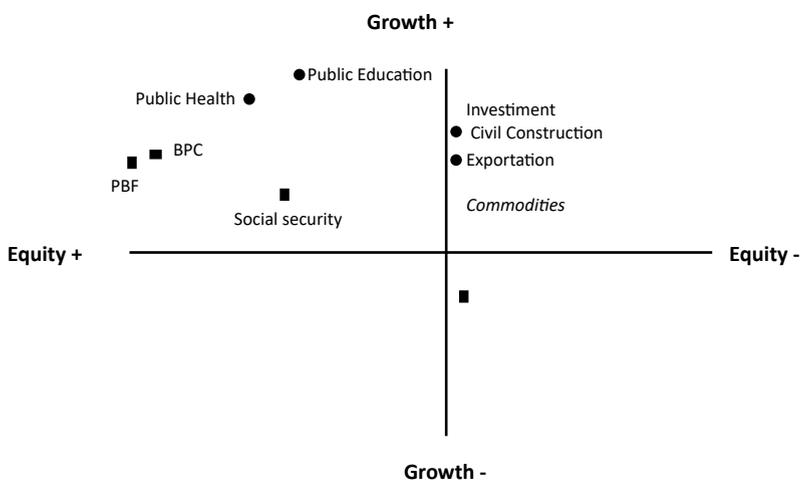
ANNEX

Table 1 – Brazil: Inequality, Growth and Political Regime

Year	GINI	Growth rate	Regime
1960	0,50		Unlimited Democracy
1970	0,57	++++ 1960s	Dictatorship
1980	0,60	+++ 1970s	Dictatorship
1990	0,64	+ 1980s	Redemocratization
2000	0,61	+ 1990s	Dictatorship
2010	0,52	++ "Golden decade"	Democracy and center-left coalition

Fonte: elaboração própria. Kerstenetzky, 2015a.

Table 1 – Estimated contribution of social policies to redistributive growth multiplier effect



Fonte: adaptação de esquema originalmente elaborado por IPEA 2011.

Table 2 – Contribution of the growth rates os aggregate demand items to the GDP growth rate (in percentage points) Brazil 2006-2013

Year	Household Consumption	Consumption of APU	Gross fixed capital formation	Exportation	Importation
-2,32006	3,2	0,5	1,6	0,8	-2,1
2007	4,0	1,1	2,4	1,0	-2,3
2008	3,7	0,7	2,5	0,1	-1,9
2009	1,4	0,2	-1,7	-1,5	1,3
2010	5,0	1,2	4,1	1,4	-4,1
2011	2,2	0,3	0,8	0,4	-1,1
2012	1,4	0,5	-0,9	-0,1	0,1
2013	1,8	0,5	1,0	0,4	-1,2

Table 3 – % Illiteracy and % Attendance at various levels (net rates) 2011 (ABE 2014, PNAD 2013)

Illiteracy (15y+)	Primary (6-14)	Secondary (15-17)	Tertiary (18-24)	Preschool (0-3)
8,6 (one of the highest in LA)	92.4	52.2	15.4 (2012)	23

Table 4 – Teachers (various indicators)

With only a high school degree	25% (NE=58%, N=64%, Among those teaching at the preschool=57%)
Relative earnings (compared to the earnings of other workers with a college degree)	60% (OECD=92%; Korea=136%; Brazil among the lowest ratio)
Deficit in absolute numbers, with current levels of coverage	250,000

Source: Own elaboration, on data from the Anuário Brasileiro de Educação 2014 and OECD 2014.

Table 5 – Years of Schooling: inequities (ABE 2014)

White	8.3
Black	6.4
20% poorer	7.7
20% richer	11.7

Table 6 – Health expenditures per capita: selected countries – 2005 – 2005

Country	Government expenditure per capita (US\$)	Government expenditure per capita (US\$)	Total expenditure per capita (US\$)	Total expenditure per capita (US\$)
Brazil	164,0	293,0	371,0	662,9
Average OCDE (without EUA)	2518,2	2256,3	3323,6	2989,2
Average Am. Latina (without Cuba)	174,8	335,2	355,4	674,3

Fonte: World Bank (2008) e WHO Statistics Report (2008). Elaboração própria.

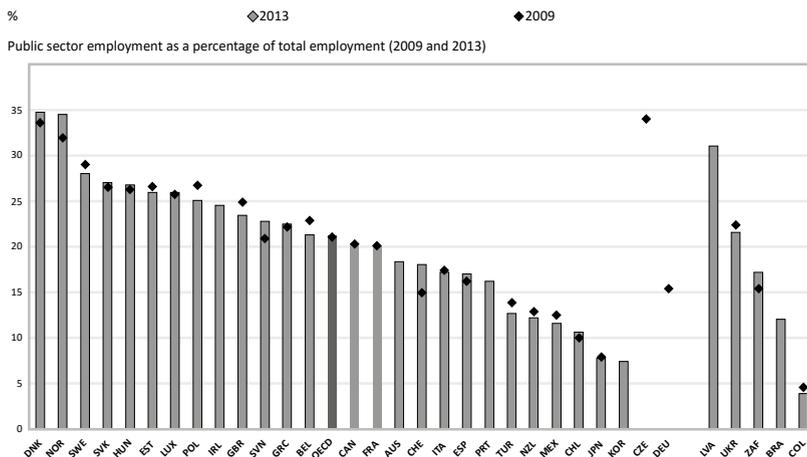
Tabela 7 - Education Current Expenditure (2011): Brazil x OECD

	% GDP	Primary (per student)	Secondary (p.s.)	Tertiary (p.s.)	Preschool 3-6 (p.s.)
Brazil	5,85 (24/37)	2,673.49 (32/37)	2,662.3 (35/37)	10,901.95 (23/37)	2,345
OECD	6.07	8,295.84	9,280.48	13,957.75	7,446

Table 8 - Composition of the Union's social spending: 2006-2013

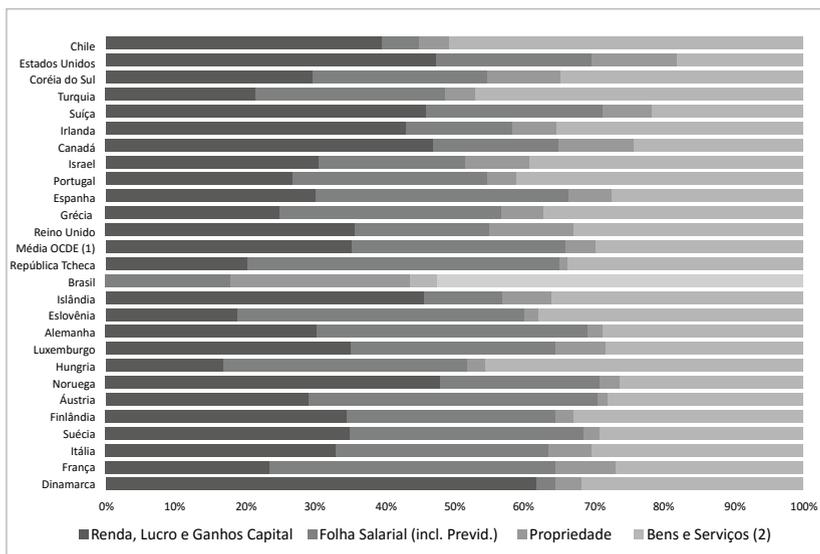
% Social Expenses	2006	2007	2008	2009	2010	2011	2012	2013
Social Security	68,0	66,0	65,5	63,5	63,4	62,2	60,2	60,0
Health	12,1	12,1	12,1	12,1	11,5	11,9	11,6	11,0
Social Assistance	7,0	7,2	7,5	7,6	8,2	8,1	8,3	8,4
Work and Employment	5,2	5,5	5,8	6,5	6,2	6,3	6,2	6,5
Education and Culture	5,6	6,3	6,7	7,5	8,8	9,3	9,6	9,6
Agrarian Organization	1,5	1,6	1,3	1,5	1,1	1,3	0,8	0,9
Basic Sanitation and Housing	0,6	1,3	1,2	1,2	0,8	0,8	3,3	3,6

Fonte: Ceccato 2014.

Graph 1 – Public Employment OCDE and Nrazil 2009-2013

Source: International Labour Organization (ILO), ILOSTAT database. Data for Italy are from the National Statistical Institute and the Ministry of Finance. Data for Portugal are from the Ministry of Finance. Data for Korea were provided by national authorities.

Graph 2 – Composition of the tax burden: Brazil and OCDE 2012



Fonte: Nascimento 2015.

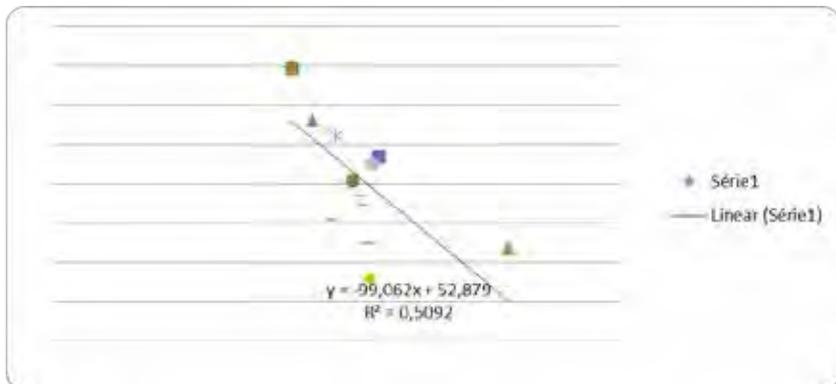
Table 9 - Gini Index and Public Employment/Total Employment: OECD 2013

2013			
Initials	Country	Gini	Public Employment/Total Employment
DNK	Denmark	0.251	34.89103489
NOR	Norway	0.253	34.61538462
SWE	Sweden	0.274	28.09530895
HUN	Hungary	0.288	26.83668996
LUX	Luxembourg	0.299	26.06761566
CAN	Canada	0.316	20.42670547
AUS	Australia	0.324	18.39645525

ITA	Italy	0.325	17.32111394
NZL	New Zealand	0.333	12.39053895
JPN	Japan	0.336	7.938520044
GBR	United Kingdom	0.344	23.49271855
MEX	Mexico	0.482	11.78059507
BEL	Belgium	0.264	21.45774011
FRA	France	0.306	19.8439653
GRC	Greece	0.338	22.6173842
TUR	Turkey	0.412	12.85986315
DEU	Germany	0.291	15.39857192
CZE	Czech Republic	0.251	34.01787488

Source: OECD 2015

Chart 3 – Gini Coefficient Dispersion – Public Employment/Total Employment. OECD 2013



Source: Prepared by the author. OECD 2015.

ADVANCES AND CHALLENGES FOR SOCIAL DEVELOPMENT IN BRAZIL

Tiago Falcão and Patricia Vieira da Costa

Introduction

Social progress in the past decades has made contemporary Brazil a very different country from what it was before the 1988 Federal Constitution. This process of improvement has gained speed in the last 15 years, as shown by recent evolution in social indicators. In a few years, Brazil, which had constantly been cited as an example of unequal society, gained international recognition for the quality of its social policies, for boldness in their implementation, and for the results achieved. International organizations such as the World Bank refer to the past 10 years as "the golden decade in Brazilian social development" (WORLD BANK, 2016).

Despite the progress achieved, the fiscal crisis and intense post-election political debates have brought up questions on the quality, scope and sustainability of social policies – topics which had been dormant and once again pervade the national agenda.

Based on a lecture given at the International Seminar *The Role of the State in the 21st Century: challenges for public management*, and in light of the theme proposed by the event, this text reminds that recent social gains largely stem from public policies resulting from informed policy decisions based on the provisions of the Brazilian Constitution of 1988. Although it recognizes the importance of the economic scenario to enable the project for extending social policies, it finds fault in interpretations that attribute advances only to the socioeconomic effects of growth. Moreover, it criticizes the simplistic

prescription of dismantling social policies as a solution to the country's fiscal situation.

The text is divided into six sections, following the structure of the lecture. After this *Introduction*, *Background* quickly explores social aspects of pre-Constitution of 1988 Brazil, as well as the situation immediately after its promulgation. Then, *Social Protection and Promotion System* discusses the development of public policies that have come to substantiate constitutional principles in the social field. The section *Results* reviews the fruits of this system in terms of improving social indicators. The item *Challenges*, in turn, addresses some of the most pressing issues on the agenda for coming years, and is followed by the *Conclusion* of the text.

Background

To understand the depth of the country's transformation since the 1988 Constitution, it is important to recall some of the historical elements of the social debt accumulated over the centuries in Brazil, and also national social characteristics immediately before the promulgation of the 1988 Constitution.

Brazil was the last country in the Americas and one of the last in the world to formally abolish slavery. For nearly 400 years, it developed a political, economic and social system based on slavery relations (PRADO JR., 1945). In the late nineteenth century, while Brazil discussed the end of slavery, neighboring countries like Argentina and Uruguay were debating universal access to education. Slavery and the delay in implementing policies to aid the poorest have left us one of the greatest known social debts.

In the twentieth century, Brazil has experienced a late, limited and subordinated industrialization process, which also resulted in substantial liabilities. Concurrently, an intense, rapid and disorganized urbanization process took place. In a period of just four decades,

the country's profile went from rural to urban in a disorderly way, with serious social consequences (FARIA, 1991). Add two decades of repressed social demands during the military dictatorship to these processes, and we will have the context in which the Constitution of 1988 was discussed and approved in Brazil, which was then considered the most unequal society on the planet.

Poverty afflicted more than 30% of the population and 15% of Brazilians lived in severe food insecurity or hunger situation. Child mortality was 50 per thousand live births, illiteracy reached 20% of the population and life expectancy at birth was less than 65 years¹.

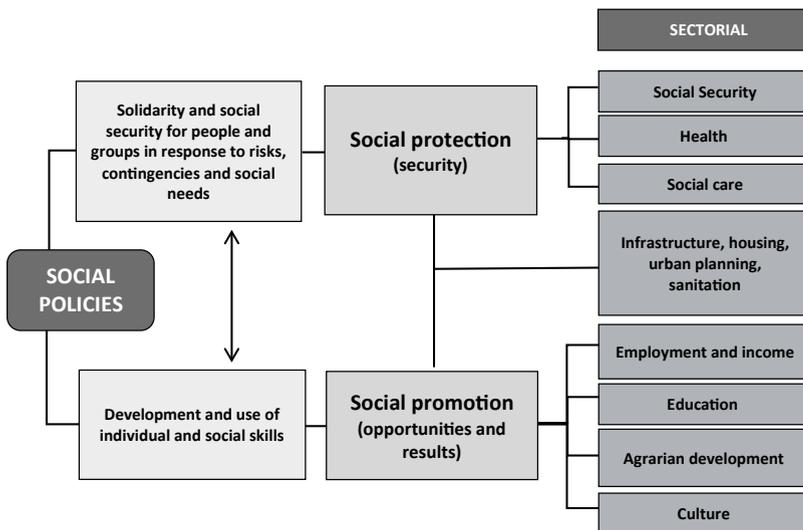
To address this situation, one of the fundamental principles laid down by the Federal Constitution of 1988 was to "eradicate poverty and substandard living conditions and to reduce social and regional inequalities" (Art. 3). The Constitution established the social rights to education, health, work, housing, leisure, security, social security, protection of motherhood and childhood, and assistance to the destitute (Art. 6). To structure the social policy systems that enforce these rights, the Constitution defined as guidelines: the universality of coverage and service, uniformity and equivalence of benefits and services for urban and rural populations, equitable participation in funding, community participation and decentralization of administrative management (Art. 194).

Upon its promulgation, the Constitution was criticized on very similar grounds to the ones used in our days. It was alleged that the Charter was anachronistic because it instituted a "Welfare State" at a time when other countries were dismantling their protection systems. It was also argued that the Constitution did not "fit" the Gross Domestic Product (GDP), i.e., that the wealth produced in the country was not enough to finance all the rights granted by the Higher Law. This topic fueled fierce debates in the late 1980s and early 1990s.

¹ Sources are the Food and Agriculture Organization (FAO) for food and the Brazilian Institute of Geography and Statistics (IBGE) for other information.

The social protection and promotion system

Since 1988, Brazil has developed a complex system combining social protection and promotion, with very comprehensive sectoral policies which involve capacity-building and risk coverage throughout the life cycle of its citizens.



Source: Adapted from Castro et al., *Gasto social federal: prioridade macroeconômica no período 1995-2010*

(IPEA Technical Note No. 9, 2012).

Public social spending (Federal Government, states and municipalities) exceeded 25% of GDP in the early 2010s (including expenditures on general workers' and civilservants' social security, health, social assistance, education, labor, housing and sanitation)². The benefit structure is equally sophisticated for those who are active in the labor market and for those who are inactive. In April 2015, 32.4 million benefits were provided by social security, including retirement pensions, non-contributory pensions and aids, involving both the

² As calculated by MDS' Secretariat for Evaluation and Information Management and by Jorge Abrahão de Castro, director of the Secretariat of Planning and Strategic Investment of the Ministry of Planning, Budget and Management (MPOG).

general pension regime (for the private sector) and its public service regime (for civil servants)³. The Unemployment Insurance Programme accounted for about 700 to 800 thousand benefits a month. There is also the Continuous Cash Benefit Programme (BPC), which paid 4.2 million welfare benefits in April 2015. And, of course, there is the Bolsa Família Program, which paid benefits to 13.8 million households⁴ in the same month.

Main Benefits	Inactive*	Active*
Contributory	<ul style="list-style-type: none"> Age Pensions Benefit for occupational accidents and diseases 	Unemployment insurance
Non-contributory	Social Assistance benefits (elderly and disabled)	Bolsa Família

Prepared by: Ministry of Social Development.

**Active or inactive in the labor market.*

Thus, more than 50 million benefits are paid to the population every month, which means a monthly transfer of 39 billion reais through social programs (social security and social assistance; some contributory, other non-contributory). The number of beneficiaries and the amounts involved indicate a robust system. But what results have been achieved from the implementation of this system?

Results

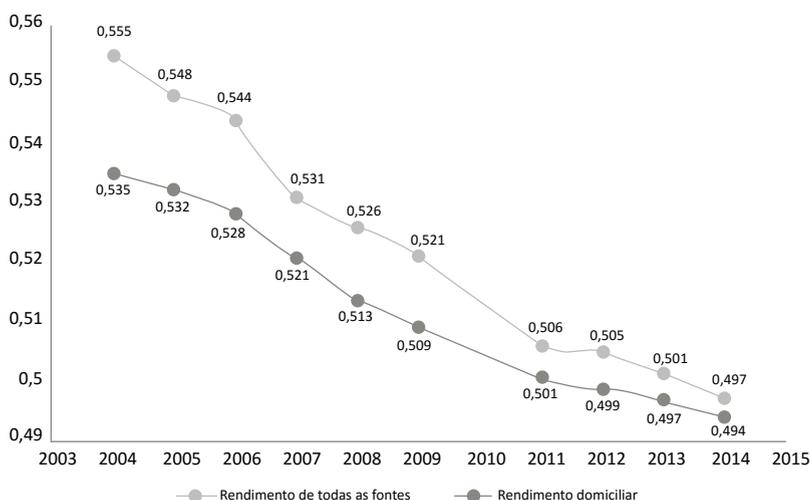
One of the most important outcomes of the establishment of the system described above was providing an unprecedented pattern of development for the country: for the first time, Brazil grew economically while distributing income. In the decade ended in 2014, there was a marked reduction in the level of inequality (see chart below) and

³ Informe de Previdência Social (May 2015, Vol. 27, No. 5).

⁴ MDS, Data Social http://aplicacoes.mds.gov.br/sagi-data/METRO/metro.php?p_id=4.

consistent increase in GDP *per capita*. This is explained by the policy to increase the value of the minimum wage, cash transfer programs, family farming support,, strengthened actions for employment formalization, and many other public policies. In short, the possibility of this new pattern of development is strongly related to state action; it has become clear that such a result is not a natural consequence of economic determinants, as these determinants had been observed in previous periods without similar impact on inequality.

Evolution of the Gini Index (2004-2014)



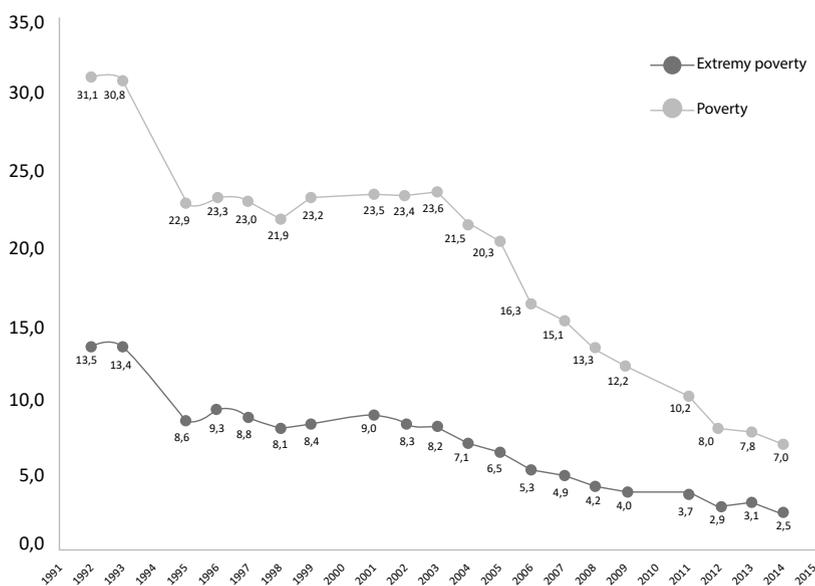
Source: PNAD/IBGE. Prepared by: SAGI/MDS

In addition to the reduction of inequality, there was also a substantial drop in the percentage of poor or extremely poor people in the country, as shown in the chart below. Increasing the income of the poorest population – which, in recent years, occurred more sharply than in other population income groups – is observed regardless of the poverty line considered.⁵ This was decisive to reduce both inequality and poverty.

⁵ Such as the national administrative poverty lines of the Brazil without Poverty Plan and the Bolsa Família Program (R\$ 77 *per capita* per month for extreme poverty and

According to the World Bank, extreme poverty can be considered eradicated when it affects less than 3% of the population. Based on information from the National Household Sample Survey (PNAD), the extreme poverty rate in 2014 was 2.5%, confirming that Brazil has managed to overcome poverty.

Evolution of poverty and extreme poverty rates (1992-2014) (% of the population)



Source: PNAD/IBGE.

Prepared by: SAGI/MDS applying the lines of R\$ 70 and R\$ 140 per capita per month, adjusted by INPC based on the year 2011 (year when the Brazil without Poverty Plan was launched).

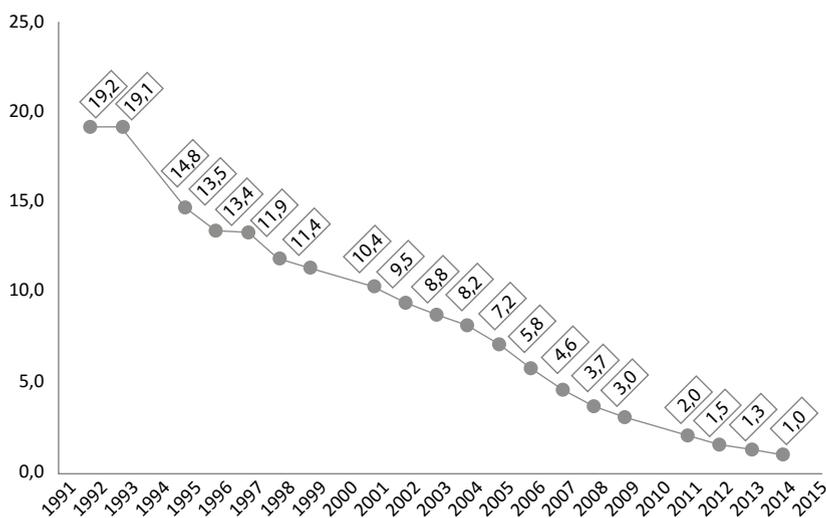
From a multidimensional perspective, i.e. taking into account not only income, but also other dimensions of poverty, such as health, education, housing and access to water and electricity, Brazil's evolution was even better. Unlike most countries, in Brazil multidimensional

R\$ 154 for poverty), the international line used to measure the achievement of the United Nations Millennium Development Goals (USD 1.25 per day for Purchasing Power Parity), and other lines used by researchers from national and international institutions in studies on poverty.

poverty is lower than monetary poverty, according to the United Nations Development Programme (UNDP)⁶. Brazilian uniqueness is due to the social protection and promotion system established in the country since the 1988 Constitution, which provides non-monetary benefits to the poorest families in the form of goods and services that are not offered in other countries.

The Multidimensional Poverty Index published by UNDP in its Human Development Report pointed to a multidimensional poverty rate of 2.9% in Brazil in 2014, and a severe multidimensional poverty rate of 0.4%. A World Bank multidimensional indicator registered 1% of chronic poor (poor from the monetary and non-monetary point of view) in the same year, as shown in the chart below.

Evolution of chronic multidimensional poverty rate (1992-2014) (% of the population)



Source: PNAD/IBGE. Prepared by: MDS, based on World Bank methodology.

The methodology used was developed by the World Bank including, besides income, information on six other dimensions:

⁶ According to the 2013 UNDP Human Development Report, the only country besides Brazil that has lower multidimensional poverty than monetary poverty is Indonesia.

education, access to water, sanitation, electricity, housing and goods. Articulating programs aimed at reducing poverty such as Bolsa Família, Water for All, Light for All and My House, My Life, through the Brazil without Misery Plan, has helped Brazil achieve this result.

This shows that, despite the relevance and wide recognition of Bolsa Família as one of the best cash transfer programs in the world (TEPPERMAN, 2015), its effectiveness is mainly due to Brazil's robust and complex social protection and promotion system, which includes universal provision of health and education public services, as well as a number of other programs, such as the ones mentioned in the paragraph above. This combination of policies brings the results that Brazil has achieved in recent years, as corroborated by analysis of international organizations (WORLD BANK, 2016; UNDP, 2014).

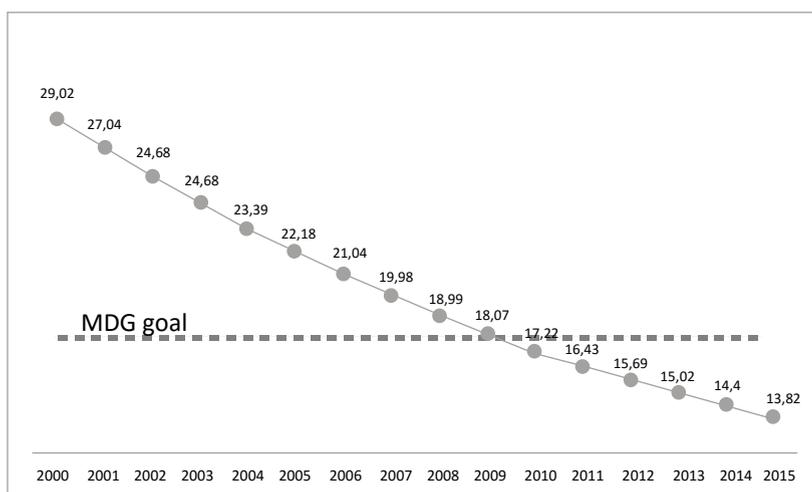
Another important collaboration to poverty reduction is the increasing formal employment –which result from strong state action, combined with economic growth. In this regard, it is worth mentioning the Individual Micro-Entrepreneur Program (*microempreendedor individual*, MEI), whose creation has allowed many self-employed poor people to access the benefits of formalization in a simplified, low-cost manner. In 2015, there were more than 5.6 million MEIs⁷ in the country.

With regard to food, data from the United Nations Food and Agriculture Organization (FAO) shows that, before the Constitution of 1988, about 15% of the population was in malnutrition situation. In 2015, this percentage dropped to 1.7%, removing Brazil from the World Hunger Map prepared by FAO. This is the result of several public policies to support family farming developed in recent years, including the National School Feeding Programme (*Programa Nacional de Alimentação Escolar*, PNAE), which in 2014 served more than 42 million students per day.

⁷ <http://www.portaldoempreendedor.gov.br/estatistica/lista-dos-relatorios-estatisticos-do-mei>

Child mortality is another important indicator because it implies issues related to health, education, housing quality and sanitation. In 2000, Brazil was in a difficult situation regarding child mortality, with 29 deaths per thousand live births⁸. There has been a strong downward trend in this indicator, reaching the target set in the UN Millennium Development Goals and coming very close to the results of neighboring countries. In 2014, the indicator was half the observed in 2000: 14.4 deaths per thousand live births.

Child mortality (deaths per thousand live births)



Source: IBGE.

Life expectancy at birth, another indicator reflecting a set of public policies⁹, has grown consistently, also signaling social progress in the country. Brazilian's life expectancy at birth, which was 71.6 years in 2004, rose to 75.1 years in 2014¹⁰.

⁸ According to data published in *Síntese de Indicadores Sociais: Uma análise das condições de vida da população brasileira – 2015*, by the Brazilian Institute of Geography and Statistics (IBGE).

⁹ Life expectancy at birth is a synthetic indicator of mortality, which combines a number of factors ranging from socioeconomic status to access to health services.

¹⁰ *Síntese de Indicadores Sociais: Uma análise das condições de vida da população brasileira – 2015*.

With regard to education, the average years of education have also grown consistently, from 6.4 years in 2004 to 7.8 years school years in 2014¹¹. Illiteracy between 15 and 24 years fell from 9.73% in the 1990s to approximately 8.3% in 2014, with marked reduction of regional inequalities, and ambitious goals for the future set out in the National Education Plan (*Plano Nacional de Educação, PNE*).

Challenges

The substantial improvement in social indicators described above does not mean that the country's social problems have been solved in recent years. Regarding child mortality, for instance, Brazil has advanced in international terms, reaching Argentina, but it is still behind Uruguay, Costa Rica and Chile (CECHINI, FERNANDO-MARTINEZ, ROSSEL, 2015). Therefore, we must continue improving our social policies while acting on new agendas.

Several of these agendas are related to the rapid demographic transition which Brazil is undergoing, with fast reversal of the age structure of the population. This structure is no longer pyramidal and now has the shape of a top. This change is due to a strong decrease in the proportion of children and young people (base), due to decreased fertility; and to an increase in the elderly population (top), resulting from increased life expectancy. This poses great challenges not only in terms of social security, but also in other areas such as health and housing. Furthermore, it sparks off a debate around new demands that are increasingly present on the public agenda: environmental issues, youth, early childhood and violence, which require new responses of the Brazilian government.

Another important issue is promoting equity. We live in a very heterogeneous country, from the regional point of view and from the perspective of specific populations. Brazil has advanced a lot in social

¹¹ *Idem*. Average schooling of the population 25 years and over.

indicator averages, but there are still alarming regional, racial, age and gender inequalities which must be addressed. In some instances, the discourse for universality arising from the Constitution of 1988 constitutes an obstacle to the development of policies designed specifically for the most vulnerable. This is because there are still some who follow the logic of "universality *versus* targeting" debate – a discussion from the 1990s, when it was said that, given the scarcity of resources, the solution was to target interventions, thus limiting the service to the poor. The contemporary debate is very different: the need of targeting certain populations as a means to bring them coverage, thus ensuring universality. The idea is to organize government actions differently for each region, for each municipality and for different populations; moreover, it is to do so by developing new arrangements, since, with the current design of public policies, many vulnerable people will not be incorporated in the required speed. The experiences of Brazil without Misery's active search approach, Bolsa Família and the Single Registry for Social Programs are central to this debate on targeting policies to the most vulnerable populations, and there is still much to advance and innovate in this area.

As regards education, health, and social assistance policies, one of the most important discussions today is on raising quality – which is a step forward in a debate started with discussions on access and universality. The guarantee of a minimum standard of quality in a social protection and promotion system as comprehensive as the Brazilian one (more than 200,000 educational units in 5,575 municipalities, to mention only the case of education) is a major challenge that requires discussion. In Brazil, the responsibility of municipalities in relation to social policies is very large, and many of them are not yet able to respond as expected by society. That is why federalism needs to be discussed more thoroughly, aiming to seek ways to reduce the risk of the federal government transferring financial resources to municipalities which will not meet expected standards in actions "at the end". That

is not so much due to embezzlement and corruption (although these are serious problems that need to be addressed), but mainly to the low administrative capabilities of many municipalities to assume such responsibilities in terms of social policy. By closely evaluating the funds transferred for health, education and social assistance services, one may realize that some municipalities are not capable to use the resources or fear doing it and becoming subject of investigations and accountability audits. All this needs reassessing so that a leap can be made in terms of quality in social policy.

Another issue is the amount of money invested. It is not uncommon to find analysts who make international comparisons on the quality of education with reference to spending in education as a percentage of GDP. The problem with this approach is that, although Brazilian spending in percentage of GDP is similar to Belgium spending, the *per capita* GDP of Belgium is much higher than the Brazilian one. That is, the amount spent per student in Belgium is much higher than the amount spent here, which undermines the comparison. This discussion is important because, although there is room for management improvements, the amount invested in social policy is directly related to the quality of services provided.

Also regarding funding, there is currently intense debate on budget, with questions returning on the sustainability of the model set by the Constitution of 1988, with recent addition of new elements. In this discussion, we must bear in mind that the Brazilian tax structure is highly regressive, so it "reverses" part of social policy achievements. A beneficiary of the Bolsa Família Program pays more than 30% of tax burden¹², which means that, from the amount received, at least 30% is absorbed in the form of taxes. It is evident that this tax structure which penalizes the poorest requires renewed discussion. Million-dollar tax waivers benefiting big businesses and bringing no benefit to the

¹² According to Jorge Abrahão de Castro, director of the Secretariat of Planning and Strategic Investment of the Ministry of Planning, Budget and Management (MPOG).

poorest strata of the population must also be taken into account in the debate on the fiscal space for social investment in Brazil.

Conclusion

Issues regarding social spending have a number of intriguing aspects. We have now returned to the debate that took place upon the promulgation of the Constitution of 1988: the Brazilian "welfare state" is not compatible with the national economy. There are even some who wish to reassess our Social Pact and the principle of solidarity that guides the Constitution. This debate requires attention, so that we can avoid setbacks in the social achievements of recent years.

For a long time, high rates of poverty and inequality were considered a natural stage in the development of nations. Many economists analyze this issue based on the "Kuznets curve" (in the form of an inverted "U"): poverty and inequality are part of the history of economic development, and will be resolved at the time when the Kuznets curve reaches its inflection point, when economic growth will be accompanied by a reduction in poverty and inequality. Such a perspective is so ingrained in Brazil that American historian Thomas Skidmore once said that if a movie were to be made about Brazilian economists, the title would be *"Waiting for Kuznets"* (SKIDMORE, 2004) – hoping that some day the poorest segments of the population would naturally be incorporated into the development process.

This notion no longer represents the majority view in international literature, having been called into question by thinkers like Joseph Stiglitz (2013) and Paul Krugman (2016). Not even the most conservative institutions, such as the International Monetary Fund (IMF) and the World Bank, embrace this vision. In recent reports, both institutions refer to poverty and inequality as an impediment to development (DABLA-NORRIS, KOCHHAR, SUPHAPHIPHAT, RICKA, TSOUNTA, 2015; CRUZ, FOSTER, QUILLIN, SCHELLEKENS, 2015), which must be addressed so that inequality between economies will not jeopardize the capitalist system – given the fact that the fundamental capitalist logics of

meritocracy and possibilities of advancement are undermined in extremely unequal societies.

Brazil has dared to change the Kuznets equation by showing that the fight against inequality and poverty is also a driving force of economic development. The advances made in recent years based on this new model are undeniable, but debate remains open. After all, income distribution is one of the most pressing and heated topics of our days.

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STATE CAPABILITIES AS A CHALLENGE TO PUBLIC POLICY*

Renato Boschi

Introduction

The concept of state capabilities has often appeared in political science literature since the 1970s, mainly in response to scant attention given in theory to the role of the state. Initially, that was due to the functional use of political system concepts in the analysis of modernization. Later, it derived from an attempt to operationalize its relations with society and the process of economic development, the state being an entity with unique capabilities, different from other actors or institutions.

When the state is brought back under the spotlight – for example, by the set of articles published by Peter Evans in *Bringing the State back in* 1985, preceded by Charles Tilly's ground-breaking "From Mobilization to Revolution" (1978), and by Peter Evans' more recent "Embedded autonomy: States and industrial transformation" (1995) – as a response to the said absence, it is then necessary to specify more clearly the kinds of capabilities which are created to give the state such a specific and distinctive role.

In contrast with these approaches, interspersed with absences and presences on state action, the state was rather emphasized in analyses on Brazil, both in approaches which identified patrimonialism as a typical feature of our tradition, and in economic history approaches, in which the extent of state intervention was highlighted as a key dimension of economic development. In the former case, one stressed mainly the appropriation of public space by segments of

regional elites, a significant aspect of the state field in Brazil. However, one disregarded this important dimension of interventionism, whose effectiveness depended on the creation of capabilities. Thus, the aim of this paper is to point out some areas of public policy for whose results the generation of capabilities is a key requirement.

The aim of this paper is not offering a historical overview on the use of the concept of state capabilities, presented along with different moments in the institutional trajectory of several Latin American countries, for example, in the period of democratization after authoritarian regimes. Instead, the goal here is to point out that, similarly to the pervasive silence in past discussions on the role of the state, contemporary discussion on varieties of capitalism, characterized by an emphasis on the role of companies, has also tended to give little space to the state as such. In proposing a variety of state capitalism to characterize the reality of many Latin American countries along their paths, it is then necessary to recover the notion of state capabilities as an important basis for analyzing and understanding different types of state interventionism.

In this context, this paper will emphasize some of these dimensions of public policy related to the concept of state capabilities as distinctive feature of the current concern about the role of the state in development, especially in recent studies regarding the return of a so-called “developmentalist” perspective. In recent years, this perspective has involved state action to promote social inclusion policies, thus establishing the possibility of a growth model founded on the domestic market, especially since the year 2002, through the 2008-2009 crisis and reaching our days. Thus, considering that this crisis at first led to a relative reconfiguration in in the international system, and also in view of the leading role that China has played in recent decades, we will take a comparative perspective to reflect on which and how certain state capabilities have shown to be strategic from the perspective of Brazilian development.

Thus, this text aims to guide discussion on a series of dimensions related to the dynamics of development, especially the nature of the new patterns of state intervention and political conditions in which the role of strategic actors and support coalitions are important for the design of a country project. In other words, we seek to analyze and define certain state capabilities in the formulation of a new public agenda. A more specific purpose would be identifying aspects of public policy aiming at Brazil's active inclusion in the new world economic order, while trying to explain comparative advantages of the country in this context, which allow changing its performance levels in strategic areas. To that end, we stress external factors which impact the success of such an agenda.

State Capabilities: dimensions and endogenous processes

In the history of capitalism, cases of successful development are scarce and concentrated in the North Atlantic axis (United States, Europe) and East Asian economies (Japan and Korea). In fact, the attempt to explain why a country can generate the conditions to modernize its productive structure is one of the major issues in development studies. Part of the literature seeks to analyze the role institutional change takes in development dynamics (STRECK, 2005; STRECK & THELEN, 2005; AMABLE & PALOMBARINI, 2009; HALL & SOSKICE, 2001). The understanding is that the institutional structure of a country shapes the dynamics of interaction between strategic actors for development, and therefore may promote or hinder economic efficiency. By comparative institutional advantages, we mean the benefits that an appropriate institutional framework provides for the consolidation of development dynamics. Underlying this assumption is the understanding that nations can thrive because they rely on institutional advantages to enhance innovation, diversification of production, income generation, and social inclusion. Therefore, it is

important to analyze the concept from both sectoral and comparative stances. A country may have advantage in one area and institutional weaknesses in another. Creating advantages in strategic areas for development is, in itself, a process of expanding state capabilities. In terms of methodology, in order to operationalize the concept, one could either identify certain capabilities in which a country excels or analyze strategic areas for development and assess the performance of each country in these fields (KJAER, HANSEN & THOMSEN, 2002).

The notion of state capability refers mainly to the ability of a state to set goals and fulfill them. On the one hand, such capabilities include, from the content point of view, certain policy areas usually considered critical in international strategic competition. On the other hand, these capabilities are related to the dimension in the strict sense of policy making, its implementation and monitoring, as well as the crucial aspect of coordination between various segments and ongoing initiatives at a given time. The capability of coordination also points to the centrality of consultation mechanisms and articulation between the public and the private sector for the implementation of common priority targets and the monitoring of initiatives. In the former case, examples of relevant areas are technological innovation and the theme of industrial policies, as well as development funding and promotion activities. In the second case, focus is more closely on the performance of different levels of the state apparatus and the links and networks established between them from the perspective of policy effectiveness.

According to Weaver & Rockman (1993), state capabilities include: i) defining priorities among the conflicting demands made upon the government; ii) targeting resources where they are most effective; iii) innovating when necessary, i.e. whenever old policies show signs of failure; iv) coordinating competing objectives; v) being able to impose losses on powerful groups; vi) ensuring the effective implementation of policies after their definition; vii) representing

diffuse and unorganized interests, in addition to powerful and more organized ones; viii) ensuring political stability so that public policies will have time to mature; ix) making and maintaining international commitments on trade and defense in order to achieve long-term well-being; x) managing political cleavages to ensure there is no internal friction. Stein & Tommassi (2007) add three capabilities to the list: i) ensuring the adaptability of policies when necessary; ii) ensuring consistency between the different spheres of policy, so that new policies will complement existing ones; iii) ensuring effective coordination between different actors in the same policy sphere.

The above points draw attention to political and bureaucratic political-bureaucratic dimensions of state capabilities. On the other hand, from the point of view of structural dimensions, one can also analyze state capabilities by focusing on a number of substantive contents of strategic policies towards a developmental project.

First, **innovation**, in both the private and the public sector. The relative position of a country or region in the international system is increasingly related to its ability to generate and expand the use of technology, as this is a key factor for achieving competitiveness gains, which, in turn, would ensure stronger presence in global markets. A historical examination reveals that development processes have been based on mass diffusion of technology as a guarantee that social progress will be irreversible. Such was the path of development by industrial revolution in classical models of development of the nineteenth century (United States, Germany, Japan) and of the Asian Newly Industrializing Countries (NICs) in the second half of the twentieth century (both the pioneering dragons Singapore and Korea and, later, the tigers Malaysia, Thailand, Vietnam), as well as the recent case of Ireland. These were all experiences in which special efforts were focused on increasing the capabilities of technology development and uptake by the population as a whole. Unlike Latin America, which had its era of growth grounded in the export of raw materials and foreign

industrial investment, these countries invested huge sums in research and development, university systems, technological and productive apparatus renewal. In a world characterized by the primacy of knowledge, Schumpeter's old dilemma about the need for innovation to survive is particularly relevant. Innovation is indeed fundamental because development is always connected to the replacement of existing products with more sophisticated ones. New technologies act as engines which can foster modernization of the productive structure as a whole and increase the general level of productivity.

The processes that involve knowledge generation and innovation have been thoroughly renovated. These processes do not occur only in companies, universities and public and private research institutions. New forms of research organization and product and process development, different environments for generation and diffusion of innovations, distinct business models, hybrids composed of markets and business networks are emerging. In these new types of organizations, knowledge is both proprietary and fragmented in multiple entities, often flowing freely in databases, wikipedias, knowledge commons (OSTROM, 1990), incorporated in intangible assets, whose value becomes difficult to measure (TEECE, 2002). Such intangible assets are traded in different ways and in different emerging market structures (BURLAMAQUI, L., CASTRO, AC & KATTEL, R., 2012). Catching up or technology convergence paths (NELSON, 1993) conceived as inevitable paths for the development of emerging countries are reviewed in light of the recognition that the technological frontier is rapidly distancing, slowing down its relentless pursuit.

Middle-income countries like Brazil, Argentina, China and India are at constant risk of being caught by technology pitfalls that may cause relative loss of the international competitiveness for their products. As innovation takes unexpected features and pace due to an ever-moving technology frontier (the endless frontier), experiences, however successful, have been characterized by continuous sequences

of “catching-up and fall-behind” processes – thus imposing new, increasingly challenging obstacles (WU, MA & SHU, 2010). This process has come to characterize what was recently described as the “middle-income trap” (ANGANG, H., 2011), in which countries that attempt technology convergence get caught.

Overcoming the so-called trap then depends on assessing the conditions for the competitive and strategic insertion of Brazil and other middle-income countries. The ability to escape the trap seems to be linked to three conditions: 1. Ability to define “secondary innovation” paths, i.e. competitive technological routes around the frontier of the product/process/knowledge base; 2. Possibility of overcoming the almost inevitable crisis of limited capability to innovate through dynamic capability-building and institutional comparative advantages; and, what only a few countries can achieve, 3. Ability to define the technological frontier.

Thus, the assessment of compared state capabilities with regard to innovation and knowledge governance cannot fail to promote a conceptual update considering ongoing transformations. This is not only to assess comparative institutional advantages and capabilities to implement innovative strategies and policies, but also to project the future position of countries in international competition.

In second place are state capabilities to formulate and implement **industrial policies**. Development necessarily implies change in the productive structure. In Latin America, this issue has been thoroughly discussed, especially because of the historically tense relationship between agribusiness and industry. The argument of an unbalanced production structure, for example, referred to an industrial sector that absorbed funds without having generated them and an agricultural sector that was responsible for the generation of capital but had much slower growth.

The diversification of the production matrix requires the preparation and implementation of sectoral policies. Both funding

and clear strategies for the rural sector, the industry and the service sector are important. Neoliberalism has sold the idea that sectoral policies would not be necessary; they were considered inherently harmful, attracting corruption and rent-seeking. For a developmental strategy, on the other hand, these policies are essential to generate competitiveness.

A number of approaches to development, ranging from classical formulations by authors like Gershenkron (1962), to more recent ones, like Chang (2004, 2007), recognize that countries with high growth rates have not been the most open and liberal ones. On the contrary, they are characterized by implementing a series of active policies, especially industrial policies. In a world where competition for market access and technology generation and diffusion are central, sectoral policies cannot be ignored. The state must assume its role in fostering competitive industries, funding innovation in products and processes and mitigating the uneven impact of the so-called creative destruction process. However, this mechanism must be used sparingly and, above all, strategically in order to ensure support of the local private sector without breaking potential alliances at the regional level. In this way, it will be possible to compete with global players who have great power to change the dynamics of production, of which the emergence of China in recent decades is a case in point.

The predominance of the neoliberal perspective over the last decade of the twentieth century has made the use of the expression “industrial policy” less frequent, although the actual practice of governments was very far from acting exclusively to guarantee the mere operation of market forces. In fact, even countries which promoted reforms for the opening of national markets, for reducing the presence of the state in business, and for deregulating various markets have adopted active policies to attract foreign capital and stimulate exports (RODRIK, 2004). Especially in countries that, in the second half of the 20th century, bet on import substitution industrialization,

with high levels of domestic market protection and selective state support to different sectors, the industrial policy changed names and focus, and in some cases lost intensity. Very seldom, however, was it abandoned and replaced with state presence restricted to the enforcement of contracts, intellectual property rights, and free market operation. By the end of the twentieth century, given repeated crises in the international scenario and the controversial results – to say the least – of market reforms in countries that adopted them more fully, the borders between discourse and practice had started to fade. The concept of industrial policy, which had been stigmatized as a tool for the orchestration of spurious schemes between state bureaucracy and business sectors, or condescendingly admitted when geared only to *correct market failure*, was then rehabilitated.

The comeback of the notion of industrial policy does not mean, however, a convergence of views in relation to its scope (RODRIK, 2004; WADE, 2004, 2010; BIANCHI & LABORY, 2006). From a *minimalist* perspective, today's industrial policy would involve a set of measures to overcome the resistance of firms to change and adaptation to an increasingly competitive environment, resulting from difficulties experienced by economic actors to master the complexity of change processes and identify their meaning. A so-called *maximalist* perspective would point out that actions for research infrastructure and human capital development, combined with an emphasis on collaborative processes involving multiple institutions at the local and regional levels, are not enough for articulation between *domestic integration* and *international integration* of developing economies. Without the combination of these two dimensions, both actions aimed at promoting technological development at the local and regional level, and support for international integration may have little impact in boosting the national economic arena.

Strictly speaking, difficulties in the development of innovative activities in developing countries tend to lie more in the realm of

demand than supply of human resources or existence of research infrastructure (RODRIK, 2004). Therefore, without the presence of a diversified industrial structure, possibilities for changing such a scenario are reduced. Besides, international integration focused only on specialization in certain comparative advantages tends to accentuate the vulnerabilities of the national economy, thus lessening the chances of domestic integration. In this sense, industrial policy for developing countries could not fail to include the maintenance of typical import substitution instruments, favoring the internalization of innovative activities capable of increasing the competitiveness of domestic production, both domestically and abroad (WADE, 2004). On the other hand, it would also imply the exploitation of existing comparative advantages to increase presence in the global market, linked to the promotion of activities that concurrently stimulate *domestic integration* and *competitive insertion* in *international integration* within a coherent development strategy.

Third are capabilities to generate **infrastructure** for development. Infrastructure is defined as the “set of engineering structures and facilities – generally of longer economic life – that forms the basis for providing the services needed for development for productive, political, social and personal purposes” (IDB, 2000). This includes electricity and forms of energy, telecommunications, transportation, water and sanitation networks, among others. Infrastructure is essential for the establishment of economic growth and social improvement objectives. It guarantees competitiveness, special access to input and outputs, thus impacting productivity and development as well. The infrastructure of a country must be such as to allow for both external and internal territorial articulation, and it must evenly cover the entire national territory in order to meet the social and economic needs of actors. Investments in social infrastructure by semi-periphery countries are still insufficient to fulfill the needs of large segments of the population. The expansion of such an infrastructure becomes even

more important for the development of these countries as we observe that their social mobility in recent years has broken the boundaries of social sensitivity of groups that had been excluded from the universe of protections. A key aspect concerns the possibility of funding for investment in infrastructure, whose implementation has strong impacts from the point of view of employment and, therefore, on the social protection of labor.

The **forms of social protection** are the fourth of the so-called “structural” dimensions that make up the substantive agenda of public policies suggested in this paper. The main task for the current development strategies is to restore the centrality of social policy, as conceived by Karl Polanyi (2000) based on the concept of embeddedness of economic structures in the protection of communities. In recent years, the idea that social security systems are important foundations for economic development has been gaining ground. Currently, in the field of social intervention, increasing exclusion has been the great driver of government actions and also the *final object* of such an intervention. However, it is particularly in peripheral and semi-peripheral societies that the fair priority concern about the excluded cannot be considered without taking into account the destabilizing factors related to structural weaknesses of the labor market and protections. In these countries, a growing number of workers is in a gray area, moving between different work situations. The centuries-old persistence of inequality is at the heart of society, and not only on its fringes. It constantly reproduces an heterogeneity of working conditions which ultimately feeds back the increasing number of excluded citizens.

Finally, sustainability currently appears as a critical dimension in terms of new state capabilities required from the developmental state of the 21st century. In this sense, one must also examine how **environmental resources** are managed and how they are strategically designed to ensure efficient exploitation combined with long-term

preservation. Therefore, the relationship between actors and interests around energy policy, minority rights policy and environmental policy is a critical element in the dynamics of development, quite differently from the periods of classical, second-, and third-wave industrialization. First, as in the past, energy policy is a strategic element in models with strong state induction of the development process, as energy generation is a *sine qua non* condition for the promotion of industrial and technological development policies. Second, however, unlike previous conditions, energy policy is a case in point to illustrate the contradiction between infrastructure policy and environmental policy. In contemporary policy, state action in the field of large infrastructure projects in the early twenty-first century must take into account civil society organizations (such as indigenous movements, movements of people affected by dams, and environmental movements). Besides, such policies need to be jointly designed by multiple departments within the government apparatus involved in different areas of public policy such as energy policy, transport, minority rights and environmental policy.

From an analytical point of view, consideration of the above-identified structural dimensions does not imply an assessment of each one as installed capacity, presence or absence of certain resources, but rather consideration of the possibility of efficiently establishing and fulfilling objectives. In this sense, political-bureaucratic capabilities may be conceived as an independent variable, crossing the structural dimensions of the development agenda.

Support Coalitions and the Definition of a Development Project

The debate on new developmentalism (BRESSER-PEREIRA, 2014; BOSCHI & GAITÁN, 2008) raises a series of questions which have been left aside by the neoliberal rhetoric. Such issues include the role of

the state, relationship with the market, establishment of the public agenda to achieve sustainable growth, the role of political institutions and the government and, crucially, the importance of institutional change. As previously argued, the state is reinstated as a key actor for generating a development dynamics. In an attempt to address the working dynamics of the state apparatus, it is necessary to analyze it as a set of structures, actors and procedures in the context of the capitalist mode of production. Thus defined, the state is presented as a competitive arena, stirred by the interest groups of capital and labor, collective actors within and around the state apparatus, and the manner in which goals, strategies and means are defined in order to achieve growth and development.

Although part of the studies on new developmentalism restrict their analysis to the economic issue, we assume that the possibility of consolidating a developmental platform is directly related with the formation of coalitions to support a national development project. Therefore we stress the political issue as part of the dynamics. Indeed, our hypothesis is that development is only possible when there are leaders to establish a “historical bloc” that is efficient not only in drawing up a development agenda, but also in blocking potential opposition from strategic actors with alternative proposals. The eventual conception of a national development project, which is increasingly important in a changing global capitalism, largely depends on domestic support coalitions that will buy into new common goals and visions. The possibility to change a vicious trajectory depends on the existence of a broad coalition to support a post-neoliberal project involving economic, political and social elites.

The failure of neoliberal policies, as extensively discussed, has raised the possibility of setting a new agenda, comprised in center-left party platforms of several Latin American countries (BOSCHI & GAITAN, 2008). In Brazil, the return of the state in the public agenda was promoted by a labor front, led by the Workers Party (PT). Thereby,

it started to implement a series of topical and targeted policies labelled “neodevelopmentalist” but which in fact more broadly served the interests of national capitalism. Ultimately, it was an articulation involving participation of the financial sector (with the maintenance of monetary stability and high interest rates) on the one hand, and of the agricultural export and raw-material export sectors on the other, as well as industry sectors (through BNDES funding and programs, among other factors).

On the other hand, the strong emphasis on social inclusion programs – a priority of Labor governments – had such distributional implications that it offered the prospect of a development model based on the expansion of the domestic market. More recently, the public agenda has been gradually diversified and redefined with decisive action in reducing interest rates, currency devaluation, as well as other tax relief measures aimed at reversing a framework which leaned to de-industrialization in the country, as, for example, the reduction of energy costs. All these measures aimed at incorporating the interests of the industry, a fact that meant redefining the original pact.

However, the impact of the 2008-2009 systemic crisis has been felt over time, in a process we could call crisis endogenization. This has led to the recent adoption of neoliberal fiscal adjustment measures, and, consequently, to reversal of the previous framework. Without judging the merit of adopting restrictive measures, the question that arises in this context concerns the possibility of forming a new coalition to support a development project defined in terms of raising the value of the Brazilian productive matrix, expanding it domestically and internationally, engaging the set of state capabilities described above. In particular, innovation policies and industrial policies become critical in the sense defined by Castro (2012) – as “visions” of the country, capable of raising the productive matrix to a frontier technology level. To this end, it would be necessary to have state policies which would not be impacted by discontinuities caused by potential changes of

government after elections, as well as drastic changes in the substantive content of government platforms.

On the subject of coalitions, two essential theoretical aspects must be considered: first, the dynamics of inclusion/exclusion of interests in forming support coalitions; second, the importance of democratic political and electoral institutions and arenas for participation and consultation with different social actors.

Regarding the first aspect, analysis must highlight the importance of an inclusive social pact involving reconciliation of diverse interests in some key dimensions. For example, it is clear that business strategies emphasize very limited aspects which, while favoring the industry as a whole, ultimately confront the interests of labor, demanding the loosening of labor legislation and reduction of labor costs. As discussed, labor protection mechanisms are at the core of the dynamics of capitalist performance and development. Social movements express silenced interests and, accordingly, an examination of the main claims of such movements ought to include the analysis of excluded interests in order to attest to the strength of such pacts.

In the second sense, the argument is that democratic institutions imply transaction costs which can be recovered, nevertheless, through legitimation gains. A solid pact is one whose legitimacy is not questioned and to which institutionalized negotiating arenas may contribute.

The relationship between **political institutions** and economic and social development has long been on the agenda of scholars and policymakers, and continues to cause controversy. Since Polanyi (2000) we have known the importance of institutions to curb the destructive tendencies of the self-regulated market. Marshall (1973) highlighted the obstacles for the exercise of democratic citizenship given a very strong pattern of social inequalities. According to the theory of modernization, the emergence of democracy would be an endogenous consequence of economic and social development. If we review the

ideas of Lipset, Przeworski, Alvarez, Cheibub and Limongi (2000) we will notice that they consider democracy exogenous to development. Yet, they agree with Marshall in affirming that performance is affected by surrounding conditions.

Therefore, despite any agreement on the existence of links between political institutions and economic and social development, the nature and direction of such connections remains controversial. In the so-called developing countries, significant variations are observed with regard to existing political institutions. The most conspicuous differences are related to domestic political regimes, ranging from democracies to autocracies. In the universe of polyarchies (DAHL, 1989), it is worth noting important distinctions from democratic models (LIJPHART, 2003) and levels of polyarchization. Autocracies, if we can characterize the cases of Russia and China as such, also face, each in their own way, different challenges in terms of capabilities in the areas of identified policies.

As Przeworski argues (1991), under democratic capitalism there are two different yet complementary resource allocation mechanisms: the state and the market. The former is informed by the principle of authority and the latter by the principle of ownership. Thus, the author states, under democratic capitalism citizens can decide on the allocation of resources they do not possess and they do so through political institutions that allow them to voice their preferences about alternative courses of action to be followed by the state in the implementation of economic and social policies. The same could not be said on the exercise of the principle of authority by autocratic states where who decides, how s/he decides and on behalf of whom s/he decides on the allocation of resources under state authority and who controls and monitors such allocation decisions is farther away from the exercise of political sovereignty for the expression of preferences.

It is thus relevant to look at how different domestic political regimes affect economic and social development. It is particularly

relevant to evaluate their effects on the building of capabilities required for relevant actors (Executive Power, Legislative Power and citizens) to produce public policies which express consistent decision-making and allocation standards for the tackling of issues on the social and economic agendas of these countries.

Depending on the combinations between institutions and conditions, it is worth examining how rights and resources are distributed among relevant actors and translated into capabilities. To that end, three analytical movements are necessary: in the first, political institutions must be described and analyzed, with emphasis on the following dimensions: method of creation of decision-making institutions; decision-making rules; composition of decision-making institutions (SARTORI, 1994). In the second, one must examine how these institutions distribute rights and resources to the relevant actors (Executive Power, Legislative Power and citizens). In the third, how such rights and resources are translated into capabilities required for the creation of public policies for development.

Finally, it is worth mentioning that speaking of state and citizen capabilities does not mean examining them only at the domestic level, but also at the regional and systemic level, since today development necessarily involves the definition and implementation of public policies (including foreign policy) at all these levels, which are interconnected in complex ways. At the regional level, it is also necessary to look at capabilities relating to regional integration and the exercise of leadership; at the international level, it is worth considering those related to cooperation between countries and their participation in multilateral organizations.

Conclusions: state capabilities, institutions and relations between internal and external spheres on Development

In the field of political economy, literature on varieties of capitalism (VoC) analyzes the patterns of interaction of strategic actors (particularly businesses) in different production systems. Based on a set of criteria, Hall & Soskice (2001) present two ideal types of capitalist economies: coordinated market economies and liberal market economies. Based on this theoretical framework, Becker (2014) draws a distinction between ideal types and empirical cases, stating that national economies may find themselves closer to an ideal type or another, or present a combination of elements of both types. Another line of studies (SCHMIDT, 2006; BOSCHI, 2011) introduces the importance of the state and its institutions to the configuration of the varieties of capitalism or modes of development.

The central point in this literature – similar in orientation to the one developed by the French school of regulation – is precisely that diverse performance, competitiveness and even catching-up strategies result from a combination of different dimensions of production systems and the institutional environment where economic actors and firms operate. In other words, endogenous processes have an impact from the perspective of international insertion of countries. This also means that domestic production arrangements are subject to changes that alter the configuration of varieties of capitalism, either toward more market-determined systems or toward more centralized coordination, with greater or lesser state intervention. Thus, it would be relevant to identify institutional change processes in a given time period in order to verify how close or far a certain country is from the ideal types.

Different trajectories and institutional matrices would result in different varieties of capitalism, in which state coordination is more or less central. In the case of emerging countries, the state is certainly

decisive in breaking with inefficient patterns, rigid structures, vicious circles of inequities by effectively introducing a new development pattern. Hence the importance of equally evaluating how state elites in prominent positions devise medium-term strategies for the country given the policy instruments at hand. However, it is also important to identify the main axes of current policies which can help follow a new path. Comparative analysis of the dynamics of market expansion through proactive policies and the building of domestic support coalitions are essential to the success of such strategies, especially in terms of links between political coalitions and international arenas with the aim of taking competitive spaces in the new scenario.

Development, as emphasized throughout this paper, is a polysemic concept and its meaning has changed over time, from the first studies on production factors and causes of backwardness to the United Nations contributions to sustainable development. In this text, we discuss socioeconomic development as a dynamics resulting in diversification of the production structure, innovation and national control over the economy, as well as job generation, income distribution and social inclusion, i.e. a welfare project connected with citizenship rights. In this sense, development refers both to the qualitative aspects of capital accumulation and economic growth and to social protection, also including a sustainability dimension, linking short-term goals with a long-term perspective through concern with natural resources and environmental protection. Politics is a key component in this dynamics, which is not limited to achieving economic growth, both in terms of process and in terms of institutions devoted to these goals.

Thus understood, development is an internal process, closely linked to the emergence and consolidation of states with capabilities to intervene in the economy and society. Furthermore, a central aspect of the concept applied in this study is that development involves both internal processes and changes in the relative power of countries in the international scenario.

As noted, one of the axes we highlight refers to a particular understanding of how center/periphery relations are rearticulated in the international capitalist system according to the cyclical crises and China's strong inducing power in this context. As we have argued, the recovery and success of certain countries in promoting policies to achieve higher levels of development requires state capabilities. First are bureaucratic capabilities, which are necessary to support the strategies implemented. Second are specific capabilities to renovate the production matrix through industrial policies and the possibility of formulating a strategic vision for technological innovation processes capable of developing the country, which also requires the consideration of sustainability and environmental resources – energy and others – as critical elements.

Another axis is related to the fact that the possibility of domestic expansion – fostered by the adoption of social inclusion policies with distributional effects which alter the population's consumption patterns – is another key element. It is important to note that this window of opportunity opens to a rather small number of countries, either due to the size of their domestic markets or to their specific trajectories. Here, it is also worth mentioning the importance labor protection mechanisms at the core of the dynamics of development, a dimension that has been present in the Brazilian dynamics historically, and in recent times, especially through the policy to increase the value of the minimum wage (BOSCHI *apud* BECKER, 2014).

Moreover, as emphasized, such a development project also implies another axis concerning support coalitions. In this sense, a more inclusive project, meeting the needs of both capital and labor, would be essential for the establishment of a social pact. As a project of this nature varies over time, it is important to note that a more consistent formulation depends on the dissemination of ideas which take different paces at different times, depending on the articulation of different private and public arenas. In recent times, as some studies

have pointed out (BRESSER PEREIRA, 2014), its potential definition as a national project, legitimized by democratic institutions, comes to the fore. New arenas of negotiation and participation are the result of institutionalization and expansion of democracy, and therefore constitute comparative advantages, although the democratic process makes the game more complex by allowing for conflict, on the one hand, while setting more legitimated goals.

Finally, we have argued that a continuous path in the role of the state has generated the accumulation of public bureaucracy capabilities in terms of policymaking and implementation capacity. As extensively described in the literature, the association of state capabilities with the strengthening of democracy (TILLY, 2007) favors the achievement of negotiated, more consensual results and fosters credibility in the international system. Consequently, it impacts the levels of foreign investment in the country. Democratic institutions may increase transaction costs, but they reduce uncertainty about erratic decisions.

Institutions shape the relationship between actors, the modes of policy implementation, as well as their results and impact. In this sense, analysis of the political and institutional scenario is a key dimension for the possibility of changing the relative position of Brazil in the international context. The strengthening of state capabilities is expressed in strategic areas for development agenda, such as the ones discussed in this paper (social policy, education and technical training, investment in science and technology, international capabilities, macroeconomic policy for development), as well as in the potential ability to articulate consensus around a developmental agenda (articulation between strategic actors, constitution of support coalitions, ability to achieve policy stability).

As noted above, however, it is not enough to have only domestically established processes. Internationalization of the production matrix and all the processes inherent to a country's projection abroad are also an important axis in the new dynamics of

development. A strategic approach at the regional level could help facing competitiveness-related challenges imposed by globalization and the redefinition of the international scenario.

The reconfiguration of power relations in the international system and the increased possibilities of thinking Brazil's role stress the need to think more thoroughly about the recovery of the state's role as a key player in the development process. Countries with higher growth rates (China, Korea, Taiwan) have historically been those with greater state capabilities. Therefore, analyzing the state and its institutional capabilities is key to the strengthening of development dynamics. The limits and boundaries in periphery and semi-periphery are far from static, regularly changing direction. Countries in privileged position may lose it; states with potential for growth may «take the leap». On the other hand, China's entry into the international arena as a relevant actor has profoundly altered the structure and relationships in the capitalist system, thus constituting one of the core elements in the reconfiguration of ongoing center/periphery power relations.

There is evidence that the present context is rich in possibilities and opportunities typical of moments of crisis and paradigm shift. In this scenario, one can thus assume, a sustained growth cycle will heavily depend on increasing state capabilities as a challenge to public policies and the consequent generation of advantages at the institutional level.

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