ISSN 2364-0790
Proceedings of the Symposium on Business and Economics in Times of Crisis Vol. 3 (2015)
Lupcon Center for Business Research

An Integrated Overview of Innovation to Overcome Economic Crises: Past, Present and Future

Elisabeth T. Pereira
(Department of Economics, Management and Industrial Engineering and Research Unit in Competitiveness, Governance and Public Policies (GOVCOPP), University of Aveiro, Portugal)

Preliminay Draft

Abstract
The main goal of this paper is to analyse the importance of innovation to overcome crises in modern economies at an evolutionary perspective. The understanding of different frameworks of innovation, with a particular emphasis on the effects of innovation and governmental incentives to innovate, as relevant issues to overcoming economic crisis, especially if studied through an integrated framework of innovation to overcome economic crises in long business cycles over time.
The methodology of the present paper is based on a survey on a wide literature review and analysis of case studies that will perform the importance of innovation to overcome different crisis.

Key words: Innovation, Economic Crises, Schumpeterian Framework, Innovation Theories, Business Cycles.

1. Introduction

Innovation acquired a critical and central importance in contemporary economies. It's a key driver of the improvement in consumers' living standards, the growth and success of firms, and also for the wealth of nations. Innovation is related and strongly supported in research and development (R&D), being R&D essential for firms and nations to produce innovations and compete for a better future (Tellis et al, 2009).

The crises that occurred in the last century, and particularly the recently crisis of 2007, reinforces, according to Applegate and Harreld (2009), that financial and economic crises provides a sobering reminder of what happens when innovation fails to drive productive economic growth. What finds the words of the former European Commission President, Durão-Barroso (2009), that "*Economic crisis makes creativity and innovation in general and social innovation in particular even more important to foster sustainable growth, secure jobs and boost competitiveness*".

The principal concern of this paper is to analyse the importance of innovation to overcome crises in modern economies at an evolutionary perspective. The understanding of theoretical models of innovation, with a particular emphasis of the effects of innovation and the governmental incentives to innovate, are very important to overcoming economic crisis, which is supported by previous empirical evidence, especially if study through an integrate framework of innovation to overcome economic crisis in business cycles over time.

The methodology of the present paper is based on a survey on a wide literature review and analysis of case studies that will perform the importance of innovation to overcome different crisis.

Despite the increasingly strong evidence about the importance of innovation as a central force to overcome crises, the surveys with a general overview about empirical studies and approaches evidencing innovation to overcoming crises over the time are scarce. In this sense, one hopes this study contributes to a better overview knowledge and understanding of the relationship between innovation and economic and financial crises.

The present paper is structured in five parts. After this introduction, that introduces the relevance, pertinence and description of the theme under study, section 2 presents the different frameworks to explain

how innovation drives economy over different time perspectives. Section 3 describes, in an evolutionary approach, the crises through time based in some case studies and presents empirical evidence about innovation and strategies to overcome crisis. In section 4, after analysing the past and the present, in the previous sections, disserts about the future on innovation in modern economies. Finally, section 5 concludes.

2. Different Frameworks to Explain How Innovations Drives Economic Development

Different frameworks try to explain how innovation drives economy over time, through its influence on economic growth, improving population welfare, new products, processes and services. In some of this times occurred crisis, that induces Schumpeter (1939) to postulate that crises were seedbeds of innovation and entrepreneurship. Innovations developed during crises stimulates the *creative destruction* that launch new technologies, remake existing industries, and give birth to entirely new ones - setting in motion new rounds of economic growth. Schumpeter (1939) refers to the connection crises-innovation-economic growth, in which the clustering of radical innovation forming booming clusters driving the capitalist business cycle.

This macro level framework is supported by the relations identified between long waves, depression and innovations by Kleinknechet (1986, 1987, 1990). This framework postulates that long waves occur along the business cycle where a depression is succeeded by a wave of innovations successively since 1750 till the twenty century.The waves are based on product-related key and master patents from Baker (1976) classified according to Kleinknechet (1986:93).

Similar to Kleinknechet (1986:93), Perez (2011:107) identifies, in a historical record, bubbles prosperities before periods of recessions, followed of golden ages periods characterized by important innovations. This occurs systematically over time, succeeding in the long business cycle.

Others long waves, which verifies the succession between prosperity, recession, depression and recovery, with occurrence of innovations, are related also by the authors Bieshaar and Kleinknecht (1984), Freeman (1982), Marchetti (1980), Thompson (1990), Van Duijn (1983, 1984), and others.

Groot and Franses (2009) review the literature of several authors that identified different types of innovations as driving force according to the time cycle. For other side, Fosaas (2010:55) found and identified some stylized facts of long waves during time, and related the occurrence of the technical and organizational innovations with specific real examples, the core and key inputs, the support infrastructures, and the necessary managerial and organizational changes.

Some other seminal frameworks to explain how innovations drive economic development are found in the approaches of Mensch (1979), Freeman (1982). These authors examined the historical timing of innovations.

In **Mensch's framework**, fundamental innovations (radical and basic innovations) tend to cluster in periods of economic recession and stagflation. The lead time of radical innovations is shorter in recessions than in periods of economic growth, which leads to the called "*acceleration principle"*, and the repetition of these mechanisms leads to a pattern of economic development similar to the cyclical pattern of economic growth, called the "*discontinuity hypothesis"*.

The **Freeman's framework** is based on the explanation of national institutional systems of R&D and public policy to induce innovative structural conditions of countries and their ability to respond to crisis, and identify a existing "*pessimistic mood"* in recessions.

Schumpeter (1939, 1942), Mensch (1979) and Freeman (1982) agree upon that the main driver behind the problematic of economic development is innovation and technical change.

Originated by Lundvall (1988, 1992), Freeman (1987, 1988) and Nelson (1988, 1992, 1993), in the late 1980s and middle of the 1990s, the **National Systems of Innovation approach** are related to the flow of technology and information among people, enterprises and institutions which is central to the innovative process on the national level. For Johnson, Edquist and Lundvall (2003) and Filippetti and Archibugi (2010), the theoretical, empirical and historical research demonstrates that national institutional setting has a major impact upon how economic agents behave and how firms perform. So, the national institutions shape the structural conditions of countries and their ability to respond successfully to changes.

The concept of **National Systems of Innovation**, according to Filippetti and Archibugi (2010:46), is based on:

- countries systematic differences in terms of economic performance;
- the economic performance depends on different technological and innovation capabilities on the one side, and from the development of institutions on the other side;
- innovation and technology policies are an effective tool for fostering innovation performance of countries.

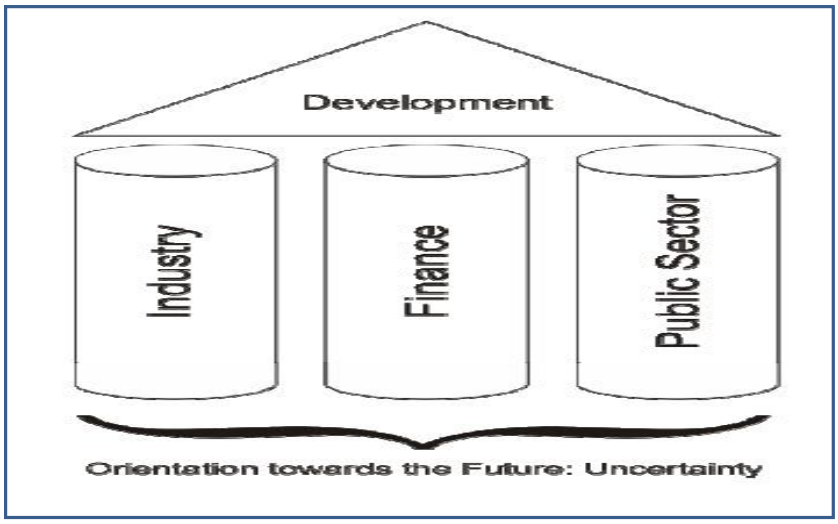
In this approach the way in which organizations carry out innovation activities and set their learning processes is affected by specific national factors including the nature of the scientific and technological institutions, the education and training system, the financial system, the structure of the labour market, and industrial specialization. In the European Union, based on the European Commission (2009) the characteristics, variables and indicators of the National System of Innovation considered and monitored are the ones presented in Figure 1.

NSI characteristics	Variable	Indicator
Stock of knowledge	Business R&D	Business R&D expenditures (% of GDP)
	Public R&D	Public R&D expenditures (% of GDP)
	Non-R&D expenditure	Non-R&D innovation expenditures (% of turnover)
	EPO patents	EPO patents per million population
	IT expenditures	IT expenditures (% of GDP)
Human resources	S&E and SSH graduates	S&E and SSH graduates per 1000 population aged 20–29 (first stage of tertiary education)
	S&E and SSH doctorate graduates	S&E and SSH doctorate graduates per 1000 population aged 25–34 (second stage of tertiary education)
	Tertiary education	Population with tertiary education per 100 population aged 25–64
	Life-long learning	Participation in life-long learning per 100 population aged 25–64
	Youth education	Youth education attainment level
Credit system	Venture capital	Venture capital (% of GDP)
	Private credit	Private credit (% of GDP)
Industrial Specialization	Employment in medium-high and high-tech manufacturing	Employment in medium-high and high-tech manufacturing (% of work-force)
	Employment in knowledge-intensive services	Employment in knowledge intensive services (% of workforce)

Source: (European Commission,

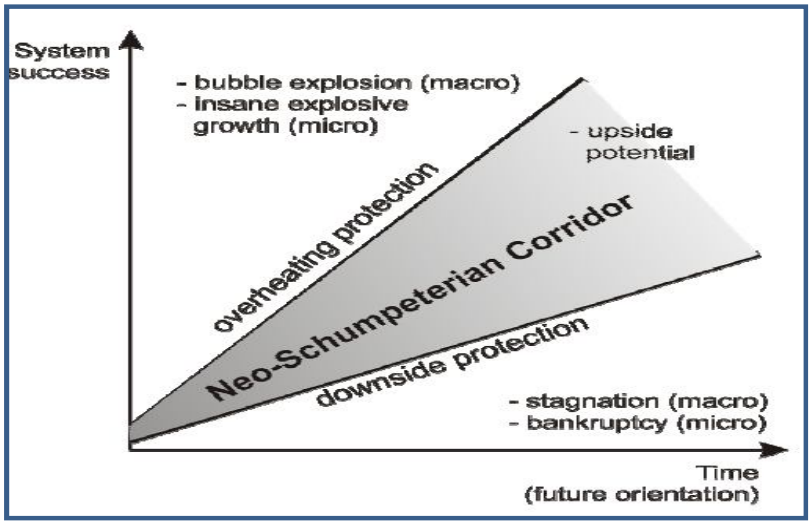
Figure 1 – Characteristics of National System of Innovation

The **Neo-Schumpeterian Corridor** theoretical framework (Hanusch & Wackermann, 2009; Hanusch, 2010) focus on innovation-driven qualitative development based on theoretical concepts of three main pillars: industry dynamics, financial markets, and the public sector (Figure 2). Innovation, as a consequence of uncertainty, characterises each pillar and each one of these are also interrelated. The corridor is *future oriented* and represents an open space for economic development in which the innovation and firm driven dynamics of modern economies can be modeled taking in account the facts and macroeconomics and microeconomics changes occurred during time in the evolutionary process (Figure 3).



Source: Hanusch (2010:8)

Figure 2 – The Three Pillars of Comprehensive Neo-Schumpeterian Economics (CNSE)



Source: Hanusch & Pyka (2007:1168)

Figure 3 - The Neo-Schumpeterian Corridor

At the micro-level two different perspectives are dominant (Filippetti et al, 2013). The first perspective, based on the *most dynamic firms,* consider that "innovation and technical change are rooted in a cumulative

learning processes and path-dependent patterns that are woven into organizational routines (Filippetti et al, 2013:303). This is led by well established firms (Dosi, 1982; Nelson and Winter, 1982; Antonelli, 1997 Dosi & Nelson, 2010; Filippetti et al, 2013) that contribute at the firm level to the *creative accumulation*. The second perspective is based in *firms that are new innovators.* So, it is based on the assumption that economic turbulence makes it possible for new and small firms to emerge in a competitive market through innovation (Tushman & Anderson, 1986; Henderson & Clark, 1990; Freeman & Louca, 2001; Perez, 2002, 2009). These kinds of firms contribute to the c*reative destruction* in the economy.

Schumpeter and the Neo-Schumpeterian ones suggest that economic cycles are consequence of innovation, but also that innovative activities and innovative organisations are re-shaped by economic crises. Many studies has been developed in different countries about innovation to overcoming crisis. One can divide it in institutional studies, realized by institutions like *OEDC, European Commission, Innobarometer, European Innovation Scoreboard;* and research studies, developed for authors like Schumpeter (1939, 1942), Mensch (1979), Freeman (1982, 1984, 1995, 2001), Freeman, Clark and Soete (1982), Freedman and Soete (1997), Van Duijn (1983), Kleinknecht (1987), Dosi (1988), Lundvall (1988, 1992), Nelson (1993), Fagerberg (1994), Freeman and Louca (2001), Perez (2002, 2011, 2012), Fagerberg and Verspagen (2002), Lundvall and Borras (2004); Von Tunzelmann and Nassehi (2004), Castellacc (2004), Fagerberg and Godinho (2005), Hanusch and Pyka (2007), Hanusch and Wackermann (2009), Filippetti and Archibugi (2010), Thompson and Stam (2010), Filippetti and Archibugi (2010, 2011), Archibugi, Filippetti and Frenz M. (2013). Filippetti, Archibugi, and Frenz (2013), between others.

3. Crises Trough Time: some case studies

The economic and financial crises could be studied in different ways and with different proposes. Some studies overview crises in a historical perspective looking at:
- differences among crises (Shachmurove, 2011);
- specific mechanics of the shocks triggering a crisis (Gorton, 2008; Shachmurove, 2011);
- similarities across countries and historical episodes (Reinhart & Rogoff 2008a, 2008b, 2009, 2010a, 2010b; Shachmurove, 2011); and
- for other authors, crises, booms and busts are an inherent part of the capitalist system (e.g. Bieshaar and Kleinknecht, 1984; Freeman, 1982; Gerster, 1988; Kleinknecht, 1987; Marchetti, 1980; Thompson, 1990; Van Duijn, 1983, 1984).

3.1. Great Depression of the 1930s in the United States of America

Based on Shachmurove (2011) and Thomas (2006), the Great Depression of the 1930s that stated in the United States of America (USA) characterized by having as:

- principal causes: the construction boom in the 1920s, stock market speculative bubble followed by a crash, banking panic, Federal Reserve Bank (Fed) with a restrictive monetary policy, low interest rates, inadequate regulation of the financial sector.
- main consequences:
  - Decrease of sales leading to accumulation of stocks;
  - Gross Domestic Product (GDP) fell about 50%, in nominal terms and 30% in real terms;
  - industrial production fell by half of its initial value;
  - unemployment rate rose to 25%;
  - stock prices lost more than 85% of their value;
  - aproximatly of 9000 banks failed (impairing the savings of millions of families);
  - price level fell by 25%,

- business failures with down-sizing.

- regulatory response to the crisis the main measures: the Glass-Steagall Act of1933 (limited the size and scope of banks) and Regulation Q, Agricultural Adjustment Act; and the first New Deal carried out by the president Roosevelt (1933-35), followed by the 2nd New Deal in the 1935-1940s.

Two decades after the Great Depression the increase of lots of innovations lead to prosperity and to the Golden Age that characterize the economic growth and development of the 1950s and 1960s, that was mentionaed by e.g. Kleinknechet (1987), Perez (2011), Fosaas (2010).

3.2. Economic Crisis in Finland in the 1990s

Based on OECD (2009), the economic crisis in the 1990s in Finland characterized by having as:

- principal causes: external shocks (collapse of trade URSS), domestic bank crisis
- main consequences: output reduced 10%, unemployment rate increased to 17%, collapse in consumption and investment spending;
- governmental response:
  - drastic measures to improve competitiveness and consolidate public finance, e.g. some taxes were raised and some public expenditures were cut – with exception to the R&D spending, which increased instead of being cut (in particular, the counter-cyclical funding support of the Finnish Funding Agency for Technology and Innovation);
  - macroeconomic stabilization was complemented with measures to sustained the investment in infrastructures, education and incentives for structural change, promoting R&D and innovation, which helped to put the Finnish economy on a stronger, more knowledge-intensive, growth path.

3.3. Economic Crisis in Korea in the 1990s

Based on OECD (2009), the economic crisis in the 1990s in Korea characterised by having as:

- principal cause: the Asia financial crisis of late 1990s;
- main consequences: down-sizing among large firms in Korea, and large reductions in corporate R&D spending , output reduced, unemployment rate increased
- response of Korean government:
  - boosting education expenditure (e.g. new ideas, improvement of technology, and others);
  - to increase its R&D budget to offset the decline in corporate R&D spending;
  - the crisis was used as an opportunity to develop a technology-based SME sector, using a special law to promote venture firms;
  - a policy mix measures was put in place: regulations to improve the environment for venture start-ups and their growth; government-backed venture funds and tax incentives for investors; as well as measures to support research.

The Korea's crisis experience is pointed as illustrating how a good crisis' management can accelerate the structural adjustment. In this case the innovation, based in the increase of R&D labs promoted the economic development overcoming the country from the crisis.

3.4. Recent Crisis of 2007

Based on Roubini and Mihm (2010), Filippetti and Archigugi (2010), Ranga and Etzkowitz (2012), Shachmurove (2011), Shahrokhi (2011), Perez (2012), and Pereira (2014), the recent economic crisis that start in 2007 characterised by having as:

- principal causes: speculative housing bubble (low interest rates, government programs to homeownership, and large trade deficits to foreigners investing), credit excess, expansion and collapse of housing prices, the bankruptcy of Lehman Brothers, effect contagion to other economies, complex financial products, structure of financial systems, failure regulation, sovereign debt problems;
- main consequences [1]: bank and business failures, output fell, unemployment rate increased, investment fell, large reductions in corporate R&D spending, banking system, impacts in multiple sectors and industries, gap between rich and poor and inequality in the distribution of resources;
- institutional / governmental response:
  - rescue plans to avoid a collapse of the financial and banking systems and limit the economic effects of the credit crunch;
  - economic stimulus packages aiming to revive economic growth became the most common policy tool for government intervention in many countries, including the USA, European Union, China, India, Japan, Australia, Argentina;
  - stimulus packages of varying sizes were adopted in most countries;
  - new financial regulations at country and international levels,
  - interventions of the Troika in the European countries in situation of crisis;
  - restructuration of public sector, taxes, and other ways.[2]

For an individual response to the crisis, in each country, the European Commission adopted in November 2008 the 2-year European Economic Recovery Plan, amounting to 200 billion representing about 1.5% of the European Union GDP.

In the more recent crisis, innovation has been one of the keys to emerging from the crisis, but it risks being hit hard by the downturn. The crisis affected innovation and a number of other determinants of long-term growth, the investments in innovation declined in many firms and the crisis had a detrimental effect on entrepreneurship and business dynamism trough many financial constraints (OECD, 2009, 2013).

Nevertheless, according to OECD (2009, p. 6):

> "The crisis can, however, magnify the competitive advantage of research-intense firms who seize the opportunity to reinforce market leadership through increased spending on innovation and R&D. Many of today's leading firms such as Microsoft or Nokia were born or transformed in the "creative destruction" of economic downturns. And several of today's leading technology firms such as Samsung Electronics, or Google strongly increased their R&D expenditures during and after the "new economy" bust of 2001."

---

[1] The main general consequences of economic and financial crises are: decrease of income, decrease of investment, bank and business failures, increase of unemployment rate, gap between rich and poor and inequality in the distribution of resources (wealth inequality), welfare loss, downward adjustment in working hours, wages and employment across countries, large reductions in corporate R&D spending, impacts in multiple sectors and industries, uncertainty. The general impacts reflect the economic efficient and social impacts with psychological problems and poverty.

[2] See also Shachmurove (2011); Filippetti and Archigugi (2010), and Freund (2000).

The effects of recession on Europe countries related to innovation, based on the analysis done by Filippetti and Archigugi (2010, 2013a), was that before the economic downturn, firms expanding their innovations were well-established; engaged in formal research activities both internally and bought-in; exploit strong appropriability conditions; involved in collaboration with suppliers and customers; and technological opportunities verified a positive impact on investment. During the economic downturn, the few firms that increased their innovation investment were characterised for being of smaller size and younger than before; collaborating more with other businesses; exploring new market opportunities; using methods of technological appropriation; less likely to compete on costs; and explore more innovative solutions by looking at opportunities in new markets.

4. Some Evidence about Crises and Strategies

Innovation is one of the keys to emerging from crises, but it risks being hit hard by the downturn. The recent crisis of the first decade of the XXI century affected innovation and a number of other determinants of long-term growth (OECD, 2009, 2015): Investments in innovation declined in many firms, as well as the entrepreneurship and business dynamism due to the financial constraints, a counter balance in international trade affects global value chains – that represents a source of innovation, the uman capital depreciated as consequence of crisis-driven layoffs and unemployment, and decreased the incentives to develop a greener economy. But crises also offers opportunities to foster innovation for sustainable growth, and past experiences demonstrate the opportunities of crisis to enhance innovation performance, for example in th cases of Finland and Korea in 1990s, as well as the anti-crisis policy measures can provide built-in incentives to innovate, to entrepreneuship and to internationalisation.

Once the crisis increase the firms' market failures and bankruptcies the investiment in R&D and innovative activities it came to be considered more risky and some of the longer term investments in new technologies were affected. So, there was the necessity to stimulate some measures as strategies to reinforce the resources for innovation that skilled labour and support private investment in innovation. Some policies that can be considered in this context include (OECD, 2009, 2010):

- Focusing public support on promising research and innovation affected by the crisis, *e.g.* long-term and risky research, research conducted by start ups, and research addressing societal challenges (environment, ageing, etc).
- Stimulate well-designed public-private partnerships of investments in R&D over the business cycle. This can also be used at the local or regional level, e.g. in innovative clusters.
- Investments in education and research to stimulate demand in the short term and supply in the long term.
- Open and competitive public procurement can also be used to support R&D, contributing to solve social challenges, e.g. mobility, energy, social inclusion, health.
- Reforming education and training polices, e.g. investing in human capital, education, employment and training.
- Promoting the development of sustainable and competitive firms and SMEs, as well as promoting the entrepreneurship.

4.1. Innovation to overcome crisis: Strategies

Considering innovation as relevant to overcome from financial and economic crisis, the OECD presents an overview of strategic responses shown in Figure 4.

	Actions (pledges, instruments, etc.)	Policy recommendations	Monitoring/ surveillance
Finance, competition and governance			
Incentives	X	X	X
Corporate governance		X	X
Taxation	X	X	
Business environment & competition policy		X	X
Consumer protection and education		X	
Regulatory management quality	X	X	
Sustainable long-term growth			
Keeping markets open	X	X	X
Macro, fiscal & labour market policies for stability & resilience		X	X
"Green" and innovation-led recovery		X	X
Development	X	X	X
Balancing markets and policies and fostering exit from public ownership		X	X

From

Figure 4 - OECD Strategic Overview to Response to Financial and Economic Crisis

At the same time, other strategies could be taken under the strutural factors that could be able to mitigate the effects of economic downturn and the negative impact of the crisis on innovation, at the level of reinforcing the competences and quality of human resources, the development of the specialisation in the high-technology sector, and the development and credibility of the financial and credit system (OECD 2009, 2010).

According to different authors and different frameworks innovation plays a fundamental role in fostering long-term growth performance. So, the existing asymmetries across the economies of European countries lead to different economic and institutional structures between countries representing a determinat factor to the direction of national innovation and economic growth.

This implies that policy-makers relies on EU innovation policy as a fundamental instrument. It was present in the *Lisbon Strategy*, with jobs and economic growth focused on innovation, entrepreneurship and in a knowledge-based economy; as well as in the current *European 2020 Strategy*, that has innovation at its centre, as a means of stimulating a more dynamic, inclusive and sustainable social market economy.

4.2. The role of innovation in driving the economy: Lessons from global crisis to future

According to Hausman and Johnston (2013) and Gummesson (2013) the impact of innovation on economy follow some evidence propositions:

- Innovation is positively related to job creation, economic growth and development, creation of wealth, improving the standards of living;
- Innovation is positively related to increased profitability,
- Economic stability is positively related to discontinuous innovation;

- Stimulate increasing levels of innovation: factor conditions in an economic downturn favor innovation as a means to recover.

This prepositions are relevants to support the government funding for innovation, R&D and applied research, education, competitive factors, protection of property rights and other legal issues, National Systems of Innovation, and other issues.

Based in evolutionary evolution, there are parallels between firms and species, which considering survival through natural selection, the governments and firms must understand evolution as a constant adaptation to change, based on innovation to create competitive advantage, improve improved performance and economic growth, through which only the most able survive (Pereira et al., 2011).

5 Conclusion

The main goal of the present paper was to present an integrated overview of innovation to overcome economic crises trough an evolutionary perspective over time, past, present and future perspectives. It investigates the relation between innovation and crisis in an evolutionary perspective based on a literature review. In this specific orientation, and according the different frameworks addressed is possible to conclude for correlations between different dimensions of innovation to overcome crises in modern economics since the industrial revolution, as well as to find common patterns in the different frameworks to explain how innovations can drives economic development in long bussiness cycles. This path, with innovations leading to prosperity times and golden ages of economic growth after a recession was mentionaed by Kleinknechet (1987), Perez (2011), Fosaas (2010).

The current interest and actualyty on the theme under study reinforces it relevance and pertinence based in the different frameworks to explain how innovation drives economy over different time perspectives, supported in theorectical approachs and based in empirical evidence from some real case studies about innovation and strategies to overcome crisis. The present work allow to conclude for the importance of innovation to overcome crises in the past, and the increasing importance in modern economies.

Bibliography

Applegate, L.M. & Harreld, B (2009). *The Role of Innovation in Driving the Economy: Lessons from the Global Financial Crisis*, Harvard Business School, Working Paper Nº

Antonelli, C. (1997). 'The economics of path-dependence in industrial organization', *International Journal of Industrial Organization,* 15, 643-675.

Archibugi, A., Filippetti, D. & Frenz M. (2013). Economic Crisis and Innovation: Is Destruction Prevailing over accumulation? *Research Policy* 42:303-314.

Bieshaar, H., Kleinknecht, A. (1984). Kondratieff Long Waves in Aggregate Output? An Econometric Test, *Konjunkturpolitik*, 30 (5): 279-303.

Dosi, G. (1982) Technological paradigms and technological trajectories. A suggested interpretation of the determinants and directions of technical change. *Research Policy*, 11(3), 147-162.

Dosi, G. & Nelson, R.R., (2010). Technical change and industrial dynamics as evolutionary processes. In: B.H. Hall and N. Rosenberg eds. *Handbook of the economics of innovation,* Volume 1. Burlington: Academic Press, pp.51-128.

Fagerberg, J. (1994), Technology and International Differences in Growth Rates, *Journal of Economic Literature* 32: 1147-1175.

Fagerberg, J. & Godinho, M. M. (2004) "Innovation and Catching-up", in Fagerberg, J., Mowery, D., Nelson, R. (eds.), *The Oxford Handbook of Innovation*, Oxford: Oxford University Press, p. 514-544.

Fagerberg, J. & Verspagen (2002), *Technology-Gaps, Innovation-Diffusion and Transformation: An Evolutionary Interpretation*, Research Policy 31: 1291-1304.

Filippetti A. & Archibugi D. (2010). *Innovation in times of crisis: the uneven effects of the economic downturn across Europe,* Uni Munchen Working Paper, MPRA Paper No.22084, April.

Filippetti, A. & Archibugi, D. (2011). Innovation in times of crisis: national system of innovation, structure and demand. *Research Policy,* 40 (2), 179–192.

Filippetti, A., Archibugi, D & Frenz M. (2013). Economic crisis and innovation: is destruction prevailing over accumulation? *Research Policy* 42(2), 303-314.

Freeman, C. (1982). *The Economics of Industrial Innovation*, Frances Pinter, London.

Freeman, C. (1984). Prometeus Unbound, *Futures,* 16, 494-507.

Freeman, C. (1995). "The 'National System of Innovation' in Historical Perspective," *Cambridge Journal of Economics*, vol. 19, n. 1, pp. 5–24.

Freeman, C., Clark, J., Soete, L.(1982). *Unemployment and Technical Innovation.* Frances Pinter, London.

Freeman, C. & Louca. F. (2001). *As Times Goes By: From the Industrial Revolution to the Information Revolution*. Oxford University Press, Oxford.

Freeman, C. & Perez, C. (1988). Structural crises of adjustment, business cycles and investment behaviour, in: C. Freeman, R.R.Nelson, G. Silverberg, and L. Soete, eds. *Technical change and economic theory*. London: Pinter Publishers.38-66.

Freeman, C. & Soete, L.(1997). *The economics of industrial innovation*. 3rd ed. London and Washington: Pinter.

Groot, B. & Franses P.H (2009) . *Universal Cycle Periods,* NRI Research Paper Series, Paper nº. 09-06.

Henderson, R.M. & Clark, K.B. (1990). "Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms"; *Administrative Science Quarterly*, Vol. 35, No. 1, pp. 9-30.

Hanusch, H. & Pyka, A. (2007) "Principles of Neo-Schumpeterian Economics," *Cambridge Journal of Economics*, Oxford University Press, 31(2), 275-289.

Johnson, Edquist & Lundvall (2003), Economic Development and the National System of Innovation Approach, Economic development and the national system of innovation approach. In: FIRST GLOBELICS CONFERENCE. 1, 2003, Rio de Janeiro. Rio de Janeiro: 1-24. in http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.565.1695&rep=rep1&type=pdf (accessed in July 2015).

Kleinknecht, A. (1986). Long Waves, Depression and Innovation, *De Economist*, 134 (1), March: 84-108.

Kleinknecht, A. (1987). Innovation Patterns in Crisis and Prosperity. Schumpeter's Long Cycle Reconsidered, MacMillan, London.

Kleinknecht, A. (1990). Are there Schumpeterian waves of innovations?, *Cambridge Journal of Economics*, 14 (1) : 81-92.

Kleinknecht, A.; Van-Montfort, K. & Brouwer, E. (2002), "The Non Trivial Choice between Innovation Indicators", *Economics of Innovation and New Technology* 11(2), pp. 109-121.

Lundvall, B.A (1988), "Innovation as an Interactive Process: From User-producer Interaction to the National System of Innovation," in G. Dosi, C. Freeman, R. Nelson, G. Silverberg, L. Soete (eds.), *Technical Change and Economic Theory*. London and New York: Pinter Publisher, 349–369.

Lundvall, B.A. (1992), *National Systems of Innovation. Towards a Theory of Innovation and Interactive Learning*. Pinter Publisher.

Lundvall, B. Å and Borrás, S. (2004), 'Science, Technology, and Innovation Policy', in Fagerberg, J., Mowery, D. C. and Nelson, R. R. (eds): *The Oxford Handbook of Innovation, Oxford*: Oxford University Press, p. 599-631

Marchetti, C. (1980). Society as a Learning System: Discovery, Invention, and Innovation Cycles Revisited, *Technological Forecasting and Social Change,* 18 (4) December: 267-282.

Mensch, G. (1979). *Stalemate in Technology. Innovations Overcome the Depression*, Ballinger, Cambridge.

Nelson, R. &Winter, S. (1982). *An Evolutionary Theory of Economic Change*, Cambridge. Harvard University Press.

Nelson R.R. (1993), *National Innovation Systems: A Comparative Analysis*. Oxford, University Press.

OECD (2009). *Policy Responses to the Economic Crisis: Investing in Innovation for Long-Term Growth*. OECD, Paris.

OECD (2010), *OECD Reviews of Innovation Policy: Synthesis of Country Reports*, OECD, Paris.

OECD (2015), *POLICY LESSONS FROM FINANCING YOUNG INNOVATIVE FIRMS,* DIRECTORATE FOR SCIENCE, TECHNOLOGY AND INNOVATION COMMITTEE ON INDUSTRY, INNOVATION AND ENTREPRENEURSHIP, OECD, Paris.

OECD and Eurostat (2005), *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*. OECD, Paris

Perez, C. (1983). Structural change and assimilation of new technologies in the economic and social systems , *Futures*, 15 (5), 357-375.

Perez, C. (1985). Microelectronics, long waves and world structural change: New perspectives for developing countries, *World development*, 13(3), 441-463.

Perez, C. (2002). *Technological revolutions and financial capital: The dynamics of bub-bles and golden ages*, Edward Elgar Publishing.

Perez, C. (2004). Technological revolutions, paradigm shifts and socio-institutional change, *Globalization, Economic Development and Inequality: An Alternative Per-spective,* Cheltenham, UK: Edward Elgar, pp. 217-242.

Perez, C. (2009). The double bubble at the turn of the century: technological roots and structural Implications. *Cambridge Journal of Economics* 33 (4), 779–805.

Perez, C. (2010). Technological revolutions and techno-economic paradigms, *Cambridge Journal of Economics*, 34 (1)

Perez, C. (2011). The financial crisis and the future of innovation: A view of technical change with the aid of history" in van Tilburg et al. (Eds), *Let finance follow and flow: Essays on finance and innovation*, The Hague: AWT.

Perez, C. (2012). *Financial bubbles, crises and the role of government in unleashing golden ages*. (WP Finnov No. 2-2012)

Pereira E.T., Fernandes A.J. & Diz, HM (2011). Competitiveness and Industrial Evolution: The Case of the Ceramics Industry, *Evolutionary and Institutional Economics Review*, March 2011, 7 (2), 333-354.

Reinhart, C., & Rogoff, K. (2008a), *This Time is Different: A Panoramic View of Centuries of Financial Crisis*, NBER Working Paper 13882.

Reinhart, C., & Rogoff, K. (2008b). *Banking Crises: An Equal Opportunity Menace,* NBER Working Paper 14587.

Reinhart, C., & Rogoff, K. (2009). *The Aftermath of Financial Crises,* NBER Working Paper 14656.

Reinhart, C., & Rogoff, K. (2010a). *From Financial Crash to Debt Crisis*, NBER Working Paper 15795, March.

Reinhart, Carmen M and Kenneth S Rogoff (2010b), "Growth in a Time of Debt" *American Economic Review,* May.

Schumpeter, J.A., (1939). *Business cycles. A Theoretical, Historical and Statistical Analysis of the Capitalist Process, abridged, with an introduction, by Rendigs Fels*, McGraw-Hill, New York.

Schumpeter, J.A., 1942. *Capitalism, socialism and democracy*. New York:Harper.

Shachmurove, Y. (2011), A historical overview of financial crises in the United States, *Global Finance Journal,* 22 (2011), 217-231.

Tellis, Gerard J., Jaideep Prabhu and Rajesh Chandy (2009), "Radical Innovation of Firms Across Nations: The Preeminence of Corporate Culture," *Journal of Marketing,* 73 (1), pp. 3-23.

Tushman, M. L., & Anderson, P. (1986). Technological Discontinuities and Organizational Environments. *Administrative Science Quarterly*, 31(3): 439-465.

Thompson, W.R. (1990). Long Waves, Technological Innovation, And Relative Decline, *International Organization*, 44 (2) Spring : 201-233.

Van Duijn, J.J. (1983). *The Long Wave In Economic Life*, Allen And Unwin, London.

Van· Duijn, J.J. (1984). *Economic Prospects for the remainder of the 1980's: the interaction of long wave and the business cycle.* Paper presented at the Conference "Economic cycles and the present crisis", Centre d'6tudes europ6ennes de Waterloo, 6-8 December.