Innovation based quality growth for Europe (based on PhD thesis)

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Abstract

The purpose of my PhD thesis is to explore whether National Innovation System (NIS) could be an alternative analytical framework for the development of better innovation capabilities and absorptive capacities. This is in contrast with the current neoclassical competitiveness focused agenda which dismisses the role of national governments to enhance innovation capabilities through stronger and more dynamic NIS. Recent macroeconomic data shows that Europe has been falling behind other regions of the world in knowledge creation and innovation. With my research I explore the factors of this relative decline by comparing and contrasting neoclassical growth theory with the National Innovation Systems approach theoretically and empirically. In this paper I compare and contrast different economic theory views to knowledge creation, innovation and quality growth. While all theories have their strengths and weaknesses, I try to justify appropriateness of NIS framework to address the most realistic issues related to decreasing competitiveness of Europe. Furthermore, I compare and contrast the NIS approach with the endogenous growth theory in addressing factors which increase national innovation capabilities and absorptive capacities. Endogenous growth theory focuses on the role of knowledge in macroeconomic growth, but it leaves knowledge in a 'black box' of the aggregate production function. Innovation systems approach, on the other hand, analyse microeconomic context within the box, especially by focusing on the role of the state and institutions within the system. This paper is based on a literature review part of my PhD thesis.

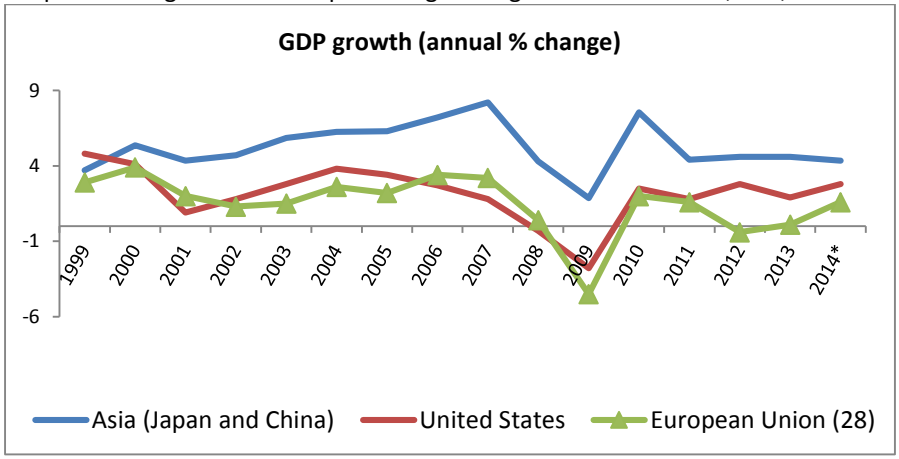
Keywords: knowledge creation, innovation, competitiveness, neoclassical growth theory, national innovation system.

Introduction

The purpose of my paper is to explore whether National Innovation System (NIS) could be an alternative analytical framework for the development of better innovation capabilities and absorptive capacities in Europe. This is in contrast with the current neoclassical competitiveness focused agenda which dismisses the role of national governments to enhance innovation capabilities through stronger and more dynamic NIS. All countries have some form of innovation system, which may work well or badly. However, all NISs differ in institutional structure, policies and internal dynamics. The term 'NIS' was first used by Freeman in 1987 and was defined as "the network of institutions in public and private sectors whose activities and interactions initiate, import, and diffuse new technologies" (Freeman, 1987, 1). Edquist (1997) provides a broader definition of NIS: "all important economic, social, political, organizational, institutional and other factors that influence the development, diffusion and use of innovations" (Edquist, 1997, 14). Lundval (1992) suggests a narrower definition, he argues that NIS includes "the structure of production" and "the institutional set up" which "jointly define a system of innovation" (Lundval, 1992, 10). For the purpose of this paper, I define NIS as a network of institutions (private and public), policies and socio-economic relations affecting national innovation capabilities and absorptive capacities.

In 2015 Europe is still going through the worst financial and economic downturn times. The global crisis revealed long term ongoing unsustainable growth patterns in Europe leading to high unemployment, stress in financial markets, overall growth (graph 1) and competitiveness decrease. As noted by IMF (2014) the global economy is slowing down and may never return to its pre-crisis growth levels. Therefore, Europe is facing increasing external and internal pressures. A decreasing global demand is shrinking potential export markets for Europe, a prolonged post-crisis recession, an aging population and increasing divergence within the region slows down growth and innovation processes. An accelerating growth of large developing countries (like BRICS) poses a real challenge for Europe to stay competitive and catch up with their growth. Therefore, only high-quality innovation growth, not just any growth will lead to a long term sustainable economic success in Europe.

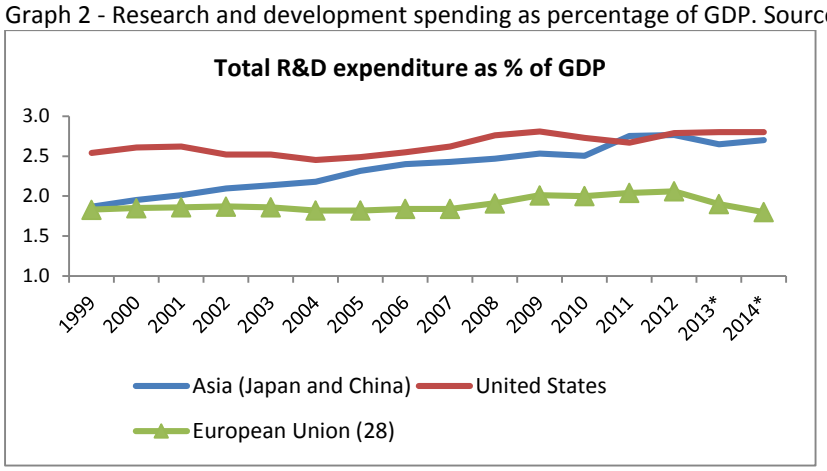
Graph 1 - GDP growth annual percentage change. Source: Eurostat, IMF, World Bank.



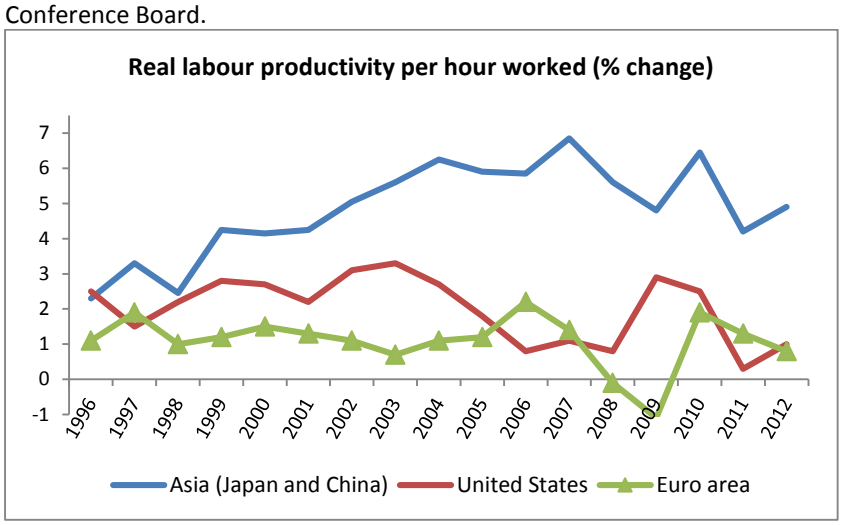
As Stiglitz and Greenwald (2014) emphasize, continuous learning R&D and innovation are the most important for a successful knowledge economy. However, in 2012 the EU allocated only 2.1% of GDP for R&D spending, while Japan spend 3.7%, China 1.8% and the US 2.8 %, therefore the gap has been getting wider (as indicated by data in graph 2).

Decreasing productivity could also be a cause of the lack of competitiveness and therefore negative growth or stagnation in Europe. Based on productivity and economic growth analysis papers of EU KLEMS data (Timmer, Inklaar, O'Mahony and Bart Van Ark 2008) it is clear that European productivity slowed down because of "slower emergence of the knowledge economy" since 1973 (ibid, 25). During last 20 years Asian countries increased their efficiency and productivity very significantly, but the US and especially Europe was lagging behind (graph 3). As a result growth of the EU has been the slowest as well.

Graph 2 - Research and development spending as percentage of GDP. Source: Eurostat, IMF, World Bank.



Graph 3 – Labour productivity in Asia (japan and China), the US and the Euro area. Source: Eurostat, OECD, the Conference Board.



The recent crisis has highlighted inadequate economic convergence problem within the Europe, "a stark competitiveness divide between highly productive countries and those lagging behind" (The 2014 Global Competitiveness Report, 2014). More than half of European countries belong to the European Union (28 out of 50 countries) and follow the five Maastricht Treaty criteria (inflation, interest rates, deficits, debt, and exchange rates) which are agreed requirements for all Member States of the European Monetary Union. However, as argued in academic literature, these requirements may have restricted growth and development because of different inflationary conditions and institutional arrangements in core and periphery countries (Arestis and Sawyer, 2012). These EU rules together with recent austerity policies may have been a factor leading to current-account imbalances, a widening core-periphery gap within the EU and overall decreased

competitiveness of Europe (Paleta, 2012). With my paper I enquire whether more powerful, entrepreneurial, innovation focused national states (following NIS approach) could increase competitiveness and sustainable growth of lagging (low and mid income) countries and make Europe stronger as a whole.

The role of state versus competitive markets in accelerating growth has been a controversial issue in recent decades. The push for deregulation and minimal state intervention has been imposed by neoliberal reforms since 1980s. It especially affected low income, developing, periphery countries, which were under great pressure from high income core countries and international institutions IMF, World Bank, WTO and European Union Commission to adopt restrictive macroeconomic policies, liberalization of trade and investment, privatization and deregulation. However, as argued by Chang (2003) neoliberal programs, despite their wide scope, performed poorly and failed to generate faster growth. Chang argues that neoliberal policies increased income inequality and economic instability in many post-communist countries. A third of European countries are post-communist with only 20 years of market experience. Thus, their state institutions lack innovation capabilities to implement appropriate innovation policies as argued by Kaderabkova and Radosevic (2011). In addition to that, Kattel and Primi (2010) argue that both Southern and Eastern European countries have high corruption and informal economy levels which act as another barrier to innovation. Therefore, a country tailored NIS approach could be a more appropriate alternative solution to neoliberal competitiveness focused growth agenda, since it focuses on learning processes, institutions, considers historical perspective and does not seek an optimal outcome so countries follow their own development paths.

Neoliberalism is often defined as the ideology of the market and private interests in contrast to state intervention and draws on neoclassical economics, the Austrian critique of Keynesianism and Soviet-style socialism, monetarism and even Adam Smith (Saad-Filho and Johnson, 2005). However, as Saad-Filho and Johnson (2005) argue, neoliberalism became a fundamentally new social order where the power and income of the wealthiest was re-established. They define this power as 'finance' which is re-enforced through the upper capitalist class and the financial institutions. Neoliberalism uses state power systematically to impose (financial) market requirements domestically or internationally through 'globalisation'. However, this approach does not benefit the whole country or region it only benefits the wealthiest, the upper capitalist class and the financial institutions as argued by Saad-Filho and Johnson (2005), Chang (2003) and Stiglitz (2012). Furthermore, Stiglitz (2012) notes that this approach limits innovative capabilities and absorptive capacities of nations.

For the purpose of my thesis I focus on the neoliberal/ neoclassical policy implications to innovation and growth by exploring the following six features. **First**, the neoclassical theory uses a principle agent framework which assumes a rational wealth-maximizing individual. However, empirical evidences show that people do not act this way. NIS approach, on the other hand, focuses on learning and interacting agent with different innovative capabilities. **Second**, it advocates for free competitive markets and high industrialization to increase innovative growth. However, not all countries are able to be innovation leaders. Therefore, NIS approach advocates focusing on better absorptive capacity rather than being first in innovation. As Lundvall and Joseph (2001) argue small Nordic countries prosper because of highly developed capacity to absorb innovation developed somewhere else, not because of being leaders in innovation. NIS talks about evolutionary aspect and path dependency in innovation process. Which means that each

country will innovate differently based on their particular needs; hence, one size does not fit all.

Third, the neoclassical theory dismisses an active role of state and need for infant industry protection. However, the state has always been important in knowledge creation and innovation since "markets on their own do not create a learning society" (Stiglitz and Greenwald, 2014, 370), which is the key element in the 21st century innovation driven knowledge economy. Chang argues (2003) that historical evidence show all advanced economies (the UK, the USA, Germany, France, Sweden, Belgium, the Netherlands, Switzerland, Japan and East Asian countries) using different protectionist policies based on their specific needs to innovate and grow their industries. Import substitution policies pursued by Japan, Korea and Taiwan before 1980s, social capitalism by Nordic countries, unique planned capitalism policy mix by China. NIS approach is more useful since it argues for an active role of government through policies and institutions in innovation process.

Fourth, the neoclassical theory sees entrepreneurship as an individual activity, however, as Schumpeter (1987), Mazuccato (2013) and Dosi (1988) argue innovation is a collective effort with many public, private actors and state support is usually one of them. Multiple analyses in academic literature show the state acting as an active entrepreneur in innovation creation (as argued by Mazzucato 2013, Chang 2003, Stigliz 2014). **Fifth**, it uses only formal mechanistic models to analyse growth and innovation, which explains why so many unrealistic assumptions listed in previous points are used. In contrast, NIS approach uses qualitative analysis and gives more realistic explanation of learning process, institutional structure, historical perspective and path development. **Sixth**, the neoclassical theory views innovation just as an R&D allocation, not a long term process with multiple interacting agents because of mechanistic models. In contrast, NIS approach views innovation as interactive process and argues for an active role of government (through policies and institutions) in the process.

There are many alternatives to the neoclassical theory, however, in my thesis I attempt to show that NIS approach may be the best in addressing the most realistic issues related to innovation based growth in Europe. NIS framework helps to explain international differences by drawing attention to national policies enhancing non-price competitiveness. It also focuses on a "system" dimension in innovation and knowledge development, because innovation is not a linear, but rather very interactive process. As Nelson (2005) argues the concept of NIS has common characteristics with engineering approaches since it analyses innovation as an interactive process. Therefore, Nelson calls NIS a critical social engineering approach with theoretical ambitions. NIS could be viewed as a critique to neoclassical approach but also as solid a grounded theory since it is based on accumulation of many empirical studies as argued by Nelson (2005).

Literature Review

Large differences in income and quality of life amongst richest and poorest countries has always been at the centre of academic literature. The recent economic crisis has highlighted inadequate growth within Europe, which may explain decreased competitiveness of the region. The purpose of my literature review is to compare and contrast different economic theory views to knowledge creation, innovation and quality growth. While all theories have their strengths and weaknesses, I try to justify appropriateness of NIS framework to address the most realistic issues related to decreasing competitiveness of Europe. Furthermore, I compare and contrast NIS approach with

neoclassical endogenous growth theory in addressing six previously mentioned factors which increase national innovation capabilities and absorptive capacities.

The Classical perspective on growth and the role of state

The role of state in accelerating development and growth has been a controversial issue in different economic theories. Classical welfare economics and neoclassical theory dismiss the role of state beyond fixing market failures and providing legal support. As Chang (2003) notes these theories view regulations, rules and institutions as rigidities, which might limit free markets operating smoothly. Eighteenth century classical economic growth theory was based on Smith's (1776) argument for minimum government intervention (laissez faire) to stimulate growth, and only to ensure a stable legal framework. Smith introduced the 'invisible hand' or market efficiency argument stating that markets self-regulate and self-fix inefficiencies. Therefore, he dismissed industrial policy as an important factor which can shape markets and influence economic growth. Smith's (ibid) contribution to growth theory is still very important and include following points. He advocated for division of labour (to improve labour productivity) and specialization (to achieve absolute advantage) as well as for accumulation of capital and population growth to enhance growth. He emphasized that population growth could be controlled in order to achieve output per capita increase in the long-run, since capital accumulation and population growth will reach ceiling in the steady state mode where economy can't grow anymore (Smith, 1976, 82).

Later on, Ricardo (1817) developed a comparative advantage theory and model, which showed that industry specialization combined with free trade, has positive results for national economic growth. With this theory Ricardo argued for the active role of state by focusing on the most competitive industries. Ricardo's analysis (1821) was based on a two sector economy with constant returns to scale in manufacturing sector and diminishing return to scale in agricultural sector. Therefore, capital owners accumulate capital, but due to employment growth and higher productivity their profit decreases. As a result, less capital is accumulated and the economy reaches its steady state (ibid). The classical economic theory assumes the level of technology as given. Technological change is usually necessary for higher productivity and returns to scale, but it is not explained at all by Smith (1776) or Ricardo (1817, 1821). For this reason, from my thesis point of view, the classical growth theory does not provide basis for technological change, learning and innovation analysis. However, it provides basis for the role of state and efficient markets argument which will be discussed later on.

The Neoclassical perspective on growth and innovation

Neoclassical growth theory explains long run steady growth by changes in labour and capital based on the original formulation of Solow (1956). Later on technological change is added to the model. However, technological change is treated as exogenous variable and remains unexplained by all neoclassical models, even though the theory argues that it is the key for growth. The model coming from Solow (1956) and Swan (1956) is based on the technological progress rate and provides basis for the neoclassical growth theory with the production function Y= F (K, AL) at the centre of the model. According to the model output (Y) depends on capital (K) and labour (AL), which is measured by the amount of labour and the productivity of labour determined by the available technology. The neoclassical growth model focuses on a closed economy and assumes constant returns to scale. It also implies full employment (Solow 1956 and 1957, Swan 1956). Besides these market clearing

conditions, focusing mostly on accumulation of capital as the major source of growth and treating technological progress as neutral (because of scale effects as argued by Solow, 1957) could be seen as a weak point of neoclassical growth model.

Mankiw-Romer-Weil (1992) model provides an important contribution to neoclassical growth modelling by augmenting Solow (1956) model to explain international differences in per capita income. It adds human capital accumulation to the Solow growth model to analyse 1960-1985 growth of Western European and North American countries. Authors claim that predictions of Solow model (that saving and population growth increase income) are consistent with evidence and "more than half of the cross- country variation in income per capita can be explained by these two variables alone" (Mankiw-Romer-Weil, 1992, 407). They show that population growth has larger impact on growth per capita than predicted by Solow. In terms of growth dynamics while economy is not in steady state, the model predicts that countries with the same technology, population growth and accumulation rates will converge in income per capita (in line with Solow). However, Solow predicted that an economy would reach half steady state in 17 years, while Mankiw-Romer-Weil model showed that the same changes could happen in 35 years. Even though Mankiw-Romer-Weil model supports Solow model and provides explanation of cross-country variance in income, it still fails to account for technological progress. As a result, endogenous growth models try to explain technological progress by adding additional economic variables.

Endogenous growth theory developed as a critique to neoclassical exogenous growth theory by building macroeconomic models out of microeconomic foundations. As argued by Romer (1990) and Mankiw (1995) the neoclassical theory is not useful for explanation of growth variations in different countries, since it assumes "that different countries use roughly the same production function at a given point in time" (Mankiw, 1995, 281). They both argue that international differences are too big and initial conditions of economy matter for much longer than the model predicts, also variations in rates of return across countries are smaller. Mankiw also critiques unrealistic steady state prediction: how is it possible that the steady state of growth depends on technological progress, but technology is exogenous variable in the model?

The work of Arrow (1962), Uzawa (1965) and Sidrauski (1967) formed the basis for endogenous growth theory. They argued that economic growth is the result of endogenous (e.g. investment in human capital and knowledge), not exogenous forces. As a result, positive externalities and spillover effects from innovation cause development in the knowledge based economy. The endogenous growth theory states that the long run growth depends on policy measures. Therefore, subsidies for R&D increase the growth rate by increasing incentives for innovation. Two types of endogenous growth models were developed: the "AK" style models by Romer (1986, 1987), Lucas (1988), Rebelo (1991) and the "R&D" based models by Romer (1990), Grossman and Helpman (1991), Aghion and Howitt (1992). The AK model gives a constant saving rate of endogenous growth (assumes exogenous savings rate) and models technological progress with a single parameter (A, measured as level of technology). It assumes that production function does not lead to diminishing returns (Romer, 1986), because of positive spillovers from investments or improvements in technology leading to further improvements, learning by doing (Lukas, ibid). The R&D models add significant contribution to growth theory, because they incorporate imperfect markets (Romer, 1990) and R&D leading to technological progress.

Back in 1962 Arrow did not account for population growth and treated it as exogenous, so Romer (1986) filled in this gap with increasing returns model of long run growth. He proposes a competitive equilibrium model with endogenous technological change and knowledge as an input in production with increasing marginal productivity. Romer emphasizes knowledge as the basic form of capital which increases marginal product. He treats knowledge as a natural externality, because new knowledge created by one firm has positive external effect to other firms, since it can't be kept as a secret. He combines three elements: externalities, increasing returns in production of output and decreasing returns in production of knew knowledge in a model which explains "historical growth in the absence of government intervention" (Romer, 1986, 1004).

Romer's (1986) model proposes an alternative view of long-run growth which shows that large countries may always grow faster that small countries, because growth is driven by "the accumulation of knowledge by forward-looking, profit-maximizing agents" (ibid, 1003). According to the model, small and developing countries may experience persistently slow growth. Therefore, per capita income of different countries will not converge. The lack of convergence could be viewed as a first critique of model, since it can't be used to compare different countries. Also, Romer (1989) states that his model allows for possibility of the aggregate production function of economy as whole, but at the same time he admits that model does not account for institutional factors and government policies. He admits that evolution of institutions and policies affect opportunities for investment and future returns, therefore, it should be included in theoretical foundations of growth theory.

Lucas (1988) introduces increasing returns and human capital effects to account for sources of technological change and to address the issue of international comparison in his models. He proposes three models: a model focusing on physical capital accumulation and technological change, a model of human capital accumulation through schooling and model of human capital accumulation through learning by doing. He argues that with these models he found suitable mechanics to study economic development and growth, because models take into consideration both kinds of capital: physical and human. Physical capital utilizes production, human capital increases productivity of both labour and physical capital (Lucas, 1988, 38). However, Lucas is analysing a closed single economy system. As a result, all changes depend on the initial conditions and initially poor countries will remain poor, which is in line with Romer's (1986) conclusions.

Even by introducing trade and labour mobility, Lucas (1988) does not address economic development and international comparison questions as he claims, because with labour mobility human capital changes are not internal anymore. By moving to wealthier country and earning more money, employee "will increase wealth of a country where in which he is employed" (Lucas, 1988, 40). Lucas also admits that his models do not capture one pattern to which all economies conform or forces that change growth patterns within countries. He only captures some mechanics affecting these forces, but a more systematic analysis could give more insights to growth and development theories and models.

In 1990 Romer introduces endogenous technological change model. He treats technology as intentional investment by profit-maximizing agents in a monopolistic competition. The model has four inputs: capital measured as consumption goods; labour measured as skills by counts of people; human capital as cumulative effect of formal education and on the job training, which is more limited measure compared to Lucas (1988) model; and an index of the level of technology (Romer, 1990). The model suggests that free international trade can speed up growth and that an economy with large population will

have faster growth. It also suggests that low levels of human capital (measured as formal education and on the job training) may explain why growth is slow in closed underdeveloped economies (Romer, 1990, 99). This model points out to the role of national capabilities for growth and development. However, as argued by Castellacci (2013) it neglects structural analysis of country innovation dynamics and change.

Endogenous growth theory provides important contribution by acknowledging that many factors contribute to growth and innovation. It helps to explain technological progress better by offering interdependence links (e.g. between growth and R&D or education and growth) in one economy, but becomes too complex and unmeasurable empirically if used for multiple countries (as argued by Sardadvar 2011 and Krugman 2013). Pack (1994) notes that endogenous growth models are still neoclassical models, they continue testing previous models by adding additional variables, but they do not question or test endogenous growth theory itself. Mankiw (1995) states that they still do not help macroeconomists to understand international differences better.

Both Pack (1994) and Mankiw (1995) agree that endogenous growth models have too many assumptions about international production functions. These models look good in theory, but not in practice, since many variables like knowledge are unmeasurable. Mankiw suggests a different assumption for growth analysis: all countries have the same access to knowledge, but different abilities or needs to "take advantage of this knowledge by investing in physical and human capital" (Mankiw, 1995, 301). His proposal is in line with the concept of absorptive capacity used in innovation analysis to understand firm's abilities to absorb innovation and in innovation system analysis to analyse country's abilities (by Abramovitz 1986, 1995; Dahlman and Nelson 1995).

On the empirical side of neoclassical cross-country growth models, Mankiw (1990) and Pack (1994) emphasise simultaneity, multicollinearity and degrees of freedom problems. "Right hand side variables are not exogenous, but jointly determined with the rate of growth" (Mankiw, ibid, 303), which could lead to positive correlation between investment and growth for example. Therefore, cross-country data analysis does not show real direction of causality between growth and investment (ibid). Multicollinearity shows strong correlation amongst the right side variable: e.g. high income countries have high investment, high enrolment in schools and more developed financial markets. Pack also argues that there are not enough degrees of freedom to answer all the questions about growth and that there isn't easy solution to the problem, so most of the time results depend on what variables economists chose to exclude. Mankiw states that relying on any cross country estimates would only lead to harmful policy, which according to him is worse than no policy at all.

Neoclassical growth theory sheds light on many important factors contributing to economic growth and innovation. However, it neglects the role of state in innovation and leaves it to competitive markets and rational individuals. Endogenous growth theory contribution to understanding internal factors of innovation is especially important. It reveals important links between education, learning by doing, population growth, R&D and growth. However, it still fails to develop a systematic point of view in endogenous growth models. It fails to address factors changing system wide national innovation capabilities and absorptive capacities, because it leaves out analysis of networks between institutions, policies and people. These factors are hard to incorporate in formal mechanistic models; therefore, qualitative methods could provide additional very useful analysis.

Industrial policy, varieties of capitalism and competitive advantage approach

Many alternative approaches favouring an active role of state in development, growth, competitiveness and innovation through policies and institutions are available in academic literature. There is evidence of renewed interest in industrial policy, but there is a great deal of confusion about what is meant by the term 'industrial policy'. Definitions have changed together with historical industrialization and innovation processes, but in the simplest way, an industrial policy is a government effort to influence (or not to influence) an economy vertically or horizontally. Also, the 'term industrial' policy is often used as a synonym for the competition policy since it overarches to mergers, state aid regulation and promotion of inward direct investment.

Warwick (2013) suggests comparative advantage-following or comparative advantage-developing industrial policy approach depending on economy's caching-up or the frontier mode. He defines industrial policy as "any type of intervention or government policy that attempts to improve the business environment or to alter the structure of economic activity toward sectors, technologies or tasks that are expected to offer better prospects for economic growth or societal welfare than would occur in the absence of such intervention" (Warwick, 2013, 16). On the other hand, Milberg, Jiang and Gereffi (2013) argue that traditional view of industrial policy changed with the expansion of global value chains (GVCs) since 1990s. They propose vertically specialized industrialization (VSI) to accommodate industrial upgrading within GVCs with less focus to national economy and more on international networks of firms.

Wade (2011) focuses on a different industrial policy perspective. He advocates an industrial policy as a support for meso-level networks since international organizations like WTO consider only hard policies (protection, subsidies, and quotas) illegal. He defines "industrial policy focused neither on the individual firm nor on the geographic region but on networks of firms" (Wade 2011, 223). Wade argues that industrial policy as a support for meso-level networks could be used by middle-income countries to get out of a 'middle income trap'. However, as argued by Botta (2014) and Pianta (2013) Europe wide industrial policy is not very effective because of large differences amongst countries. Individual national industrial policy might be not effective since by definition it does not consider all agents and networks involved in the innovation process.

The current Europe 2020 strategy places innovation at the core of industrial policy (Bosch, 2014) and uses Horizon 2020 program as the main financial instrument to provide 80 billion euros (in 2014-2020) for research and innovation through its industrial leadership pillar (European Commission, 2013). The EU countries have to compete in order to get the funding in key priority areas. However, as argued by Pianta (2013) these policies ignore the different capabilities of various Member States to participate in these research projects, to adopt and implement the proposed practices. The EU policies ignore current internal differences and problems of Member States, their financial capabilities and possible shortage of experienced staff to participate in Horizon programs.

Porter (1999) offers a very different perspective on national competitiveness compared to industrial policy approach. He argues that national difference is the key for competitive success; therefore, it is up to national government, industry and firms to increase it. Porter offers a national diamond approach for analysis of national competitive advantage and innovation potential. Four angles of the diamond include factor conditions, demand conditions, related and supporting industries, and firm strategy, structure, rivalry. Porter defines factor conditions as skilled labour and infrastructure. Demand conditions are

defined as national demand for products and services of particular industry. Presence of absence of related supplier and supporting industries are considered as well. Conditions of national policies relating to opening, organizing and managing companies together with domestic rivalry amongst firms compose the last determinant of the national diamond.

Porter (1999) argues that dynamic determinants of the diamond and links amongst them shape speed of improvements and direction of innovation in firms and industries. He analyses national diamonds of 10 developed countries to explain their competitive advantage in chosen industries. He starts with competitiveness of individual industry and then builds up to national economy competitiveness as a whole. With this analysis Porter shows that national attributes are very important for competitive advantage of a nation. He urges firms, industries and governments to understand that changes come from within a country and not from "outside help that eliminates the need to improve" (Porter, 1999, 735). Porter argues that globalization didn't diminish role of national governments in economic upgrading and only a choice to act or not to act on it could change standards of living.

The varieties of capitalism approach proposed by Hall and Soskice (2001) compares two types of capitalism: the coordinated market economy (CME) and the liberal market economy (LME). They argue that these two approaches mostly differ in institutional settings and policies; hence, they have different comparative advantages in human capital formation, production and innovation. Hall and Soskice stress importance of institutional structure and argue that value of one institution is enhanced by the other. The coordinated market economies (like Germany and Nordics) invest in competencies and resolve coordination problems through interactions between firms, industries and supportive institutions. Hall and Soskice address the following features of CME model: the financial system provides firms with access to 'patient finance', the internal structure of a firm supports networking, production strategies of a firm depend on highly skilled labour force, a firm relies on education and training system from trade union or industry employee association, a firm depends on inter-company relations to facilitate diffusion of technology.

Hall and Soskice (2001) note that firms in the LME model (practiced in the US and the UK) achieve growth by relying on market relations to solve all coordination problems, while CME rely more on non-market institutional coordination. Therefore, authors argue that these differences in institutional structure provide different comparative institutional advantage for innovation. CMEs are better in incremental innovation, since workforce is very skilled to come up with innovations, while LMEs institutional structure limits incremental innovations, therefore, LME countries are better at radical innovations. To illustrate these differences Hall and Soskice provide innovation analysis of Germany and the US and prove that "Germany specialises in technological developments that are just the reverse of those in the USA" (2001, 41).

While the varieties of capitalism (Hall and Soskice, 2001) and Porter's (1999) comparative advantage approaches broaden analysis by bringing in institutional network, policies and culture to the analysis, they both neglect the possibility of institutional evolution and change. Both approaches state that each country has a very specific institutional setting which can't be replicated by any other country. These approaches are not very helpful for my project since I assume that institutions, policies and networks could change and could become more effective in facilitating innovation.

Development perspective on growth, innovation and the role of state

Innovation systems approach draws on a few similar debates and issues raised by development economics theory many years ago. However, the position of development economics was weakened by the neoclassical growth theory favouring efficient markets and free trade during the second half of the twentieth century. Neoclassical economists used theoretical models to explain growth, but completely dismissed analysis of structures and mechanisms lying behind development. Therefore, for the purpose of my thesis, it is worth revisiting some ideas from the theory of development economics.

Development economics field evolved in 1940s and 1950s with Rosenstain-Rodan (1943), Dobb (1951), Lewis (1954), Hirschman (1958) and debated between balanced versus imbalanced growth, between Marxian capitalist accumulation and more liberal high productivity focused growth advocated by Lewis (1954). The role of state versus markets, free trade versus protected markets and industrialization as necessity towards modernization of economy are the three key issues debated by development economists. Most development economists agree on the importance of import substitution and are in favour of the active role of state in protecting infant industries to increase sector competitiveness. In addition, in 1983 Sen proposes capabilities approach which suggests that a state should also be responsible for social change in a society.

Sen (1983) raises an important issue in development theory by linking human wellbeing with development and growth. Sen introduces personal capabilities and freedoms as important attributes of development. He argues that experiences and abilities to do certain things (e.g. getting in to a good university) matter for people more compared to owning or earning money. He urges governments to consider freedoms, opportunities and personal abilities in order to achieve better outcomes in economic policies. Innovation systems approach also draws on Sen's ideas. Gu and Lundvall (2006) show parallels between economic growth and welfare in their analysis of China following Sen's (ibid) capabilities approach. They argue that government of China has been protecting domestic competences, developing "independent innovations" and working on "harmonious growth" to increase capabilities and wellbeing - access to education, health services, clean air and water.

Development economics ideas were weakened by the emergence of the neoclassical growth theory, but Sen (1983) notes that successful countries actually followed the development advice and experienced export led growth after practicing import substitution. Chang (2003) and Mazzucato (2013) agree with Sen and provide examples of historical data confirming that the most advanced world economies (the UK, the USA, Germany, France, Sweden, Belgium, the Netherlands, Switzerland, Japan and East Asian countries) used protectionist policies successfully in 19th and 20th century to grow their industries. A study by Maddison (1989) of the largest OECD economies (based on 1950-1987 data) showed that the fastest per capita growth was in Japan (6%), Austria (3.9%), Germany (3.8%), Italy (3.7%), Finland (3.6%), Norway (3.4%), and France (3.2%). These countries practised significant degrees of protectionism like tariff protection and subsidies to promote targeted industries. They also set up state-owned enterprises or public-private joint ventures for risky projects, regulated foreign direct investments, and implemented many other measures of industrial policy during this period (Chang 1993, 2002 and 2007).

The role of government policy in development, growth and innovation has always been very important. The state has been the key player during industrialization period by

protecting local industries as previously argued. The state is still important in the 21st century innovation focused knowledge economy. The state still creates and shapes markets, acts as an entrepreneur, conflict manager and innovator. Chang (2003) argues that the two roles – entrepreneurship and conflict management are especially important in the process of development and structural change. As the entrepreneur the state provides a vision for a change and also institutional structure to facilitate coordination. As the conflict manager the state acts like a guarantor of property rights and as a designer and executor of public policy. Chang (2003, 69) provides the role of state examples from two types of capitalism: the Anglo-Saxon variety of capitalism (liberal market economy) and the industrial policy capitalism like East Asia and Nordics (coordinated market economy). He notes that both types of capitalism use the state as an entrepreneur and a conflict manager. The first role is more important in liberal market economies while the second one in the coordinated market economies, but as Chang states it is obvious that the state is able to perform these functions successfully. Chang (2003) argues that "the state is bound to play critical roles" in modern global innovation economies and by dismissing its role countries "will delay emergence of coherent coordination structure" and make the economy unable to change without the considerable waste and/or social division" (2003, 70).

Stigliz and Greenwald (2014), Mazzucato (2014) also provide convincing rationales for the role of government in knowledge development, growth and innovation. Stiglitz and Greenwald focus on the role of state in knowledge creation and Mazzucato on the role of state as entrepreneur. Stigliz and Greenwald argue for the active role of government, since "markets on their own do not create a learning society" (2014). They provide convincing arguments for the infant economy protection and argue that public policies should move beyond creating a learning economy to creating a learning society and a learning mind-set. Stigliz and Greenwald (2014) contribution is important because it goes beyond the role of government in fixing market failures, they focus on the role of knowledge creation. Authors urge countries to tailor their industrial, innovation, education and labour policies to promote a learning society based on their local needs. Mazzucato (2013) gives the same message and provides the US based evidence for support. She focuses on IT, biotech and pharmaceuticals sector case studies to show that the state has been a successful entrepreneur in R&D innovation. Therefore, she advocates for a strong national public sector role in Europe to allow weaker countries to make strategic industry investments that Germany and other advanced countries did in previous century.

The role of state as a controversial issue in academic literature could be explained by increasing focus on econometrics. Krugman (1995) argues that development economist couldn't present arguments in a language understandable to mainstream economist and endogenous or new growth theory should have helped. Following this idea, Stiglitz and Greenwald (2014) try to merge development, innovation as knowledge creation ideas inot theoretical endogenous growth models in their recent work. They draw on Arrow's endogenous growth theory to argue that creating a learning society should be one of the main objectives of public policy. Their analysis provides basis for a new theory of the firm and a new way of thinking about static and dynamic comparative advantage.

Stiglitz and Greenwald (2014) argue that most of learning in societies happens within firms: they lay out simple models which identify learning spillovers and show that monopolies are more innovative compared to duopolies or even more competitive markets. They also create dynamic models to show that innovation could be welfare enhancing by lowering unemployment and inequality. However, the analysis provided by Stiglitz and

Greenwald (2014) reveals some weaknesses of endogenous growth theory. They advocate for the active role of government to stimulate knowledge creation, innovation and growth, but they develop theory of a firm and fail to show links to policies or institutions. Their proposed models are at the micro level, however, the role of government is discussed at the macro level. A meso level analysis of links and structures between them is missing and could make these theoretical models more useful.

Lundvall and Joseph (2011) argue that innovation system (IS) approach could enrich development and growth theories by expanding on analysis of knowledge creation and competence building, and by revealing links between micro and macro level factors. Early work of IS approach originated in small Nordic countries (Finland, Sweden, Norway and Denmark) and helped them prosper and compete with large industrialized countries (the US, Japan, Germany, France, the UK) by developing "highly developed capacity to absorb and use new technology developed elsewhere" (Lundvall and Joseph, 2011, 9). Freeman (1995) provides evidence to argue that high rate of technological change, development and growth in 1950s and 1960s depended less on high R&D or being first with innovation and more on the efficient diffusion of knowledge.

Lundvall and Joseph (2011) propose focusing on competences of people and capacities of organizations to absorb, diffuse and create knowledge. Therefore, they advocate for a 'third way' or meso level analysis of economic structures and institutions in order to assess how they affect competence and capacity building. Innovation system approach follows Sen's (1983) message that material growth does not equal welfare or well being growth. Lundvall and Joseph (ibid) argue that efficient use of intellectual capital depends on social capital. Therefore, Sen's capabilities approach is fundamental for national capability to learn. It is also acknowledged as the most important factor in creating a learning society approach advocated by Stiglitz and Greenwald (2014). As a result, I turn to IS approach as the most useful for my thesis since it addresses important links amongst actors, structures and mechanisms dismissed by neoclassical economics despite their importance in knowledge creation, development and growth. I will use National Innovation System framework since I am focusing on a national level capability and capacity building analysis.

National Innovation System approach

All countries have an innovation system, but there is no single definition of it. Some authors use broad some use narrow definition of NIS in academic literature. Some authors distinguish between formal and informal elements of NIS (see table 1) and all acknowledge active role of state. For the purpose of this thesis I use broad definition covering formal and informal elements. I define NIS as a network of institutions (private and public), policies and socio-economic relations enhancing innovative capability and capacity.

Table 1 - Interaction between formal and informal elements of NIS (Schoser, 1999).

	Narrow	**Broad**
Formal	Science and technology organizations, institutions and formal networks	Organizations, supporting innovation in general, institutions and formal networks
Informal	Science and technology informal institutions and informal networks	Informal institutions influencing innovation in general, institutions and informal networks (defined as cultural and historical values)

National innovation system approach is an alternative analytical framework to standard neo-classical economics and a critique to the "neglect of dynamic processes related to innovation and learning when analysing economic growth and development" (Nelson, 2005, 4). Nelson argues that NIS concept has common characteristics with engineering approach since it analyses innovation as an interactive process. NIS is a grounded theory since it is based on accumulation of empirical studies. It is also a critical theory, since it established as a critique to Washington consensus international competitiveness concept determined by relative wage cost in OECD countries (Freeman, 1982). Therefore, Nelson (2005) calls NIS a critical social engineering approach with theoretical ambitions. He separates two most important accomplishments of NIS. First, it helps explain international differences by drawing attention to national policies enhancing non-price competitiveness. Second, it focuses on "system" dimension in innovation and industrial development, since innovation is not a linear, but rather very interactive process. Nelson (2005) argues that NIS concept shifted policy towards "building linkages and strengthening absorptive capacity of users" by "promoting learning and utilizing knowledge more widely" (ibid, 6).

Dosi and Nelson (1994) argue that innovation systems approach gives new rationales for government policies and interventions besides just fixing market failures as argued by neoclassical economists. Innovation destroys old jobs, but it also creates new employment opportunities, therefore, Nelson argues that systems of innovation approach is very relevant, since it helps to address and offset negative aspects of innovation towards employment. Carlsson (2007) argues that endogenous growth theory focuses on the role of knowledge in macroeconomic growth, but it leaves knowledge in a black box of the aggregate production function. Innovation system approach, in his opinion, analyse microeconomic context within the box, especially by focusing on the role of institutions within the system. He gives three reasons why innovation systems analysis is better: "it makes it necessary to specify the components (and therefore the boundaries) of the system; the relationships among various components in the system need to be analysed; the attributes or characteristics of the components need to be specified (Carlsson, 1998, 158).

Development of innovation systems approach was influenced by evolutionary growth theory (Nelson and Winter 1977, 1982) and interactive learning theory. Evolutionary growth theory was inspired by Schumpeterian innovation (1943) and emerged as a critique to static neoclassical growth model. Schumpeter (1943) stated that the technological progress (or innovation) is the main source of growth. He also argued that the technological progress could be shaped by policies and institutions, therefore, industrial policy and institutional arrangements are important factors in economic growth (ibid, 1943). The evolutionary theory expanded Schumpeterian innovation analysis to institutions and organizations at the centre of economic growth analysis.

Lundvall, Nelson and Edquist are the most influential authors in development of innovation systems approach. Nelson (1982) argues that innovation could be analysed as evolutionary process, not just as a direct result of technological changes within firms seeking to maximise profits. He adds that technological change is an open ended and path dependent process without an optimal solution and evolves randomly. Randomness of innovation nature suggests that evolutionary models of technological change are more relevant to explain innovation than neoclassical models (Nelson, 1981). Lundvall (1992) notes that technological change is evolutionary and draws on processes of learning, interactive learning and user producer interactions for his NIS framework. He bases his

National Innovation System analysis on innovation theory and contributions from Aalborg University (Denmark). Edquist (1997) contributes to the system of innovation (SI) approach by emphasizing collective interactive process with wide range of private and public actors, firms and organizations.

Innovation system approach has been used for over 30 years to study national, regional and sectoral systems, but definitions or descriptions of IS still varies between authors in academic literature. Therefore, some of them chose to define each term separately. Nelson and Rosenberg (1993) use a narrow definition of 'innovation' and restrict it to technical innovations, so naturally they argue for 'sectoral' approach and debate over national system. They think that 'national' approach is too broad since institutions supporting aircraft do not overlap with institutional system supporting pharmaceuticals (ibid, 5). However, they admit that some institutions in technology field which could affect all sectors may be international. Lundvall (1992) implies that 'innovation' could be viewed as new combinations in technological process and production, new forms of organizations and institutional changes. He is against 'national' innovation system approach because of increasing internationalization and argues for systems of innovation approach. Carlsson and Stankiewicz (1995) define 'innovation' as technological change with focus on institutional infrastructures of technological systems. They talk about technological systems, but do not draw clear line between national, regional or sectoral approach and them depending on circumstances.

The concept of 'system' is central in national, regional and sectoral analysis. Fleck (1992) defines 'systems' as "complexes of elements or components, which mutually condition and constrain one another, so that the whole complex works together, with some reasonably clearly defined overall function" (1992, 5). Edquist (1997) argues that the systemic character goes beyond the linear view of technological change, where R&D leads to productivity growth through innovation and diffusion. Carlsson (1992) with Nelson and Rosenberg (1993) take different sides regarding the role of state in creating or changing innovation system. Carlsson states that governments consciously build and enhance technological and other systems. Nelson with Rosenberg, on the other hand, argue that systems of innovation can't be consciously created or developed by policy makers. They (Nelson and Rosenberg, 1993) define the 'systems' concept as set of institutions influencing innovation, but there is no presumption that these institutions work together. Edquist (2011) argues that truth is in between these two extremes. He agrees that a national system as a whole can't be created, but some elements may be consciously designed by policy.

Despite all the differences Nelson (1993), Edquist (1997) and Lundvall (1992) stress importance of innovation in national systems, since all policies influencing innovation process are designed and implemented at the national level. Various NIS case studies show that nations vary in many different aspects: language, culture, institutional set up, investment in R&D, size of public sector, standard of living and so on. Lundvall (1992) emphasizes that institutions and industrial structure are two key components of NIS. However, the authors do not give a clear criteria for identifying them. Lundvall (ibid) stress that definition of IS should be kept flexible and open. Edquist (2011) suggests including all important economic, social, political, institutional and organizational "factors which influence the development, diffusion and use of innovation" (ibid, 14). He proposes identifying factors (determinants) of innovation, which is hard to do with such open definition of IS.

Edquist (2011) defines nine common characteristics of innovation system approach:

1. Innovations and learning (learning processes) are at the centre of IS.
2. The approach is holistic (no a priori exclusion) and interdisciplinary - all determinants of innovation are important (includes economic, institutional, organizational, social and political factors).
3. A historical perspective is natural and important.
4. Differences between systems and non-optimality. There are substantial differences amongst IS of different countries. There is no optimal IS, because evolutionary learning cause continuous change.
5. Emphasis on interdependence (interaction between elements of the system) and non-linearity. Emphasis on demand of innovation – draws on Porter's determinants of national advantage, not just linear input/output approach.
6. Encompasses product technologies and organizational innovations. Product innovations are even more important than technological process of innovation. Organizational changes are important because they impact productivity growth, competitiveness and employment. They are closely related with technological changes. Also, technological changes are 'socially shaped' within specific organization.
7. Institutions are central. All systems of innovation – national, regional, sectoral emphasize role of institutions in innovation process.
8. Conceptually diffuse. No limits to IS, which may be viewed as a strength and/or weakness of the approach.
9. Conceptual frameworks rather than formal theories. IS is not considered a formal theory, since it can't propose formal models showing relationships between variables.

Hanusch and Balzat (2004) notice that two major groups of studies continue development and application of NIS analysis. First group is performance and policy oriented cross country and country benchmarking NIS studies of highly industrialised countries. A good example is Eichors's (2001) broad empirical cross-country analysis where Germany is benchmarked with 17 countries of OECD. Another international analysis proposed by Polt (2001) where he looks at relationship between private sector and scientific research organizations. European Commission (2000) also proposed indicators and methodologies for the benchmarking of national research policies for the EU 15. OECD also did numerous studies on best practices and policies related to technology and innovation. Such studies focus on the concept of NIS and operational dimension, include performance and efficiency measurements, use analytical models with innovation indicators and index numbers to rank systems analysed. However, Hanusch and Balzat (ibid) note that such studies usually neglect historical perspective of NIS.

The second group of NIS studies defined by Hanusch and Balzat (2004) includes descriptive studies of low and middle income countries. Within this group studies analyse the development stage of NIS and verify the relevance of the NIS concept. Methods used are detailed verbal descriptions and use of innovation indicators. These studies also emphasise historical perspective of innovation patterns and institutional frameworks. For example, conceptual framework proposed by Liu and White (2001) focuses on five activities of innovation process: research, production, end users, linkages and education. First, they imply that a system-level analysis should analyze how fundamental activities of the innovation process are organized, distributed and coordinated. Second, they suggest using primary, secondary and institutional actors to distinguish amongst elements of innovations

system based on relationships between the five activities, also structure and dynamics of the system.

Liu and White (2001) define primary actors as organizations that perform under the five activities. They define secondary actors as organizations affecting behaviour amongst primary actors. Institutions are defined as set of rules, which guide and constrain behaviour of primary and secondary actors. Institutional actors act as government, through legal, paten and tax system in Liu and White model. They claim that all these proposed elements address structure, dynamics and performance of NIS. Authors apply this framework to NIS of China and compare it under central planning period and under recent economic reforms to show analysis of two very different innovation systems. The study (Liu and White, 2001) focuses on differences in organization of the five innovation process elements, also on dynamics and outcomes of organizational changes in two different periods of time. The proposed framework is important, because it bridges the gap between study of innovation outcomes and elements of the innovation system.

Conclusion

I have reviewed many economic theories relating to knowledge development, growth and innovation. All of them offer valuable views on different issues. However, NIS approach seems to be the most appropriate for my project since it addresses the most realistic issues related to innovation based quality growth in Europe. NIS framework helps to explain international differences by drawing attention to national differences. Besides firms and policies it focuses on institutions, networks and linkages within the system, it also acknowledges importance of human capabilities, as well as historical and cultural differences of nations. NIS approach offers this meso level analysis of networks, links and structures which is missing from neoclassical growth theory. This analysis could be employed together with econometric models to make the overall innovation analysis more realistic and more useful.

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