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R&D AND INNOVATION ACTIVITIES – SEARCH FOR BETTER DEFINITIONS AND AN ECONOMIC-HISTORICAL APPROACH*

Abstract:

The paper examines the challenges social scientists face when analysing innovation, especially R&D and innovation activities of firms, i.e. their strategies in typical stages of an innovation process in a defined economy. The motivation behind is to describe properly the innovation activities of firms in the proper economic-historical context. There are many ways innovation can be understood (inter-culturally/inter-nationally) and different ways in which firms, institutions, and governments organize and undertake innovation activities. Entrepreneurs and multinationals are an essential part of market mechanism and innovation is, ex ante, beneficial for them. There are many theories and the current ones demand interdisciplinary approach. It is due to the dynamic nature of innovation and the global context – economic crises, the Internet. At the end of the paper current definition misunderstanding in social sciences is discussed and a better understanding is introduced, which builds upon the simultaneous nature and almost interchangeable relationship between innovation, imitation and invention.

Keywords:

Innovation, imitation, invention, firm's strategies, market conditions, institutions, productivity, cliometrics, developing country, endogenous growth, technological change.

JEL Classification: L60, O38, D24

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Introduction

This paper provides an understanding of firms' innovation activities and their economy-wide consequences in a defined institutional setting. It emphasizes the role of many innovation strategies in different stages of a typical innovation process (Andersson, Johansson, Karlsson, & Lööf, 2012). The motivation behind is to describe properly the innovation activities of firms in economic-historical context. It is based on the premise that institutional setting, i.e., rules and limitations; market conditions, i.e., competition; cooperation and the level of economic development, i.e. economic-historical context; and firm-level characteristics/strategies may be linked to the act of innovating. There are many ways innovation can be understood and different ways in which firms, institutions, and governments organize and undertake innovation activities. The aim of this paper is to contribute to the general understanding and describe possible definition misunderstanding in social sciences.

The analysis of innovation activities in a defined economy requires a rich theoretical background and places relatively high demands on the researcher. Especially in social sciences where, recently, data processing, resource critique and interdisciplinary approaches are required along with "publish or perish" pressure (Rond and Miller, 2005). This paper brings together theoretical contributions of theories dealing with endogenous growth theory and perspectives from scholars who have contributed to the empirical testing in the field of innovation strategies, international competition, business strategies, and generally, economics of technological and social change.

I am summarizing an innovation framework which help us and also allows us to broaden our understanding in the field of economics of innovation. The methods respect traditional econometric and economic historical approaches. My aims are thus traditional in the sense of their practical scientific contribution to the field. Definitions (entrepreneur, dynamics, crisis, cliometrics) and theories are discussed in order to contribute to a better understanding, especially of the so-called "i-terms" (innovation, imitation, invention) and their definitions, i.e., to promote their dynamic and simultaneous relationship and the need of revealing author's innovation definition and theoretical understanding.

Motivation – How to approach economic historical analysis of a country in transition?

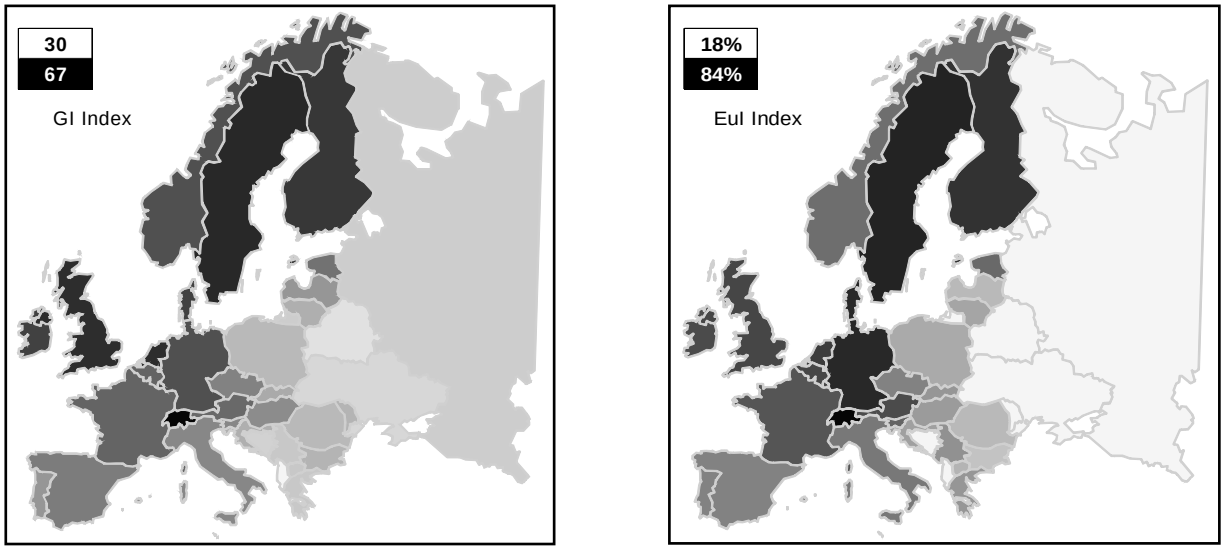
This paper is also a reflection upon my analysis of innovation in Czech economy throughout my studies at University of Economics, Prague. The Czech economy has experienced quite substantial changes. Should we count it as an innovation? The fall of communism in 1989 started a massive transformation process. We can observe the development of a new type of small open economy - Czechoslovakia. In 1993, separate Czech and Slovak Republics emerged. Foreign capital inflow and structural changes shaped a new democracy, new trade partner for the European Union. Social change and technological change began to influence everyday life.

An important role also started to play previously almost non-existent private companies, commercial and state banks, and mainly the small and medium enterprises in the industrial development (McDermont, & Mejstřík, 1992) in the nineties. A process of de-monopolization, privatization and the western foreign market orientation, i.e. transformation process has to be taken into account and perceived as an innovation process at the firm level.

According to the Czech Statistical Office (CZSO), the share and influence of multinationals have been growing rapidly since 1998. On average, foreign companies are more productive and pay higher wages per employee. These firms invested more than half of all the money in the economy into new fixed and intangible capital in 2010. That year multinationals employed more than 40% of Czech inhabitants and their share of total sales was more than 50%.

Again, this unique testing ground, the Czech economy, has interesting historical periods in which all kind of innovations played an important role. We will be focusing on the period between 1998 and 2010. The Czech economy went through immense technological, institutional and social change. New routines and strategies have been implemented, and firms have learned to compete in international markets. However, microeconomic analysis of innovation behaviour by Zemplinerová and Hromádková (2012) still shows, for example, poor R&D to sales appropriation ratio in comparison to other west European countries. Does this mean we don’t observe change and good innovation activities?

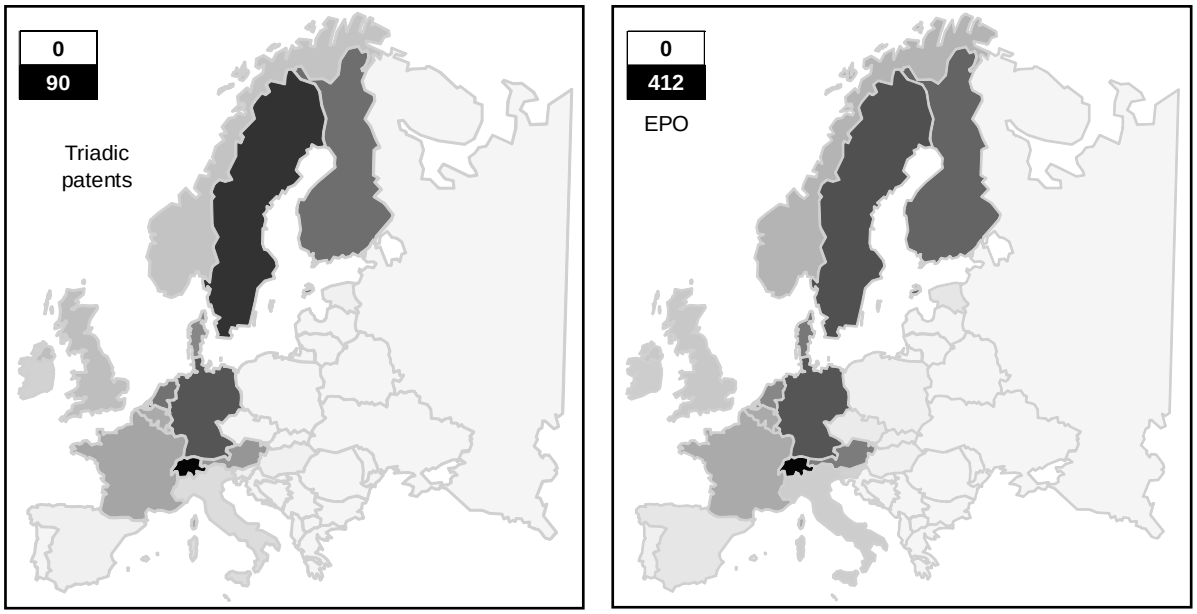
Figure 1: European innovation indexes heat-map, WIPO and EU scores in 2013



Data: WIPO, EuroStat. **Note**: GI Index - Global Innovation index. EuI Index – Innovation Union Index. EuI Index is only for EU countries.

As shown in the first and second figure, the Czech economy is not an innovation leader between 2011 and 2013. It is also apparent that patent output does not universally reflect the intensity of technological and subsequent social changes in a particular country (Hall & Ziedonis, 2001; Cohen, Nelson, & Walsh, 2000; Archibugi, 1992), but unfortunately it is still one of the most used indicators.

Figure 2: European countries and their patent output heat-map, Triadic and EPO patents, 2011



Data: Nowcast OECD, World Bank. **Note**: Albania, Bosnia and Herzegovina, Macedonia and Serbia – unknown or N/A, reported as zero patents. EPO – European Patent Office

According to Figures 1 and 2, we could mistakenly believe that almost no innovation is observable in all of the post-communist EU countries. But innovation manifested in other ways, for example, through foreign direct investment and by adoption of thousands of institutional changes. The level of development and the historical context are important factors in the special, international, comparisons of innovation which I consider to be a complex social phenomenon on microeconomic and macroeconomic level. Not only all kind of patent numbers (regional, triadic, obscure, strategic, not-lasting-long, pooled, in cooperation with 10 countries, to-get-public-research-money patents etc.) and erroneously reported firm's R&D expenditures.

Entrepreneurs – what should we do with/to them?

I believe Boettke & Coyne (2003) have a point that entrepreneurs, national or multinational, cannot be the "cause" of economic development in an economy because they are an essential part of it, an inherent part of market mechanism respectively. Entrepreneurship is in the human nature and it always will be present. There is no need to construct hypothetical worlds where human nature doesn't exist. Apart of doomsday predictions, they will be always popular. Also, in this paper no causality is ever to be found or encouraged, we can only suspect the existence of simultaneity. This teaching about entrepreneurs is based on the classical heritage of Richard Cantillon, Adam Smith, and John Stuart Mill. There are more interesting things to be analysed - their different strategies, what cause them and when, i.e. in defined historical and institutional context.

Because we are usually interested in the wealth of a nation (at least as an economist, not necessarily as a politician) we can only make it better or worse for all the entrepreneurs, including multinationals. It means that we are looking for factors (barriers, obstacles) that ensure economic growth in a peaceful environment with suitable institutional infrastructure for everyone.

For example, for multinationals to exist, this environment has to be tolerant and open to foreigners. If this is the case, then multinationals are simply entrepreneurs like all others. They rise, they cease to exist, they are successful, and they seek new profit opportunities in simultaneous supply-demand & demand-supply global market environments. They are special in some aspects for developing

countries because they are most likely to be messengers of social and technological change.

Role of multinational influence – entrepreneurs from abroad or something else?

On a macroeconomic level, FDI and technology inflow is a dynamic process and can stimulate local entrepreneurs (Acs et al 2009). Potential competitors and new firms can cooperate, be part of the supply chain, and also imitate (both in a good and bad way) foreign firms' know-how and technology. This learning process (Arrow's "learning-by-doing concept", 1962) can usually help the SME's (small and medium enterprises, especially the high-tech start-up firms) catch up to global competition and exploit new opportunities by themselves.

We, economists, assume that all firms are profit motivated and seek opportunities in a changing environment. Those firms can be divided according to the nationality of the owner. A multinational is a firm with the majority share (more than 50 %) owned from abroad. Multinationals are seen as a "special case" of entrepreneurs. They might be encouraged by government FDI incentives and other government support programmes (Zemplinerová, 2006). Multinationals possess know-how and most of them have previous long-term experience as a company (a Linder hypothesis is predicted for FDI, see Fajgelbaum et al, 2011). They are also special because technological transfer and other positive externalities are expected (Djankov & Hoekman, 1998).

The experience of multinationals reflects in their confidence and investment activities. To some extent, this experience ensures them at least an effective employment of production factors. However they don't possess much knowledge about local informal institutions. This is a crucial incentive for governments to ensure stable, efficient and easily understandable formal institutions. With "good institutions" there might be little room for corruption, a black market and mafia- like structures. There is evidence that multinationals are agents of prosperous change for host-country institutions (Kwok & Tadesse, 2006; Zemplinerová, 2004).

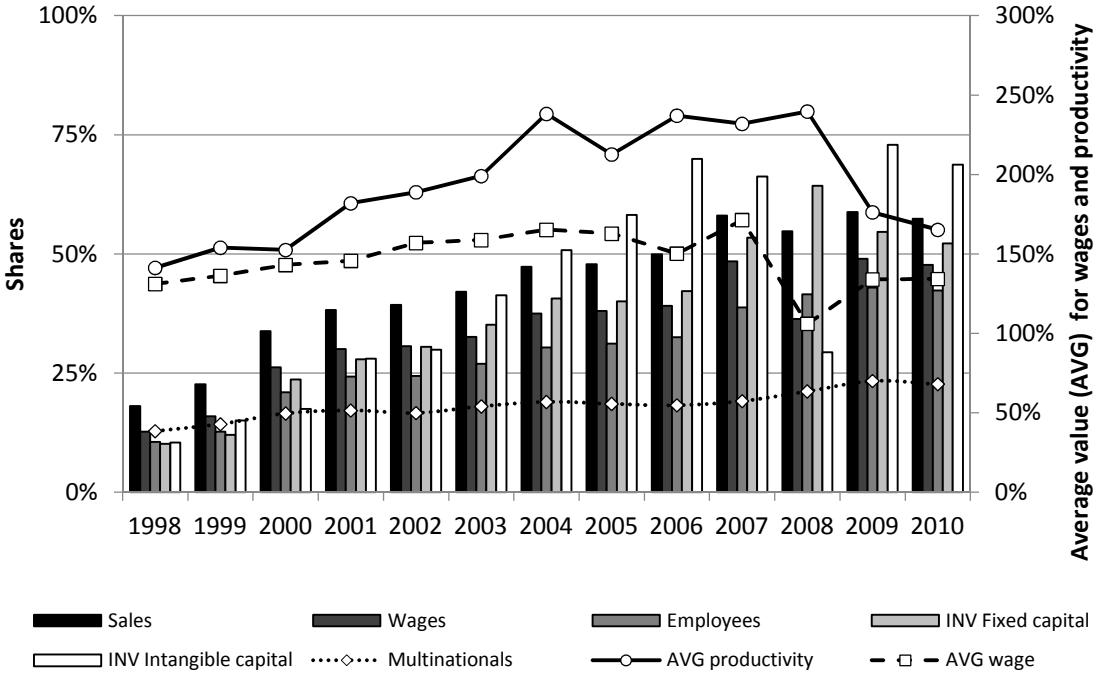
Previous research suggests that multinationals are usually entering the economy with new- to- the- market technology (at least in the form of know- how) and they don't have to necessarily start their in-house R&D projects (Srholec, 2005;

Zemplinerová & Hromádková, 2012). In time, the motivation for foreign companies to do their internal R&D projects in the host country may occur due to cheaper high-skilled personnel and government support.

What is the evidence for the Czech Republic? According to Czech Statistical Office (CZSO) the share and influence of multinationals has been growing rapidly since 1998. In our sample (Figure 3) there are about 22.7 % of them with sales share over 45 % in 2010. The fall of communism in 1989 started a costly transformation and development of a new type of small open economy - Czechoslovakia. In 1993 the Czech Republic emerged.

The capital inflow and structural changes shape a new democracy. Social change and technological innovation began to influence everyday life. The Czech Republic (CR) was a catching- up economy facing dramatic institutional changes in its early years of existence. Political representation chose to pursue a liberal and entrepreneur- friendly model of economy. In fact, serious state intervention in prices and in the form of state ownership was still present; however, it was a good enough political declaration for multinationals to take the risk and invest here.

Figure 3: Multinationals in CR 1998-2010, % shares of total, % average value in comparison to local firms



Data: CZSO questionnaires P5-01. **Notes**: Right vertical axis is linked with AVG productivity and AVG wage. Sales represents sales of own goods (N=392332), Wages represents wage costs without other

personal costs (N= 390536), Employees are as an average evidential number (N=392332), INV Fixed capital represents new investments in fixed capital (N=361230), INV Intangible capital represents new investments in intangible capital (N=328313), Multinationals are defined by institutional sector - share of foreign capital 50-100 % (N= 377697), AVG productivity indicator consists of sales per employee and it shows average relative % value (N=392332), AVG Wage shows average relative % value (N=390536) of total wages per employee.

On average, foreign companies are more productive (in terms of sales per employee) and pay higher wages per employee (Figure 3). These firms invested more than half of all the money in the economy to new, fixed and intangible capital in 2010. That year multinationals employed more than 40 % of Czech inhabitants and their share on total sales was around 57 %. These numbers are rough and come from a limited data sample; however, they give a very good overall look at the Czech economy and are in accordance with official CZSO (2012) press release.

Theories of innovation and growth of nations

As a sophisticated concept, the strict exogenous nature (Solow, 1964) of innovation belongs to the first modern theories which acknowledged the importance of innovation in an econometric model. However, this theory failed to survive empirical testing. The so-called “Solow residual” proved to be endogenous in the econometric sense and the critics (Romer 1986, Lucas 1988) started to support their own theory which wasn’t dependent on the exogenous nature of technology. Since then, a variety of neoclassical endogenous growth theories and models have emerged. These models are basic economic text book theories today.

The basic AK model and its children are a linear interpretation of capital as an aggregate expression (K) of both physical and knowledge capital. The constant marginal product of capital (A) represents the slope of the line[1] and more importantly, infinite economic growth. Such growth is ensured only if both knowledge and tangible capital are invested. Such an investment belongs to the initial phase of an innovation process (Baregheh, 2009; Greenhalgh & Rogers, 2009) which usually[2] ends up with the introduction of a new-to-the-market product or process innovation.

Arrow (1962) tried to address some of the innovation issues in his theory called “Learning-by-Doing”. According to this theory, there are spill-over effects (positive externalities) from innovation activities. Knowledge bound up with inventions is a

[1] Formally Y/L=AK, where Y/L is the output to the labour number in the economy.
[2] Detailed typology in OECD manual (2005)

public good. This is generic knowledge which is available to everyone. Basic research is the most beneficial for economic growth according to Arrow. This generic knowledge is a source of inspiration, imitation,[3] and motivation, which are all essential to the innovation process. This process can result in an invention of specific knowledge. This kind of innovation can be appropriated in the short term. Such an advantage is considered to also be an economic good (licences, patents, and other IPR's). In summary, this kind of innovation is a good incentive to make more investments.

This nice framework; however, is not always working. Why is there a lack of innovation activities, where is the theoretical infinite economic growth, and why are there economic crisis and fluctuations? To some extent, competing growth theories are working with these issues. We will focus on one theory based on microeconomic principles and an economic history analysis. Data is essential and a constant reminder of the importance of the recorded historical context. However, we have to keep in mind that both the data and the recorded historical context are like the theories - they can be easily falsified.

J. A. Shumpeter is one of the most influential economists and historians. His theories, however imperfect, were a source of inspiration for the Schumpeterian growth theories and the evolutionary growth theories. Propagators of these theories are building on the tradition of creative destruction (Grossman, 1993), potential competition, uncertainty (Aghion & Howitt, 1998) and the theory that, "At a fundamental level, economic development is about the building of individual and institutional capabilities that we understand exist but do not as yet model well." (El-Erian and Spence, 2008, p. 94).

Models of creative destruction and their empirical testing are aimed at the economic history of developing and recently developed countries. Endogenous growth with economic fluctuations (business cycles) is possible and relies on R&D investment, i.e., knowledge capital accumulation, R&D workers (engineers, managers) and entrepreneurial skills which allow for the detection of market opportunities in an endlessly adapting institutional setting.

[3] By imitation, we are not interested in a usurpation of creative activity and sheer plagiarism. See Brozen (1951) for more details.

The evolutionary theories amplify the role of dynamic efficiency, the competition outcomes, the survival conditions and the role of bounded rationality, i.e., a critique of "*homo economicus*" (Nelson, 1982; Dopfer 2005). A multidisciplinary approach is required to analyse economic history, behavioural sciences, and the ecology of populations, and their evolution and development. There are certain routines and regularities in decision making which firms deal with when innovating. One of the routines is the ability to profit from the innovation activities of the other firms in the marketplace. There is an innovation potential, a technological frontier, and a spill-over effect which allows a firm to know its place in the market competition and the necessary market and firm strategy to adapt accordingly (Silverberg & Verspagen, 1994).

The school of complexity economics (Antonelli, 2008) goes further. It applies the complex system theory with heterogeneous agents and stresses the role of social capital. It is also a multidisciplinary approach based on non-linear dynamics and information theory. Again, microeconomic concepts such as path-dependence and network effects are used to model and predict interactions and outcomes of complex systems like an economy with all its inhabitants. Again, there are spill-overs, learning-by-doing outcomes, and certain rules, routines and strategies which can be modelled.

All the models require long and reliable datasets to be empirically tested. All of them generally expect the innovation process to play a positive role in the long run. Some of the theories also promote their short-run equilibrium models. Economic fluctuations are, in short, taught to be demand based, or supply based. We have to assume a more or less haphazard arbitrary output to which we can relate a fluctuation. This textbook concept of monetary and real business cycles is a useful simplification, which is, however, far from reality and rarely empirically tested, for example, on developing countries.

Technological innovation, along with social innovation in a broader sense, is generally viewed to be the key to infinite economic growth. The two key issues we need to stress are: (1) How to motivate firms to invest more of their scarce resources? Are there any barriers to be removed? (2) How to motivate societies and their members to invest in health and education? And are there any barriers to be removed? Societies today need highly skilled engineers and managers which is

possible to attain only if there is a supply of such a labour force. Can we, the social scientists, help somehow in that context?

Incentives to create and explore may be an essential part of the human spirit; however, they are limited by a given institutional setting. Usually we speak about the state policies and the intellectual property rights (IPR) which are in place to help firms secure their inventions. These factors influence, for example, the ease of doing business, the law enforcement efficiency, and the way people gain their education and specialization.

There is extensive literature on the strategic behaviour of firms and incentives given in an institutional setting (Scotchmer, 2004). Intellectual property rights play a dominant role in innovation economics analysis. Most of the IPR's instruments are double-edged, with exceptions, and empirical testing is rather problematic. We need to account for abandoned innovation projects and sometimes even for all the innovations that would emerge if an institutional change were adopted. This is a good testing ground for the institutional change analysis but it needs good counterfactuals, hard work and time-consuming interdisciplinary approach, qualities many social scientists lack.

Why is innovation important for a firm?

Although it is more or less a struggle, which does not every time pay off, then ex ante, yes, it is and not only for a firm. At least when we speak about profits and costs. As I illustrated in the previous chapter, more and more microeconomic principles and concepts were introduced. One of the concepts is a strategic profit-seeking behaviour which deals with the ability to capture future profits, i.e. appropriability.

The standard effects of extreme market conditions (monopoly and perfect competition) are summarized in Greenhalgh and Roberts (2009). A perfect competitor would not gain from a process innovation; it would only increase the consumer surplus. A monopoly would gain higher profit from a process innovation and is therefore motivated to do it. In the case of product innovation, a monopoly or the dominant firm model is assumed. It is assumed that the innovation is new to the

market and, as the firm has created this new market, it is naturally dominant there, thereby making it profitable for the firm to innovate.

Role of market and firm dynamics – can we even measure it?

Innovation, is a dynamic process in itself, a process of change, and we need to, for example, account for time between investment into R&D, blueprints, and final outcome. But there are other dynamic factors as well. The most studied is the intensity of competition on innovation incentives (Nickel, 1996; Gilbert, 2006). We expect more innovation with more intense competition. There are, of course, results and competition definition differences among researchers.

Table 1: Indicators of competition intensity

Hefindal Index	$HHI = \sum_{i=1}^{n} (\frac{\text{sales}_i}{\text{industry sales}} * 100)^2$
Concentration Ratio	$CR_3 = \frac{\text{sales of 3 firms with higest sales}}{\text{sales in that industry}}$
Lerner Index	$\text{LI} = \frac{\text{price} - \text{marginal costs}}{\text{price}}$
Price Cost Margin	$\widehat{\text{PCM}} = \frac{\text{sales} + \text{inventory change} - (\text{personal, material, energy costs})}{\text{sales} + \text{inventory change}}$

It is very problematic to measure the intensity of competition in a market. Some of the researchers use the number of firms on the arbitrary (NACE based) relevant market, the Herfindal index (HHI), or the forms of Lerner Index (LI).

These indicators (Table 1) deal with market structure and indirectly with the competition intensity a firm faces. A proper indicator would be a Lerner index (LI); however, we do not observe the marginal costs and price for each final product. As an approximation, the Price Cost Margin (PCM) is used. This indicator is biased, inaccurate and obviously branch specific, but it is a good unique proxy indicator a variable that relates directly to the firm. These indicators will, to some extent, account for market structure and firm dynamics in terms of competition intensity.

There are groups of indicators that are scarcely used. A form of competition intensity indicator can be also an international competition indicator (whether a firm faces foreign markets or the local market only), entrants and firms in insolvency,

mergers and acquisitions, type of ownership, the amount of exports and imports, and new investments in tangible and intangible capital. These are very rare indicators and there are not usually enough representative observations to account for it in a dynamic econometric model.

The importance of macroeconomic development and global anomalies - how crises and economic fluctuations relate to innovation activities?

There are lessons to be learned from the history of financial crises (Kindleberger, 2000). These bubbles occurred in about ten-year intervals (1816-1866), then, they occurred rather randomly. There are certain routines and strategies we can observe in times of an economic crisis: speculative mania, hysteria, and herd behaviour, i.e., violation of assumed “Homo Economicus” rationality.

Usually, the value of assets rises while money expansion is skyrocketing. Then a moment of disillusionment leads to the bursting of the bubble. There are different anatomies of crises, and we can distinguish them as defined by a threshold of poor currency and by events like poor external debt (Reinhart & Rogoff, 2009).

We can easily blame the state institutions which run the state currency monopoly and feel delight in creating more debts. We can also analyse why, at the moment of the bubble bursting, many economic agents were in grave insolvency and why no one recognised the early warning signs. These are easy tasks for an economist. We can do the ex-post analysis quite well and perhaps even recommend appropriate tools and rules to prevent this from happening again (inflation and debt limits) or ease the after-crisis development (bank crisis). But can we predict them, or are they a random, spontaneous element?

Not many authors used technological innovation as a factor of economic fluctuations and a determinant of a financial crisis when they were analysing the latest economic crisis. The idea that innovation influences economic fluctuations is quite old. In addition to Schumpeter's (1934) analysis of the role of innovation, Schmookler (1966) came to the hypothesis that the innovative behaviour of entrepreneurs depends on the level of aggregate demand.

Firms are motivated to speculate and adjust their conditions appropriately (lead time, IPR protection). In times of an economic boom they expect higher sales and

want to introduce as many innovated goods and services as possible. Empirical testing suggests that demand theories are more plausible (Geroski & Walters, 1995). However, there are not many economists analysing innovation as a determinant of economic fluctuations. And yet, we, for example, speak about financial sector innovations, which were not regulated by appropriate authorities in the period before the most recent financial crisis.

Role of the historical context

Even with a complete dataset we wouldn't be able to interpret the results without knowing the historical context. In this study we are promoting endogenous growth theories and particularly the Schumpeterian ones which are, by nature, economically historical and always multidisciplinary. I argue that the next step can be achieved by using a relatively new method within the social sciences called "cliometrics". Stanley Reiter introduced this method in the US in the middle of the 20th century and it became fashionable there (Fogel, 1962; McCloskey, 1976; North&Weingast, 1989), and of course, leading to a massive wave of criticism (Kolchin, 1992; Heckman, 1997; Boldizzoni, 2011).

Cliometrics as a method is associated with the terms "New economic history", "Econometric history", and "Global history". This method is characterized by using historical data and statistical methods in the analysis. Cliometrics is a method of a multidisciplinary social science and, to a pure historian, is as untrustworthy as economics and vice versa. However, this (a)historical (Redlich, 1965) approach to economic history is a very useful method when used properly, i.e. when typical mistakes in asking questions and searching for answers are eliminated (Vokoun, 2013).

In short, this method follows the basic principles of historiography and is trying to avoid "cons"[4] (Leamer, 1983) in econometric analysis. It also means that the statistical and econometric analysis is not a "heavy" or necessary component of a cliometric analysis and basic statistical methods can be used instead. Thus, this method utilises rather general economic principles. Why? Multi-

[4] The inferences based on an econometric analysis are very fragile and by the "cons" Leamer understands not only common econometric mistakes, for example a missing sensitivity analysis, but also the praxis of drawing inferences from data itself, and generally the praxis of drawing inferences based on, sometimes unreported, whimsical assumptions (normality, non-existent alternative hypotheses, data sampling, "narrow horizon", etc.).

disciplinary/interdisciplinary approach. If there is an economic or sociologic theory behind an analysis, for example, “rational choice theory”, “neoclassical endogenous growth theory”, or “theory of organization”, it has to be stated at the beginning of the analysis. The author also has to be aware of all the recent critiques which can influence the interpretation of the results, for example from sociology, behavioural economics, psychology, and ecology.

This multidisciplinary cross-checking of theories places high demands on researchers. In fact, a cliometrician is expected to build his or her own meta-theory every time an analysis is done. This means that this approach can be very provocative and can result in a very conflicted interdisciplinary discussion. So far the topics have been more about particular institutional and technological changes. However, more and more studies are deeply interested in the global comparison of living standards, i.e., issues regarding health, education and economic growth.

Cliometricians can interpret an event in history and relate it to a present one, i.e., there are no general laws of economic history and no claims over some powerful predictive powers. They can do this in terms of the global historical approach. This step allows them to see the historical events globally. They are looking at the planet earth and the economies from a distance. For example, we can expect demographical revolutions in a catching-up developing economy and private property rights, education, and so on, with higher living standards.

We have to find a real counterfactual situation which is, in fact, nearly impossible to find, or create a plausible one (Lebow, 2000) and narrate (a)historically probable outcomes. There is also an extreme and completely separated branch of cliometrics which believes in prediction powers and the law of large numbers. It is called “cliodynamics” and it is used as a method to analyse and model “big” historical events and define general laws of history (Turchin, 2011).

Definitions in the field of the economics of innovation

There is much confusion when economists speak about certain terms. In most cases we have to deal with two different viewpoints and precisely distinguish them. The same term is used identically as an “act” and also as an “end product”. For example, the term *innovation* is identically used as the act of innovating (the whole

innovation process) and also as an end product (an invention). This is based on the dictionary definition (Keir & Pearsall, 2013) and the usage of the term in the economic literature.

This is not the only confusion we have to face. There are complicated ties between the terms. What is the connection between innovation and invention? How are imitation and innovation related? Is there a possibility to invent something by imitating? It all depends on the definition of each term. And even if we do it properly, a definite answer cannot always be given because certain stages are generally assumed. Therefore, we have to define these usual stages of an innovation, or the imitation process.

We are clearly in a dynamic environment and there is no universal definition of the term *innovation*, although many scientists (Baregheh et al., 2009) define it as a complex process. It encompasses all the activities associated with the act of innovating from the beginning to the end. Therefore, we have to define the beginning and end of the process. Typically (Schmookler, 1966), the initial phase is characterised by (1) a generation of ideas through (2) experiments and problem solving methods. The final phase is characterised by (3) the implementation of ideas and (4) its market and society diffusion. From another point of view we can speak of (1) basic research activities, followed by (2) applied and experimental research in the initial innovation input phase. In the output phase we observe (3) piloting and prototyping, followed by (4) commercialization, and changes to the market and in the society. (Greenhalgh and Rogers, 2009).

There are countless interactions between economic agents in every phase of the innovation process. Mostly we observe the firms' reaction (imitation, cooperation, innovation, etc.) and their adaptation (mergers, exits, court battles, etc.) to new market conditions. But there are also customers and governments, and we can track the impact of an innovation internationally, i.e., on a global scale. The demand side, governments, and global tendencies are all important sources of information. This extraction of desires is a valuable innovation factor in every phase of the innovation process.

A lot of dynamic factors and simultaneous processes are linked with the act of innovating. We are not able to track and observe all of the outcomes of economic

agent interactions and not even all outcomes of the innovation process. There are abandoned innovations, defence and military R&D projects, and simply all the secrets and strategic non-declaration in the financial statements and surveys.

Two interesting simultaneous processes are invention and imitation. They also have dual meanings as does the term innovation. We observe an act of inventing/imitating and a final invention/imitation. As one can imagine there are many possible intersections between all the “i” terms, in particular the outcomes of a typical innovation process. But, since we are dealing with complex phenomenon and simultaneity, it all depends on the circumstances, making their relationship rather complicated.

The act of inventing is typical of the initial (1) phase of the act of innovating, i.e., we observe creativity and the generation of ideas. But the complete process of inventing, the act and the outcome, can result in a prototype (phase 2, and 3), or an innovative outcome (4) which is an invention. To put it another way, the final outcome of the act of inventing, a new law of physics, or the invention of a new chemical element, is a basic research outcome (2), i.e., not the end product of the innovation process.

A consensus on a clear differentiation of the terms has clearly been an issue in economics and the social sciences from the very beginning (Brozen, 1951) to the present (Godin, 2008). With all the “i” terms, a pejorative meaning is perceived throughout history. Innovation meant, for example, changing to socialism (Godin, 2012). In everyday life, it meant some comic news about something bizarre. Even today we laugh at tabloid what-scientists-came-up-with reports and tend to somehow undervalue innovation activities. In the general population we undervalue it, in part, because the understood definition of innovation usually means something way bigger and tangible (for example, the iPod). Also, journalists are not exactly interpreting the results according to all assumptions and tend to “glamorize” it.

Technological innovation meant also new machines that were perceived as the Devil's apparatus, as a threat for the labour force, which was automation in factories. There are downsides to the innovation process, although for some reason, this topic is rather neglected. We do not care about great inventions like planes and microchips anymore. We consume them without getting overly excited.

Again a dual form is assumed. The act of imitating is sometimes mistakenly equated with an act of copying. It's true that these terms are related, but the act of imitating can be, and usually is, a far richer act than sheer duplication. Again, we can place the act of imitating in the initial phase (1) of the act of innovating, but the relationship of these two terms is more complicated.

We are inspired, however pejorative it may sound, by the current state of technology and scientific knowledge. Imitating usually, but not universally, follows the act of inventing and sometimes outcomes emerge as a by-product of that activity, with luck, or simply by the process of trial and error, i.e., haphazardly trying possible solutions and discarding those that are in error until one works. Therefore, the act of imitating can result in a new basic research outcome (2), a new and better prototype (3), or a new invention (4). Once more, the outcome of the act of imitating can be a similar thing, without any inventive effort, a copy, which is not the outcome of the innovation process.

The terms imitation and innovation are very close to each other and sometimes we are not able to distinguish between them. To distinguish between those two terms, a measure of added novelty is introduced. We speak about imitation with a zero level of novelty. Novelty is broadly used in patent law. It is a level of originality and industrial usability which can be compared "objectively" to the current scientific knowledge and state of technologies. This objective manner is a patent office arbitrary routine which has its limitations. It is a method used to assess an innovation by an impartial spectator.

Such a routine requires educated guesses, and multiple specialists are involved. But only time will tell, if a particular innovation is useful and successfully introduced to the market. In time, after the innovation is introduced to the market, we can distinguish between incremental and radical innovations, i.e., how influential an innovation was on the market. We can also observe how a firm views its innovation impact on the market in retrospect and what type it was.

According to the Oslo (OECD, 2005) and the Frascati manual (OECD, 2002), four types of innovation are recognized. Product, process, organizational, and marketing innovation are viewed by firms as new-to-the-firm, new-to-the-local market, and finally the world's first introduction to the global market. Such typology is a useful

simplification. However, as we've shown, the field of innovation is not black and white, and a firm, an institution, even a government is not exactly a trustworthy reviewer and reporter of its financial and innovation activities.

Conclusions

The understanding of firms' innovation activities and their economy-wide consequences are the key to the growing wealth of a nation in a long run. Innovation activity is a dynamic process and like entrepreneurs is an essential part of the market mechanism. It embodies the creation of new markets and the cooperation between economic agents of different institutional sectors. For that reason, it places quite high demands on the economic agents' skills and specialization.

Existing rules and limitations, also known as the institutional infrastructure, has to be challenged. Generally, we need to promote the competition of ideas, which includes the creation of suitable conditions for continuous R&D and human capital investment (education, health). In this way we can observe productive entrepreneurial activities and the never ending learning process of a society which leads to economic growth in a long run.

Sometimes, it seems, that some historical events are linked with an immediate process of change and a slow and demanding process of adaptation. Such a sudden and vast change is typical of developing countries and new democracies. The process of adaptation is a way to study firms' strategies and describe factors hampering innovative efforts.

These innovation efforts are characterized by trials and errors. The process of innovation doesn't always result in a successful introduction of a new product to the market. There are abandoned innovation projects, failed scientific theories, dangerous inventions, economically unusable inventions, and, for example, innovation projects which are challenging our morality.

In this paper I describe the theoretical background and promote the theories of endogenous growth. I promote a method to study economic history – cliometrics and encourage scholars to build their own meta-theories when analysing the conditions of a population, i.e., economic growth and living conditions.

I contribute to the general understanding of the terms of innovation, imitation, and invention. I show how similar they can be and what causes their problematic understanding. Their dual static and dynamic form is the reason we have to always define all the “i-terms” and prefer the dynamic form which describes the whole act, the whole process. Then I show that their relationship is simultaneous in nature and also very close.

The innovation process in a society has many manifestations. The patent count is not a good measure of the intensity of technological and institutional change. Multinationals are messengers of technological change, and we can study their impact on market conditions and economic development. I observe them as sheer entrepreneurs looking for profit opportunities. Their know-how, however, made them more efficient than local firms in a developing economy and contributed to the learning process of the society.

As a scientific work and exploratory study, this paper is a long journey in which I could not possibly address all the innovation economics issues. The theoretical background promotes the need for building a sophisticated framework or scientific approach, requiring a multidisciplinary critique. This places enormous demands on scholars and also shows us the limitations of our scientific efforts. However, there is no need to travel the journey alone, and as we have shown at the firm level; cooperation, collaboration and a simple exchange of ideas leads to a higher intensity of R&D activities.

This paper analyses strategies linked with the innovative behaviour of firms in a specific economy. But, there are also a global institutional infrastructure and other factors like culture and managerial skills which influence the motives, decisions, organization and strategies of firms wanting to compete in international markets. A demanding analysis and future further research is required to reveal and interpret them in a global context.

I am aware that yet another lessons can be learned from the presence of multinational companies in an economy. We mostly analyse them in a narrower macro and microeconomic setting and show the importance of external knowledge. But, there is a macroeconomic and possible institutional question. We want to know

what influences the market entry the most. What are the beneficial and hampering market entry factors of foreign direct investment, and again, on a global scope?

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