LORD KELVIN WAS WRONG: ABOUT THE EFFECTIVENESS OF INNOVATION INDEXES

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If you cannot *measure* it, you cannot improve it.

LORD KELVIN

I
INTRODUCTION

Innovation is a fashionable concept, as many economic (and election),[1] international[2] and state[3] programmes show. Fashion might not be the essential part of the scientific discourse, however, even judging by the politicians' declarations, innovation is certainly a popular topic and a point of interest for many scholars. One would even dare to claim that innovation policy attracts more positive attention than defence policy. In the times of economic crisis and austerity that are both affecting the Eurozone, it seems that authorizing expenses on innovation is easier than defending

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[1] «Innovation and Social Capital» were one of the four pillars of the political agenda of the Winner of last parliament elections in Poland - Civic Platform (Platforma Obywatelska) «Nast pny krok. Razem, Program wyborczy 2011» – programme available on Platforma Obywatelska website: http://wybory.platforma.org/program/ (accessed 11 January 2012).

[2] 7th Framework Programme, available on: http://cordis.europa.eu/fp7/home_pl.html (accessed: 12 January 2012).

[3] «Innovative Economy» Operational Programme for 2007-2013 (Program Operacyjny Innowacyjna Gospodarka 2007-2013), NSRO 2007-2013 – publication of Polish Ministry of Regional Development, available on the Polish Ministry of Interior Affairs's website, http://7poig.mswia.gov.pl/wai/7po/105/253/ (accessed 5 October 2011).

even limited military budgets. The economists themselves are also more inclined to claim it is innovation not war that stimulates the economy.[4] Since the states are usually considered as the most active in that field, the term innovation policy was quickly coined. It encompasses all state actions directed at innovation. Some of these actions form so-called innovation indices (also known as innovation indicators), whose main aim is to measure innovation performance of the country. Other entities, private companies or individuals being the example, often engage in innovation process as well and are, to some extent, included in innovation measures. By large though these indices show the role of the state. Since they attempt to measure innovative performance, when we ask about their effectiveness, we ask about the effectiveness of innovation policies, and ultimately, the impact innovation (and innovation policies) has on economy. We will argue that the effectiveness of these innovation indicators in achieving the goal that is set before them can be questioned. Nonetheless they are still taken into account when innovation policies are shaped. In order to prove our thesis we decided to divide the paper into smaller sections. First, we will describe innovation as a theoretical concept and show its place in economic models. Then we will try answer the question why innovation is measured. Since the main goal

[4] «That is why a war has always caused intense industrial activity. In the past orthodox finance has regarded a war as the only legitimate excuse for creating employment by governmental expenditure. You, Mr President, having cast off such fetters, are free to engage in the interests of peace and prosperity the technique which hitherto has only been allowed to serve the purposes of war and destruction.» – an open letter of J.M. Keynes to F.D. Roosevelt, published on 31 December 1933 in *New York Times* – quoted after: http://socialdemocracy21stcentury.blogspot.com/2011/09/keynes-on-new-deal-in-1933.html (accessed on 26 March 2012). Keynes (and we after him) indirectly refers here to the so-called parable of the broken window – as broken window in the bakery provides job to the glazier, any military conflict and its results (reconstruction) provides work, especially in the form of government expenditure. The critique of this presumption is delivered by F. Bastiat, 18th century French journalist, who describes the accident with broken window as «what is seen». However what is «unseen» is that thanks to the broken window, the owner of the bakery cannot spend his resources on e.g. new shoes, hence the shoe-maker or cobbler are without work. See: F. Bastiat, *Selected Essays on Political Economy*, Irvington-on-Hudson, NY: The Foundation for Economic Education, Inc. 1995, available online: http://www.econlib.org/library/Bastiat/basEss1.html (accessed: 26 March 2012).

of this paper is critique of current innovation measures, we will present two traditional (and most popular at the same time) innovation indicators and most important arguments against them. We will also include indices that are considered alternative to the traditional measures. The most important and conclusive part of this paper will be devoted to the critique of both old and new indices, and any innovation indicators in general.

II
INNOVATION - THEORETICAL APPROACH

Despite the popularity of the term, one may struggle to find the definition of innovation. In «Oslo Manual» Organisation for Economic Co-operation and Development (OECD) presents one of the most acclaimed approaches and defines innovation as: «the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business, practices, workplace organization or external relations.»[5]

The issue of measuring innovation is crucial for the government authorities in one of the biggest world economies, United States, to the extent of establishing US Advisory Committee on Measuring Innovation in the Twenty-First Century Economy. The perspective of this institution is slightly broader than OECD's – innovation is «the design, invention, development and/or implementation of new or altered products, services, processes, systems, organizational structures, or business models for the purpose of creating new value for customers and financial returns for the firm».[6] Whereas this definition puts emphasis on the role of customers and financial return (though profit would be more apt) – other definitions neglect these aspects and focus on research

[5] Oslo Manual: Proposed Guidelines for Collecting and Interpreting Innovation Data, wyd.3, Paris: OECD, 2005.

[6] The Advisory Committee on Measuring Innovation in the 21st Century Economy, «*Innovation Measurement: Tackling the State of Innovation in the American Economy*». *A Report to the Secretary of Commerce*. Washington, DC: Department of Commerce, 2008.

and development (R&D)[7] activities conducted in academic centres. This approach explains why innovation is also considered as an indispensable element of knowledge-based economy, another vague term coined to highlight the role of innovation in modern economies – in other words, that innovation brings progress and eventually well-being of society.

The closest approach to ours (according to which we will provide critique of innovation indices) should refer to the concept of the dynamic efficiency. In contrast to the most widespread definition of efficiency, the Pareto efficiency,[8] the idea of the dynamic efficiency requires understanding the concept of entrepreneurship or a an entrepreneurial action which does not only prevent the waste but also: «continually discovers and creates new ends and means, and thus fosters coordination.»[9]

It might seem surprising that not even once while defining the term we referred to any academic, or more importantly, economic textbooks. Indeed innovation might be the hot topic in popular press, but the search for it elsewhere, most notably in the textbooks, resembles looking for Waldo, a popular character of children's books.[10]

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[7] Although defining R&D is not necessary for the purpose of this paper, we will refer to it nevertheless. According to OECD it is «is creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications». See: *The Measure of Scientific and Technical Activities: Proposed Standard Practice for Surveys of Research and Experimental Development*, OECD, Paris 1993, paragraph 57, p. 29.

[8] According to Pareto's concept, efficiency is a diligent action aimed at preventing the waste of given resources. See: J. Huerta de Soto, *The Theory of Dynamic Efficiency*, Routledge Foundations of the Market Economy, London 2010; also available online: http://www.jesushuertadesoto.com/books_english/dynamic_efficiency/dynamic_efficiency.pdf (accessed: August 1, 2012).

[9] R.E. Cordato, *Welfare Economics in an Open Ended World: A Modern Austrian Perspective*, Dordrecht, Holland, Kluwer Academic Publishers, 1992, qt after: J.H. de Soto, *op. cit*., p. 24.

[10] Wikipedia, SV http://en.wikipedia.org/wiki/Where%27s_Wally%3F (accessed 26 March 2012).

III
WHERE IS WALDO. INNOVATION IN ECONOMIC TEXTBOOKS AND MODELS

Innovation might not be the «red herring»[11] in these publication, but academics are reluctant to even mention it in their works. Prominent economists R.E. Hall and J.B. Taylor and authors of one of the most popular economic textbooks do not write about innovation – but rather to what they refer as the technological development, which is, according to them, one (next to capital and work) of the determinants of economic growth.[12] Similarly, Samuelson and Nordhaus[13] only claim that innovation and competitiveness if supported by State, positively affect economic development. On the other hand the very same economists ignore this factor in their models – the model of sustainable development being the best example. Hall and Taylor in their model made a provision of a closed economy, i.e. without import or export or any technological change. We owe the absence of the latter to the famous winner of Nobel prize in economic sciences – R. Solow, whom these authors quote.[14]

Some scholars that have been studying the effectiveness of the economies, use Griliches' Model,[15] where the speed of aggregate productivity of factors of production growth depends on research and development (R&D) expenditures volume. Other empirical studies examine the impact of innovation diffusion. Both parameters

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[11] *Oxford English Dictionary*. red herring, n. Third edition, September 2009; online version December 2011. http://www.oed.com/view/Entry/160314; (accessed 18 December 2011).

[12] R.E. Hall, J.B. Taylor, *Makroekonomia. Teoria,. Funkcjonowanie i polityka*, PWN, Warszawa, 1997, p. 111.

[13] P.A. Samuelson, W.D. Nordhaus, *Ekonomia 2*, PWN, Warszawa, 2004, p. 168. It is worth noting though that W.D. Nordhaus is an author of the famous model according to which longer patent protection affects innovation. See: *Idem*, *Invention, Growth and Welfare*: *A Theoretical Treatment of Technological Change*, MIT Press 1969.

[14] R.E. Hall, J.B. Taylor, *op. cit*., p. 119.

[15] Z. Griliches: R&D and Productivity Slowdown, American Economic Review, 1980, vol. 76, s. 141-154 after: I. Świeczewska, «Innowacje a wzrost efektywności sektorów polskiej gospodarki», in: T. Baczko (ed.), *Raport o innowacyjności gospodarki Polski w 2010 r.*, INE PAN, Warszawa 2011, p. 47-52.

(i.e. R&D expenditure and innovation diffusion, however the latter is called differently) form most popular innovation indices, Summary Innovation Index (SII) and Global Innovation Index (GII). Despite at least debatable status of innovation among scholars, it does not lose any popularity among politicians, who make continuous attempts to measure it.[16]

IV
WHY DO WE MEASURE INNOVATION?

Innovation may not be popular or even present in economic models, but there is still substantial demand for it, mostly fuelled by the State. Indeed, creating demand for innovation is the core of many innovation policies. As we pointed out before, the states are usually the entities behind these policies and although neither the private companies, neither the individuals' efforts shall not be neglected, they are often considered as subjects of various innovation strategies rather than partners helping to shape them. There is even a bigger difference, that, as we will see, might affect the effectiveness of their actions. Whilst individuals and private companies are usually driven by profit, especially in the world of intellectual property, where almost every effort is rewarded, states, on the other hand do not act like firms and their policies are not evaluated according to the rules of loss and profit. Even though, there is a demand to examine the effectiveness of new laws and policies. The effectiveness is a purely economic concept, and there is implicit provision, quite popular in modern economics, that every action has its measure. Where private companies refer to the income statements, the government officials look upon statistics. These are usually delivered by the local statistics offices or, in case of innovation, other institutes which pride themselves with creating their own innovation index or at least publishing their own report on innovation. As these indexes usually consist of composite scores, they do not only illustrate

[16] Our purpose here is not denying the existence of the innovation, rather indicating terminology problems that are very often neglected by the authorities in charge of innovation policies.

the state innovation policy, but also indicate the areas where the performance (in order to get higher score) should be improved. The most popular and widely used from the latter group are mentioned above Summary Innovation Index and Global Innovation Index – for the purpose of this paper we will refer to them as «traditional innovation indices». SII and GII are beyond doubt the most complex indicators, but there are also corresponding measures on national level (since 2006 Polish Academy of Sciences has been publishing annual reports on state of innovation in Poland). Except SSII and GSII, we will refer to the measure constructed by NESTA[17] and the propositions of the authors «Go Global!» report[18] as these aptly point some of the weaknesses of traditional indexes.

V
TRADITIONAL INNOVATION INDEXES (SII AND GII)

The main difference between these two strikingly similar indexes lies in the number of indicators they use – Summary Innovation Index refers to 25, whereas GII to 80.

Summary Innovation Index reflecting the innovation performance of the European Union member states, is a part of so-called Innovation Union Scoreboard (old European Innovation Scoreboard - EIS) which shows how EU 27 members implement the resolutions of Lisbon Strategy. IUS is calculated for the European Commission. For comparison purposes IUS is also calculated for non-EU or non-EU 27 (but still European) states.

Being the composite score the Summary Innovation Index is not calculated directly but collects various parameters and variables

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[17] National Endowment for Science, Technology and the Arts – independent British think-tank. In 2009 NESTA published first report (results of research in 2007-2009) on the state of UK's economy innovativeness – The Innovation Index. Measuring the UK's investment in innovation and its effects. Index Report: November 2009 – available: http://www.nesta.org.uk/ (accessed: 17 January 2012).

[18] Report prepared by the scholars from Vistula University in Warsaw for II Kongres Innowacyjnej Gospodarki (2nd Congress on Innovative Economy) - http://madra-polska.pl/raport/Raport-o-innowacyjnosci-polskiej-gospodarki.pdf

stimulating innovation, as well as the results of scientific research. The main parameters are divided into three groups: enablers, firm activities and outputs. Each group consists of different dimensions that contain together 25 indicators.[19] Actually, it consists of 24 indicators, since the last measure, «high-growth innovative enterprises as a percentage of all enterprises» is still being developed as reports from 2010 and 2011 inform.

We will also examine the way the data is processed, as it is important in the context of the critique of measurements.

The data is collected by Eurostat, member states' statistics offices or what the authors of the report refer to «internationally recognized sources» (i.e. OECD). The latter are more relied upon when the non-EU scores are concerned, however there are some substantial data lags in comparisons between EU-27 and competing economies (USA, Canada, Japan, Australia and Russia) being the most important. The data should be from the same year, but the data lags are quite often an issue. When the data from the last year is not available, data from the latest available year is imputed. In case of complete lack of data for a given country, the composite score is calculated without this indicator. The usual and average rate of data completeness (for all indicators) and comparability is 96%, albeit in some cases (some indicators) even 25% of values might be missing.[20] Eurostat data for calculations for IUS 2011 relates to 2007, 2008 and 2009 actual performance, thus the index does not capture most recent changes in innovation, neither the impact of economic and financial crisis on innovation policies.

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[19] By indicators we mean the components or measures that compose given index. As mentioned before SII consists of 25 indicators, e.g. top 10% of most cited scientific publications, R&D expenditure in public sector, venture capital, R&D expenditure in business sector, PCT patent publications, community trademarks, high-growth innovation firms, employment in knowledge-intensive activities, licenses and patent revenues from abroad.

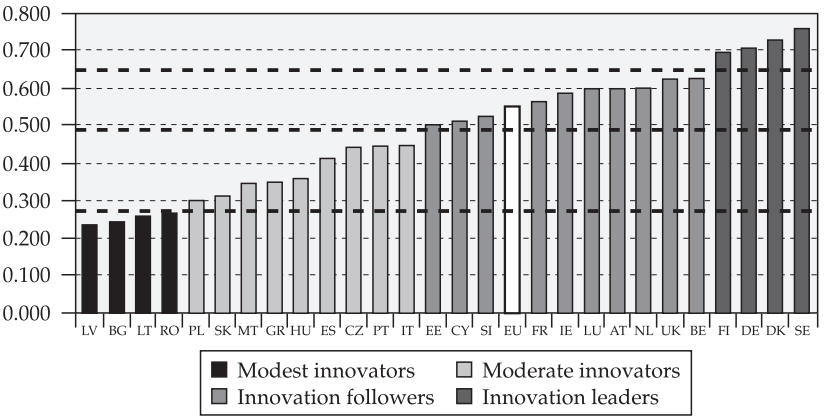
[20] The methodology of IUS is described in Innovation Union Scoreboard Methodology Report -http://www.proinnoeurope.eu/sites/default/files/page/11/IUS_2010_Methodology_report.pdf (accessed 26 March 2012), p. 15 and Innovation Union Scoreboard 2011 - http://ec.europa.eu/enterprise/policies/innovation/files/ius-2011_en.pdf (accessed 4 July 2012). In 2010 the data availability for venture capital was 69%, but we have to remember that these are mostly non-EU countries that lower the average results. The data span in of course different for different countries.

The next steps after data completion include indentifying extreme values, determining maximum and minimum scores and normalizing scores. Processed data may be aggregated in two ways, linearly or geometrically. The linear aggregation shows average scores with equal weights – each indicator is as important as the other. Another significant feature of this method lies in averaging the results – thanks to that even worse (in terms of innovative performance) countries usually get better position, whereas the better worse. In the geometrical aggregation on the other hand the emphasis is put on the scores with higher weight. This way the weaker issues are often highlighted, so the final position in the ranking gives the country guidelines to improve their position in the future. Each European country on the basis of their position in the general ranking can fall into one of the four groups: Innovation leaders (with score at least 20% above that of EU27), Innovation followers (with score between 90% and 120% of that of EU27), Moderate innovators (with score between 50% and 90% of that of EU27) and Modest innovators (with score below 50% of that of EU27).

The results for 2011 are show in chart 1.

CHART 1

SUMMARY INNOVATION INDEX 2011
(DATA GEOMETRICALLY AGGREGATED)



Fuente: Innovation Union Scoreboard Report 2011, http://ec.europa.eu/enterprise/policies/innovation/files/ius-2011_en.pdf, p. 7.

As we already observed besides the span of countries (GII is calculated for 125 countries) that are covered by Summary Innovation Index and Global Innovation Index, the differences between these two indicators are of minor character, mostly number of indicators – GII. GII as a simple average of the two sub-indices (Innovation Input Sub-Index and Innovation Output Sub-Index) includes a total of 80 various indicators organized in so-called sub-pillars that cover the same areas as SII.

VI
ALTERNATIVE TO TRADITIONAL MEASURES - MODERN INNOVATION INDICES

The traditional indices, SII and GII, mostly because of their complexity are object of broad critique. Hence the newer indexes are introduced and seen as a solution for measuring the innovation policy dilemma. Since they are considered as an alternative to traditional measures, we will call them «modern innovation indices».[21] The term modern refers not so much to their construction (as we will see in the critique despite their attempts they in fact copy the mistakes of the traditional indices), as to the fact that they constitute themselves as an alternative to traditional indicators, SII and GII. Modern indices might be less ambitious within the area they covered – both indexes we chose for this paper measure innovation at a national level, respectively in United Kingdom (NESTA's innovation index) and Poland (Go Global!), but they still intent to examine almost every (and sometimes surprising) aspect of innovation policies.

NESTA's innovation index and Go Global index are quite new measurements – the results of their research were published once – NESTA's report in autumn 2009 (after two years of studies) and

[21] For the purpose of this paper we have referred only to four chosen indices:GII, SII, GoGlobal and NESTA's. There are however many more, i.e. Innovation Index, Innovation Leadership, Country Profile by World Bank, Global Competitiveness Index, The Atlantic Century. Benchmarking EU & US Innovation and Competitiveness; etc.

Go Global! in summer 2011. NESTA's innovation index measures innovation in United Kingdom but the measuring categories are universal. Polish index on the other hand refers to the issues typical for this country, e.g. yearly employment change in public administration, national defence and ZUS (social insurance). In case of NESTA's indicator data is analysed on three levels: investments in innovative projects and their economic impact, a measure of innovation at firm level and wider conditions for innovation. Each of the components consists of composite scores. The data is collected from Office of National Statistics, other statistics offices and is a results of the questionnaire conducted among 1500 firms from different industry sectors.[22] Innovation investments include investments in knowledge and intangible goods.[23] The innovation at firm level was studied through the survey.

The final component is a descriptive indicator based on the literature review that examines wider conditions for innovation. They on the other hand are dependent on such factors as: openness of the economy, entrepreneurship, access to finance (including public support), skills and competence of workforce, competition (directly proportional to innovation), innovation demand (including stimulating demand, in particular government procurement) and public research.

Go Global! Index was thoroughly described in «Go Global. Report on Polish economy innovativeness»[24] – a report prepared by Vistula University scholars. Although it mostly refers to the specifics of Polish economy and innovation policies, we will discuss it briefly as it is not only one of the fewest attempts of

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[22] Energy production, accountancy services, specialist design, consultancy services, construction, architectural services, software & IT services, legal services, automotive. See: The Innovation Index. Measuring the UK's investment in innovation and its effects. Index Report: November 2009 – publication on: http://www.nesta.org.uk/publications/reports/assets/feautures/the_innovation_index (accessed 27 March 2012).

[23] This category encompasses: expenditures on research and development, design, organisational improvement, training and skills development, software development, market research and development, mineral exploration and copyright development.

[24] Original source: Raport o innowacyjności polskiej gospodarki. Go Global! http://madra-polska.pl/raport/Raport-o-innowacyjnosci-polskiej-gospodarki.pdf (accessed 26 March 2012).

qualitative approach but also a source of valuable data on global innovation measures. Go Global presents popular indices like SII or GSII and refers to less known: Global Competitiveness Index, World Bank's public financial support for commercial innovation or Boston Consulting Group and National Association of Manufacturers in innovation leadership.[25] The particular Go Global! index is a result of research and survey conducted among Polish companies. Though it refers to Polish economy only, it is discussed in this paper because of its construction – it refers to statistics and creates new parameters: a) young firms (present on Warsaw Stock Exchange) share in stock exchange capitalisation (for less than 5 years and less than 10 years), b) Venture Capital[26] and growth stage Private Equity investment value in Poland in relation to the overall value of these transactions in Europe, c) the number of Polish companies on the list of 100 global challengers in developing countries, d) percentage of firms indicating universities as a sources of innovation, e) percentage of industry and services companies implementing innovations, f) share of income from significantly improved products and services in company's income (for industry and services), g) Poland's position in United Nation's e-administration ranking, h) yearly employment change in public administration, national defense and ZUS (pension allowance). Where drop of employment rate means innovation growth – specific measure for Poland and Poland's position in *Doing Business* ranking (measuring regulations friendliness for business).

VII
CRITIQUE OF INNOVATION INDICES

As we see, despite all the differences (which are again of minor character), all indices have very ambitious goal: measure the effects

[25] *Ibidem*.

[26] Venture Capital is financial capital usually provided to early-stage, high-potential, start-up companies in the growth stage. Hence it is considered high-risk investment.

of innovation policies and innovation itself. But their strengths easily could be considered as their weaknesses, which we will discuss in the next part of this paper.

1. Limited approach towards innovation

The most important objection is definition of innovation to which these indices refer – another evidence of controversies within the term of innovation. It is crucial here to highlight that the number of definitions is not an issue, rather their construction. Whilst different perspectives can (and usually do) complement each other, many of them emphasize research and development as the main source of innovation. This approach limits the innovation activities to scientific research and neglects at the same time very important local, product, media, business or service innovations. Instead the emphasis is put on traditional research, which is still considered as a domain of universities or university-affiliated research centres. Since majority of these institutions (at least in Europe) is financed from tax money or other form of public support, we come to the conclusion that it is the state and its officials who play the crucial role in implementing innovation ideas. The structure of the indexes only confirms this thesis – even the Go Global index, whose authors criticize the notion at first, eventually refers to it (indicator measuring percentage of firms indicating universities as sources of innovation). Yet innovations are not only great inventions or technological discoveries made in the laboratories, but sometimes less impressive, but nevertheless useful solutions. The great example of the latter are social media: Facebook, Twitter or Groupon. The last one, Groupon offers possibility of purchasing goods under discounted prices, provided that certain number of people buys the offer. Twitter on the other hand is more and more appraised as a mean of scientific communication between scholars, especially during conferences. The success of Facebook or Twitter encourage scholars to create their own social platforms, designed specifically for scientific purposes, like academia.edu or Polish iProfessor. Even if they do not resemble great innovations of the 20th century, radio,

telephone or computer, they are revolutionary especially (however surprising it may sound) in the world of science where the paradigm of peer-reviewed journals is still dominating. Scientific blogs or blogs created by scholars, platforms for sharing working papers[27] – these are just few that may enhance the communication within the members of Academia, if not complement the traditional models. These incremental steps are very important, especially in the times of economic crisis, when not only defence budgets are subject to severe cuts.[28] Nevertheless presented indices seem to ignore these tendencies, focusing instead on high-technology devices.

2. Expenditures on R&D

Questions concerning defining the term are not the least among many other doubts that arose around innovation indices. Some of the arguments against them concern their construction – particular indicators they use. We will try to refer to the most important ones.

It is often said that weakness of presented indicators lies in excessive emphasis on research and development expenditures, either public or private. There is an erroneous presumption that research on innovation is synonymous with innovation itself. In reality even innovative idea or one considered as such, might not be implemented or its implementation (i.e. new product, service, etc.) might not be a successful on the market.[29] When customers do not appraise the novelty, the expenditure is a malinvestment,

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[27] See: http://ekulczycki.pl/warsztat_badacza/serwis-laczacy-recenzentow-i-autorow-publikacji-naukowych-peer-evaluation-dla-open-nauki/ (accessed 5 July, 2012).

[28] See: http://naukaotwarta.wordpress.com/2011/02/25/kryzys-ekonomiczny-a-otwarta-nauka/ (accessed 5 July, 2012).

[29] Only recently Polish newspaper *Gazeta Wyborcza* reported about the bankruptcy of «one of the most promising Polish start-ups, which did not win consumers' trust, despite many awards the company received: http://wyborcza.biz/Firma/1,101618,11605196,Obiecujacy_polski_startup_zamkniety___To_nie_porazka_.html (accessed: 26 March, 2012).

unnecessary cost and most importantly a loss, because the scarce resources could have been allocated differently. The entrepreneur usually calculates alternative cost of every investment he does, we can only wonder if it is the case with public officials. It might seem that the authors of innovation and innovativeness reports forget that R&D is indeed a change of money into knowledge, yet an innovation is a change of knowledge into money. Every innovation if not accepted by the market (i.e. the customers) is only a bad allocation of scarce resources.

Last but not least, the biggest mistake the authors of given measurement make is relying on expenditures. The expenditures either that made by government or consumers do not create wealth themselves - they do not occur before any firms' investments which in turn make these expenditures possible. To prove our point we will refer to Mark Skousen and his arguments against GDP.[30] Skousen argues, that GDP is not an accurate measure because, it only shows the final products, neglecting all stages of production. We must point though, it cannot in fact show all stages of production – since some of the outputs would have eventually overlap. Hence, this feature is not its biggest failure. As we remember, in short, GDP is:

$$GDP = C + I + G + NX$$[31]

According to the most acknowledged economic textbooks, the two most important factors are: private consumption and government spending. Traditional Keynesian models focus on the demand part of this equation, claiming that without the consumers who buy certain products, no business could survive. Hence, the government should encourage consumption via spending (public works, investments, etc. – the action is certainly more important than its purpose). Saving can be seen as excessive, as it stifles consumption. However, what these Keynesian models omit is the fact, that it is not the government that produces,

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[30] See: M. Skousen, *The Structure of Production*, New York University Press 1990.

[31] Where C is private consumption, I – gross investment, G – government spending and NX – exports minus imports or net exports.

but private business and that no investment can be made without prior saving. Government can stimulate the economy, but more often than not its actions are not efficient in terms of loss and profit. Investing in risky projects might be beneficial in the short run, but not in the long run, especially where the assets are not secured, i.e. the company invests everything it earns. Another important, though often forgotten issue, is so-called crowding-out – when rise in government spending results in lower level of investment spending (i.e. of private entities). What is more, the authors of some of these indices (NESTA and Go Global!) directly call for government procurement, arguing that the official authorities should support innovative solutions, but ignoring the fact, that such actions bear great risk of moral hazard. If the entrepreneurs are sometimes wrong in their decisions, any public authorities are prone to the same mistakes, particularly with lack of knowledge and incentive to evaluate the risk when taxpayers' money is concerned. The lack of transparent mechanism of responsibility results in abuse of public funds that the same authors of various reports seem to neglect or ignore. In the best case scenarios the state officials may favour innovative, yet costly solutions. None of the mentioned indicators takes neither crowding-out risk neither moral hazard into account, and very few countries implement those rules in their policies.[32]

3. Measuring expenditures on R&D

Expenditures on R&D are usually measured in one of the two indicators: public R&D spending as percentage of GDP or Gross Domestic Expenditures on R&D (GERD). The latter encompasses: government (GovERD), private (BERD) or third-sector (PNP)[33]

[32] One of those few countries is Canada, also known for its regional approach, where actual regions shape their own policies – see: OECD, *Eco-Innovation Policies in The People's Republic of China*, Environment Directorate, OECD 2009, p. 5.

[33] GovERD stands for Government Expenditures on R&D, BERD – Business Expenditures on R&D and PNP – Private Non-Profit Expenditures on R&D. They all form GERD – Gross Domestic Expenditures on R&D.

spending on R&D. Regardless of the chosen method, these indicators are either based on measures with wrong presumptions (GDP where the most important factor is government or consumer spending) or they directly copy these measures and their wrong presumptions – their construction is similar to GDP, where it is consumption that boosts the economy. There is also another reason why GERD cannot be relied on too much. Even if we agree that GDP and hence GERD are good measures, the former does not apply to federal countries or any other where regional innovation policies are formed – it takes into account only central government or, in case of US, federal spending. It is especially important in such countries as USA or Canada, where the states or regions are encouraged to form their individual innovation policies since they are seen as more effective and transparent.[34]

The measurements of R&D expenditures does not have to reliable even in case of private companies. Where they are concerned, there are at least two ways to calculate the expenditures: take into account all expenditures of the company on innovative activities in a given year-span or limit them to expenditures on innovations implemented within given year regardless of when the costs of implementing these innovations were borne. This issue was raised also by the authors of NESTA report. Surprisingly the solution proposed by them is another report, which however imperfect, allegedly serves better as an indication of innovation.

4. Data completeness and accurateness

In the same report we will find a critique of official data completeness and accurateness. These charges apply to SII and GII. Indeed, when calculating their indices, both European Commission and OECD rely on state statistics – aggregated by national statistics offices. In case of data lag, the missing score is replaced by data from the latest available year. For example the data for IUS 2011 relates to 2007, 2008 and 2009 (if the actual data is available). If

[34] See: http://eae.alberta.ca/research/system/alberta-innovates/history.aspx (accessed 17th July, 2012).

we add that there were substantial changes to the way of calculating the indices between 2010 (IUS composed of 29 indicators) and 2011 (25 indicators, among which the 25th is still not calculated due to lack of sufficient data), we are left with another issue: data comparability. Obviously the indicators are not independent measures in the sense that they are affected by current policies and overall economic situation in the country, e.g. during the economic crunch, the investors will not likely engage in venture capital, neither the new entrepreneurs will risk starting new business. Similarly, the state may limit its expenditures and support for research and development. In other words, every economy is heterogeneous – some similarities may arise, but due to their structure, they may react differently as well, as their governments may use different means to achieve stability. As we already seen, the data discrepancy does not even allow us to comment if and how the economic crisis of 2008 has affected the innovation policies – the incompleteness of data prevents setting any trends or dynamic of changes.

If evaluating the differences between the member states of European Union (which, of course, have different economies but nevertheless are still member states and thus are subject to similar policies) poses certain difficulties, we shall ask how other comparisons are possible. Summary Innovation Index and for obvious reasons Global Innovation Index list the results for EU-27 member states, non EU-27 states and global competitors (US, Canada, Japan, Brazil, China, India, South Africa and Russia). Here we face the problem of data lag and most importantly indicator lag. Not only non-European economies but also non-EU states do not convey similar surveys to IUS. The populations of the former outweigh these of the member states. Thus for international comparisons (at least for the purposes of IUS) a group of 12 indicators was chosen, which according to the authors are nearly identical to those of IUS.[35]

For example IUS has indicator that measures the share of population aged 20 to 34 that completed tertiary education. For

[35] Innovation Union Scoreboard 2011, http://ec.europa.eu/enterprise/policies/innovation/files/ius-2011_en.pdf, p. 17 (page accessed 12th July, 2012).

the same measurement in the international group the age span was broadened to group aged 25 to 64. The fewest gaps are in data measuring the firm activities, the biggest in activities measured in official statistics. If the states statistics are not reliable, are surveys or questionnaires an answer to the problem of data completeness? NESTA seem to share that view – a significant part of the data that was used to establish the state of innovation in UK come from questionnaires and surveys conducted for the purpose of the report.[36] Certainly they provide useful pieces of information at least about the companies' activities. However even if it provides more accurate measures of the entrepreneurs behaviour (and their subjective opinion on given topic), it may not be representative. For obvious reasons the authors of these reports rarely ever present the percentage of companies which refused to take part in the study. We do not know the questions neither the details of methodological report. These doubts are not without grounds – it is important to mention that similar questionnaire is being conducted for the yearly reports prepared by the members of the Polish Academy of Science[37] – due to a significant gap in feedback, the results are as inconclusive as in NESTA report.

As we can see the common feature of indicators that rely both on official and survey data is the amount of information they aggregate and calculate. The more accurate and detailed they aim to be, the more information they require and, usually, more data lag appears. The solution at least on behalf of official statistics is more diligence, which in consequence requires more information and more control of the government over people's lives.

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[36] See the part of this article about the NESTA report.

[37] T. Baczko (ed.), *Raport o innowacyjności gospodarki Polski w 2010 r.*, INE PAN, Warszawa, 2011.

5. Innovation, innovativeness and Intellectual Property protection

Before we conclude there is another particular problem that is worth discussing. Almost all indicators refer the concept of intellectual property and, most importantly patents or trademarks. It is generally presumed that they serve as means to motivate and to reward innovative activities which are the pillars of knowledge-based economy and human kind well-being. According to popular economic models there is such thing as the optimal length of patent[38] – in the short run, the broader the patent, the bigger incentive for the innovator. If the innovations are at least partly affected by the innovators' work, the system of patents should be enhanced, as the patents do not only provide information for the other innovators (so the resources are not wasted on projects that were already started), but also improve innovation. These theories though neglect two important problems: 1) that the patents gratify the person applying for them, not necessarily the innovator; 2) the social cost of patents (and other forms of intellectual property protection system). The second question refers to the problem which in economics is known as the tragedy of anti-commons. Contrarily to the tragedy of commons, here the number of owners may prevent from achieving socially-desirable aim e.g. the microchip which has over 5000 patents, so no one can create nor develop it further, unless is granted a license. In other words patent system is a monopoly and as such creates barriers of entry to certain markets. Because of the cost (born also by the innovator or the company) it favours big businesses. Small, yet innovative firm may not have means to protect their products – quite contrary to the big firm, that may not pursue innovative activity, but wants to protect its position on the market with monopoly rent. It may not be interested in introducing neither new product neither improvement of the old product (for which it would need

[38] See: W. Nordhaus: The Optimum Life of a Patent: A Reply, *The American Economic Review*, Vol. 62, No. 3. (Jun., 1972), pp. 428-431 – available at JSTOR http://links.jstor.org/sici?sici=0002-8282%28197206%2962%3A3%3C428%3ATOLOAP%3E2.0.CO%3B2-%23 (accessed: 12th July, 2012).

to seek the intellectual property protection as well). In fact big IT companies in order to avoid costs that involve buying licence to use certain device or technology patented by their competition decide to do cross-licensing, i.e. mutual exchange of technological solutions.

Mainstream theoretical approach advocates the system of intellectual property, yet it lacks empirical evidence to support the thesis that intellectual property protection contributes to innovativeness. But there is no practical testimony to prove its counter-thesis, i.e. that the system is unnecessary burden. In order to prove any point, one would have to create the model of future economy and present the tradeoffs of intellectual protection and free copying of ideas – L. von Mises already presented the impossibility of such endeavour.[39] There is however an interesting work by M. Boldrine and K. Levine,[40] who examine the problem of the monopoly rent in the competition and monopoly. In fact, the monopoly rent might be lower in the competitive environment than it is in monopoly, albeit in the latter case it also involves higher social costs (or costs borne by third parties, i.e. the cost of a license, etc.). Even without a definitive resolution to this problem, one has to keep in mind that patented device might not be accepted by the market (i.e. there will be no demand for it, or the customers decide that other goods serve their needs better), hence it is a loss for the company that decided to launch the product. The same authors present interesting study that support the argument against the protection of intellectual property or the system of copyright in particular. As it turns out the 18th century composers create much more when their «intellectual property» was not protected by law. Boldrine and Levine also refer to acknowledged literature to point that many 19th century patented inventions were in fact a waste of resources. Hence, if neither copyright neither patents.

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[39] See: M. Machaj, Ekonomia i polityka własno ci intelektualnej, http://mises.pl/blog/2012/02/02/machaj-ekonomia-i-polityka-wlasnosci-intelektualnej/ (accessed: 23rd July, 2012).

[40] M.L. Boldrine, D.K. Levine, *Against Intellectual Monopoly*, Cambridge Univ. Press, Cambridge, 2008.

VIII
CONCLUSIONS

We tried to provide exhaustive critique of current methods of measuring the innovations. We focused on internal (the construction of indicators) and external (the number of indices) factors that may affect the final construction. As we pointed out although the indicators take into account both public (i.e. the government's) and private (i.e. the firms, including SME sector) activity, yet they only evaluate the innovativeness of the former. It is a result of presumption that the state is the most active innovator. Neither the indicators themselves neither the scores that compose them do not deliver any evidence that may supports this thesis. They only show if a given country takes actions that are considered as leading to innovativeness. Only when we presume that those actions (e.g. R&D expenditures) are innovative, we may accept their measures as appropriate and valid. If the official statistics are not satisfactory, we may ask how the companies verify their innovativeness. Not surprisingly they do not refer to any external or internal measures of innovativeness but to their income statements and the profitability of certain actions which show if given product or service were chosen by their customers. Unfortunately this basic measure is not present in statistics of innovation. Yet unsuccessful innovation (i.e. not chosen by the customer) can in no way improve the economy. Indeed we have always lived in the knowledge-based economy, knowledge of the entrepreneur how to satisfy his customers needs. Hence any innovation indicators or indexes do not have any impact on the real economy, however it is not (mostly) due to errors in calculations or controversial parameters but wrong assumption about who is responsible for innovation. The presumption that it is the state that benefits most to the innovativeness, bore wrong presumptions about (and if) the innovativeness should be measured. We do not deny that public authorities may shape innovative policy, provided it does not distort the healthy mechanism of entrepreneurial calculation and knowledge of her customers and their needs. Such a suitable and most desirable institutional framework helps furthering entrepreneurial discovery

and coordination.[41] It helps promoting the dynamic efficiency – the knowledge how to adjust to new circumstances, and find new means and ends to achieve set goals and hence serve the customers. The current trends in innovation policies chose different strategy which means more state involvement in the economy and questionable means to measure the outcomes of this policy. The outcomes that may not even achieve goals set before them. Thus Lord Kelvin was wrong: an improvement in innovation is possible without measuring it.

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[41] J. Huerta de Soto, *op. cit.*, p. 25.

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