A SNAPSHOT OF THE TECHNOLOGICAL COMPETITIVENESS OF COUNTRIES

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Abstract: *It is well known that technology is a key factor for the economic progress and helps countries competing more successfully in markets for new goods and services. Technological competitiveness becomes this way closely related to the degree of innovativeness of a country. Although there are several indicators that measure directly the innovativeness of a country, there are still problems at the moment related to the availability of data. In this paper, we decided to assess the technological competitiveness of countries, based on a structural decomposition analysis of the patent shares on the world market. Unlike other authors who applied this methodology in their studies, we collected our data from the* World Intellectual Property Organization *(WIPO) Statistical Database, covering 12 years, from 2000 till 2011 and we took into consideration 35 technology subsectors in 33 countries (EU 27, China, Canada, Japan, US, Switzerland and Norway). This approach should highlight the countries' technological opportunities on the world level and measure their access towards sectors with high technological opportunities. Structural decomposition analysis points out the extent to which the shifts between technological sectors were induced by the changing technological environment on the world level. The analysis also shows the extent to which a country has an advantage/disadvantage from its past specialization pattern, having had a priori patenting activities in sectors that are now offering high opportunities and the extent to which the country deliberately moved into high opportunity technology sectors, or at least out of the industries with declining opportunities. The outcomes showed that technological development of countries on the world market played an important role for the patenting activity, being highly related to a well-developed infrastructure and pointed out that there are still a lot of European countries facing problems related to the technological infrastructure and technological capabilities. Countries that managed to keep their market shares high and also to increase their market shares over the years, while taking advantage of high opportunity sectors at the world level are the real leaders in terms of technological development. These countries are Japan, US, and China from the European states: Germany, France, Netherland, and Switzerland.*

Keywords: technological competitiveness; structural decomposition analysis; patent shares;
JEL *Classifications*: O31, O33

1. Introduction

It is well known that technology is a key factor for the economic progress. From new inventions like software, robotics and biotechnology, to improvements in manufacturing systems and processes, technology makes economies and societies more efficient and productive. Technology also helps countries compete more successfully in markets for new goods and services. Technological competitiveness becomes in this way closely related to the degree of innovativeness of a country. As

Michael Porter already stated, “companies can be highly productive in any industry- shoes, agriculture, or semiconductors- if they employ sophisticated methods, use advanced technology, and offer unique products and services” (Porter, 1998). Moreover, what he was trying to emphasize is that there is no low intensive industry or sector and that all sectors can be knowledge intensive and therefore can employ advanced technology. Although there are several indicators that measure directly the innovativeness of a country, there are still problems at the moment related to the availability of data. In this paper, we decided to assess the technological competitiveness of countries, based on a structural decomposition analysis of the patent shares on the world market. This analysis was first developed by Fagerberg and Solie and later improved by Laursen (1999). It has been also applied in some empirical studies in the literature assessing trade performance and structural competitiveness in different countries or within Euro Area (Ilzkovitz et. al., 2010). Unlike other authors who also applied this methodology in their studies, we collected our data from the World Intellectual Property Organization (WIPO) Statistical Database, covering the years 2000-2011 and we took into consideration 35 technology subsectors in 33 countries (EU 27, China, Canada, Japan, US, Switzerland and Norway).

We followed the assumption that the technological gap between the developed the countries and developing ones represent an important path of development for the latter and that technology can also reveal trade patterns. This might be explained by the fact that technology accumulation lead to the development of technological capabilities that often makes export structures difficult to handle. (Lall, 1992, 2000). The outcomes of the analysis proved to be significant, highlighting the fact that technological development of the world market has an important role for the patenting activity of countries and that are also a lot of countries facing problems related to the technological infrastructure and technological capabilities. These descriptive statistics can serve as guide lines and directives for governments in drawing their goals towards improving the technological capabilities.

The plan of the paper is as follows: the following section reviews the empirical literature in the field of technological competitiveness and patents as a proxy for technological development, paying particular attention to patent shares decomposition; section 3 presents the applied methodology and section 4 reports the data and main findings. The outcomes are highlighted in the least section of the paper.

2. Related literature

Patents have been used as a proxy for technological development in many empirical studies in the literature. The number of patents was used by Furman et al. (2002) and Furman and Hayes (2004) as a measure of the “innovative capacity” of a country. Although patents refer more to inventions rather than to innovations, and although they are used much more intensively in some industries than others, we can still consider them as an important base for advanced technology and intensive knowledge. Fagerberg (1987) also considered the patent statistics in constructing an index for technological development, in order to test the basic hypothesis of the technology gap theory and to analyze the differing growth performances of some industrial countries. He emphasized a positive correlation between the level of economic development of a country, measured as GDP per capita and the level of its technological development measured as number of patents. Although this proxy

can serve as a useful tool in understanding innovation, it is an imperfect measure because the propensity to patent varies considerably across industries, with many innovations not patented (or even not patentable). So, basing the entire analysis of the technological capability exclusively on this source might lead to a biased representation of the evidence. Although the concept of technological capability covers different aspects like: production capability, investment capability and innovation capability (Dalhman et. al. 1987), we decided to base our research only on patent growth rates in main technological sectors using the structural decomposition analysis. This methodology is based on the constant market share analysis, often used in empirical studies of trade (Fagerberg *et al.*, 1987; Laursen, 1999), but Laursen (1999) has also adopted this methodology for the analysis of the structural decomposition of patent shares over time at national level. This approach should highlight the countries' technological opportunities and measure a country's access to sectors with high technological opportunities at the world level. Structural decomposition analysis points out the extent to which the shifts between technological sectors of countries were induced by the changing technological environment at the world level. The analysis also shows the extent to which the country has an advantage/disadvantage from its past specialization pattern, having had a priori patenting activities in the sectors that are now offering high opportunities and the extent to which the country deliberately moved into high opportunity sectors, or at least out of the areas with declining opportunities. Furthermore, the analysis enables us to consider as exogenous the technological environment effects in the technology share effects and structural technology effects and as endogenous the country-level effects in the growth adaptation and stagnation effects. In the article "*Trade Performance and Structural Competitiveness Developments in the Euro Area: are Member States Equipped to meet the Globalization Challenges of the 21st Century?"* (Ilzkovitz et. al., 2010). the authors apply the structural decomposition analysis to the share of patents of Euro Area Member States on the world market, paying particular attention to the Euro Area as a whole. They concluded that there is a positive relationship between technology and market opportunities and those countries that are concentrating their innovative capacities in high-tech sectors are also shifting their production structures towards the sectors that are benefiting from the strongest growth in world demand. Among the methods in the literature that explore technology diffusion, we can mention patent citations and also patent maps. While the first refers to the fact that the more a certain patent is cited by subsequent patents, the more technology is considered to be diffused, implying that technology is more widely applied and thus more valuable (S.B. Chang et. al., 2009), the second one is part of the visualization methods and is considered to be proper for representing patent information and its analysis results (Y. G. Kim et. al., 2008). Visualization methods for patent analysis are called broadly a patent map. A patent map is the visualized expression of total patent analysis results to understand complex patent information easily and effectively. This is produced by gathering related patent documents of a target technology field, processing, and analyzing them (WIPO, 2003). Patents are useful sources of knowledge about technological progress and innovative activity (Park et al., 2005) and up until recently, patents, as a means to protect inventions legally, were perceived to be only for technology intensive sectors (Bader, 2008), but as Michael Porter already emphasized, "all industries can employ advanced technology; all industries can be knowledge intensive" (Porter, 1998). A conclusion from this would be that the value of firms,