A Multi Country Comparative Study Linking Innovation with Economic Development

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ABSTRACT:

Knowledge, technology, and innovation are essential factors that influence the economic development of countries. The objective of this research study is to examine the relationship between innovation performance and economic growth in three countries: Belgium, Portugal, and Tunisia. The results reveal that the stability of political and regulatory institutions is a key contributor to innovation performance. Moreover, there is a significant positive relationship between GDP per capita and the stability of the political and regulatory environments of the country. Additionally, factors such as research and development, knowledge workers, innovation linkages, and knowledge absorption are the most dominant factors for advancing innovative infrastructure.

Key words: Innovation, Portugal, Tunisia, Belgium, economic development

INTRODUCTION

This study compares three countries with differing levels of economic growth: Belgium, Portugal and Tunisia, in order to determine which factors, or combination of factors, have led to their current level of innovation and economic development. Belgium has progressed faster than Portugal, and both have progressed faster than Tunisia. The three countries have the same population size of about 11 million. They differ along important dimensions such as culture, policymaking, institutions, economic development and political environment. One important objective of this research project is to generate insights about sustainable solutions that would enable the lower performers, such as Tunisia, to grow at a rate that surpasses their current state.

The rationale of this study is that, most research on this topic tends to focus largely on high performing economies. The results of this research will be valuable to low performing economies, as it may serve as a benchmarking tool that can help them adjust their strategic policies. Also, the results will inform foreign aid contributors such as the European Union (EU), United States (US), and International Institutions on how to allocate their aid money within the receiving country innovation framework.

This study uses data from multiple sources to assess innovation discrepancies among the three countries. The World Bank, the Global Innovation Index (GII), which is produced and published by Cornell University, and INSEAD present valuable data about the economic development and innovation capabilities of countries assessed along selected indices and indicators. Collectively, these indicators reflect the economic and innovation activities, and the ranking of countries. For example, the GII uses seven indices, five inputs and two outputs. The five inputs are: Institutions, Human Capital and Research, Infrastructure, Market Sophistication, and Business Sophistication. These five inputs reflect the capacity of a country's overall economic infrastructure to produce innovative outputs measured by two indices: Knowledge and Technology Outputs, and Creative Outputs. The objective of the two outputs is to capture actual evidence of innovation. The belief is that the higher the two outputs, the higher the economic growth, and subsequently, the higher the Gross Domestic Product (GDP) per capita.

However, the way these databases present their data offers little knowledge on the relative importance of an individual input (policy area) on the overall innovation performance and economic development. This study will attempt to remedy this problem by applying multi-level analysis using various analytical tools thus producing valuable insights to help policymakers formulate country relevant policies. This is very important because policy instruments that may be effective in improving performance in one country may be less effective in another. Randomly replicating and applying a policy to low-performing countries could be damaging to innovation performance. Even though the notion of national innovation system has been accepted for more than two decades, most countries tried to follow the US innovation policy built around industry-academia collaboration and strong intellectual property rights. Currently, in the view of many policy makers, the need for a country specific innovation system framework has become a necessity (El Hanchi and Kerzazi, 2019; Villaluz and Ma Regina, 2019).

THEROTICAL FRAMWORK

Knowledge, technology, and innovation are essential factors that affect the economic development of countries. There is a wealth of literature linking innovation with economic growth (Carrincazeaux and Gaschet 2015; Pece et al. 2015; Westmore 2013). Numerous studies

conducted by institutions (such as OECD) and individuals have shown that innovation is a crucial component in economic development (Likar et al. 2014; Boons et al. 2013; Keupp, et al. 2012; Kumar and Subrahmanya 2010; Cainelli et al. 2006). Innovation provides new ways for companies and nations to utilize resources in ways that are more efficient. In general, there are only two ways for increasing the output of an economy: increase the number of inputs, or integrate new ways into the productive processes of the economy which will increase outputs from the same number of inputs. Because resources are limited, and most countries do not have the means to acquire more inputs, the most viable option to increase the level of outputs is through the fostering of innovation and the implementation of innovative processes (Rosenberg, 2004).

The national innovation capability of a country as an economic entity can generally be defined as the potential to produce a stream of commercially relevant innovations (Stern et al. 2000). A report, which benchmarked innovation and innovation policy across 27 OECD countries, concluded that "there is a strong link between innovation performance and innovation framework conditions. A high innovation performance is directly related to an active innovation policy" (Norwegian Ministry for Trade and Industry 2004). The analysis was based on two assumptions: "1) that government initiatives have a significant impact on innovation activity, and 2) that methodology can be applied to compare micro-policies in selected countries and provide policy-direction at the individual country level" (Norwegian Ministry for Trade and Industry 2004).

There is a variation across countries in their national innovative capacity due to different innovative input levels such as human resources and investment. A nation's public policy plays an important role in determining a country's innovative capacity, it dictates the country's level of "intellectual property protection and openness to international trade, the share of research performed by the academic sector and funded by the private sector, the degree of technological specialization, and each individual country's knowledge 'stock'" (Furman, et al, 2002). These factors ultimately contribute to a country's capacity "for achieving a high market share of high-tech export markets" (Furman, et al, 2002). A study of 94 countries between the years of 1965 to 2005 concluded that stronger intellectual property rights lead to increases in innovation. The study also determined that in countries with higher level of development, stronger Intellectual Property Rights (IPR) had a positive effect while in less developed countries, stronger IPR's had no effect (Sweet and Maggio 2015).

Some of the reasons for a country not performing well are as follows: lack of integrated innovation systems; inadequate regulations to support innovation; poor innovation quality (top universities, patents, citable documents); and slow rise of R&D in the private sector (Erciş and Musa, 2015). However, a country shift in focus from labor-intensive products to technology intensive industries and increased R&D investment would improve performance (Erciş and Musa, 2015). Companies that are information intensive and have specialized science-based sectors are the greater R&D investors. And the higher the R&D intensity, the higher the innovative performance (Spithoven, 2103). Absorption of external knowledge requires substantial research efforts by firms. Nonetheless, highly qualified workers and competitive pressures, measured by export orientation have positive effects on R&D efforts (Tejan and Sabi 2019; Spithoven, 2103).

In summary because of the complexity of innovation processes, the various stakeholders must collaborate to advance a country specific innovation framework, which has become a necessity for any country's success. Countries have to develop and continuously update their

national innovation strategy. They need to use innovation strategically in order to build a sustainable competitive advantage in an economically connected world. Innovation should not be limited to high-tech sectors, it should be integrated in all sectors of the economy and assimilated and espoused in the country culture (Bendak, et al., 2020; Hanifah, et al, 2020).

METHODOLOGY

The objective of this research project is to examine the innovation performance of three countries, Belgium, Portugal, and Tunisia, using indices published by the World Bank and the GII between 2008 and 2016. Because Belgium is the top performer in this study, its indices will be used as the benchmark for the other two countries. Examining the relationship between innovation performance and innovation framework conditions in these selected countries will generate results that will be useful in designing effective policies aimed at increasing innovation performance.

The research approach consisted of extracting, collecting, preparing, and analyzing data from the databases of GII and World Bank and analyzing the data to provide new insights. Additionally, the study complemented these data by interviewing policy makers, managers, entrepreneurs, and academics to further refine and validate the results. One crucial step in this study was applying cross-sectional regression analysis on the overall data set of about 70 countries with a population of 4 million or more and with a GDP of $2000 per capita, included in the GII index at two points of time, 2012 and 2016. This step determined the significant input indices affecting innovation performance. Furthermore, this step informed us which policy areas are persisting as significant and focused the scope of the project.

The framework of the Global Innovation Index consists of seven policy areas, five inputs, and two outputs. Each policy area has three sub-indices, thus producing twenty-one variables. From the World Bank, the study used one output variable, which is GDP/capita. Five input constructs from GII*:* 1) Institution: political environment, regulatory environment, business environment, 2) Human capital and research: Education, Tertiary education, R&D, 3) Infrastructure: ICTs, General infrastructure, Ecological sustainability, 4) Market Sophistication: Credit, Investment, Trade & Competition, and 5) Business Sophistication: Knowledge workers, innovation linkages, Knowledge absorption. Three Output Variables: 1) Knowledge and technology (GII): knowledge creation, knowledge impact, knowledge diffusion, 2) Creative outputs (GII): Intangible assets, creative goods and services, online creativity, and 3) GDP/Capita (World Bank).

RESULTS AND DISCUSSION

This section presents the basic socio-economic indicators for the three countries; the results of regression analysis to determine significant input variables impacting economic activity and outputs; and highlights generated from GII main indicators.

Comparison of Countries Basic Indicators

The following is recent data about the main socio-economic indicators of the three countries. Belgium GDP per capita is about twice of Portugal's and 4 times more than Tunisia's. In addition, the sum of its exports and imports is almost the same size of its GDP while in Portugal; it is about 38% and in Tunisia, only about 23%. Overall, the economy of Belgium is

more dynamic and more integrated into the global economy than the other two economies. The size of Belgium's exports are five times of Portugal's and about twenty times of Tunisia's. In addition, Belgium's unemployment rate is the lowest among the three countries.

Tunisia's GDP growth is slow and almost isolated from the turbulence of the global economy. Literacy in Tunisia is 82%, the worst among the three countries and its level of spending on education is the lowest. Tunisia's education expenditures stands at 2.3% of its GDP compared to 5.3% of Portugal's and 6.4% of Belgium's level of spending.

Regression Analysis

This study applied cross-sectional regression analysis on the subset of the overall data of all countries monitored by GII at two points of time: 2012 and 2016. The subset comprised of 70 countries that were selected using two criteria: a population of 4 million or more and a GDP of $2,000 per capita. The rationale behind these two criteria is to exclude countries with a small population and with a low GDP per capita. The regression used three output (dependent) measures and five input measures (independent variables). This step determined the significant input indices affecting innovation performance and informed us on which policy areas are persisting as significant. It also helped in focusing the scope of the research project.

The results of the regression analysis reveal that the most important predictor of GDP growth is the input "Institutions". There is a significant and positive relationship between GDP per capita and "Institutions" at the level of 5%. Regulatory and Political environments (subcategories of Institutions) are the most dominant factors. Additional regression analysis shows that "Human Capital Research" and "Business Sophistication" as input variables have significant impact on the level of production of "Knowledge and Technology". In addition to the stability of "Regulatory and Political Environments", "Research and Development", "Knowledge Workers", "Innovation Linkages", and "Knowledge Absorption" are the most dominant factors affecting innovation performance. It is important to note that Infrastructure and Market Sophistication did not have a significant relationship with any of the three output variables, namely GDP, Creative Output", and Knowledge and Technology Output".

When running a regression using GDP/Cap against second level GII input data from 2016, it appears that the most significant relationship is with "Innovation Linkages", which is a sub-index of Business Sophistication (Criteria 5). This sub index itself is comprised of 5 criteria: University/Industry Research Collaboration, State of Cluster Development, GERD Financed by Abroad, Joint Venture/Strategic Alliance Deals, and Patent Families Filed in at Least Two Offices.

When applying a regression using Knowledge and Technology output against second level GII input data from 2016, four sub index criteria produced significant relations: "Research and development (R&D)", "Knowledge absorption", "Ecological sustainability" and "Information and communication technologies (ICTs)". Regression analysis of the Creative Output against second level GII input data from 2016 indicates showed that there are 4 sub-index criteria that have significant relationships: "Research and development (R&D)", "Credit", and "Ecological sustainability" and "Education".

Additionally, the results show a significant (level of significance 5%) relationship between online activity and level of GDP. This result may be interpreted like this: the higher the GDP level, the greater the online activity, rather than the opposite. In general, the GII data and the various indices are not mutually exclusive and suffer from overlap. As such, results from

regression analysis should be supported by additional evidence in order to become valuable insights.

The data collected from the GII does not seem to justify the levels of GDP, in that almost all of the GII criteria, Portugal is very close to Belgium, while Tunisia is lagging far behind. However, when observing the GDP/Cap data, there seem to be wide equal gaps between all three countries throughout the years. The only instance where relatively equal gaps are seen is in the "Business Sophistication" criteria, which coincides with the data collected in the regression analysis of GDP/Cap vs. second level GII input data from 2016. This data suggests that the GDP/Cap levels of these three countries is more closely reflected in the state of development of the sub index of "Innovation Linkages", and its composites as discussed above.

Global Innovation Indices

The GII captures the multi-dimensional facets of innovation of a country and as mentioned in the introduction, uses five input and two output measures. It provides detailed metrics for economies, which in 2017 included 127 economies. It presents its overall results in a scale of 1 to 100 reflecting the strength of the innovation capability of a country. In 2017, Belgium scored 49.85 out of 100 and ranked 27 of 127 countries. Portugal scored 46.05, was ranked 31, while Tunisia scores 32.30, and was ranked at 74. In 2012, Belgium scored 54.3 out of 100 and ranked 20 of 141 countries. Portugal scored 45.3, and was ranked 35, Tunisia scores 36.5, and was ranked at 59.

Since 2012, both Belgium and Tunisia have regressed noticeably, while Portugal has progressed slightly. The GDP of Belgium is almost twice the GDP of Portugal while both are ranked very closely by GII at 27 and 31. It seems the GII ranking does not reflect the capacity of an economy to achieve a higher GDP. On the other hand, one may conclude that it takes a while for a country to translate its progress in innovation capability to actual increase in its GDP. The following sections present brief discussion comparing the seven indices of the Global Innovation Index for the three countries.

Institutions: This input as measured by GII is comprised of weighted average scores that encompass factors such as political environment, regulatory environment, and business environment. Based on data from 2012 to 2017, it appears that in recent years Portugal has slightly surpassed Belgium. Belgium's decline in this area appears to be caused mostly by perceived weakness in political stability and rule of law, whereas Portugal score seems to have been slowly increasing over the years, surpassing Belgium in perceived political stability, ease of resolving insolvency and ease of paying taxes, ultimately allowing it to slightly outrank Belgium in 2017. Tunisia has seen a slight steady decline over the years as depicted in this chart, ranking lower than both other countries. This is likely due to the perceived corruption within the government, which affects its overall scores in the political, regulatory and business environments. Nonetheless, perceived political stability has managed to oscillate around the same score, and perceived ease of doing business has slightly increased in the recent year.

Human Capital and Research: The Human Capital and Research index encompasses factors such as education, tertiary education and research and development. Although Belgium and Portugal held close and slightly declining scores (data from 2012 to 2017), Belgium began to stabilize and improve its score over the past few years, whilst Portugal continued to slowly and steadily decline. This increase in Belgium's ranking may be due to the increase in school life

expectancy, tertiary enrollment percentage, tertiary inbound mobility, a noticeable increase in researchers and general, yet modest improvements in research and development. Increases in these areas are linked to Belgium's political and tax incentives aimed at increasing the country's R&D and meeting Europe's R&D intensity targets. Portugal has managed to notably exceed Belgium in the percentage of graduates in science and engineering, although it is significantly behind Belgium in all factors of research and development. Although Tunisia scores are lower in this index, has seen some slight increases in recent years. In comparison to the other two countries, Tunisia scored very low in all research and development factors, as well as tertiary enrollment percentage. It does however have a higher percentage of graduates in science and engineering than both Belgium and Portugal, which may lead to further R&D growth for Tunisia in the future.

Infrastructure: It appears that since 2012 all three countries have followed a similar trajectory. The factors that contribute to the overall values on the chart are information and communication technology, general infrastructure and ecological sustainability. Amongst the three countries, Portugal ranks highest in ecological sustainability, followed by Tunisia, perhaps due to the economic importance of tourism for these countries, and thus the need to meet increasing energy and general infrastructure needs while maintaining healthy environment and ecological systems. Portugal and Tunisia also hold higher scores in e-participation, where Tunisia slightly surpassed Portugal in the most recent year. This is a sub factor of information and communication technology, which is possibly due to the larger percentage of population between ages 15 and 54, which are more likely to use online platforms for convenience and efficiency purposes. Belgium, however, holds the lead in the overall score of information and communication technology and general infrastructure, for Belgium produces significantly more energy, and has better transportation systems than the other two countries.

Market Sophistication: This index is comprised of factors such as credit (in terms of availability to domestic businesses), investment and trade competition and market scale. Based on data from 2012 to 2017, Portugal and Belgium have achieved similar scores over the five years, with only one slight, yet notable decline in Portugal's ranking in 2014, potentially due to the scandal involving Banco Espirito Santo and its parent company in July 2014, which led to fears regarding the stability of the entire Portuguese banki system (Gurnani, 2016). Portugal has consistently ranked significantly higher than Belgium in the credit factor, which encompasses measurements of ease of getting credit and domestic credit to private sector. Whereas Belgium has taken the lead in investment and trade competition and market scale, Tunisia has followed Belgium's pattern, although at a lower rank. Its strongest factor has trade competition and market scale, which Tunisia was able to improve significantly by achieving a higher ranking on applied tariff rate weighted mean percentage. It has also progressively improved its ranking in ease of getting credit.

To foster innovation, in 2014, Tunisia signed an agreement to enable European patent applicants and owners to validate their patents in Tunisia, a non-EPC member state (Egbuonu, 2016). On the other hand, Tunisian government engaged in negative practices to boost its economy and to create new jobs. For example, trade liberalization and foreign direct investment (FDI) inflows had harmful effects on the environment (Hakimi and Hamdi, 2016).

Business Sophistication: This index is comprised of factors such as knowledge workers, innovation linkages and knowledge absorption. All three countries seem to be following a similar pattern with similar intervals between each other, although it appears that Tunisia and Belgium possess more trend similarities with each other than Portugal. Portugal has maintained a rather constant trend over the past six years. Each country has its strongest factors; Portugal and Tunisia are strong in knowledge workers and weak in innovation linkages, whereas Belgium is also strongest in knowledge workers, but weak in knowledge absorption.

The findings about Tunisia are confirmed by a study, which focused on innovation culture in small Tunisian ICT firms (El Harbi, et al 2014). Firms have internal innovation but there is little sharing with outside sources. Moreover, universities and technical institutes are neglected because they do not function as institutions for exchange of knowledge. Because there seems to be no forum for knowledge transfer, there are no spillovers or no collective learning and therefore no opportunity to combine local tacit knowledge. There also seems to be little investment in time and financing where social capital and collective learning is concerned. The opportunities to scale up are not existent. Because Tunisian firms seem to be isolated in themselves, there is no engagement in knowledge flow (El Harbi, et al 2014).

A major problem in Portugal is the uneven regional development. A study of patents application in Portugal from the years of 1980-2008 revealed that, the area of Lisbon has the greatest concentration of patent applications (de Noronha Vaz, 2013). The majority of Portugal's regions seem to be excluded from the process of producing potentially patentable knowledge. The main protagonists of this recent increase in patents have been universities and other academic institutions. The establishment of the Gabinetes de Apoio à Propriedade Industrial (support Cabinet for the Promotion of Industrial Property) facilitated the diffusion of patent information to the universities. Also, the increased amount of PhD's in scientific and technological subjects in recent decades created the necessary conditions for a surge in innovations to occur. However, the lack of innovation at a firm level is a significant problem, as Portugal is lagging far behind leading innovative countries (Godinho, 2009).

Belgium, similar to Portugal, suffers from uneven national innovation development. In a study comparing Netherlands, Belgium, and Estonia it was concluded that in Belgium, differences in regional, policy, and governmental structure have not allowed for the countrywide assessment of open innovation policy framework. The federal government has little experience with proactive innovation policies, but it did initiate fiscal system changes aimed at stimulating R&D through a series of tax and social security reductions (OECD 2017), there is also information indicating that although the Belgian education system is performing well, there is evidence for an innovation skills mismatch. Furthermore, there is a need to boost entrepreneurship and ensure the retention of innovative enterprises (Koldzin, 2011).

Knowledge and Technology Output: This index is comprised of scores for knowledge creation, knowledge impact and knowledge diffusion. Portugal and Tunisia have maintained a rather steady trend over the five years (2012-2017). Belgium endured some shifts in its scores, seeing two significant drops- one in 2015 and another in 2017. These are mostly due to a dramatic decrease in the FDI net outflows, which were negative for the two years mentioned. Portugal has scored higher than Belgium in the knowledge impact factor, mostly due to comparably large numbers of ISO 9001 quality certificates issued, which was likely developed as a method to make business more efficient during the economic crisis that Portugal faced over the past decade. Although Tunisia scores are about 10 points below Portugal, it ranks higher than Portugal in the

knowledge impact criteria of high and medium-high tech manufacturers and in the knowledge diffusion criteria of high-tech exports less imports as a percentage of total trade.

Creative Output: This index measures factors such as intangible assets (intellectual property measurements), creative goods and services and online creativity. Belgium and Portugal seem to be closely aligned with each other for most of the six-year period captured by the data. Tunisia however, although maintaining a similar pattern to that of Belgium, is ranking lower than the other two countries, except for 2013 when its score caught up to that of Belgium and Portugal. When it comes to intangible assets, Portugal's ranking stands out among the three countries due to its large number of trademarks and industrial designs - which coincides with the data collected from WIPO database. Belgium maintains close ranking with Portugal in ICT business and organizational model creation. Tunisia ranks the lowest among the three countries, showing no trademark data, and none or very little industrial design applications. Under creative goods and services, Belgium takes the lead, mostly due to its rankings in cultural and creative services exports, film production and global entertainment and media market. Tunisia ranks last on this index factor. Belgium also leads in the online creativity index factor, outperforming the other two countries in most aspects. Several reasons exist why online creativity can differ among countries, such as access to mobile technology with internet capability, internet coverage, social behavior, cultural trends in internet usage, and cost of technology in relation to income.

Other Contributing Factors

Interviews conducted with managers from Portugal in summer 2017 indicated that in addition to political stability since 2011, Portugal has been perceived as a safe country (no terrorism threats) compared to other Eurozone countries. This perception has enhanced its economic activities and growth and increased the flow of foreign investment. Interviews conducted with managers in Tunisia in summer 2016 indicated that in addition to a lack of political stability, Tunisia institutions have too much of the red tape mentality which has a negative impact on economic activity and decreases the desire of local and foreign investors to conduct business in the country (Ben Jedidia, et al. 2014, Ghali, 1999). The excessive bureaucracy in the various governmental institutions creates a culture of bending the rules via political favors and corruption. Tunisia has to increase its investment in R&D and startup programs and need to consider establishing policies aimed at curbing corruption and enhancing transparency following Portugal's strategies since 2011. For example, the government should provide incentives to knowledge institutions such as universities to act like forums where firms get together and create positive interactions through sharing and transferring knowledge.

Portugal advanced a Technological Plan (TP) 2005-2009 to create and coordinate a wider innovation policy agenda that is able to respond to the challenges of governing increasingly broad, complex, dynamic and multi-sectorial domains of innovation policy (Laranja 2012). However, According to Proksch, et al., Portugal does not currently have any preconditions for improving its innovative capacity, and it should partner with countries that already have a high innovation strategy in order to learn from them and benefit from spillover effects. Countries such as Portugal should take a holistic approach to creating preconditions necessary for the development of innovation capacity, as opposed to concentrating on only one or two factors (Proksch, et al., 2017)

CONCLUSION

The objective of this study was to explore key factors essential for improving innovation performance at a country level. Findings from the study provide valuable evidence with regard to factors or policy areas crucial for the development of a country's innovation framework. To foster economic growth, countries such as Tunisia must promote innovation and the creation of knowledge-intensive new businesses. The most important conclusion of this research is that in order to create sustainable innovation capabilities, policy makers should make concrete commitment to promote innovation. They need to develop an effective level of coordination and cooperation among ministries and institutions involved in innovation efforts. They have to encourage and develop private equity industry, which is important for transforming R&D and entrepreneurial intention to innovation and consequently to the creation of new business.

Belgium and Portugal have to solve the uneven regional development and advance a countrywide innovation policy framework. The central government has to provide financial incentives and knowledge-sharing mechanisms, and allow the regions to develop their own innovation policies. All three countries have to reduce the skills mismatched between education system outputs and the needs necessary to advance innovation. Tunisia and Portugal have to provide incentives to firms in order to increase innovation at a firm level.

In addition, they need to advance policies to attract foreign direct investment. However, a key issue in developing countries is security and safety. The perception that Portugal is a safe country has motivated foreign entities to invest. Portugal is still developing its innovation policies. The country has recently seen rapid development. There is a substantial number of young dynamic tech-based companies pursuing innovation strategies. Finally, the stability of political and regulatory institutions is extremely important. Tunisia will not be able to transform itself unless it solves its bureaucratic and corruption problems and enhances the trust of its citizens in the integrity of the political system.

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