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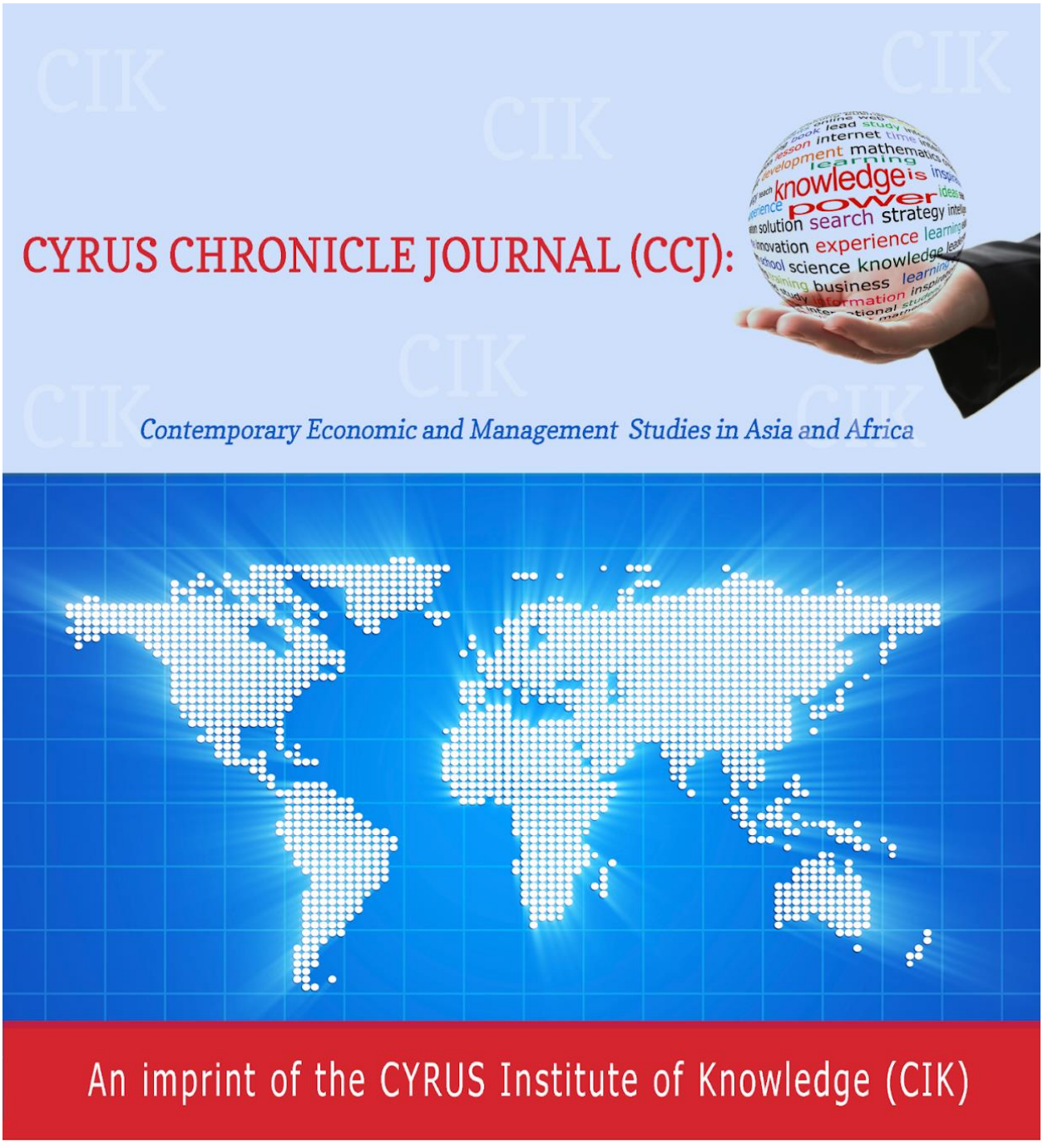

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Determinants of Innovation in the Region of MENA

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CYRUS CHRONICLE JOURNAL (CCJ):
Contemporary Economic and Management Studies in Asia and Africa

The flagship journal of the CYRUS Institute of Knowledge

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Purpose:

The CYRUS Institute of Knowledge (CIK) Journal is a refereed interdisciplinary journal. The editorial objective is to create opportunities for scholars and practitioners to share theoretical and applied knowledge. The subject fields are management sciences, economic development, sustainable growth, and related disciplines applicable to the Middle East, Central Asia (MENA) and North Africa. Being in transitional stages, these regions can greatly benefit from applied research relevant to their development. **CCJ** provides a platform for dissemination of high quality research about these regions. We welcome contributions from researchers in academia and practitioners in broadly defined areas of management sciences, economic development, and sustainable growth. The Journal's scope includes, but is not limited to, the following:

Business Development and

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International Finance

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Professor Tagi Sagafi-nejad is the editor of **CCJ**. Dr. Sagafi-nejad is ex-editor of International Trade Journal, the author, in collaboration with John Dunning of The UN and Transnational Corporations: From Codes of Conduct to Global Compact, (2008) and "The Evolution of International Business Textbooks" (2014). He was the Radcliffe Killam Distinguished Professor of International Business, founding Director of the PhD Program in International Business, and Director and Center for the Study of Western Hemispheric Trade at Texas A&M International University (2003-2013). Dr. Sagafi-nejad is well-known internationally and has outstanding credentials to develop The Cyrus Chronicle into a high quality publication. He will be assisted by an editorial board consisting of distinguished members from world-class institutions of higher learning, practice and industry. Editor is supported by several capable associate editors and a globally diverse editorial advisory board.

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We invite authors to submit their papers and case studies to Editor@Cyrusik.org. We will have a quick turn-around review process of less than two months. Every volume will be composed of about 5-8 papers and case studies. The first volume was published in the May of 2015. A selected number of papers submitted to the CIK conference will be double-blind reviewed for inclusion in ***THE CCJ***. We also have accepted papers from emerging economies about other regions of the world. We intend to have special issues on themes that are within the scope of Journal. Also, we will have invited guest issues.

THE CCJ: An imprint of the CYRUS Institute of Knowledge (CIK)

Background:

This is a historical time for the mentioned regions, and The Cyrus Chronicle intends to offer what is most urgently needed. There is no question that organizations and businesses that are capable of analyzing and applying advanced knowledge in management sciences and development are in high demand, and especially during transitional periods. It is an unusual time in the target regions and the world, a time which requires active intellectual participation and contributions. It is the era of revolution in terms of communication, technology and minds for billions of people. It is a time for intellectuals, entrepreneurs, and philanthropists to help enlighten minds and therefore enrich the quality of life for millions. It is a time to focus intensely on the regions' historical characteristics, achievements, human and natural resources, and its significant deficit in development, management sciences, and democracy. CIK's vision, "to cultivate the discourse on human capital potentials for better living," is the appropriate response to current challenges, and the journal is a platform for sharing the perspectives of scholars and practitioner with a wider audience.

CYRUS associates tend to have a foot in two worlds. First, most of the associates possess a wealth of intellectual and experiential knowledge which is enhanced by their active involvement in business, consulting and scholarly research and collegiate teaching. Second, some associates are sons and daughters of the affirmation regions and possess an ethnic identity, language skills, and the insights only embraced by insiders. Third, most of the CIK board of directors' members and associates are well-known scholars, members of editorial boards of journals, and even editors. CYRUS possesses depth, breadth, and a competitive edge to successfully manage chronicle.

CYRUS is committed to developing knowledge that positively contributes to the life of the world citizens, especially, the target regions. CIK is a charitable, educational, and scientific organization that has been in operation since 2011. It is a secular and nonpartisan organization that has many scholars and practitioner as member.

For more information on the Institute, please contact: Editor@Cyrusik.org; Sagafinejad@loyola.edu; Nasgary@Cyrusik.org. ***CYRUS Institute of Knowledge (CIK), Box 380003, Cambridge, MA 02238-0003, USA***

Editor's Introduction

Since inception in 2012, the ***Cyrus Institute of Knowledge*** has held five annual meetings. Three years ago, we published the first volume of its flagship journal, ***Cyrus Chronicle Journal (CCJ): Contemporary Economic and Management Studies in Asia and Africa in conjunction with the 2016 annual conference.***

The Institute has had seven successful international conferences since its inception. These conferences have been hosted at institutions (MIT, Harvard, Hult) in the United States and internationally (Hult - UAE, American University in Cairo, and ESCA in Morocco). Several institutions of higher education collaborated and supported these conferences. Please see CIK website for information about these institutions. We greatly appreciate their support! CIK 2020 Conference will be held at UNINOVE University, São Paulo, Brazil from May 20 -24th. You are invited to participate.

Generally, conference participants come from about 15 countries and 35 institutions, organizations, and companies. Please see CIK website for detail in this regard. For some plenary sessions we had up to 150 participants. The best papers presented at these conferences have traditionally been accepted for publication in the Journal, with additional articles by prominent scholars.

The acceptance rate of *CCJ* is generally less than 20%. Our aim is to publish the highest quality papers after they pass through multiple review process. CIK colleagues and conference participants have proposed and suggested special issues of the journal which is based on core topics (i.e., entrepreneurship, innovation, ethics, and sustainable development) and/or country specific ones. Therefore, we welcome your articles which meet these characteristics. We already have several papers about Iran.

Now we welcome you to the fourth issue (CCJ.V4). The journal intends to cover scholarship pertaining to emerging economies in Asia, Africa, and other emerging economies. Scholarship dealing with these regions tend to be either ignored or misunderstood, and there are limited outlets for scholars who work in these countries to share their scholarly outputs. Focusing on these two continents will help researchers from both developed countries as well as these two continents - which together account for the largest portion of the world population and growth. The *CCJ* intends to fill these gaps. An examination of our mission may shed some light on this question. The primary purpose of the journal is four-fold:

1. To share and promote knowledge of economic, management, and development issues facing countries of Asia and Africa and other emerging markets. Focusing on assessment, evaluation, and possible solutions help advance countries in this which has the largest world habitats. Development challenges are global; virtually all countries face challenges concerning economic development, sustainability, food and water, population and environmental degradation. Yet no country gains by shunning opportunities that globalization can provide, with the possible exception of a few countries whose leaders lack a full understanding of the opportunities that globalization can offer. To take advantage of such opportunities, knowledge is the primary requisite. And this journal aspires to make a contribution to this body of knowledge.

2. To encourage the generation and dissemination of knowledge by local scholars whose access to mainstream academic outlets may be limited. There are many scholars from academic, public and private sector organizations whose first-hand knowledge of problems and solutions is not being shared for lack of an appropriate outlet for dissemination. The *CCJ* seeks to provide an opportunity for spreading such knowledge.

3. To focus on countries that span the northern band of Asia – from China to Turkey – to the northern tier of Africa, areas that have not previously been the subject of much attention. In the past, these countries have tended to gain the attention of scholars and the media only in times of man-made or natural crises. But in fact, these nations share many challenges with others. They wrestle with shortages of food and water and the growth of population and pollution. Many countries, having

been under the shackles of dictatorship for decades, are now redoubling their efforts to educate their citizens, who have become freer to express ideas in journals such as this.

4. Academic scholarship emanating from the region under the journal's coverage tend to get lost in the academic jungle where the pressure of "publish or perish" leaves behind the younger and less experienced members. This journal will provide a venue for the scholars with first-hand knowledge of these areas. By publishing in *CCJ*, they could make important contributions to the body of management and development scholarship on which the journal will continue to concentrate. The *CCJ* will provide a platform for established as well as younger scholars who might collaborate with them in their research.

This fourth issue of the *Cyrus Chronic Journal*, contains six articles. Scholarly articles, from established scholars and policymakers, cover the gamut from the Middle East to Latin America. As part of our mission to advance knowledge about we will continue to include reviews of major scholarly books relevant to the Journal readers.

On the journal's operational side, we want to make the publication more accessible to a wide audience across the world, and so, consistent with the 21st -century trend toward electronic media, we will continue to publish this journal online. To maintain rigor and originality, articles submitted to the journal will nevertheless undergo the standard blind review process. Reviewers' anonymous comments are shared with authors, as appropriate. Submission guidelines and procedures are delineated on the journal's website: http://www.cyrusik.org/research/the-cyrus-chronicle

As the first editor of the journal, I am pleased and proud to accept this challenge. I bring some experience; my first editorial assignment was as an undergraduate student at the then Pahlavi University in Shiraz, Iran, a top-ranking institution in the region. A few students and I founded and published *Danesh-Pajouh* (knowledge seeker). In those days when freedom of expression was severely limited, we managed to publish one issue in March 1965 before the censors put a stop to the enterprise.

Years later, while directing a doctoral program in international business in Texas in the early 2000's, I also served as the co-editor - and eventually editor - of the *International Trade Journal* (ITJ) until my retirement in 2013. Under my leadership, the *ITJ* acceptance rate fell below 10%.

Publishing an academic journal is simply a labor of love. The rewards are many-fold and include working alongside a dedicated team of colleagues – Nader Asgary, Alf Walle, Nancy Black Sagafi-nejad, Dina Frutos-Bencze, reviewers, and the entire editorial Board. In addition, of course, we thank our contributors who have trusted their work of scholarship to be published in a new but growing and promising publication. They have spent many hours working to polish and prepare for the journal for publication.

In this fourth issue, we have already reached a threshold of about 20% in acceptance. Still, *CCJ* needs your support and so I ask for your help in the following ways:

- ***We are interested to offer special issues based on themes and country case studies. Your support, suggestions, and contributions are welcomed;***
- ***Contribute articles, case studies, and book reviews and commentaries;***
- ***Encourage your colleagues to do the same;***
- ***Encourage promising young scholars – especially those from developing and emerging economies from China to the northern tip of Africa – to submit their works to our journal;***

- ***Spread the word, especially in countries where CCJ can be most effective;***
- ***Cite the articles published in this journal in your own research when applicable;***
- ***Attend the annual conferences of the Institute (http:/www.Cyrusik.org the physical platforms that serves as an annual spawning ground for articles that may ultimately be published in this journal;***
- ***Give us your feedback by telling us how we can further promote and improve the journal.***

Welcome to *CCJ*, and thank you.

Tagi Sagafi-nejad, Editor

Abstract
This paper investigates determinants of innovation in MENA (Middle East and North Africa) countries. This investigation focused on GDP per capita (PPP), higher education enrollment, economy openness, business disclosure and unemployment rates, among other factors. The analysis uses the Global Innovation Index (GII), patent applications and high technology export as dependent variables in separate models. Panel regression is applied in the study. The result indicates that in the MENA region, all the above four factors except unemployment rate are determinants of innovation, and it is also shown that high technology export is the best proxy for innovation among the three dependent variables. This study is organized in the following format: introduction, followed by literature review, then data and methodology, then the results and discussion; finally, the paper closes with its conclusion and potentialities for future research.

Keywords: innovation determinants, GII, high tech export, MENA countries, panel regression

1. Introduction

1.1 Innovation

Innovation has garnered extensive interest and scrutiny today and plays a key role throughout the world. It serves as a solution to challenges facing humanity and acts as a catalyst for solving a plethora of demands worldwide. Innovation could be the creation of new technology, or a new business model.

An important part of economic dynamism is innovation, which together with entrepreneurial activities and market power, play critical roles in trade (Schumpeter, 1934). Monopolies are created due to technological innovation, which further brings excessive profits, and provides incentives in developing new products. Innovation is a process of risk taking to some degree. Organizations will enhance or evolve their offerings via innovative activities, which are revolutionary technologies or creative products. However, compared to price competition, this kind of technological innovation, or market power originated from innovation, can be more effective (Schumpeter,1934). Technological innovation is not necessary for a business success; however, it identifies new customers' needs; innovation drives new value for the customers (Teece, 2010). Innovation can transfer a new idea or invention into either goods or service, which brings value to customers who would like to pay for the innovation. Maranville (1992) argued innovation serves as a better solution to satisfy either existing market needs or new requirements.

Innovation is the reworking of current products or creation of new products, processes, ideas and service. It includes not only original invention, but also creative implementation (Kant, 1997). Also, innovation is identified as both outcome and process, is defined as production or exploitation, which could be new methods of production, new market and management systems (Crossan and Apaydin, 2010).

In a business context, innovation attracts customers. In a social context, creation of buyers' purchasing power, flexible working hours, new forms of alliance, joint venture, all of which relate to innovation. Drucker (2002) argued that innovation could be new wealth created by entrepreneur, or endowments toward wealth producing via existing resources. In his view, innovation originated from public service, business practice, or even an individual's family kitchen. He believed entrepreneurship is the soul of innovation (Drucker, 2002).

In an organizational context, innovation helps effect positive changes in productivity, market share, competitiveness and performance improvements (Salge and Vera, 2012). West (2002) indicated that both performance and profits would be enhanced within an organization with innovation resources and work opportunities.

1.2 Innovation vs invention

Innovation and invention are not the same even though they are close concepts. Invention is the "creation of a product or introduction of a process for the first time" (Bhasin, 2012). However, "innovation happens when someone improves on or makes a significant contribution to something that has already been invented" (Bhasin, 2012). Invention likely originated from experiments or studies and became a brand-new

feature. This kind of invention could include not only any newly released products, but also a cognitive discovery, or even musical composition.

Morgan (2015) wrote that "invention creates an ability, but innovation takes that ability and allows it to scale and create some kind of a market impact." Although the two concepts overlap, the sense of innovation is more like a change in an existing idea, product or field. He argued that Google Glass, for instance, was an invention; while Apple iPhone was an innovation. In Morgan's view, innovation would be more market oriented, meaning that an innovation generally will bring a positive impact to the market, a practical implementation of invention.

1.3 Innovation input and output

Innovation inputs are those elements of the national economy that enable innovative activities. Innovation outputs are the results of innovative activities within the economy (Global Innovation Index 2018 Report).

The Global Innovation Index (GII) measures the innovation inputs with five enabler pillars: Institutions, Human capital and research, Infrastructure, Market sophistication, and Business sophistication. Enabler pillars represent all the dimensions in a country's innovation activities. There are two output pillars as well: Knowledge and technology outputs and Creative outputs. Each input or output pillar is further included three sub-pillars, which compose 80 different individual variables in total for the year (Cornell University, INSEAD and WIPO, GII Report 2018).

1.4 Types of Innovation

The OECD (Organization for Economic Co-operation and Development) defines innovation broadly to include process, methods (either marketing or organizational), together with traditional perceived product and service in existing organization and business; all of these are either new implementation or at least improved significantly compared to the current occurrence (Eurostat and OECD, 2005).

This is an indication how the concept of innovation has been developed from only the narrow understanding of R&D based technological product innovation in past time to current non-R&D innovative service and business model as well. Traditional innovation was mostly found in the manufacturing field with necessary technological breakthroughs; it was more perceived to be determined by new technology exploiting. However, innovation today has expanded across research or non-research.

1.5 Innovation measurement

All the innovation factors with necessary adjustments are continually evaluated in every year's Global Innovation Index, which presents more than 90% of the world's population and the world's GDP (in current US dollars). Detailed innovation metrics for most nations are disclosed in the GII annual report.

The GII report is composed of four measures: the overall GII, the Input and Output Sub-Indices, and the Innovation Efficiency Ratio. The overall GII score is the simple average of the Input and Output Sub-Index scores. The Innovation Efficiency Ratio is the ratio of the Output Sub-Index score to the Input Sub-Index score; It discovers nations' innovation from aspects of its investment and achievements as well (Global Innovation Index 2018 Report). There is reviewing and updating to every year's GII variables to indicate the newest trend in terms of global innovation.

1.6 Middle East and North Africa

Based on classification from the World Bank, the Middle East and North Africa (MENA) region includes 21 countries: Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Malta, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, United Arab Emirates, West Bank and Gaza, and Yemen (World Bank Definition: MENA. Worldbank.org).

45% of the world's natural gas reserve, 60% of the world's oil reserve and 6% of the world's population is in the MENA region. 12 OPEC nations are mostly MENA countries, which are key players as petroleum suppliers in today's world.

With an average growth of 2.6% in year 2019 to 2020, MENA region is expected to improve its economics modestly by oil exporters in a higher oil price related to external oil demand (worldbank.org/en/region/mena).

2. Literature review

2.1 Schumpeter's innovation theory

Schumpeter believed innovation brings change, which is also a historical process of development, driving by entrepreneurship (Schumpeter, 1912). There are five types of innovation during this development process: "1. Launch of a new product or a new species of already known product; 2. Application of new methods of production or sales of a product (not yet proven in the industry); 3. Opening of a new market (the market for which a branch of the industry was not yet represented); 4. Acquiring of new sources of supply of raw material or semi-finished goods; 5. New industry structure such as the creation or destruction of a monopoly position" (Schumpeter, 1934).

He argued that innovation stems from current means of productive suppliers, and can contribute to profits (Schumpeter, 1934). In his analysis, innovation creates change and brings destruction. It is a "process of industrial mutation that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one"(Schumpeter, 1942).

Schumpeter's most distinctive contribution to economics are probably the concepts of innovation and entrepreneurship (Hanush and Pyka, 2007). Schumpeter viewed that economic growth cycles occur because of innovation fluctuation (Rosenberg, 1994). Schumpeter likened innovation to "neighborhoods of equilibrium", in specific time periods innovation clustered were formed, and then entrepreneurs took the risk providing warrant innovative commitments; finally, this equilibrium generates accelerated growth in a long round (Rosenberg,1994)

2.2 Disruptive Innovation of Christensen

Christensen (1997) classified two categories of innovation as being sustaining and disruptive. Sustaining innovation usually does not alter the current market and may improve the existing products, not always bringing a new product (King and Baatartogtokh, 2015). On the other hand, disruptive innovation creates new product and a market niche (Christensen et al.,2015); it leads to a new trend in the market by replacing the current products.

Further, Christensen believed that disruptive innovation could be a threat to those successful companies in the sense that further growth space is limited, and also profit margin is tight as well in the ignored market; those established companies with steady customers, excellent development and research were very susceptible to disruptive innovation (Christensen, 1997).

2.3 GII report (2018)

The Global Innovation Index (GII) annual reports specify innovation indices, correlated with economic growth, which usually represented by GDP per capita.

"GDP per capita based on purchasing power parity (PPP). PPP GDP is gross domestic product converted to international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources" (World Bank, International Comparison Program database).

Education quality plays a key role in a country's innovation activities. Tertiary education, whether research originated or not, having strict admission requirement and being expected to accomplish education in an advanced level, is an important determinant of a nation's innovation capacity, which raises the value chain

from the lower level through higher technological products processing. In GII annual report (2008), tertiary education is also an indicator in terms of human capital and research. Tertiary gross enrollment ratio "is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown" (UNESCO Institute for Statistics).

The institutions pillar in GII report represents a nation's institutional framework, which is crucial for attracting business and economic growth. Good governance is essential to innovation ensuring this kind of institutional framework with appropriate business protection and incentives.

A series of indicators regarding corporate governance are used in GII annual report (2008). For example, it includes a percentage variable of working females who have higher education degrees to investigate business sophistication, which is one of the five pillars in measuring innovation inputs in GII. Also, ease of starting a business is an indicator in GII annual report (2008) in measuring business environment, or economic openings in regard to institution from the business aspect.

3. Methodology and data

3.1 Propositions

Innovation as a combined phenomenon usually closely correlates with social institutions, it can only be understood better when embedded in its specific area complex environment (Lundvall, 1992; Asheim, 1999).

Factors influencing the regional innovation environment include institutional contexts in a specific geography and its localized structure (Iammarino, 2005), regional systems (Cooke et al., 1997), or in other words, innovation systems (Lundvall, 2001). Regional institutions such as universities, research center and companies, together with legal system, regulation and value norms in terms of social institution, affect simultaneously the overall performance of innovation (Smith, 1995).

Also, interplay between local context and relevant proximity plays the important role in shaping innovation (Camagni, 1995). In details, Iammarino (2005) mentioned "inter-organization networks, financial and legal institutions, technical agencies and research infrastructures, education and training systems, governance structures, innovation policies" in the innovation process.

3.1.1 GDP per capita

In the innovation related literature, GDP per capita, which is a usual proxy for economic growth, is frequently used in constructing the innovation model to account "for the stock of existing knowledge and of its distance to the technological frontier (Fagerberg, 1988). The rationality disclosing the close interaction between regional economic income and its innovation indicators originated from the empirical studies (Lundvall, 1999, Nelson, 1996).

It is the economic input of GDP invested to regional R&D activities that brings innovation, which Rodriguez-Pose and Crescenzi (2008) argued is a linear model using GDP as a main factor.

Further, Chen and Puttitanun (2005) disclosed a U shape in terms of GDP per capita and IPRs (intellectual property rights). Regarding innovation, it is shown that in developing countries, for instance, there is a significant positive influence by IPRs, which however indicates a U-shape association with GDP per capitol. In addition, Maskus (2000) and Primo Braga et al. (2000) also mentioned this kind of U shape when discussing GNP per capita and IPRs in their empirical research. The central idea for an optimum IPRs developments in developing countries is born out to relate to economic performance. In the earlier economic growth stage, less IPRs would be preferable when imitating being more efficient than innovation. However, with the continuous economy growth and technology progress, only imitatied technology is not enough to demonstrate innovation. Innovation arises to satisfy technological upgrades, which brings more IPRs protection in this phrase (Chen and Puttitanun, 2005). Similarly, according to Acemoglu et al. (2002),

technology adoption, which strategically benefits nations' low economic development level, would be replaced by strategical innovation when these countries approaching to the technology frontiers.

Based on the above literature regarding relationship between innovation and economic development level, or in other words, GDP per capita, no matter whether it is a positive association or a U-shaped curve, we have thus proposition as follow:

Proposition 1: GDP per capita is a determinant in innovation.

3.1.2 Higher Education

Followed by the economic development level, higher education, or in more specific, universities are broadly recognized for their crucial contributions in area innovation from both empirical application and theoretical aspect. Universities are economic growth and innovation drivers, which develop regional high technology by educating labors, transferring knowledge and investing new business models (Castells & Hall, 1994).

Universities in current innovation related literatures are assumed to be providers in regional innovation system (Cooke et al., 2000; Varga, 2000). Massachusetts Institute of Technology (MIT) in Boston (Saxennian, 1994), for instance, represents a successful case, where universities facilitate learning and innovation and impact area development.

However, as also mentioned by Park and Ginarte (1997), Chen and Puttitanun (2005) indicated that education effect is insignificant, though it is positive to innovation. In addition, it is argued whether the successful example of MIT in developed region of Boston area could also be applied to other regions with totally different district institutions and economic levels (Chen and Puttitanun, 2005). Instead, it seems to exist a gap or paradox in terms of universities' involvement in regional innovation framework as theoretical model and real engagement in an area innovation practice (Chen and Puttitanun, 2005).

In the concerns of higher education's role in innovation, we therefore have the next proposition:

Proposition 2: Innovation is correlated with higher education.

3.1.3 Economic openness.

Again, existed literatures stressed regional institution context affects innovation in learning process (Howells, 1990). In details, how knowledge is built and transferred in a specific area, and whether this kind of transfer and building system is effective and efficient, are dependent on the governance and institution context in the region. In this article, we focus the institution context on three factors as economic openness, business disclosure and unemployment as well.

There is no doubt that competition is everywhere, every time. Competition between the new entries and existed industry giants is also daily occurred. The difference for the new comers is that they are usually very innovative, but instead of investing much in research and development by themselves, they would more likely outsource. If it is possible, more newer entrepreneurs are waiting in line to enter the industry with purchased external discoveries (Chesbrough, 2004).

Accompanying the competition in industrial leading giants is the decline of innovation creativity. From "closed innovation" to "open innovation", in this "paradigm shift", Chesbrough (2004) described how companies optimize innovation investment. In past times, firms were more self-reliant to make sure the products' quality, capability and availability. They complete the whole production circle, initiating the idea and research, then manufacturing, delivering, financing and customer serving; in a word, all by themselves. This was once the traditional closed innovation with more control. However, nowadays, the old paradigm of innovation has switched to the open innovation, when companies can utilize both the internal and external resources for advanced technologies and markets as well (Chesbrough, 2003, 2004). Innovation itself is no longer circled in a close environment, instead, it can flow freely in the market.

After Chesbrough advanced the concept of open innovation, interest in this field research increased exponentially (West & Bogers, 2017). Based on Chesbrough (2003) early study, which focus on an isolated innovation model, either optimizing internal innovation in markets, or vice visa outsourcing outside innovation in internal innovation, latter literature such as Enkel, et.al (2009) also investigated the interaction between both the inbound and outbound innovation in combined mode. Chesbrough (2006) articulated the open innovation paradigm as effected by the inside and outside knowledge resources breaking through a limited self-boundary.

Further, Chesbrough (2004) studied metrics among different groups inside an institution regarding monitoring innovation and utilizing opportunity within the open innovation paradigm. These metrics, which close to time related efficiency concern, care about how much time it needs to transfer a patented idea to practical use within the firm's inner production and service process, and the elapsed time between innovation being patented and finally licensed. The time efficiency, how much time it takes for either a new product or service being released to market is regards as another kind of currency for innovation activities (Chesbrough, 2004).

The central idea here is trying to shorten the required time for newly released products and service occurrence in market, so as to reduce the learning curve and increase productivity and efficiency as well in an innovation process. In addition, Amit and Zott (2001) also believed that efficiency is a key element in business innovation for entrepreneurs. Based on previous failures and gaining from those cumulative learning curves, companies should alternatively provide practical business models as quickly as possible (Chesbrough,2010).

Therefore, we use time required to start a business as a proxy in measuring innovation openness, or the broadly conceptual economic openness, and have the proposition as follow:

Proposition 3: economic openness (time required to start a business --days) explains innovation.

3.1.4 Business disclosure.

Usually for the sake of much more market share, or showing the capability in advanced technology application, firms would like to announce their innovation success to the public using different strategies. This innovation announcement process could be a coming new product and its expected date to be launched to the market, or only general information about an innovative plan on the way. Firms reveal positive signals in their innovation development and producing through these open disclosure processes.

However, issue of free-ride effect arises simultaneously with this innovation disclosure and therefore reduce or countervail another side of the so-called business-stealing effect in the innovation competition (Jason, 2010). Further, firms' revenue did not increase much after their innovation announcement to the market. Disclosure incentives were therefore challenged, and to what degree this kind of disclosure should be, either full or partial disclosure, or on the other side concealment were also frequently disputed (Milgrom 1981). Incentives for disclosure, which could bring either extreme or intermediate revenue flows, are dependent on intellectual property protection.

As Lewis and Sappingto (1989) mentioned, there is a trade-off between the business-stealing effect and free-rider effect in terms of R&D initiative. The familiar free-rider effect is a view that investors in R&D cannot always get the full innovation revenue in the concern partial innovation rewards go to siders. However, if the winners in innovation competition take all, which is the conceptual business-stealing effect, then there would be an overinvestment in R&D for the sake of monopoly profits from innovation production (Anton and Yao, 2003, 2004).

When the intellectual properties are not protected, that means the free riders can share the same rewards from innovation results, incentives for R&D declined and innovation production reduced. The free riders finally decreased their profits because of the R&D underinvestment in the whole market, though at the

earlier stage they could expect abnormal profits for their free-riding by imitating others with less self-investments in innovation.

Firms are affected differently by information disclosure (Raith, 1996, and Vives,1999). To innovation followers, they can optimize their investments based on the existed open information, especially the actual cost, and therefore possibly earn much more profits than industry average. On the other hand, innovation initiatives preferred to keep the secret, avoiding their competitors' cost adaptation and adjustments to maintain leading position in the industry, making harder for the technology follows to imitate. Bhattacharya and Guriev (2006) also expressed there are interest conflicts between the information sender and receiver in disclosure of information.

Inimitability, or tacit knowledge, is recognized by researchers to be key element in innovation competition. Grant (1996), for instance, discussed company's competitive advantage depending on its distinctive, unique and rare resources in innovation, which should not be easily substituted or transferred (Grant, 1991). It would be a disaster for company's knowledge competitive advantage when there is no attempt of tacit knowledge management (Barney, 1991; Kogut and Zander, 1992). Quinn (1992) also pointed that knowledge, especially tacit knowledge, has strategically been company's most important property and resource it owned.

Regarding the importance of tacit knowledge, or intellectual property, policy maker can control its strength and spillover size (Denicolo, 1996), so as to satisfy the economic development or manufacturing overflow.

As found in the above literatures about effects of business disclosure on innovation, we have the next proposition:

Proposition 4: business disclosure plays a role in innovation.

3.1.5 Unemployment

Innovation has long been assumed to exemplify societal Pareto progress in terms of wealth augment and economic growth brought by the advanced technology. But there were also times when groups in the society resisted innovation since advanced modern machines seemed to account for poverty and unemployment, such as the well-known Luddites in early nineteenth century. Even until twenty first century, instead of globalization, it is because of technology innovation that most jobs lost in manufactory (Greenwald and Kahn, 2009).

The central idea is that for unskilled workers, their wages were decreased, and what made it worse, is the less demand for them in the market because of replacement of improved advanced machine and technology; though on the other side, wages for skilled workers increased. The point here is the so called "skill-bias", which has been shown in series of literature researches investigating innovation in the U.S. (Greiner, Rubart, and Semmler, 2003). On one hand, they argued that there would be enhanced social welfare in the concern that advantages and social benefits from those skilled workers are more than the compensation cost to the unskilled ones. But in an unmatured and unregulated market, it could otherwise bring the inequality issue than the society original expectation. Greenwald and Stiglitz (1986), for instance, discussed in a scenario of information asymmetry or market imperfection, there existed discreteness in terms of private returns compared to social improvement.

Hicks (1932) believed at whatever wage levels, innovation reduced the demand for workers and therefore saved labor. On the other side, wages had to be increased through bargaining process when unemployment rate decreased, or available labor force reduced (Shapiro and Stiglitz, 1984). Capital invested therefore had to shift from technology upgrading to labor augmenting.

Further, firing cost, another factor related to unemployment, is discussed in existed literature. Saint-Paul (2002), for instance, mentioned a "rigid" labor market, where there is firing cost. He argued invention is

more decided by firing cost in an open market than close economy. He believed there are generally two types of innovation: primary innovation and secondary innovation. The primary innovation focusses much more on manufacturing new products while the secondary innovation paid more attention to reduce cost efficiently to the existing products. Companies in different firing cost countries will take different innovation strategies. Much more imitation instead of new primary innovation would dominate in higher firing cost countries. It could be fully technology imitated in an open economy because of the free flow of innovation production in the market (Saint-Paul, 2002).

According to Hopenhayn and Rogerson (1993) in international market, new products roughly first presented in lower firing cost countries, then flew to higher firing cost countries when the products matured and became more stable. Saint-Paul (2002) showed how firing cost had affected innovation production in this international cycle of production. The rationality beneath this product international cycle is the preference of less firing cost payment. In a flexible not rigid labor market, because of much less worries of firing cost to the current labor force, companies would have incentives for primary innovation and would like to shoot their new product to the market at a relative earlier stage even the product itself is not very matured and its demand is insured at the time. However, the rigid labor countries often introduce products in a related stage, when the demand for the products is predictable, and they would be much more interested in decreasing the cost for manufacturing the matured products, taking their comparative advantage in the secondary innovation (Saint-Paul, 2002).

Implicated from the above "skill-biased" theory and classification of the primary or secondary innovation, which is specifically to the firing cost issue, or both related to the broadly unemployment factor, we thus have our last proposition:

Proposition 5: Unemployment rate interplays with innovation.

3.2 Methodology and data.

3.2.1 Panel data

Nowadays panel data is frequently used in social science econometrics research. Panel data, or time series cross-sectional data, is a dataset in observing entities' behaviors across series of different time. Entity here could be an individual, a company or even a country. It is a multidimensional dataset for entities and also cover different periods of time, which could be days, months and years as well. With possible different variable levels, panel data can be analyzed in three regression models, which includes random effects model, fixed effects model and OLS independent pooled model.

In our study, we focused on variables that vary across time and their impacts, which requires a fixed-effects (FE) regression in the research. In other words, fixed effects model applied in the investigation of a possible association between independent variables and dependent variable in an entity (individual, firm, country,). Every entity in fixed effects model presents its own characteristics that could possible affect the independent variables. For instance, there could be a unique parameter for an entity.

As indicated above, we assumed there may be individual impact or error on independent variables or dependent variable when choosing fixed effects model. The central idea behind the assumption is that there should be control of individual bias or impact. We can focus on the net effect of independent variables on dependent variable while fixed effects model removes those invariant time individuals.

In addition, those invariant time individuals are distinctive to themselves with no correlations to other individuals. This is the other assumption when using the fixed effects mode. As also mentioned by Kohler and Kreuter (2009), the estimated parameters for independent variables would not be biased since fixed effects model controls all the invariant time individuals in multidimensional dataset. There is no invariant time characteristic. Each individual is constant and therefore does not affect a single invariant time characteristic.

We therefore have the fixed effects general regression model as:

$$Y_i = \alpha_i + \beta_1 X_1 + \beta_2 X_2 + \ldots_+ \beta_k X_k + \varepsilon \quad (1.1)$$

where:

– Y_i: dependent variable and i stands for different entity,

– α_i: intercept for every entity,

– β_k: coefficient for each independent variable k,

– X_k: independent variable k,

– ε is the error term.

3.2.2 Dependent Variable

In terms of dependent variable of innovation, two proxies are often used in innovation measurement. The first one is R&D inputs in innovation. It is also used representing capability in adapting outside innovation to the region (Maurseth and Verspagen, 1999). There is a positive association assumption between the R&D expenditures and invention outcomes about innovation. It is assumed that more innovative production, which originated from more R&D investments, will finally lead to more growth in economy. The producing cycle with the R&D expenditures as core of technology improvement, strength the innovation growth. Rodríguez-Pose and Crescenzi (2008) indicated this kind of linear relationship in higher innovation and therefore higher growth with higher R&D investment.

However, Griliches (1979) mentioned problems when using R&D as measurement to economic growth. There would be time lag issue. R&D effect on economic performance is uncertain and quite different in various areas. In European countries, for instance, R&D activities showed different results between private and public sectors (Bilbao-Osorio and Rodríguez-Pose, 2004). The conceptual R&D activities could also possible account for bias estimation in the concern that not all of them are countered from the firm aspect. Grossman and Helpman (1991) therefore argued R&D should be allocation of resource in research for the sake perceived profit.

The second measurement is granted patent or patent application from the innovation output aspect. For example, O'Donoghue et al., (1998) disclosed in tradition literature of industrial organization, patent was replaced in lieu of IPRs. Patent applications were practically used in innovation measurement when there are no R&D expenditures data available (Chen and Puttitanun, 2005).

Similarly, patent applications (by residents) is applied in our research. Patent applications are "worldwide filed through the Patent Cooperation Treaty procedure or with a national patent office for exclusive rights for an invention--a product or process that provides a new way of doing something or offers a new technical solution to a problem. A patent provides protection for the invention to the owner of the patent for a limited period, generally 20 years" (World Intellectual Property Organization (WIPO), WIPO Patent Report).

However, Chambers (2016) argued that patent is not a good proxy for innovation. Therefore, as an alternative, either GII score or high-technology exports (in current US$) are also used as indicators for innovation.

3.2.3 Model Construction and Data

Inducted from the above general model 1.1, in order to test those five propositions in our study, specifically we therefore set up five independent variables as:

$$Y_1 = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_{4+} \beta_5 X_5 + \varepsilon, \text{where:} \quad (2.1)$$

Y_1: = innovation, in this model, is Patent applications by residents.

X_1: = GDP per capita, PPP (current international $).

X_2: = School enrollment, tertiary (% gross).

X_3: = Time required to start a business (days), which serves as a proxy for economic openness.

X_4: = Business extent of disclosure index (0=less disclosure to 10=more disclosure).

Disclosure index "measures the extent to which investors are protected through disclosure of ownership and financial information. The index ranges from 0 to 10, with higher values indicating more disclosure" (World Bank, Doing Business project).

X_5: = Unemployment, total (% of total labor force).

Unemployment could possibility be a factor influencing a nation's innovation level. It refers to share of the labor force available for and seeking employment but without job for the time being.

Beta coefficients in panel data are measures "as X varies across time by one unit, Y increases or decreases by β units" in a given country (Bartels, 2008).

In the consideration that patent is not a good proxy for innovation, we replace the patent with either GII score or high-technology exports as indication for innovation, and then we have alternative models as following:

$$Y_2 = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon \text{ and:} \quad (2.2)$$

$$Y_3 = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \varepsilon. \text{ where} \quad (2.3)$$

Y_2: = Global Innovation Score;

Y_3: = High-technology exports.

Most data are coming from the World Bank database. Five to ten years period which started back to 2008 and/or 2013 and ended in 2017. In the consideration of missing data and the accuracy of the panel regression analysis, such a long period of ten years makes sense in the research.

4. Results and discussion

4.1 Results

Based on the three models mentioned above, we ran several panel regressions separately. In model one, patent applications by the residents is an indicator for the dependent variable of innovation. We got the panel regression using five years data (2013-2017):

$$Y_1 = -5262.775 + 0.068 X_1 + 45.72 X_2 - 0.168 X_3 - 57.486 X_4 + 338.73 X_5 + \varepsilon$$

As shown in table 1, the related statistic parameters are as follows:

Table 1: Panel regression results when patent as dependent variable with five years data

	X_1	X_2	X_3	X_4	X_5	R^2	Adj. R^2	D-W Stat
t	0.907	1.694	-0.003	-0.706	2.441	0.990	0.985	1.763
p	0.372	0.101	0.997	0.486	0.021			

The R square and R square adjusted values look good. Durbin-Watson statistic is also good, implying low possibility for auto-correlation statistic and p-values for school enrollment-tertiary and total unemployment rate are significant, which verifies Hypothesis 2 and Hypothesis 5. However, the positive correlation between unemployment and patent is a little bit abnormal; further, beyond our expectation, the t statistic and p value for GDP is insignificant, which rejects hypothesis 1.
In a second observation, when GII score is a proxy for innovation, the panel regression (2013-2017 data applied) is as follows:

$$Y_2 = 42.458 - 0.0004\ X_1 + 0.0111\ X_2 - 0.0871\ X_3 + 0.3988\ X_4 + 0.871\ X_5 + \varepsilon$$

we can find associated statistics in table 2:

Table 2: Panel regression result when GII score as dependent variable with five years data

	X_1	X_2	X_3	X_4	X_5	R^2	Adj. R^2	D-W Stat
t	-1.818	0.155	-0.576	1.404	1.835	0.981	0.971	2.079
p	0.078	0.877	0.568	0.169	0.075			

It shows good R square and R square adjusted values; Durbin-Watson statistic in the amount close to 2 is better compared to the first model. GDP per capita, PPP now is a possible a determinant of innovation (GII) regarding its t statistic and p value. However, the negative correlation still expresses problem, which is possibly because of the insufficient data sets, or the U-shape effect as discussed before.

Alternatively, we also used high-technology exports (2013-2017 data used) as a proxy for innovation and the model is:

$$Y_3 = 1.53E{+}09 - 7133.562\ X_1 - 6175933\ X_2 - 573699.9\ X_3 + 47094136\ X_4 - 30188287\ X_5 + \varepsilon$$

The statistics are presented in Table 3:

Table 3: Panel regression result when High Tech as dependent variable with five years data

	X_1	X_2	X_3	X_4	X_5	R^2	Adj. R^2	D-W Stat
t	-0.132	-0.322	-0.016	0.671	-0.316	0.984	0.971	2.564
p	0.896	0.750	0.988	0.567	0.754			

Surprisingly, none of the five individual dependent variables are significant when high technology export is a proxy for innovation.

4.2 Discussions

4.2.1 Five years data vs ten years' data

The results get better when there are five more years' data used in the panel regression analysis. As shown in table 4, which used patent application as an indicator for innovation, and has five years (2013-2017) and ten years (2008-2017) data separately, the results are as follows:

Table 4: Results difference using data of 5 years vs. 10 years when patent application as a proxy

		X_1	X_2	X_3	X_4	X_5	R^2	Adj. R^2
Y_1-5 years	t	0.907	1.694	-0.003	-0.706	2.441	0.990	0.985
	p	*0.372*	*0.101*	*0.997*	*0.486*	*0.021*		
Y_1-10 years	t	2.302	2.043	4.590	-1.338	-0.106	0.984	0.980
	p	*0.024*	*0.045*	*0.000*	*0.1853*	*0.916*		

Now it clearly shows that most independent variables except unemployment rate are significant in both t statistics and p values. In general, all the four hypotheses except hypothesis five are verified hereby.

In addition, we can also find similar progress when data increase from five years (2013-2017) to ten years (2008-2017) in case of high-technology exports serving as innovation indicator. As shown below in Table 5, none of the independent variable is significant when used five year data. However, when a ten years period applied, we find GDP per capita PPP, time required to start business and unemployment rate are all significant factors in determining innovation (high tech exports). Besides, it makes sense that unemployment rate is a negative coefficient value.

Table 5: Results difference using data of 5 years vs. 10 years when high tech exports as a proxy

		X_1	X_2	X_3	X_4	X_5	R^2	Adj. R^2
Y_3-5 years	t	-0.132	-0.322	-0.016	0.671	-0.316	0.989	0.984
	p	*0.896*	*0.750*	*0.988*	*0.507*	*0.754*		
Y_3-10 years	t	2.444	-0.466	-1.466	0.670	-2.419	0.971	0.964
	p	*0.016*	*0.642*	*0.146*	*0.505*	*0.017*		

Therefore, we believe in measuring innovation using panel regression, more years' data would be preferred.

4.2.2 Unemployment as a determinant

As shown in the above multiple regressions results, either patent applications by residents or high-technology exports would be the appropriate proxy for the innovation, which is expresses as in Model one (Y_1) and Model three (Y_3). However, as the results shown, not only in Table 4, unemployment rate seems to be insignificant when patent application is used as proxy. Further, in Table 5 while high technology export is the innovation indicator, no matter five- or ten-years data applied, it is a little bit weird to see that the school enrollment-tertiary is both negative and insignificant.

Regarding the above concerns, we further run the models with a dropping independent variable of unemployment rate. When used patent application as proxy for innovation, the updated panel regression (2008-2017 ten years data applied) is expressed as this:

Y_1= -3378.757 + 0.0876X1 + 25.093 X2 + 122.664X3 -86.349X4 + Ɛ

And all the four independent variables now keep significant. Specifically, when high technology export (2008-2017 ten years data applied) is the dependent variable and drop the unemployment from the model, all the other four independent variables, including school enrollment-tertiary, are significant. Finally, when panel regression used GII score (2013-2017 ten years data applied) as a proxy in measuring innovation, we find improvements regarding the independent variables' significance of p values with no unemployment rate added. But in the prior table 2, almost none of the independent variables have significant p values.

Therefore, we drop unemployment from the model(s), and have all the updated statistics results regarding three models when three different indicators for innovation applied. They are presented in table 6:

Table 6: Statistics results for three models without unemployment

Regression Models		X_1	X_2	X_3	X_4	R^2	Adj. R^2
Y_1: patent application	t	2.443	2.059	4.652	-1.419	0.984	0.980
	p	0.017	0.043	0.000	0.160		
Y_2: GII score	t	6.097	1.827	1.225	3.329	0.967	0.948
	p	0.000	0.076	0.229	0.002		
Y_3: high tech export	t	6.450	5.545	-1.273	6.426	0.880	0.847
	p	0.000	0.000	0.207	0.000		

So far, we have three proxies for innovations, patent applications by residents, GII score and high technology exports. As shown in the above table 6, anyone of the three could serve as an appropriate indication for innovation; however, in the consideration of the possible abnormality of too higher R square and adjusted R square values in both model one (Y_1) and model two (Y_2), which are more than 95%, we conclude model three, or high technology exports as innovation proxy, would be the best choice among the three panel regressions.

4.2.3 Other issues

We have additional information regarding innovation among the countries in the same region. Based on GII 2018 report, there is huge imbalance in terms of innovation among countries. In terms of all the patent applications, for ten years between 2008 and 2017 in five random selected countries, Algeria and Bahrain were almost in the same very lower level, only few applications for the period. Egypt was better than the above two countries, but less than Israel. We can see the huge gap between Iran and Israel; applications in

Iran is very higher than all the other four countries, even though the line is fluctuated, and it dropped to the bottom in the year of 2012.

In regard of high technology exports, again we find the similar imbalance among the five countries as shown in figure 1. Israel has much more high technology exports (in US Dollars) than other four countries.

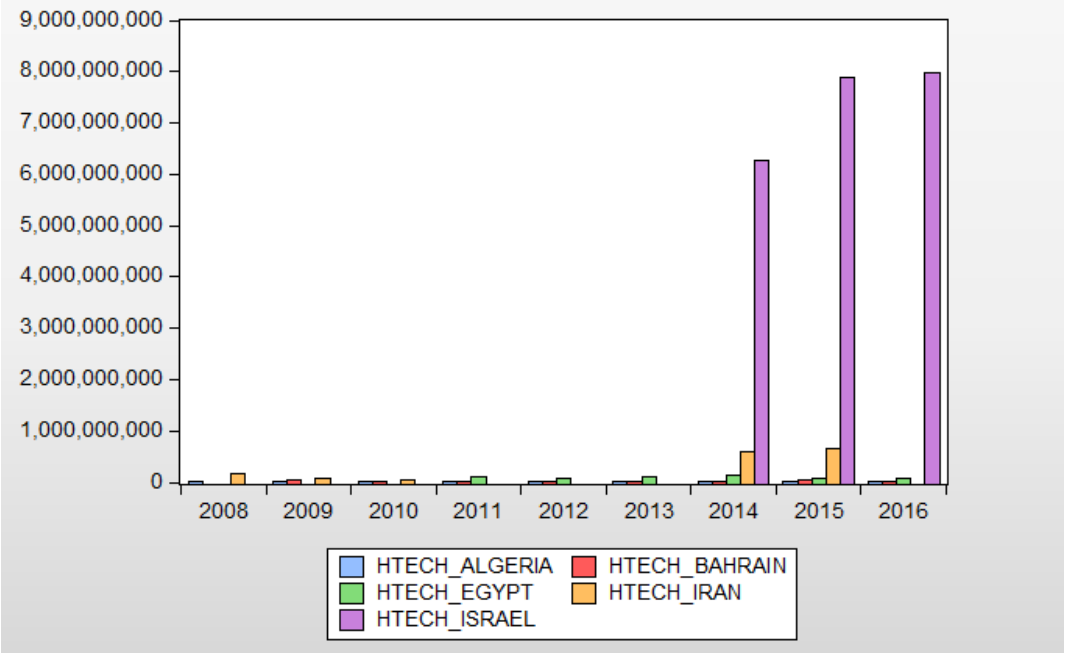

Figure 1: high technology exports among five countries

Besides the innovation imbalance among countries in MENA region, the Global Innovation Index 2018 published the newest report, which provided us the GII score for all the regions in today's world. As shown in Figure 2, the GII score in MENA is 34, which is ranked the fourth after North America, Europe and South East and East Asia regions, but a higher score than regions of Latin America, Sub-Saharan Africa and Central and South Africa.

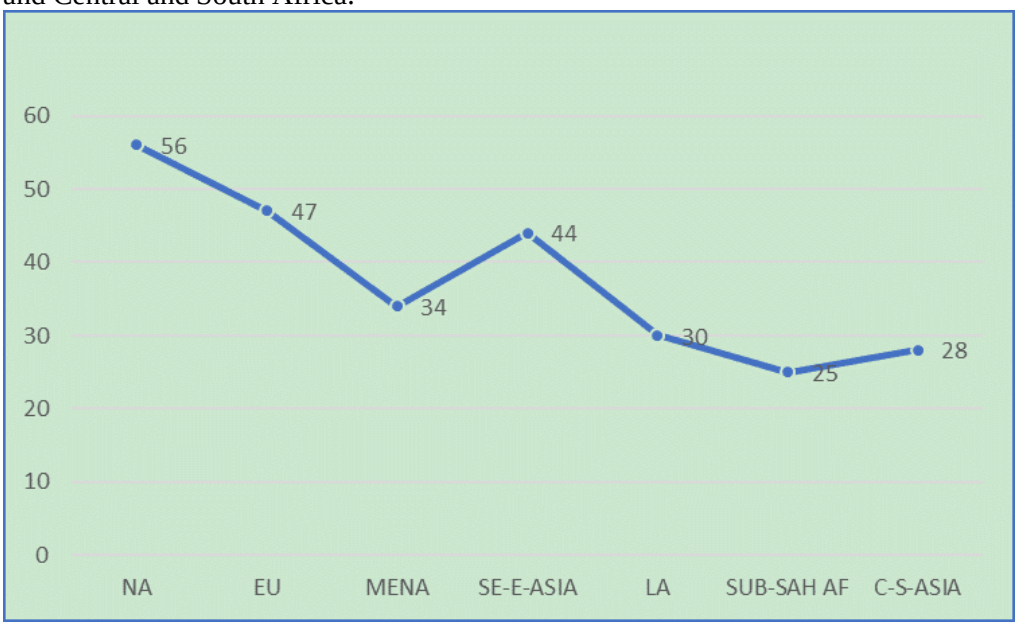

Figure 2: GII Scores among regions (2018)

According to GII 2018 report, Israel (11th) and Cyprus (29th) are the top two nations in innovation in the MENA region for six consecutive years. Israel makes the striking upward move stepping up by six while Cyprus moves up by one. The United Arab Emirates (38this in the third place in innovation even though it really moves down by three places.

In addition, there are many GII score Top 100 countries as well in the MENA region: Qatar (51st), Kuwait (60th), Saudi Arabia (61st), Iran (65th), Tunisia (66th), Oman (69th), Bahrain (72nd), Morocco (76th), Jordan (79th), Lebanon (90th), and Egypt (95th). Egypt moves up by 11 places in the overall GII ranking, therefore makes the most regional progress. Algeria (110th) and Yemen (126th), however, are still below the top 100.

5. Conclusion and further research

In this paper, we try to investigate innovation in the region of Middle East and North Africa (MENA). Based on current literature, we have GII score, patent applications by residents and high technology exports as possible proxies for innovation. However, limited by the data availability, in a series running of panel data, high technology export serves as a best indicator for the innovation. Hypotheses are developed as five independent variables of GDP per capita, PPP, tertiary school enrollment, economic openness, business disclosure, and unemployment rate of total labor force being potential determinants. However, as shown in the multiple regression results, all the other four hypotheses are verified except unemployment as a significant factor in terms of innovation. Generally, there is the concern that a relative low unemployment indicates a better economy, which could benefit the innovation activities; but in my research there is no sign of such a connection.

Regarding future research, we would like to extend our study to other regions separately. Will there be the same or similar results, or will there be different factors in determinant of the innovation? As a whole picture, will there be both a series of common determinants and also different existing factors as well in terms of innovation? These concerns will be our future focuses.

Endnotes:

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