INNOVATION AND INSTITUTIONAL QUALITY ON ECONOMIC GROWTH IN ASIA

The Honors Program
Senior Capstone Project
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April, 2015

ACKNOWLEDGEMENT

First and foremost I want to thank my advisor, Professor Ramesh Mohan, for his help, support and guidance to my research. I appreciate all his contributions of time and ideas to make my Honors Capstone experience productive and rewarding.

I also want to acknowledge the help of Professor Alex Perullo and my personal librarian William Doughty during my research.

I also wish to thank all the members of my committee for their valuable participation and insights.

Lastly, I would like to thank my family and friends for all their love and encouragement. For my parents who raised and gave me this wonderful opportunity. For the presence of Mauro di Pietro who is always there for mental support. And for all my fellow Honors students who have been walking this path with me.

Thank you.

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ABSTRACT

When looking at the different effects of institutional quality on economic development, namely control of corruption, there are two different hypotheses that explain such effects. One is the "grease the wheel" hypothesis, which predicts that corruption is beneficial for growth, and the other one is the "sand the wheel" hypothesis, which says the opposite. Corruption is normally blamed for the slow economic growths in some countries, but some Asian countries' exponential growths have proven the "grease the wheel" hypothesis otherwise. The "Asian experience"[1] phenomenon occurs when corruption does not seem to hamper business activities in some Asian countries. This research will focus on finding how institutional quality variables, such as corruption control and government effectiveness, can correlate with innovation variables to contribute to economic growth. Using data and examples from Asian countries, this study finds a positive correlation between corruption and economic growth in some developed countries, such as China and South Korea.

JEL Classification: D73, F43, O19

Keywords: Asia, ASEAN, Corruption, Economic Growth, Innovation, Institutional Quality

[1] Kaufmann and Wei, 1999

1.0 INTRODUCTION

Institutional quality includes many different areas, such as control of corruption, government effectiveness, and political stability. However, since corruption is a macroeconomic problem that almost every national government has to deal with, this study is going to focus mostly on the effect of corruption on economic development. The term corruption covers a broad range of actions, which directly translates to the action of abusing public power for private gain. According to the World Bank, corruption can include the following activities: bribery in the public sector, theft of state assets by officials, political patronage, or corruption in private sector.

Theoretically, corruption creates inefficiency, slows down growth and hampers developing progresses. When looking at economic study, corruption is normally named as the main reason that causes slow economic growth in countries in Africa, South East Asia and Eastern Europe. However, is corruption actually bad for economic development for all countries in the world? When looking at recent trends in some developed Asian countries, such as China, South Korea and India, the data shows otherwise. Those countries are growing exponentially in the past ten years even though their corruption perception indexes are pretty low.

Even though there are various studies on this topic in Asian region, the results vary. There are studies that explain why some countries would benefit from corruption, while there are other studies that blame corruption for the slow economic growth. This study aims at studying the relationship between institutional quality variables and innovation variables on growth in Asian countries. This research will test the hypothesis that corruption network can encourage more innovation in a country and hence, improve economic conditions. From a policy perspective, this study is important because this proves that corruption is not necessarily a bad institutional quality variable for all development. There is no "one-size-fits-all" approach for economic development that can be applied to every country. Policy makers and economics reformers should take into considerations different areas that could help economic development, rather than just focus on slashing corruption.

In addition, this paper is contributes to the literature on the subject to comply different kinds of study to prove the "grease the wheel" hypothesis. First, this study separates the data set into two sub sets based on GDP per capita: developed countries and developing countries. Then, it examines the correlation between corruption and economic development through innovation, as well as possible explanations for such patterns in those countries.

The structure of the paper is organized as follow: Section 2 describes the current economic trends in Asian countries in recent years. Literature review is on section 3. Section 4 explains the data and empirical model use in this study, where empirical results will be presented and discussed in Section 5. Finally, section 6 concludes the study, following by the appendices and bibliography.

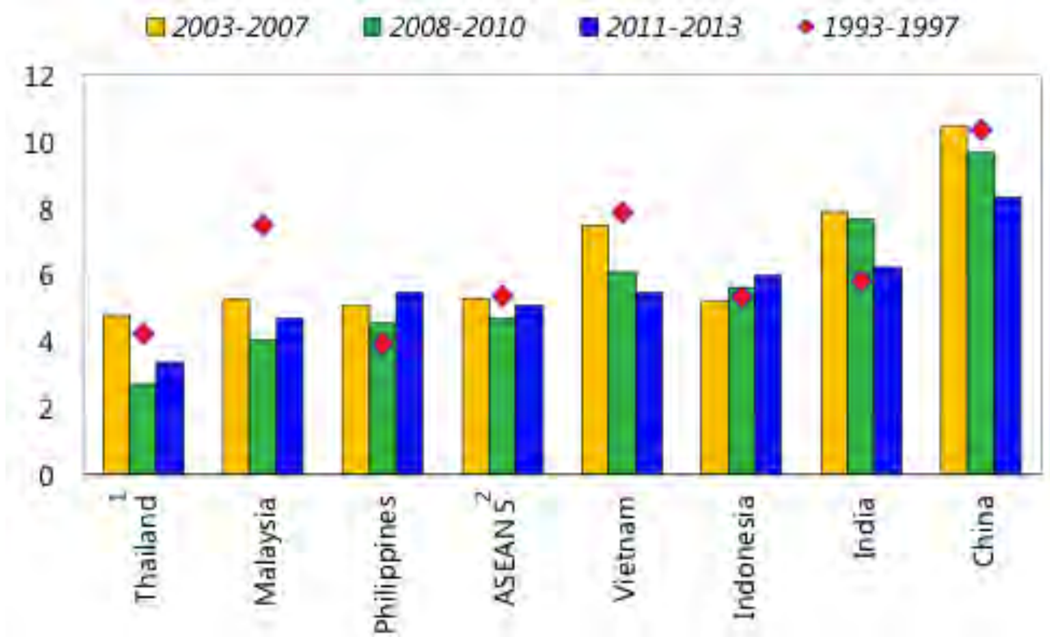
2.0 CURRENT TRENDS

2.1 Current Growth Trend

With the slowdown in world leading economies, namely the United States and Europe, Asian countries are experiencing spillover effects from the global financial crisis

(GFC). According to a report by the IMF, as of January 2014, both China and India have shown declining growth since the GFC. In China, growth has slowed from a rate of above 10 percent to below 8 percent in the past two years. Likewise, India's growth has slowed from 8 percent to 6 percent during the same period. Some economists believe that those slowdowns reflect structural factors and the "middle-income trap"[2].

Figure 1: Trend Growth Across Countries (Average across methods; in percent)



Source: IMF, World Economic Outlook; World Development Indicators; CEIC data Company Ltd.; Haver Analytics; U.N. Population Database; and IMF Staff Calculations.

[1] *1993-1997 average excludes 1997 as Thailand's pre-crisis boom ended in 1996.*

[2] *PPP GDP weighted average used for ASEAN 5.*

Overall, different reports consistently point to a gradual decline in growth trend in recent years in Asia. China's growth peaked around 2006-2007 at around 11 percent, and then slowly decline to 8 percent in 2013. Similarly, India's growth peaked at 8 percent

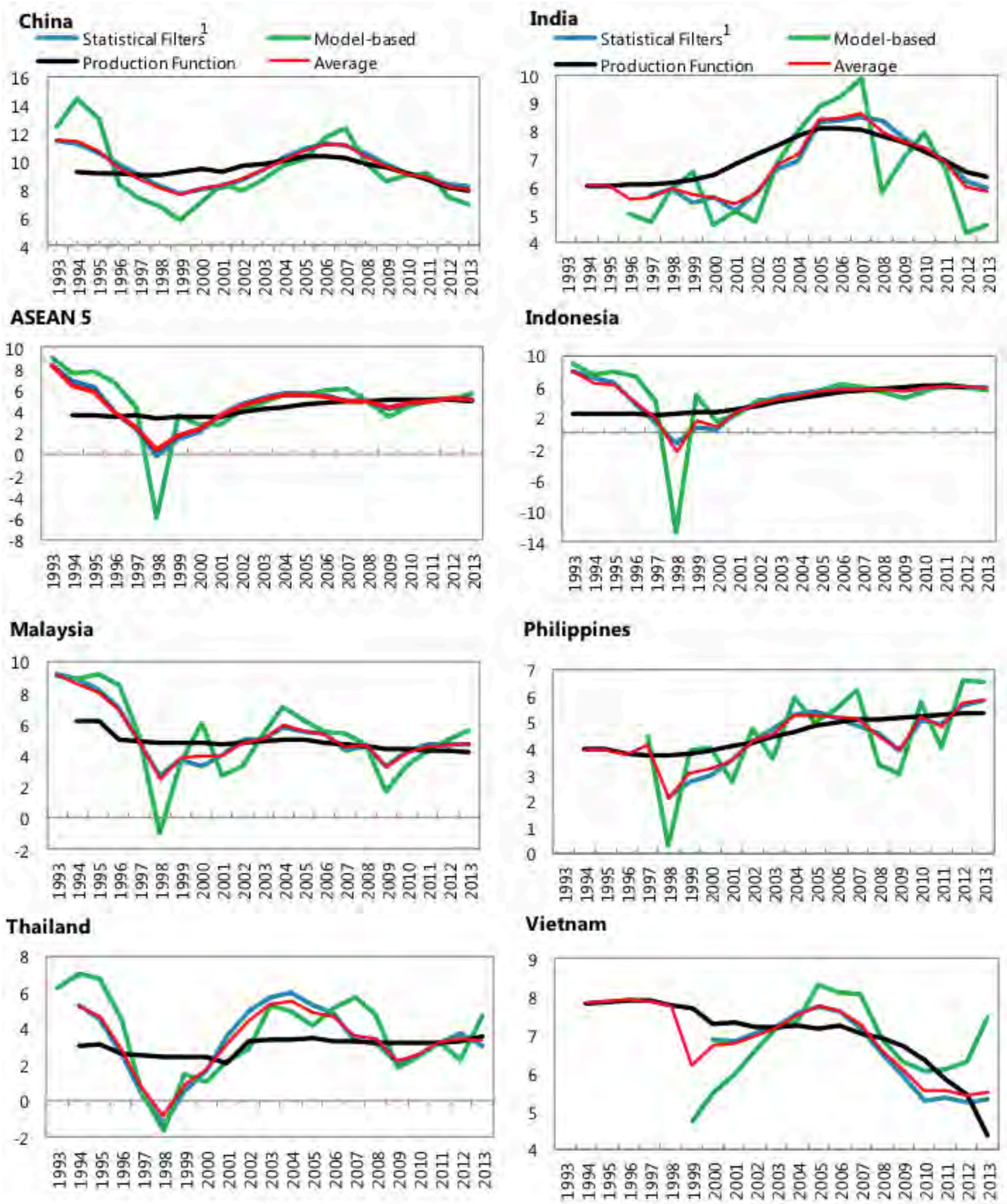
[2] Middle-income trap: a phenomenon of rapidly growing economies stagnating at middle-income levels and failing to graduate into the ranks of high-income countries (IMF Working Paper, WP/14/2)

before the GFC, and then gradually declined to 6 percent. ASEAN 5[3], as a whole, shows little changes since the GFC. This reflects "strong domestic demand, intra-regional integration, improved governance and structural reforms" (Anand et al., 2014, p. 7). However, there is some disparity across the different countries in the group.

Indonesia has been showing strong growth and it has been shielded from global shocks. After the Asian crisis in the 1990s, Indonesian's economy has been showing a steady upward trend, with the highest in 2011-2012. Malaysia, the Philippines and Thailand also show a growing trend, but less significant. Only the Philippines growth rate surpassed its pre-GFC rate because of their low trade and financial openness. On the other hand, Malaysia and Thailand are still recovering after the crisis. Lastly, Vietnam's growth is declining since the GFC and is currently estimated to be at the lowest since 1990. A more detailed graph of trend growth estimates for individual country is shown in Figure 2.

[3] ASEAN 5 countries include: Indonesia, Malaysia, Philippines, Thailand, Vietnam

Figure 2: Trend Growth Estimates (In percent)



Source: IMF, World Economic Outlook; World Development Indicators; CEIC data Company Ltd.; Haver Analytics; U.N. Population Database; and IMF Staff calculations.

2.2 Current Corruption Trend

According to the most recent Corruption Perception Index (CPI) by Transparency International in 2014[4], out of the 28 Asian Pacific countries in the survey, a majority of Asian countries are lagging behind in their fighting corruption efforts. About 18 out of 28 countries' CPIs score are less than 40 out of 100[5]. Philippines and Thailand both scored 38, Indonesia scored 34, Myammar scored 21. Whether or not the low scores are results of corruption or the government's accountability, persistent low scores call to attention to the leadership and government management of Asian countries as corruption can pose a threat to sustainability of their somewhat fragile economies.

In 2014, the Chinese government is making a commitment to fight and prosecute corruption due to an increasing number of corruption scandals in China. It is making an effort to catch "tigers and flies", public officials big and smalls. However, China 2014 CPI score still shows a downward trend compared to previous years, making it questionable whether their corruption efforts are working or not. According to Plipat (2014), recent corruption prosecutions in China are efforts only to "clamp down on political opponents of the regime as opposed to genuine anti-corruption commitments". Nanayakkara (2014) listed reasons why corruption is getting worse in China, and the main reason is that Chinese government does not have enough transparency or accountability to detect and punish corruption.

[4] Corruption Perception Index 2014: Results. (n.d.). In *Transparency International online.* Retrieved from https://www.transparency.org/cpi2014/results
[5] Corruption Perception Index is a measurement of how corrupt a country is perceived to be where 0 is very corrupt and 100 is very clean.

India, on the other hand, is also struggling with corruption despite significant improvement in engagement, innovation and civil participation. India's political corruption comes from the inadequacy of structure of accountability, as well as transparency to detect corruption. The Transparency International warns that India, along with other South East Asian countries, needs stronger law enforcement to fight against corruption, as well as a protection policy for whistleblowers.

3.0 LITERATURE REVIEW

Economic growth has been driven by many factors. Many researches have proven that knowledge-based economies tend to grow faster as innovation capability is a critical factor to national economic growth (Porter, 1990). There is an undeniable fact about the possible correlation between innovation and growth, as Singh (2006) states:

> *Radical innovations open up new opportunities and push the frontiers of knowledge, which dramatically alter the existing economic structure. Incremental innovations not only improve the practices of the existing technologies but are potent factor of diffusion of the radical innovation that engineer structural change in the economic system.*

Many countries now recognize the importance of research and development (R&D) and innovation as the driving competitive forces (Nelson, 1993). Thus, they start to foster and stimulate the national R&D and innovation system to aid the performance to its full potential. According to Singh (2006), developed countries' national innovation systems are evolved without external intervention and political pressures. On the other hand, developing countries' national innovation systems are "at their stage of infancy"

(Singh, 2006, p. 18) as they are still trying to create a system that encourages firms to be productive and competitive.

In this context, many governments have executed policies to strengthen the growth of R&D and innovation, mostly through Intellectual Property Rights (IPR). This is because of the belief that researchers and investors will be encouraged to invest time and resources into research and innovations, if they know their results will be repaid adequately in the future. For instance, China and India, two superpower nations in Asian region whose average growths were approximately ten percent per year, credit most of their exponential growth to innovation capability, IPR and innovation policies (Fan, 2008).

Normally, it is assumed that R&D and economic growth has a positive relationship. Prodan's (2005) study presents a regression model to test the correlation between the amount of R&D expenditure and the number of patent applications to economic growth. The author finds that there is a positive correlation, taking into account the time lag differences between countries on patent application.

Kuroiwa et al. (2011) showed that China, Japan and Korea achieved their current economic state by completely transforming their economic system to focus on technology. This economic renewal has significantly upgraded their economic systems to a whole new level, allowing them to maximize their competitive advantage and produce the most outputs possible. From the 1970s to 2000s, Japan's economic strength changed from electronics components, semiconductors to electronic circuits, and communication technologies. Likewise, China changed from processing industry in 1990s to electronic and circuits and communication technologies in 2000s. Korea showed a dramatic shift in its technological specialization in 1980s from lighting, steam generation and heating to electronics components semiconductors in 2000s.

Even though it has been successful for some countries to completely switch to technological manufacturing, other countries struggle to find their competitive advantage. It is commonly believed that developing countries should imitate growth models that were previously used by developed countries. However, through empirical research, it is "analytically wrong and empirically flawed to draw direct policy lessons or to develop models from Asia for other developing countries to imitate" (Hobday, 2011, p. 19). Hobday used examples from "the four Asian dragons" [6] and found that a country became developed by only using its own model which fits best with the country's current economic conditions. The author believed that the development process and strategy must be individually crafted to best suit the nation's natural and human resources, capabilities, institutions and external conditions, not "on the paths or models of previous industrializers" (Hobday, 2011, p. 17).

Another study also agrees that a "one-size-fits-all" system of IPR is illusionary and can create detrimental social costs by "blocking the development of complimentary innovations or of better substitutes" (Vallée & Yildizoglu, 2006, p. 3). Hence, the authors suggest that models of innovation and of patenting must take into account the complexity and individuality of each country, such as global influences, national strength and weaknesses.

On the other hand, besides R&D and innovation, economic growth can also be influenced by the institutional quality variables of a country. Institutional quality

[6] Korea, Taiwan, Singapore and Hong Kong

variables include control of corruption, government effectiveness, and political stability. Those institutional quality variables can influence innovation both domestically and internationally, and hence, change the economic growth.

Corruptions appear in various forms: bribery, theft of public assets, or political patronage. It can be decentralized or centralized: occasional, incidental, or systematic. The Organization for Economic Co-operation and Development (OECD) develops two types of hypothesis testing regarding the effects of corruption on economic growth. One is the “greasing the wheel” hypothesis, which predicts that corruption is beneficial for growth, and the other one is the “sand in the wheel” hypothesis, which says the opposite.

The idea that corruption is undesirable to growth was pioneered by Mauro (1995). Mauro found a strong negative relationship between corruption and investment, which later extended directly to growth. Using an assembled data set from the Business International indices on corruption, red tape and judicial system from 1980 to 1983, Mauro proved that efficient government institutions foster economic growth. Mauro was also aware of the subjectivity of the variables, which claimed to be useful because subjectivity measures “investors’ perception of political uncertainty that determine the investment rate” (p. 690). Mauro concluded that there is a “negative association between corruption and investment, as well as growth, is significant in both a statistical and economic sense” (p. 705).

Subsequently, other studies have confirmed Mauro’s results and extended to other macroeconomics variables, such as foreign direct investment (Wei, 2000) and productivity (Labsdorff, 2003). The general idea that corruption is detrimental to investment and growth is also supported by Bardhan (1997), Rose-Ackerman (1999), Wei (2000), and Méon and Sekkat (2005).

Likewise, Kuroiwa et al. (2011) explains the growth in economies is due to the openness approach. Institutional openness, as opposed to corruption, would allow innovative collaborations between companies, universities, and public research institutes. Furthermore, the reasons why countries like China, Japan and Korea could develop at an exponential rate are due to ample supply of human capital, research capabilities and large firms that are encouraging innovation and R&D. In order to protect the rapid growth rate, Asian countries should ensure that IPR are well enforced and consistent among the countries. They should also together develop common regulations and standards in emerging fields to encourage collaborations among countries.

However, when looking at the "grease the wheel" hypothesis that states corruption is beneficial for growth, the hypothesis shows different patterns of corruption effects. The hypothesis, proposed by Leff (1964), Leys (1965) and Huntington (1968), stated that corruption might be beneficial in a second-best perspective. That is, "corruption, though generally detrimental to macroeconomic growth, can increase overall efficiency in the presence of deeper distortions, such as a rigid and over centralized administration, excessive regulatory barriers, or poorly efficient and weakly competent bureaucracies" (Hanoteau and Vial, 2010, p. 694).

Moreover, the hypothesis postulates a scenario for an inefficient bureaucracy that poses an impediment to economic development, "some 'speed' or 'grease' money may help circumvent" (Méon and Weill, 2008, p. 5). In brief, the hypothesis implies that corruption can in fact serve as a trouble-saving device, which will eventually raise efficiency, investment and hence, economic growth. This perspective disproves Mauro's hypothesis.

The one popular explanation for the "grease the wheels" phenomenon suggest that bribes can work as a means of insurance for foreign and domestic investments, encouraging investors to spend their money in the country (Leff, 1964). In addition, bribe can reduce the negative impacts of regulations (Hanoteau and Vial, 2010), as well as long administrative delays (Lui, 1985). Leys (1965) said that bribes give bureaucrats incentive to speed up processing time and cut down the amount of unnecessary red tape. For instance, in an effort to fight and prevent corruption in India, the Indian government found that corrupt officials might deliberately cause delays in order to attract more bribes from investors and businesses that would want to speed up the process (Myrdal, 1968).

The "grease the wheel" corruption hypothesis is particularly applicable in the Asian region. Kaufmann and Wei (1999) called this the "Asian experience". The "Asian experience" explains that corruption does not seem to hamper business in Asian countries due to a recognized corruption culture. Noticeably, panel data studies show that large, more developed countries suffer less from the effect of corruption, while smaller, less developed countries will face more detrimental effects from corruption activities. Rock and Bonnett (2004) suggested that "corruption is likely to be much more damaging to investment and growth in small, as opposed to large, developing countries".

For instance, newly industrializing economies, such as Japan, Hong Kong, and Malaysia, enjoy a high growth and investment rate. Meanwhile, South East Asian countries, such as the Philippines and Indonesia, have a high level of corruption, but low rate of growth and investment. In their 2010 study, Hanoteau and Vial (2010) found that even though Indonesian firms pay bribes to the corrupted system, their favorable returns, such as reduced taxes, delays, red tape and civil servant harassments, or exclusive rights to license and contracts, are not sufficient and hence do not have an instantaneous impact on output and productivity.

Bonnet and Rock (2004) explained that corruption could grease the wheels of growth due to large internal markets and supplies of labors. This means that foreign investors are more likely to accept corruption as a price, regardless of the high level of corruption, if they really want to have access to business in the country. Moreover, international institutions, regional development banks and bilateral aid donors may have more motivation to focus their anti-corruption programs on smaller activities, partially because it is more difficult to reform corrupted governance system in large countries (Bonnet and Rock, 2004).

In brief, there is an adequate amount of scholarly work in the field that supports the view that corruption can actually have beneficial effects for economic growth in some countries. The "grease the wheel" hypothesis works well for some countries with a more centralized government system, a highly recognized corruption culture, and abundant economic resources. Bonnet and Rock (2004) confirmed that the "sand the wheel" hypothesis is not necessarily true in every country as corruption may slow growth and reduce investment in most small developing countries, but not in large, newly industrializing economies.

However, there are not many studies that focus on how corruption can encourage innovation and growth. This study hopes to see the relationship between corruption and innovation, which will eventually explain the exponential growth in some Asian countries, such as Korea, China and Japan. It is also striving to look at why such culture of corruption works well in those countries, while the same culture destroy the economic systems in others. The study will use economic panel data from official sources and historical evidences to answer the question raised above.

4.0 DATA AND EMPIRICAL METHODOLOGY

4.1 Data, explanation, sources, table

The study collects panel data from 1996 to 2013 of seventeen countries from South East Asian, East Asian and Central Asian. Due to some data limitation, the data set excludes data from the following countries: Bhutan, Korean Democrat Republic (North Korea), Myammar, Nepal, Tibet, Taiwan and East Timor (Timor Leste).

As mentioned above in Section 3, the impact of institutional quality variables on growth and innovation depends on the governmental effectiveness and corruption system. With that said, Table 1 presents a two-by-two table of possible outcomes based on different combinations of government effectiveness and organization of corruption system. Government effectiveness uses GDP per capita (GPC) as a proxy to look at how governments create wealth for individuals in the country. Effective governments is assumed be able to generate more than $10,000 GPC per year. Organization of corruption network uses the Corruption Perception Index (CPI) as a proxy. If CPI is below 40, then the country has a recognized corruption network and vice versa.

Table 1. Government Effectiveness and Organization of Corruption Combinations[7]

<table>
<tr><th rowspan="2">Organization of Corruption Network</th><th colspan="2">Government Effectiveness</th></tr>
<tr><th>Low GPC
(Below $10,000)</th><th>High GPC
(Above $10,000)</th></tr>
<tr><td rowspan="2">Strong centralized and recognized corruption network
(Low CPI below 40)</td><td>The effects of corruption on growth are expected to be negative or no change because those countries already suffer from inefficient government management. Thus, corruption would either worsen the situation, or create no change.</td><td>The effects of corruption on growth would be positive. Those countries have huge economic resources for businesses to use as well as recognized corruption cultures. Businesses are willing to pay bribe to have access to the resources.</td></tr>
<tr><td>Bangladesh (25)
Cambodia (21)
Indonesia (34)
Lao (25)
Mongolia (39)
Philippines (38)
Thailand (38)
Vietnam (31)</td><td>China (36)
Malaysia (52)
Korea (55)
Macao (51)
India (38)</td></tr>
<tr><td rowspan="2">Less recognized corruption network or corruption network is non-exist
(High CPI above 40)</td><td>The effects of corruption on growth will be negative.</td><td>The effects of corruption on growth would be negative because those countries have already successfully battled corruption and achieved a higher standard of living. Any corruption activities will push them backwards.</td></tr>
<tr><td>No specific country found in this category.</td><td>Brunei (60)
Hong Kong (74)
Japan (76)
Singapore (84)</td></tr>
</table>

Note: Number in the bracket ( ) next to each country is its 2013's CPI statistics

Data were obtained from the World Development Indicator (WDI) by the World Bank, the World Intellectual Property Organization (WIPO), the U.S. Census Bureau's International Database, the World Governance Indicator and the Transparency International Database website. Summary statistics for the data are provided in Table 2, Table 3 and Table 4 below.

[7] The table is adapted from Rock and Bonnett's study (2004)

4.2 Empirical Model

Following the model provided by Kowalski (2000), this study adapted the model by using some of the variables in the original regression model to estimate economic growth. Additional variables, such as education, innovation variables and corruption variables, are added in order to best suit the hypothesis.

The model could be written as follow:

$$\begin{aligned} \text{GROWTH}_{it} = {} & \beta_0 + \beta_1 \text{GPC} + \beta_2 \text{EDUGDP} + \beta_3 \text{FDI} + \beta_4 \text{POP} + \beta_5 \text{TRADE} + \\ & \beta_6 \text{PATENTN} + \beta_7 \text{PATENTR} + \beta_8 \text{RDE} + \beta_9 \text{RESEA} + \beta_{10} \text{TRADEMN} + \beta_{11} \text{TRADEMR} + \\ & \beta_{12} \text{CC} + \beta_{13} \text{GE} + \beta_{14} \text{POLSTA} + \beta_{15} \text{CPI} + u \end{aligned}$$

In the regression stated above, the dependent variable $GROWTH_{it}$ is the rate of growth of a country *i* at year *t*. Growth refers to a "purely statistical estimation of changes in GDP data" (Anand et al., 2014). Hence, the variable percentage of GDP growth is served as a proxy to see how fast or slow a country is developing economically.

Independent variables consist of fifteen variables obtained from various data sources. Appendix A will provide more detail about the data source, acronyms, description, expected signs and justification for usage.

4.2.1 Economic Growth Variables

First, *GPC* represents GDP per capita in different countries. Second, *EDUGE* is public spending on education as percentage of government expenditure. Third, *FDI* represents the net inflow of foreign direct investment in the country. *POP* looks at population growth as annual percentage. And *TRADE* looks at the openness of trade of the country to foreign investors; it is calculated by dividing the sum of exports and imports of goods over GDP.

Table 2. Summary Statistics on Economic Growth Variables

Variables	Observation	Mean	Standard Deviation	Minimum	Maximum
GROWTH	306	5.388116	4.401301	-13.12672	27.49896
GPC	306	11512.28	15477.35	246.1455	91376.02
EDUGDP	306	3.450764	1.349857	0.34	9.35011
FDI	306	1.57e+10	4.22e+10	-4.55e+09	3.48e+11
POP	306	1.388099	306.7976503	-1.476362	5.321578
TRADE	306	124.5055	99.55762	18.75639	458.3322

4.2.2 Innovation Variables

Innovation is calculated is by looking at the number of new patents issued each year, the amount of R&D expenditure spent, the number of scientific research conducted per year, or number of scientists in the country (Fan, 2008). For innovation variables, this study uses four variables.

First, *PATENT* is the number of patent applications filed through the Patent Cooperation Treaty to ask for protection of ideas for up to 20 years. *PATENTN* is the number of patent applications from non-residents, and *PATENTR* is the number of applications from residents. Second, *RDE* shows the amount of research and development expenditure as a percentage of GDP. Variable *RESEA* shows the number of researchers and scientists in the country. Lastly, *TRADEM* shows the number of trademark applications with a national or regional Intellectual Property office. *TRADEMR* are trademark applications from domestic applicants, and the other *TRADEMN* are applications filed by applicants from abroad.

Table 3. Summary Statistics on Innovation Variables

Variables	Observation	Mean	Standard Deviation	Minimum	Maximum
PATENTN	306	12371.94	21743.05	0	128072.3
PATENTR	306	36160.34	99485.15	0	656983
RDE	306	0.7475464	1.03886	0	4.64195
RESEA	306	1119.232	1818.306	0	6883.037
TRADEMN	306	10386.06	14610.03	277	137675.8
TRADEMR	306	59501.44	185237.8	10	1794446

4.2.3 Institutional Quality Variables

For institutional quality variables, this study also incorporates four different variables that would help explain the relationship between corruption and economic growth. *CC* is Control of Corruption, capturing the "perceptions to which public power is used for private gain, including both petty and grand forms of corruption"[8]. The variable *GE* captures perceptions of government effectiveness. The third variable *POLSTA* reflects the perceptions of the likelihood of whether the government will be destabilized or overthrown by unconstitutional or violent means. All variables *CC*, *GE*, and *POLSTA* are measured in percentile rank where 0 as the lowest and 100 as the highest.

The last variable *CPI* represents the Corruption Perception Index, collected and published by Transparency International. According to the organization, *CPI* is based on perception because corruption activities are deliberately hidden, and by "capturing perceptions of corruption [...] is the most reliable method of comparing relative corruption levels across countries"[9].

[8] Definition is provided by the Worldwide Governance Indicators.
[9] Explanation is given by the Transparency Index's FAQ #2: Why Is The CPI Based On Perceptions?

Data for four institutional quality variables are collected from the World Governance Indicators and from the Transparency International websites. Variables *CC*, *GE* and *POLSTA* are all collected from the World Governance Indicator Database so they are highly correlated. However, the CPI and the World Governance Indicators' indices aggregate two different sets of indicators using two different methods[10]. Hence, those variables complement each other.

Table 4. Summary Statistics on Institutional Quality Variables

Variables	Observation	Mean	Standard Deviation	Minimum	Maximum
CC	306	50.5001	27.45381	2.926829	98.57143
GE	306	59.37917	25.19012	10.2439	100
POLSTA	306	48.41274	28.1031	2.884615	97.11539
CPI	306	40.96405	21.43175	4	94

5.0 EMPIRICAL RESULTS

This section presents the results of the regressions, descriptions and explanations for their significance.

In order to test the "grease the wheel" hypothesis on corruption and innovation, this study runs different regressions on three different data sets. One set uses data from all Asian countries. The second set is comprised of developing countries with GPC under $10,000. Those countries include: Bangladesh, Cambodia, India, Laos, Mongolia, Philippines, Thailand and Vietnam. The third data set is comprised of developed countries with GPC over $10,000, including data from Brunei, Hong Kong, Japan, Korea, Macao, Malaysia and Singapore.

[10] Meon and Weill (2008) descriptions of the composition of each indicators, based on the study of Lambsdorff (1999) and Kaufmann et al. (1999)

In each data set, we study the interaction between a different dimension of institutional quality variables and innovation variables on economic growth. For each of the four institutional quality variables, the relationship is estimated twice to see whether those variables are correlated. According to the results, three out of four institutional quality variables are statistically insignificant except for CPI variable. However, if each institutional quality variable is put in the regression, it is significant at the 1% level of significance.

5.1 Findings

Since this study uses panel data, we run the regressions in Ordinary Least Square (OLS), Fixed Effect Model (FEM) and Random Effect Model (REM). FEM takes into consideration the impact of country effects, while REM looks at time effects. Results of OLS regressions are shown in Table 5 and Table 6, followed by results of FEM regressions in Table 7 and 8, and then results of REM regressions in Table 9 and 10.

All FEM and REM regression models are ran on the same manner as OLS regressions. We also did the Hausman Test to see which regression model would be the most accurate to use in this panel, which results are shown in Table 11 and Table 12. The Chi-square value shows that FEM is the best to use given the panel data this study is using.

Overall, all OLS, FEM, and REM regression results consistently point to the same direction. This has further confirmed the hypothesis that institutional quality variables can influence economic growth through innovation. Using regression results from FEM regressions, it is shown that corruption in some countries with a developed economy and technology system can be beneficial. On the other hand, corruption can be detrimental to some newly developing countries. In addition, as a whole, innovations do have impacts on economic development, but not significant. The numbers of patent and trademark applications, both domestically and internationally, have a positive correlation to growth for all Asian countries. However, if looking into different sub groups of developing countries and developed countries, statistical results show that applications from nonresidents seem to do more harm than good in some developing countries.

At first glance, the estimated coefficients result in the way they were expected. In addition, estimated coefficients are quite similar to those reported in other literature, despite some differences in the coefficient results of independent variables chosen. Overall, there is a positive correlation between institutional quality variables and economic growth in Asian countries. This means that a point increase in institutional quality variable ranking, there is a one percent decrease in GDP growth rate. This is consistent with economic theories about the effects of institutional performance of economic growth. The coefficient results for developing countries are also similar. For each point increase in the percentile ranking for *GE* and *CPI*, meaning that the country is doing better in battling corruption, there is a percent increase in GDP growth.

However, for coefficient results for developed countries, the results confirm the hypothesis that some developed Asian countries are immune from corruption behaviors. The results display in Table 6 for developed countries show a negative correlation between institutional quality variables and economic growth. This means that a point in crease in any of the institutional quality variables (*CC*, *GE*, *POLSTA* or *CPI*) would result in a percent decrease in GDP growth. This implies that any attempt to improve or change the corruption system in developed Asian countries may result in an unfavorable effect in economic growth, and corruption activities in developed countries have been beneficial for the economy.

There is a positive correlation between institutional quality variables and innovation variables. An increase in perception of institutional performance would lead to an increase in the number of innovations, which would therefore lead to an increase in economic performance. However, there are some interesting relationships that appear in the regression results for the correlation between innovation variables and economic growth.

Interestingly, there are opposite directions on the effect of innovation variables on economic growth in developing countries and developed countries. The number of patent applications from non-residents *(PATENTN*) is negatively correlated with growth for developing countries but is positively correlated with growth for developed countries. On the other hand, the number of patent applications from residents *(PATENTR)* the result is the opposite. Developing countries show a positive correlation between *PATENTR* and growth (significant at 10% level), while developed countries show a negative correlation (significant at 5% level).

The correlation between the numbers of trademark applications *(TRADEM)* also shows the same patterns. The numbers of trademark applications from non-residents *(TRADEMN)* is negatively correlated with growth in developing countries, but positively correlated with growth in developed countries. In contrast, the number of trademark applications from residents *(TRADEMR)* is the opposite. It is positively correlated (significant at 5% level) with growth in developing countries, but negatively correlated (significant at 5% level) with growth in developed countries.

These results are showing growth patterns in those Asian countries. For developing countries, they do not have a centralized and well-governed system for control of corruption or government effectiveness. Hence, even if investors come to invest in those countries, they tend to leave without transferring the technology and knowledge over to the country. Multinational corporations who come to work in developing countries would create short-term growth, but not long-term growth for the economy. They take and exploit what they need, and then leave the country when the opportunities are no longer lucrative. Most developing countries would benefit more from an increase in intellectual contributions of their direct residents through various means: education, R&D or protection for domestic intellectual properties.

On the other hand, developed countries show different growth patterns. Developed countries with a more centralized, systematic network of corruption tend to benefit from such a network. Multinational corporations and foreign investors come into the market, create wealth and knowledge, and then transfer the technology and knowledge over to the country after they leave. Developed countries have the technology and infrastructure needed to transfer and obtain new technology, and then regenerate the knowledge to benefit their economies further. Case studies about institutional quality control in South Korea and the Philippines will better illustrate this topic in the section below.

5.2 Case Studies

5.2.1 South Korea

Governments in developed countries have been successful at using corruption networks to enhance investment and growth by exercising monopoly control. From 1961 to 1979, President Park Chung-Hee's regime held strong autonomous government that gave out favorable patronage to firms that prove efficient. Over that period, South Korea celebrated high economic growth.

President Park admired the leaders of the Meiji Restoration and the idea of cultivating a close link between national security, economic development and social cohesion. During his time, President Park has successfully established the framework of the Korean political economy and "nationalized" corruption system in which the state set the parameters of where corruption takes place. As a result, corruption functions as a dynamic part of the developmental process and corruption coexists with economic development.

President Park was known for picking winners, and "firms needed to be efficient because they would have to perform to receive further support, and would have to pay a percentage of their assistance back to the state in the form of political funds" (Moran, 1999, p. 571). Corruption in this sense is "productive" as political favors were not granted based on political patronage, but on the potential of economic performance. Firms that want support from President Park need to prove that they are capable of achieving his goals in return for political favors. For instance, companies like Hyundai and Daewoo received extensive support in return for their abilities to achieve President

Park's targets. Chung Ju Yung, founder of Hyundai, excelled at developing the construction industry and shipbuilding industry in Korea, while Kim Woo-choong, founder and chairman of Daewoo, successfully reformed the loss-making industry.

5.2.2 The Philippines

The Philippines's economic development story has taken an opposite direction to that of South Korea. Its political economy have provided the context for corruption and prevented the transformation of the state in a more efficient direction, especially during President Ferdinand Marco's era. From 1965 to 1986, the Philippines were under the rule of Marcos, who is infamously known for his practice of corruption, extravagance and brutality. Statistically, for a twenty-five-year period from 1965 to 1989, the Philippines could only manage an average annual gross growth rate of 1.6 percent per year, as compared with its neighbors with an average rate of 4.2 percent. The impact of this sluggish corruption structure continues even in the post-Marcos era. Rapid improvements in some areas occurred after Marco resigned, but the Philippine's overall economic development is generally disappointing.

When Ferdinand Marco was in power, he used his martial powers to facilitate centralization to his favor. This dictatorship regime was exploited to distribute political and economic resources. If in South Korea, favorable treatment was given in return for economic development; then in the Philippines, favorable treatment was given for the development of cronyism. During his office time, Marcos strengthened his supporters' control, corrupted the military, and stole a considerable amount of wealth from the country. To this day, investigators are still having difficulty determining precisely how much money was stolen by Marcos (Mydan, 1991). It is estimated that approximately 21.6 billion U.S Dollars, adjusted for inflation in 2014, was stolen.

6.0 CONCLUSION

In summary, the study found contradicting effects of institutional quality variables on innovation and economic growths in South East Asia and East Asia countries. Those measures differ in different government systems, as foreign investors react differently to developing countries and to developed countries.

For developed countries with a well-established corruption system, the results supported the "grease the wheel" hypothesis. In which developed countries benefit from transferrable technology and knowledge from foreign investors even if they have a high level of corruption and government inefficiency. It is concluded that corruption and institutional factors in those countries have assumed a developed form. Anti-corruption reforms will be heavily dependent upon commitment of political elites and society groups, yet it does not guarantee that corruption will be completely abolished. It is argued that corruption could possibly be controlled, but not destroyed entirely.

Vice versa, for developing countries, the results supported the classic theory that corruption is detrimental to growth. Any attempt to improve the government effectiveness and corruption problems would lead to a positive change in economic performance.

However, this study does not intend to argue that corruption is a good thing for a country. Even though in some country, corruption and government inefficiencies provide a pole of mobilization for civil society groups; however, this study does not recommend it as a policy option to other countries. The dynamics of corruption depend on different important factors such as national political economy, state ideology and autonomy, as well as external linkages and pressures.

Instead, this study expects to highlight the differences from a macro-level perspective to show that some countries may benefit from ineffective institutional quality variables at the expense of others. In addition, the study is aware of possible perception biases, given that institutional quality variables are from an index rating. To look at the topic further, a counterfactual approach could give more insights about the effects of corruption on economic development. A study on innovation outputs and economic performance achieve in a purely competitive, corrupt-free country could give another view in this topic.

Yet, this study still provides valuable information about the impact of institutional quality variables on innovation and economic development. From a policy-perspective, it is important for governments to examine their current condition individually. Programs designed to fight corruption and institution inefficiencies must take into consideration the different structural factors and corruption effects on their own country's economic development.

Table 5. OLS Test Regression Equations For All Developing Countries and All Developed Countries

Dependent Variable	GROWTH (Developing Countries)					GROWTH (Developed Countries)				
Regression	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
GPC	0.0009*** (2.61)	0.0008*** (2.60)	0.0009*** (2.71)	0.0008*** (2.63)	0.0008*** (2.60)	0.0001** (2.19)	0.0001** (2.51)	0.0001 (1.44)	0.0001** (2.26)	0.0001** (2.06)
EDUGDP	-0.8678*** (-3.07)	-0.6773** (-2.26)	-0.7390** (-2.43)	-0.9154*** (-3.02)	-0.8683*** (-3.05)	-0.5472 (-1.27)	-0.7418* (-1.68)	-0.7204 (-1.63)	-0.6087 (-1.39)	-0.7578* (-1.87)
FDI	0.0000 (0.11)	0.0000 (0.17)	0.0000 (0.00)	0.0000 (0.12)	0.0000 (0.11)	0.0000 (-0.57)	-0.0000 (-0.91)	-0.0000 (-0.43)	-0.0000 (-0.60)	-0.0000 (-1.13)
POP	0.6255 (0.88)	0.7390 (1.05)	0.6676 (0.94)	0.6592 (0.92)	0.6056 (0.85)	0.4746 (0.88)	0.3139 (0.58)	0.3223 (0.59)	0.4518 (0.84)	0.4011 (0.79)
TRADE	0.0272*** (3.04)	0.0256*** (2.87)	0.0251*** (2.75)	0.0256*** (2.65)	0.0279*** (3.02)	-0.0044 (-0.53)	0.0107 (0.89)	-0.0166 (-1.47)	-0.0028 (-0.34)	0.0241** (2.40)
PATENTN	-0.0003* (-1.54)	-0.0003 (-1.52)	-0.0003 (-1.21)	-0.0003 (-1.55)	-0.0003 (-1.51)	0.0001 (0.98)	0.0003 (0.63)	0.0005 (0.98)	0.0004 (0.83)	0.0001* (1.65)
PATENTR	0.0011 (1.27)	0.0013 (1.47)	0.0009 (1.13)	0.0011 (1.26)	0.0011 (1.26)	0.0000*** (-3.30)	-0.0001 (-1.21)	-0.0003 (-3.66)***	-0.0002*** (-2.55)	-0.0001 (-1.36)
RDE	3.9152* (1.75)	4.4007** (1.97)	4.1085* (1.83)	3.9259* (1.75)	4.0444* (1.78)	0.3035 (0.17)	0.5288 (0.31)	-0.0512 (-0.03)	-0.1024 (-0.06)	-0.0904 (-0.06)
RESEA	-0.0071* (-1.38)	-0.0051 (-0.97)	-0.0049 (-0.90)	-0.0067 (-1.30)	-0.0070 (-1.37)	-0.0002 (-0.22)	-0.0003 (0.27)	-0.0001 (-0.10)	0.0001 (0.01)	0.0003 (0.36)
TRADEMN	-0.0002 (0.96)	-0.0023** (-2.16)	-0.0002** (-2.14)	-0.0002** (-2.05)	-0.0002** (-2.19)	0.0002 (-0.08)	0.0002* (1.76)	0.0002** (2.16)	0.0002 (-0.85)	0.0001 (1.53)
TRADEMR	0.0001** (-2.18)	0.0001 (0.53)	0.0002 (0.83)	0.0002 (0.96)	0.0002 (1.26)	0.0009** (1.94)	-0.0000 (-0.27)	0.0000** (2.16)	0.0000 (1.49)	-0.0000 (1.53)
CC		-0.0377* (-1.80)					-0.1223* (-1.70)			
GE			-0.0294 (-1.14)					0.1457 (1.58)		
POLSTA				0.0073 (0.44)					-0.0342 (-0.85)	
CPI					-0.0156 (-0.34)					-0.1942*** (-4.44)
Constant	5.2971	5.5598	5.8474	5.1955	5.6079	3.5803	10.6841	-4.6512	6.1533	9.7245
Obs	162	162	162	162	162	144	144	144	144	144
R^2	0.2683	0.2838	0.2746	0.2692	0.2689	0.2349	0.2515	0.2492	0.2391	0.3351

t-statistics are displayed in parentheses under the coefficient estimates.

, **, * Denote an estimate significantly different from zero at the 10%, 5% or 1% level, respectively.*

Table 6. OLS Test Regression Equations For All Asian Countries

Dependent Variable	**GROWTH**				
Regression	**1**	**2**	**3**	**4**	**5**
GPC	0.00003* (1.32)	0.0001*** (3.37)	0.0001*** (3.22)	0.00002 (1.36)	0.00007*** (3.15)
EDUGDP	-0.5745*** (-2.55)	-0.4059* (-1.81)	-0.3137 (-1.35)	-0.5535** (-2.40)	-0.5536** (-2.57)
FDI	0.00000 (0.52)	0.0000 (0.23)	0.0000 (0.18)	0.00000 (0.50)	0.0000 (0.12)
POP	0.06763 (0.17)	0.1811 (0.47)	0.2985 (0.76)	0.0663 (0.17)	0.1752 (0.46)
TRADE	0.00452 (0.81)	0.0141** (2.35)	0.0099* (1.75)	0.0055 (0.91)	0.0248*** (3.79)
PATENTN	0.00002 (0.42)	0.0003 (0.83)	0.0004 (1.04)	0.0002 (0.44)	0.0001 (1.57)
PATENTR	-0.0002*** (-2.83)	-0.0001** (-2.39)	-0.0001*** (-3.09)	-0.0002*** (-2.65)	-0.0002** (-1.98)
RDE	1.77169* (1.46)	2.7113** (2.24)	2.3158* (1.93)	1.8006* (-1.74)	2.2545* (1.94)
RESEA	-0.00117** (-1.70)	-0.0016** (-2.42)	-0.0014** (-2.09)	-0.0012 (1.59)	-0.0011* (-1.70)
TRADEMN	-0.00008* (-1.40)	-0.0004 (-0.79)	-0.0002** (-2.09)	-0.0001 (-1.46)	-0.0007 (-1.35)
TRADEMR	0.00010* (1.55)	0.0000 (0.92)	0.0000 (0.82)	0.0000 (1.59)	0.0000 (1.03)
CC		-0.0718*** (-3.90)			
GE			-0.0701*** (-3.55)		
POLSTA				-0.0061 (-0.43)	
CPI					-0.1451*** (-5.35)
Constant	6.79892	7.2433	7.6423	6.8901	8.5483
Obs	306	306	306	306	306
R^2	0.1529	0.1948	0.1878	0.1535	0.2284

t-statistics are displayed in parentheses under the coefficient estimates.
*, **, *** *Denote an estimate significantly different from zero at the 10%, 5% or 1% level, respectively.*

Table 7. Fixed Effect Model (FEM) Regression Equations For All Developing Countries and All Developed Countries

Dependent Variable	GROWTH (Developing Countries)					GROWTH (Developed Countries)				
Regression	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
GPC	0.0018*** (4.58)	0.0018*** (4.44)	0.0019*** (4.90)	0.0019*** (4.68)	0.0018*** (4.44)	0.0001** (2.38)	0.0001** (2.18)	0.0001 (1.52)	0.0001** (2.54)	0.0001** (2.18)
EDUGDP	-0.7997** (-2.40)	-0.7988** (-2.38)	-0.9526*** (-2.81)	-0.8264** (-2.47)	-0.7845** (-2.36)	-0.7227 (-1.22)	-0.6471 (-1.09)	-0.5936 (-1.07)	-0.5847 (-1.04)	-0.7198 (-1.21)
FDI	0.0000 (-0.43)	0.0000 (-0.40)	0.0000 (-0.77)	0.0000 (-0.48)	0.0000 (-0.58)	0.0000 (-0.62)	0.0000 (-0.41)	0.0000 (-0.17)	0.0000 (-0.46)	0.0000 (-0.56)
POP	1.3959** (1.60)	1.4029 (1.57)	1.4959*** (1.74)	1.0651 (1.14)	1.7551* (1.92)	-0.0932 (-0.16)	-0.0044 (-0.01)	-0.2631 (-0.48)	-0.1328 (-0.24)	-0.0682 (-0.12)
TRADE	0.0393** (2.09)	0.0393** (2.08)	0.0408** (2.19)	0.0353* (1.83)	0.0404** (2.15)	0.0239 (1.58)	0.0189 (1.24)	0.0058 (0.39)	0.0093 (0.63)	0.0226 (1.40)
PATENTN	-0.0002 (-0.58)	-0.0001 (-0.58)	-0.0001 (-0.56)	-0.0002 (-0.66)	-0.0002 (-0.62)	0.0001 (0.85)	0.0001 (1.08)	-0.0001 (-0.35)	0.0001 (1.08)	0.0001 (0.76)
PATENTR	0.0013 (0.97)	0.0013 (0.96)	0.0013 (0.98)	0.0013 (1.00)	0.0014 (1.07)	0.0000 (-0.18)	-0.0000 (-0.40)	-0.0000 (-0.62)	-0.0000 (-0.50)	-0.0000 (-0.20)
RDE	1.4581 (0.45)	1.4565 (0.44)	2.4149 (0.74)	1.6695 (0.51)	1.4602 (0.45)	-3.5592 (-1.35)	-3.4177 (-1.31)	-4.0776* (-1.65)	-0.9367 (-0.37)	-3.7509 (-1.36)
RESEA	-0.0003 (-0.03)	-0.0003 (-0.03)	-0.0004 (-0.05)	0.0048 (0.48)	-0.0002 (-0.02)	0.0005 (0.52)	0.0005 (0.47)	0.0004 (0.39)	-0.0005 (-0.48)	0.0006 (0.56)
TRADEMN	-0.0002 (-1.38)	-0.0002 (-1.37)	-0.0002 (-1.40)	-0.0002 (-0.58)	-0.0002 (-1.29)	0.0001 (0.42)	0.0001 (0.61)	0.0001 (0.32)	0.0001 (0.85)	0.0001 (0.45)
TRADEMR	-0.0001 (-0.60)	-0.0002 (-0.06)	-0.0002 (-0.48)	-0.0002 (-0.58)	-0.0002 (-0.75)	0.0000 (0.06)	-0.0000 (-0.04)	0.0000 (0.59)	-0.0000 (-0.20)	0.0000 (0.45)
CC		-0.0011 (-0.04)					0.1621* (1.77)			
GE			0.1088** (2.01)					0.4247*** (4.34)		
POLSTA				0.9255 (0.40)					0.2217*** (4.10)	
CPI					0.0769 (1.29)					0.0319 (0.25)
Constant	1.5359	1.5626	-2.9056	0.9254	-1.0336	3.5735	-8.1846	-24.5367	-11.0550	2.1697
Obs	162	162	162	162	162	144	144	144	144	144
R^2 (Overall)	0.0731	0.0743	0.2530	0.0421	0.0665	0.0408	0.1490	0.2425	0.1381	0.1279

t-statistics are displayed in parentheses under the coefficient estimates.

, **, * Denote an estimate significantly different from zero at the 10%, 5% or 1% level, respectively.*

Table 8. Fixed Effect Model (FEM) Regression Equations For All Asian Countries

Dependent Variable	GROWTH				
Regression	**1**	**2**	**3**	**4**	**5**
GPC	0.00011*** (3.45)	0.0001*** (3.44)	0.0001*** (2.99)	0.0001*** (3.51)	0.0001*** (3.18)
EDUGDP	-0.4376 (-1.56)	-0.4385 (-1.56)	-0.5230* (-1.89)	-0.4934* (-1.76)	-0.4361 (-1.55)
FDI	0.00000 (0.15)	0.00000 (0.15)	0.00000 (0.22)	0.00000 (0.09)	0.00000 (0.23)
POP	0.0441 (0.10)	0.0331 (0.08)	-0.0445 (-0.10)	-0.1176 (-0.27)	0.1388 (0.31)
TRADE	0.0268** (2.45)	0.0268** (2.45)	0.0214** (1.97)	0.0256** (2.35)	0.0247** (2.22)
PATENTN	0.00002 (0.35)	0.0001 (0.37)	-0.0001 (-0.23)	0.0001 (0.33)	0.0000 (0.16)
PATENTR	-0.0000 (-0.86)	-0.0000 (-0.48)	-0.0000 (-0.70)	-0.0000 (-0.51)	-0.0000 (-0.47)
RDE	-1.6251 (-0.86)	-1.5967 (-0.84)	-1.3604 (-0.74)	-0.6536 (-0.34)	-1.9212 (-1.01)
RESEA	-0.0003 (-0.41)	-0.0003 (-0.43)	-0.0005 (-0.70)	-0.0006 (-0.86)	-0.0002 (-0.30)
TRADEMN	-0.00003 (-0.40)	-0.0003 (-0.36)	-0.0000 (-0.13)	0.0000 (0.03)	-0.0001 (-0.21)
TRADEMR	0.0000 (0.46)	0.0000 (0.45)	0.0000 (0.62)	0.0000 (0.27)	0.0000 (-0.21)
CC		0.0111 (0.34)			
GE			0.1856*** (3.55)		
POLSTA				0.0551** (2.20)	
CPI					0.0636 (1.07)
Constant	3.7598	3.1890	-5.7325	1.1783	1.4790
Obs	306	306	306	306	306
R^2 Overall	0.0208	0.0896	0.1288	0.01049	0.0930

t-statistics are displayed in parentheses under the coefficient estimates.
, **, * Denote an estimate significantly different from zero at the 10%, 5% or 1% level, respectively.*

Table 9. Random Effect Model (REM) Regression Equations For All Developing Countries and Developed Countries

Dependent Variable	GROWTH (Developing Countries)					GROWTH (Developed Countries)				
Regression	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
GPC	0.0008*** (2.61)	0.0008*** (2.60)	0.0008*** (2.71)	0.0008*** (2.63)	0.0008*** (2.60)	0.0001** (2.19)	0.0001** (2.51)	0.0001 (1.44)	0.0001** (2.26)	0.0001** (2.06)
EDUGDP	-0.8677*** (-3.07)	-0.6773** (-2.26)	-0.7390** (-2.43)	-0.9154*** (-3.02)	-0.8683*** (-3.06)	-0.5472 (-1.27)	-0.7418* (-1.68)	-0.7204 (-1.63)	-0.6087 (-1.39)	-0.7578* (-1.87)
FDI	0.0000 (0.11)	0.0000 (0.17)	0.0000 (0.00)	0.0000 (0.12)	0.0000 (0.11)	0.0000 (-0.57)	0.0000 (-0.91)	0.0000 (-0.43)	0.0000 (-0.60)	0.0000 (-1.13)
POP	0.6255 (0.88)	0.7390 (1.05)	0.6677 (0.94)	0.6592 (0.92)	0.6055 (0.85)	0.4746 (0.88)	0.3139 (0.58)	0.3225 (0.59)	0.4517 (0.84)	0.4011 (0.79)
TRADE	0.0272*** (3.04)	0.0256*** (2.87)	0.0251** (2.75)	0.0256*** (2.65)	0.0279*** (3.02)	-0.0044 (-0.53)	0.0107 (0.89)	-0.0167 (-1.47)	-0.0028 (-0.34)	0.0.241** (2.40)
PATENTN	-0.0003 (-1.54)	-0.0003 (-1.52)	-0.0003 (-1.21)	-0.0003 (-1.55)	-0.0003 (-1.51)	0.0000 (0.98)	0.0000 (0.63)	0.0000 (0.98)	0.0000 (0.83)	0.0001* (1.65)
PATENTR	0.0011 (1.27)	0.0013 (1.47)	0.0009 (1.13)	0.0011 (-1.26)	0.0011 (1.26)	0.0000*** (-3.30)	-0.0000 (-1.21)	-0.0000*** (-3.66)	-0.0000** (-2.55)	-0.0000 (-1.36)
RDE	3.9151* (1.75)	4.4007** (1.97)	4.1085* (1.83)	3.925* (1.75)	4.0444* (1.78)	0.3035 (0.17)	0.5287 (0.31)	-0.0512 (-0.03)	-0.1024 (-0.06)	-0.0905 (-0.06)
RESEA	-0.0000 (-1.38)	-0.0050 (-0.97)	-0.0049 (-0.90)	-0.0067 (-1.30)	-0.0070 (-1.37)	-0.0002 (-0.22)	-0.0003 (-0.27)	-0.0001 (-0.10)	0.0001 (0.01)	0.0003 (0.36)
TRADEMN	-0.0002** (-2.18)	-0.0002** (-2.16)	-0.0002** (-2.14)	-0.0002** (-2.05)	-0.0002** (-2.19)	0.0002 (-0.08)	0.0002* (1.76)	0.0002 (2.16)	0.0001 (1.49)	0.0001 (1.53)
TRADEMR	0.0000 (0.96)	0.0000 (0.53)	0.0000 (0.83)	0.0000 (0.96)	0.0000 (0.96)	0.0009* (1.94)	-0.0000 (-0.29)	0.0000 (0.13)	0.0000 (0.08)	-0.0000 (-0.23)
CC		-0.03772* (-1.80)					-0.1227* (-1.70)			
GE			-0.0294 (-1.14)					0.1457 (1.58)		
POLSTA				0.0073 (0.44)					-0.0342 (-0.85)	
CPI					-0.0156 (-0.34)					-0.1942*** (-4.44)
Constant	5.2971	5.5598	5.8473	5.1955	5.6079	3.5803	19.6840	-4.6512	6.1533	9.7246
Obs	162	162	162	162	162	144	144	144	144	144
R^2 Overall	0.2683	0.2838	0.2746	0.2692	0.2689	0.2349	0.2515	0.2492	0.2391	0.3351

z-scores are displayed in parentheses under the coefficient estimates.

, **, * Denote an estimate significantly different from zero at the 10%, 5% or 1% level, respectively.*

Table 10. Random Effect Model (REM) Regression Equations For All Asian Countries

Dependent Variable	**GROWTH**				
Regression	**1**	**2**	**3**	**4**	**5**
GPC	0.0001**	0.0001***	0.0001**	0.0001**	0.0001***
	(2.53)	(2.91)	(2.52)	(2.15)	(3.05)
EDUGDP	-0.4411*	-0.4398*	-0.4261*	-0.4625*	-0.5274**
	(-1.72)	(-1.75)	(-1.66)	(-1.82)	(-2.21)
FDI	0.00000	0.00000	0.00000	0.00000	0.00000
	(0.59)	(0.47)	(0.55)	(0.65)	(0.24)
POP	-0.0071	0.0579	0.0177	-0.0162	0.0011
	(-0.02)	(0.14)	(0.04)	(-0.04)	(0.00)
TRADE	0.0023	0.0072	0.0036	-0.0001	0.0175**
	(0.32)	(0.98)	(0.48)	(-0.01)	(2.26)
PATENTN	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.65)	(0.66)	(0.72)	(0.59)	(1.16)
PATENTR	-0.0000**	-0.0000**	-0.0000**	-0.0000**	-0.0000**
	(-2.04)	(-1.83)	(-2.06)	(-2.36)	(-1.98)
RDE	0.0357	0.8361	0.2783	0.3122	1.5825
	(0.02)	(0.59)	(0.19)	(0.22)	(1.21)
RESEA	-0.0004	-0.0007	-0.0005	-0.0005	-0.0008
	(-0.62)	(-0.98)	(-0.71)	(-0.71)	(-1.21)
TRADEMN	-0.00001	-0.0000	-0.0000	-0.0000	-0.0000
	(-0.24)	(-0.12)	(-0.17)	(-0.22)	(-0.62)
TRADEMR	0.0000	0.0000	0.0000	0.0000	0.0000
	(-0.24)	(0.43)	(0.57)	(0.76)	(-0.62)
CC		-0.0452**			
		(-2.05)			
GE			-0.0175		
			(-0.61)		
POLSTA				0.0094	
				(0.51)	
CPI					-0.1157***
					(-3.49)
Constant	6.2401	7.3204	6.8148	6.2005	8.4678
Obs	306	306	306	306	306
R^2 Overall	0.1103	0.4535	0.3418	0.2927	0.2191

z-scores are displayed in parentheses under the coefficient estimates.
, **, * Denote an estimate significantly different from zero at the 10%, 5% or 1% level, respectively.*

Table 11. Hausman-Test for Fixed Effect Model and Random Effect Model

Dependent Variable	**GROWTH**		
Regression	**OLS**	**FEM**	**REM**
GPC	0.0000882** (3.01)	0.0000907** (2.62)	0.0000882** (3.01)
EDUGDP	-0.518* (-2.22)	-0.575* (-2.09)	-0.518* (-2.22)
FDI	1.24E-12 (0.06)	6.70E-12 (0.32)	1.24E-12 (0.06)
POP	0.264 (0.69)	0.0162 (0.04)	0.264 (0.69)
TRADE	0.0230*** (3.46)	0.0161 (1.46)	0.0230*** (3.46)
PATENTN	0.00007 (1.60)	-0.00004 (-0.69)	0.00007 (1.60)
PATENTR	-0.00001* (-2.31)	-0.00001 (-0.68)	-0.00001* (-2.31)
RDE	2.578* (2.18)	-1.06855 (-0.56)	2.57803* (2.18)
RESEA	-0.00125 (-1.86)	-0.00069 (-0.86)	-0.00125 (-1.86)
TRADEMN	-0.00001 (-0.14)	0.00003 (0.44)	0.00000 (-0.14)
TRADEMR	0.00000 (0.38)	0.00000 (0.38)	-0.00000 (0.38)
CC	-0.0299 (-0.88)	-0.0620 (-1.72)	-0.0299 (-0.88)
GE	-0.0155 (-0.50)	0.198*** (3.56)	-0.0155 (1.63)
POLSTA	0.0259 (1.63)	0.0531* (2.03)	0.0259 (1.63)
CPI	-0.125*** (-3.83)	0.108 (1.79)	-0.125*** (-3.83)
Constant	8.295	-9.545	8.295
Obs	306	306	306
R_2	0.241	0.006	0.241

t-statistics and z-scores are displayed in parentheses under the coefficient estimates.
** p<0.05, ** p<0.01, *** p<0.001*

Table 12. Hausman Test Results

Note: the rank of the differenced variance matrix (9) does not equal the number of coefficients being tested (15); be sure this is what you expect, or there may be problems computing the test. Examine the output of your estimators for anything unexpected and possibly consider scaling your variables so that the coefficients are on a similar scale.

	---- Coefficients ----			
	(b) femodel	(B) .	(b-B) Difference	Sqrt(diag(V_b-V_B)) S. E.
GPC	0.0000907	0.0000882	2.48E-06	0.0000183
EDUGDP	-0.5747232	-0.5176392	-0.057084	0.1466998
FDI	6.70E-12	1.24E-12	5.47E-12	2.06E-12
POP	0.016197	0.2644478	-0.2482508	0.2195265
TRADE	0.016126	0.023031	-0.006905	0.0088239
PATENTN	-0.0000373	0.0000696	-0.0001068	0.0000321
PATENTR	-0.0000118	-0.0000144	2.64E-06	0.0000162
RDE	-1.068546	2.57803	-3.646576	1.485246
RESEA	-0.0006864	-0.001249	0.0005626	0.0004386
TRADEN	3.82E-06	2.50E-06	1.32E-06	7.76E-06
TRADER	0.0000328	-8.82E-06	0.0000417	0.0000411
CC	-0.0619505	-0.0299371	-0.0320134	0.0120425
GE	0.1977211	-0.0154876	0.2132087	0.046069
POLSTA	0.053143	0.0258523	0.0272907	0.020907
CPI	0.1083856	-0.125328	0.2337136	0.0507644

----
b = consistent under Ho and Ha; obtained from xtreg
B = inconsistent under Ha, efficient under Ho; obtained from xtreg

Test: Ho: difference in coefficients not systematic

chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
= 30.71

Prob>chi2 = 0.0003
(V_b-V_B is not positive definite)

APPENDIX A: Variable Description and Data Sources

ACRONYM	DESCRIPTION	DATA SOURCE
GROWTH	Annual percentage GDP growth based on local currency (constant 2005 U.S. dollars)	World Development Indicator (WDI) by the World Bank
GPC	GDP per capita in current U.S Dollars	World Development Indicator (WDI) by the World Bank
EDUGDP	Public spending on education as percentage of GDP	World Development Indicator (WDI) by the World Bank
FDI	Net inflow of Foreign Direct Investment in current U.S Dollars	World Development Indicator (WDI) by the World Bank
POP	Annual percentage growth in population growth	World Development Indicator (WDI) by the World Bank
TRADE	Trade openness is the sum of export and import as percent of GDP	World Development Indicator (WDI) by the World Bank
INNOVATION VARIABLES		
PATENTN	Total number of patent applications from non residents (in thousands)	World Intellectual Property Organization (WIPO) and World Intellectual Property Indicators.
PATENTR	Total number of patent applications from residents (in thousands)	World Intellectual Property Organization (WIPO) and World Intellectual Property Indicators.
RDE	Total expenditures on research and development as percentage of GDP	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics and World Development Indicator
RESEA	Total number of researchers in R&D (per million people)	United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics and

		World Development Indicator
TRADEMN	Total number of trademark applications from direct nonresidents	World Intellectual Property Organization (WIPO) and World Intellectual Property Indicators.
TRADEMR	Total value of imports of goods and services as percentage of GDP	World Intellectual Property Organization (WIPO) and World Intellectual Property Indicators.
INSTITUTIONAL QUALITY VARIABLES		
CCRNK	Control of corruption in percentile rank from 0 to 100 (0 is lowest rank, and 100 is highest rank)	World Governance Indicators
GERNK	Government effectiveness in percentile rank from 0 to 100 (0 is lowest rank, and 100 is highest rank)	World Governance Indicators
POLSTA	Political stability and absence of violence/terrorism measurement in percentile rank from 0 to 100 (0 is lowest rank, and 100 is highest rank)	World Governance Indicators
CPI	Corruption Perception Index	Transparency International

APPENDIX B. Variables and Expected Signs

ACRONYM	VARIABLE DESCRIPTION	WHAT IT CAPTURES	EXPECTED SIGN
GROWTH	GDP growth (annual %)	Annual percentage growth rate of GDP at market prices based on constant local currency.	N/A
GPC	GDP per capita (current US$)	GDP per capita is gross domestic product divided by midyear population.	+
EDUGDP	Public spending on education (% of GDP)	Public expenditure on education as percentage of GDP is the total public expenditure on education, expressed as a percentage.	+
FDI	Foreign direct investment, net inflows (current US$)	Net inflows FDI shows new investment inflows less disinvestment in the reporting economy from foreign investors.	+
POP	Population growth (annual %)	Population growth is the exponential rate of growth of midyear population from year t-1 to t.	+
TRADE	Trade openness	Trade openness is calculated by finding the sum of exports and imports of goods and services measured as a share of gross domestic product.	+
INNOVATION VARIABLES			
PATENTR	Patent applications, residents	Patent applications are filed through the Patent Cooperation Treaty, providing protection for the invention to the owner of the patent for a limited period (20 years).	(+) for developed countries (-) for developing countries

PATENTN	Patent applications, non residents	Patent applications through the Patent Cooperation Treaty, providing protection for the invention to the owner of the patent for a limited period (20 years).	(+) for developed countries (-) for developing countries
RDE	Research and development expenditure (% of GDP)	Expenditures for research and development on creative work undertaken systematically to increase knowledge. R&D covers basic research, applied research, and experimental development.	+
RESEA	Researchers in R&D (per million people)	Researchers in R&D are professionals engaged in the conception or creation of new knowledge, products, processes, methods, or systems and postgraduate PhD students engaged in R&D.	+
TRADEMN	Trademark applications, direct nonresident	Direct nonresident trademark applications are those filed by applicants from abroad directly at a given national IP office.	(+) for developed countries (-) for developing countries
TRADEMR	Trademark applications, direct resident	Trademark applications filed are applications to register a trademark with a national or regional Intellectual Property (IP) office. Direct resident trademark applications are those filed by domestic applicants directly at a given national IP office.	(+) for developed countries (-) for developing countries
INSTITUTIONAL QUALITY VARIABLES			
CC	Control of Corruption: Percentile Rank	Control of Corruption captures perceptions of the extent to which public power is exercised for	+

		private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests. Percentile rank: 0 (lowest rank) to100 (highest rank).	
GE	Government Effectiveness: Percentile Rank	Government Effectiveness captures perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. Percentile rank: 0 (lowest rank) to100 (highest rank).	+
POLSTA	Political Stability and Absence of Violence/Terrorism: Percentile Rank	Reflects perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism. Percentile rank: 0 (lowest rank) to100 (highest rank).	+
CPI	Corruption Perception Index	The CPI scores and ranks countries and/or territories based on how corrupt a country’s public sector is perceived to be.	+

BIBLIOGRAPHY

Almeida, A. & Teixeira, A. C. (2008). One size does not fit all… An economic development perspective on the asymmetric impact of Patents on R&D. *Working Papers (FEP) -- Universidade Do Porto, (*200), pp. 1-23.

Anand, R., Cheng, K., Rehman, S. & Zhang, L. (2014), Potential Growth in Emerging Asia, *IMF Working Paper,* Asia and Pacific Department, WP/14/2

Bai, J., Jayachandran, S., Malesky, E., & Olken, B. (2013). Does Economic Growth Reduce Corruption? Theory and Evidence from Vietnam. *National Bureau of Economic Research.* NBER Working Paper No. 19483.

Bonnett, H. & Rock, M. (2004). The Comparative Politics of Corruption: Accounting for the East Asian Paradox in Empirical Studies of Corruption, Growth and Investment. *World Development,* Vol. 32, No. 6, pp. 999-1017.

Edward, S. (1998). Openness, Productivity and Growth: What Do We Really know? *The Economic Journal*, Vol. 108, No. 447, pp. 383-398.

Fan, P. (2008). Innovation Capacity and Economic Development: China and India. *United Nations University Work Institute for Development Economics Research (UNU-WIDER).* Research Paper No. 2008/31.

Goldberg, I., Branstetter, L., Goddard, J., & Kuriakose, S. (2008). Globalization and Technology Absorption in Europe and Central Asia: The Role of Trade, FDI and Cross-border Knowledge Flows. *World Bank Working Paper,* no. 150, pp. 1-150.

Hanoteau, J. & Vial, V. (2010). Corruption, Manufacturing Plant Growth, and the Asian Paradox: Indonesian Evidence. *World Development*, Vol. 38, No. 5, pp. 693–705.

Habiyaremye, A. & Raymond, W. (2013). Transnational Corruption and Innovation in Transition Economies. *Maastricht Economic and social Research Institute on Innovation and Technology UNU-MERIT & Maastricht Graduate School of Governance MGSoG.* NU-MERIT Working Papers. ISSN 1871-9872.

Hobday, M. (2011). Learning from Asia's Success Beyond Simplistic 'Lesson-Making'. *World Institute for Development Economics Research (UNU-WIDER),* Working Paper No. 2011/42.

Kaufmann, D. & Wei, S. (1999). Does "Grease Money" Speed Up the Wheel of Commerce? *National Bureau of Economic Research.* NBER Working Paper No. 7093.

Kowalski, E. (2000). Determinants of Economic Growth in East Asia: A Linear Regression Model. *Honors Projects Illinois Wesleyan University*. Paper 74.

Kuroiwa, I., Nabeshima, K. & Tanaka, K. (2011). Innovation Networks in China, Japan and Korea: Evidence from Japanese Patent Data. *Institute of Developing Economies,* IDE Discussion Paper No. 285.

Kuroiwa, I., Nabeshima, K & Tanaka, K. (2011). Innovation Networks in China, Japan and Korea: Further Evidence from U.S. Patent Data. *Institute of Developing Economies,* IDE Discussion Paper No. 297.

Leff, N.H. (1964). Economic development through bureaucratic corruption. *American Behavioral Scientist* 8: 8-14. Reprint in A.J. Heidenheimer, M. Johnston and V.T. LeVine (Eds). *Political corruption: A handbook*, 389-403. 1989. Oxford. Transaction Books.

Leys. C. (1965). What is the problem about corruption? *Journal of Modern African Studies* 3: 215-230. Reprint in A.J. Heidenheimer, M. Johnston and VT. LeVine (Eds.), *Political corruption: A handbook.* 51-66. 1989. Oxford: Transaction Books.

Mauro, P. (1995). Corruption and Growth. *The Quarterly Journal of Economics,* Oxford University Press, Vol. 110, No.3, pp. 681-712.

Méon, P. G. & Sekkat, K. (2005). Does corruption grease or sand the wheels of growth? *Public Choice*, 122(1–2), 69–97.

Méon, P. G and Weill, L. (2008). Is Corruption an Efficient Grease? *Bank of Finland, BOFIT Institute for Economies in Transition*. BOFIT Discussion Papers 20.

Moran, J. (1999). Patterns of Corruption and Development in East Asia. *Third World Quarterly*, Vol 20, No 3, pp 569-587.

Mydans, S. (1991 March 31). "Hunt for Marcos's Billions Yields More Dead Ends Than Hard Cash". *The New York Times*. Retrieved from http://www.nytimes.com/1991/03/31/world/hunt-for-marcos-s-billions-yields-more-dead-ends-than-hard-cash.html?src=pm&pagewanted=1&pagewanted=all

Nanayakkara, R. (2014). Five Reasons Corruption is Getting Worse in China. *Transparency International*. Retrieve from http://blog.transparency.org/2014/12/03/five-reasons-corruption-is-getting-worse-in-china/

Organization for Economic Co-operation and Development for G20 Anti-Corruption Working Group (2013). Issues Paper on Corruption and Economic Growth. *Organization for Economic Co-operation and Development OECD*, Working Paper.

Plipat, S. (2014). Asia Pacific: Growing Economies, Growing Corruption. *Transparency International.* Retrieve from https://blog.transparency.org/2014/12/03/asia-pacific-growing-economies-growing-corruption/

Prodan, I. (2005). Influence of Research and Development Expenditures on Number of Patent Applications: Selected Case Studies in OECD Countries and Central Europe, 1981-2001. *Applied Econometrics And International Development, 5*(4), pp. 5-22.

Rock, M. & Bonnett, H. (2004). The comparative politics of corruption: Accounting for the East Asian paradox in empirical studies of corruption, growth and investment. *World Development*, 32(6), 999–1017.

Singh, L. (2006). Innovations and Economic Growth in a Fast Changing Global Economy: Comparative Experience of Asian Countries. *MPRA Munich Personal RePEc Archive*, MPRA Paper No. 80.

Transparency Index. "FAQ#2: Why Is The CPI Based On Perceptions?" *Corruption Perceptions Index 2014: Frequently Asked Questions.* Http://Www.Transparency.Org/Cpi2014/In_Detail#Myanchor1. Mar 23, 2015.

Vallée, T. & Yildizoglu, M. (2006). Social and Technological Efficiency of Patent Systems. *Journal Of Evolutionary Economics, 16*(1/2), pp. 189-206. doi:10.1007/s00191-005-0004-2.

World Bank (1997), Helping Countries Combat Corruption: The Role of the World Bank, *THE WORLD BANK: Poverty Reduction and Economic Management*.