



UNIVERSITI PUTRA MALAYSIA

***EFFECTS OF FINANCIAL DEVELOPMENT AND INSTITUTIONAL
QUALITY ON INNOVATION***

LEE WENG CHANG

FEP 2016 30



**EFFECTS OF FINANCIAL DEVELOPMENT AND INSTITUTIONAL
QUALITY ON INNOVATION**

By

LEE WENG CHANG

**Thesis Submitted to the Graduate School of Management Universiti Putra
Malaysia, in Fulfilment of the Requirements for the Degree of
Doctor of Philosophy**

December 2016

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia
in fulfilment of the requirement for the Degree of Doctor of Philosophy

EFFECTS OF FINANCIAL DEVELOPMENT AND INSTITUTIONAL QUALITY ON INNOVATION

By

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December 2016

Chairman : Assoc. Prof . Law Siong Hook, PhD
Faculty : Economics and Management

This study aims to examine the role of institutional quality and financial development in innovation activities using international data. This thesis is organized into three major parts namely institutions-innovation, finance-innovation and segregated finance-innovation nexus.

The first part of this thesis examines the various roles of sub-component institutions (e.g., formal and informal institutions) in countries' innovation activities. Most of the recent works only focus on the roles of formal institutions. However, informal institutions such as social capital are equally important in determining innovation as it could promote the culture of knowledge sharing and thus, encourage innovation activities as a whole. The sample consists of 62 developed and developing countries. The study adopts instrumental variable estimators, and the empirical results indicate that formal and informal institutions complement one another in determining countries' innovations level. Moreover, the evidence suggests that innovation level tends to be higher in countries with higher social capital. Thus, focus should be given in improving formal and informal institution in promoting innovative activities.

The second part of this thesis aims examine the non-linear relationship between financial development and innovation using panel system generalized method of moments (GMM) estimators. The motivation of this study is to resolve current disparities of finance-innovation relationship as suggested by previous literature. The sample countries consist of 75 developed and developing countries and the sample period covers from 1996 through 2010. The empirical results reveal an inverted U-shaped non-linear relationship between finance and innovation. This implies that finance enhances innovation only up to a certain level; beyond that level, further development of finance tends to adversely affect innovation. We incorporate the institution interaction term to examine its role in governing such relationship. The

empirical results suggest that the pattern of the finance-innovation curve varies with different settings of institutional quality. Specifically, only countries with high institutional quality follow an inverted U-shape of the finance-innovation curve. Hence, we conclude that sound institutional quality is a prerequisite before financial development has any beneficial impact on innovation. This reflects the inefficiency of finance market in facilitating innovation activities in most developing countries.

Finally, the third part of this thesis aims to validate the non-linear dynamic finance-innovation nexus using a panel data of 69 developed and developing countries. This study is to investigate the roles of different financial market in influencing innovation activities. The empirical results support the idea that there is a threshold effect in the finance-innovation relationship. This findings indicate that the level of credit market and equity market development is beneficial to a country's innovation only up to a certain turning point, and development of the financial market beyond the turning point would impede innovation activities. In addition, this study incorporates the roles of market institutions (e.g market creating, market stabilizing, market regulating and market legitimizing) in overseeing the finance-innovation relationship. The findings suggest that market institutions especially market creating and market regulating institutions plays important role in the finance-innovation relationship.

Overall, the findings of this thesis conclude that i) Informal institutions is compliment to formal institutions in promoting countries innovations. ii) Non-linear relationship was found between financial development and innovation which follows an inverted U-shape curve. Here, institutional quality plays an important roles in governing such relationship. Countries with sound institutional quality follow an inverted U-shape finance-innovation curve while countries with weak institutional quality follow a U-shape curve. iii) Non-linear relationship also found between credit-innovation and equity-innovation nexus. Coincidencely, it's also follows an inverted U-shape curve. However, equity market development are found to have a lengthier beneficial impact compared to credit market development. Besides, it's also found market institutions plays an important roles on finance leads innovation relationship.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra
Malaysia sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah

KESAN PEMBANGUNAN KEWANGAN DAN INSTITUSI KUALITI TERHADAP INOVASI

Oleh

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Kajian ini bertujuan untuk mengkaji peranan kualiti institusi dan pembangunan dalam sektor kewangan terhadap aktiviti-aktiviti inovasi. Secara keseluruhan, kajian ini terbahagi kepada tiga bahagian utama. Dalam bahagian pertama, objektif kajian adalah untuk menyiasat kesan kualiti institusi terhadap aktiviti inovasi. Dalam bahagian kedua, objektif kajian adalah untuk mengkaji hubungan tidak linear di antara pembangunan sektor kewangan dan inovasi. Selain itu, ia juga mengkaji kesan tidak langsung kualiti institusi kepada aktiviti inovasi melalui pembangunan sektor kewangan. Dalam bahagian terakhir, objektif kajian adalah untuk membandingkan hubungan kredit-inovasi dan ekuiti-inovasi. Selaras dengan itu, ia juga mengenalpasti bagaimana institusi pasaran mempengaruhi mekanisme kewangan dalam menggalakkan aktiviti inovasi.

Lebih spesifik, objektif pertama dalam kajian ini adalah untuk mengkaji peranan sub-komponen institusi (contohnya institusi rasmi dan tidak rasmi) terhadap tahap inovasi. Sampel kajian ini adalah terdiri daripada 62 buah negara. Dengan menggunakan pembolehubah instrument, kajian ini mengemukakan bukti bahawa institusi-institusi rasmi dan tidak rasmi adalah pelengkap antara satu sama lain dalam menentukan tahap inovasi dalam sesebuah negara. Selain itu, bukti dalam kajian juga menunjukkan bahawa tahap inovasi adalah lebih tinggi di negara-negara yang mempunyai institusi tidak rasmi (modal sosial) yang lebih tinggi. Oleh itu, selain tumpuan diberikan terhadap dasar penambahbaikan struktur undang-undang, sesebuah negara juga perlu meningkatkan modal sosial untuk menggalakkan aktiviti inovasi.

Dalam bahagian kedua, kajian ini menganalisis hubungan tidak linear antara pembangunan sektor kewangan kredit dan intensiti inovasi yang menggunakan data panel daripada 75 buah negara maju dan membangun. Dalam hasil kajian ini, hubungan tidak linear antara pembangunan sektor kewangan kredit dan inovasi adalah

berbentuk U terbalik. Di samping itu, peranan kualiti institusi juga mempengaruhi bentuk hubungan antara pembangunan sektor kewangan kredit dan inovasi. Yang menghairankan, hasil keputusan kajian menunjukkan bahawa hubungan antara pembangunan sektor kewangan kredit dan inovasi berubah dengan tahap kualiti institusi yang berbeza. Secara khususnya, hanya negara-negara dengan kualiti institusi yang tinggi mengikut keluk kredit-inovasi yang bentuk U-terbalik. Oleh itu, kajian ini membuat kesimpulan bahawa kualiti institusi yang tinggi adalah pra-syarat sebelum pembangunan kewangan kredit mempunyai sebarang kesan positif ke atas inovasi.

Dalam bahagian terakhir, kajian ini bertujuan untuk mengesahkan hubungan tidak linear antara pembangunan sektor kewangan (kredit dan ekuiti) dan inovasi dengan menggunakan data panel yang terdiri daripada 69 buah negara maju dan membangun. Secara khusus, hasil kajian ini mendapati bahawa tahap pembangunan pasaran kredit dan pasaran ekuiti dapat memberi manfaat kepada inovasi hanya sehingga had tertentu sahaja. Pembangunan pasaran kewangan yang melepasi had tersebut akan membantutkan aktiviti inovasi. Selain itu, ia juga mengkaji peranan institusi pasaran (pembentukan pasaran, stabiliti pasaran, regulasi pasaran dan legitimasi pasaran) dalam mengawasi hubungan kewangan-inovasi tersebut. Keputusan ini menunjukkan bahawa pasaran yang mewujudkan penciptaan, kestabilan, kebebasan dan demokratik akan menggalakkan mekanisme ekuiti-inovasi dan kredit-inovasi.

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I certify that a Thesis Examination Committee has met on 19 December 2016 to conduct the final examination of Lee Weng Chang on his thesis entitled "Effects of Financial Development and Institutional Quality on Innovation" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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LIST OF ABBREVIATIONS

BERI	Business Environmental Risk Intelligence
EME	Emerging Market Enterprises
FDI	Foreign Direct Investment
GERD	Gross Expenditures on R&D
GDP per capita	Gross Domestic Product per capita
GDP	Gross Domestic Product
GMM	Generalised Method of Moments
ICRG	International Country Risk Guide
IPR	Intellectual Property Rights
IV	Instrumental Variables
OECD	Foreign Direct Investment
OLS	Ordinary Least Square
PRS	Political Risk Services
S&T	Science and Technology
SOE	State Owned Enterprises
UNCTAD	United Nations Conference on Trade and Development
WDI	World Development Indicators
WIPO	World Intellectual Property Organization

CHAPTER ONE

INTRODUCTION

This chapter presents the introduction for this study. Section 1 presents the overview of this study by discussing the current issue and framework used in the analysis. Section 2 presents the problem statement in this study. Section 3 specifies the objectives of the study. Section 4 highlights the significant and contribution of the study. Final section presents the organization of this thesis.

1.1 Overview of Study

In capitalist economy, “change” is an everlasting evolution which never can be stationary. As Schumpeter (1942) wrote “This evolutionary character of market process is not merely motivated by the ever-changing social or natural environment such as wars, revolutions and changes in social structure which alters the economic action; nor due to quasi-automatic factors such as increase in population, capital or vagaries of monetary systems”. Rather, the engine of market evolution comes from the intention of firms or enterprises in discovering new consumers, product, markets and methods of production”. In simple word, market evolution is simply driven by firm profit oriented behavior. This trait is more clear in modern economy that driven by the norm of globalization.

The “changes” mentioned in Schumpeter (1942) refers to the element of innovation in Solow-Swan growth model. By definition, innovation refers to the process of creation on new idea, device, or method used in production process. It is an important element in promoting market competency which drives the process of creative destruction. In micro perspective, competitiveness is the key for firm survival and growth in modern economy. For that reason, developing new product and services become a regular activity for today’s firm in order to maintain its uniqueness and product heterogeneity from its rival firm. Investment on innovation is indeed motivated by ability of firm in securing higher market shares which may receive short-run monopoly profit. Besides that, continuous innovating become essential for viability as firm might be obsolete by the process of creative destruction. The interaction between firms is then viable to national economic performance. For the economy as a whole, innovative activity such as research and development will boost technology advancement and hence productivity which is a crucial element for economic growth.

On this context, world expenditure on research and development tends to follow an upward trend for the past decades. By referring to 2013 Global R&D Funding Forecast in Figure 1.1, global research and development spending reached USD 1.442 trillion in years 2012 and is projected to rise by 3.7% to USD 1.496 trillion in 2013. The largest share of this increase is expected to come from China which contributed nearly 22.9

billion to this figure. The rapid expand of China which continued decades-long double digit growth in R&D investment ambitiously mark a pace on becoming world technology leading country in near future which currently lead by United States. Besides, emerging countries such as India, Indonesia and Malaysia also placed among on the top 40 countries in term of R&D expenditure. This shows that R&D investments are no longer a privilege business for developed countries but developing countries also dedicate into it. The eagerness of developing countries in R&D investment is not just mere competition between world superpower but it's essential for countries competitiveness especially in globalize world. Simply says, R&D promote country competitiveness strength that is crucial for long-run sustainable economy growth which is a crucial milestone for developing countries to graduate to developed economy.

Top 40 World Forecast Gross Expenditures on R&D (GERD)

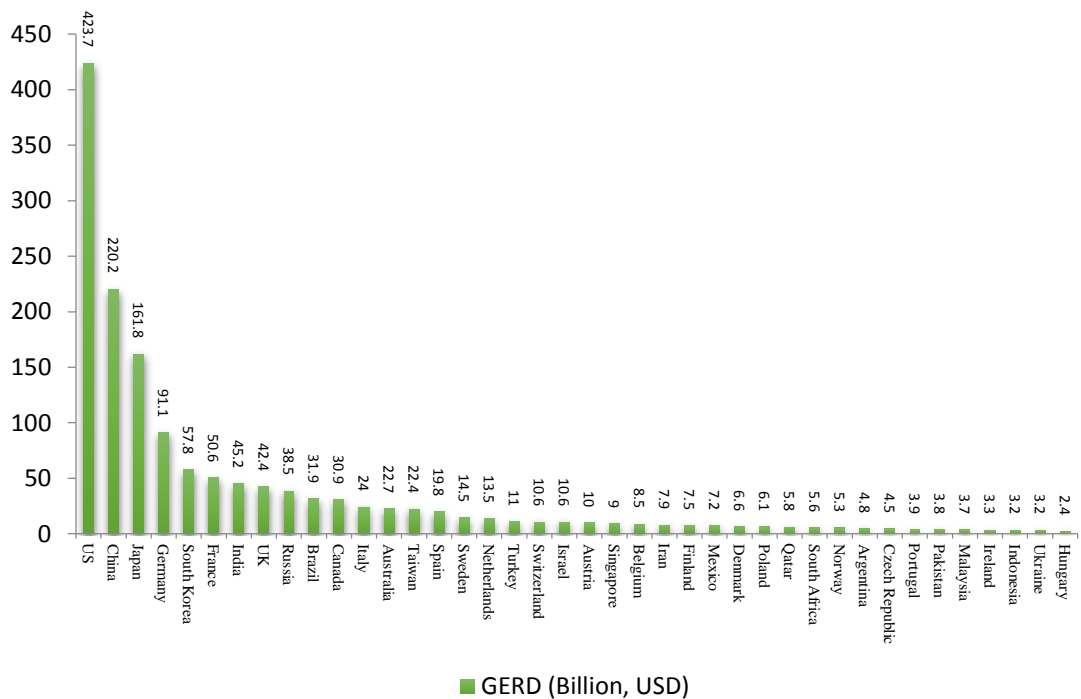


Figure 1.1: World Forecast Gross Expenditures on R&D (GERD) for Year 2013
(Source: 2013 Global R&D Funding Forecast.)

In relation to this, Figure 1.2 shows the World Patent Application from the years 2013-2015. It shows that there was a great disparity among world top innovated countries. For instance, the differences of total patent application between China and Hungary in year 2013 is about 1000 fold which China reported to have about 800000 patent application compare to Hungary which only reported to have about 700 patent application. Furthermore, by comparing Figure 1.1 and Figure 1.2, it is not hard to notice that the amount of resources injected to research and development activities doesn't necessary accompany with fair return of innovation gain. For example, United

State had injected 423.7 billion dollar on R&D activities but only about 500000 patent application are reported. This numbers are inferior compare to China which used relatively smaller amount of resources but yielded greater amount of innovation output. What factor contributes for these differences? This implies that resources injected to research and development activity for some countries might in vain with unsuccessful innovation. The variable characteristic of innovation activity also shows that innovation gain varies across countries with equal effort. This is because quality of labor, institution and government are different between countries that governing the return of R&D. The above mention highlighted that world technological convergence seems impossible for current stage. Hence, this phenomenon urges the need to re-examine the factor that determine the innovative activity.

World Patent Application From Year 2013 - 2015 (Exclude Taiwan)

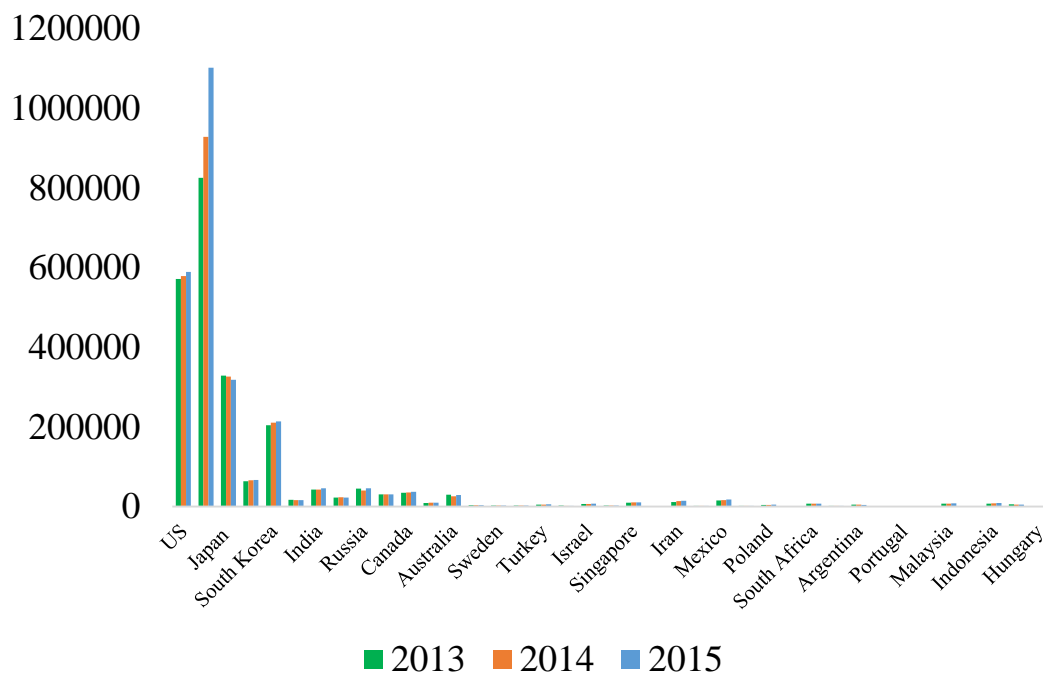


Figure 1.2: World Patent Application From 2013-2015
(Source: World Intellectual Property Organization (WIPO))

Traditionally, the determinant of innovative activities are such as foreign direct investment, human capital and financial development. Nevertheless, despite numerous works (James et.al, 2012; Hudson and Minea, 2013) have been done to examine factors that promote innovation, the role of institutional quality which governs the efficiency and distortion of economic variables have not treated in detail on this matter. The following briefly discusses the role of institutional quality in innovation based on three distinguish theories namely institutions-innovation theory, finance-innovation theory and equity-innovation theory.

1.1.1 Institutions and Innovations

In general, institutions are defined as rules involved in human interaction. Such rules include formal rules and informal rules (North, 1990; Engerman and Sokoloff, 1997). To further understand the role of institutions in innovation, this study adopted Kostova's (1997) approach to explaining how the institutional environment affects domestic business activity and, hence, innovation. Specifically, the impact of institutions on innovation takes the form of three dimensions: regulatory, cognitive, and normative.

First, the regulatory dimension of institutions consists of laws, regulations, and government policies that protect the interests of innovators, reduce the risk, provide support for new businesses, and facilitate entrepreneurs' efforts to acquire resources such as grants and funding from government-sponsored programs. Thus, the regulatory dimension of institutions is synonymous with formal institution. Here, Figure 1.3 present an overall illustration on countries formal institutions index with their respective innovation level. From the figure, it shows that countries with strong formal institutions not necessary to have a higher level of innovation output (measured by patent application). For instance, China crown to be the second most innovated country in the world. Others developed countries such as United Kingdom which have a superior formal institutions score tend to be falling behind in term of the volume of innovation activities.

World Formal Institutions and Innovation in Year 2010

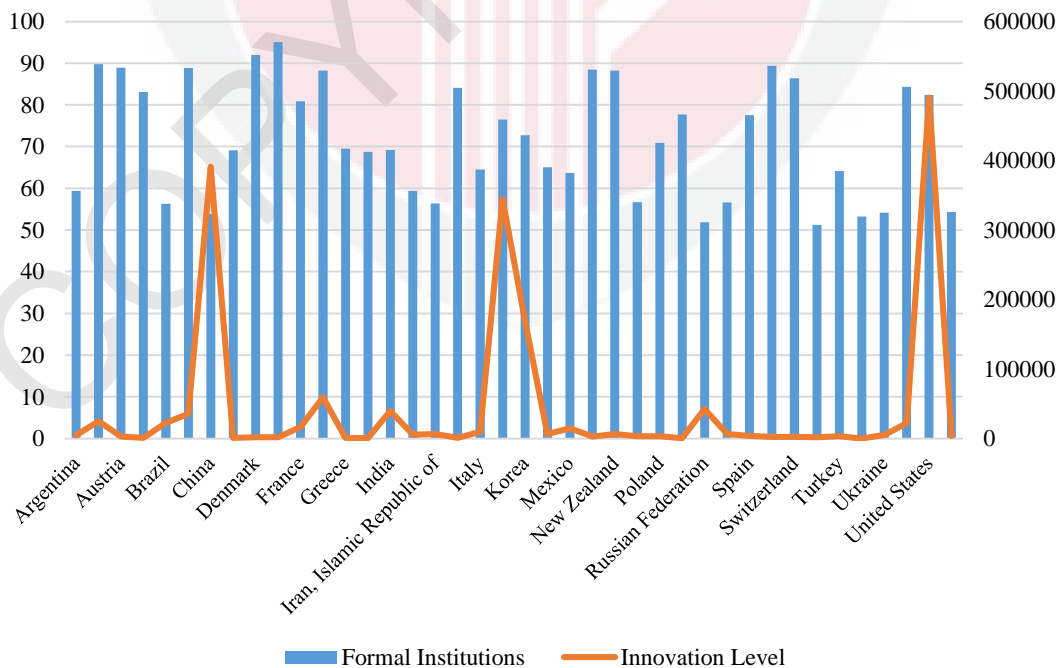


Figure 1.3: World Formal Institutions and Innovation 2010

Furthermore, Figures 1.4 and 1.5 present the correlation between institutional quality and innovation. Figure 1.4 shows somewhat strong correlation between institutional quality (INS) and labor-patent application ratio (P/Y). Similarly, Figure 1.5 also shows that correlation exists between institutional quality and innovation proxies by gross expenditure in R&D (GERD) in percentage of GDP (R/Y). Thus, although graphical illustration shows the relationship of formal institutions and innovation tend to be negative, these simple correlation test exhibit countries with higher institutional quality yield higher innovation outcome and spend more in R&D expenditure.

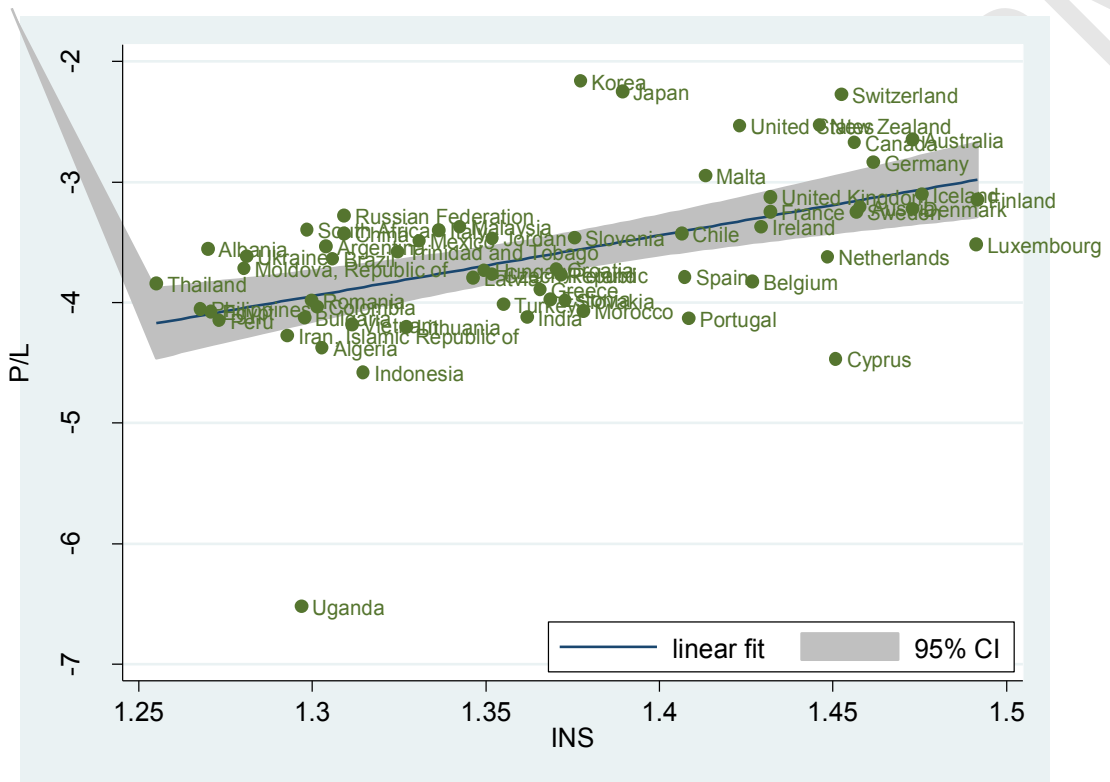


Figure 1.4: Scatter Plot of Innovation (P/L) and Institutional Quality (INS)

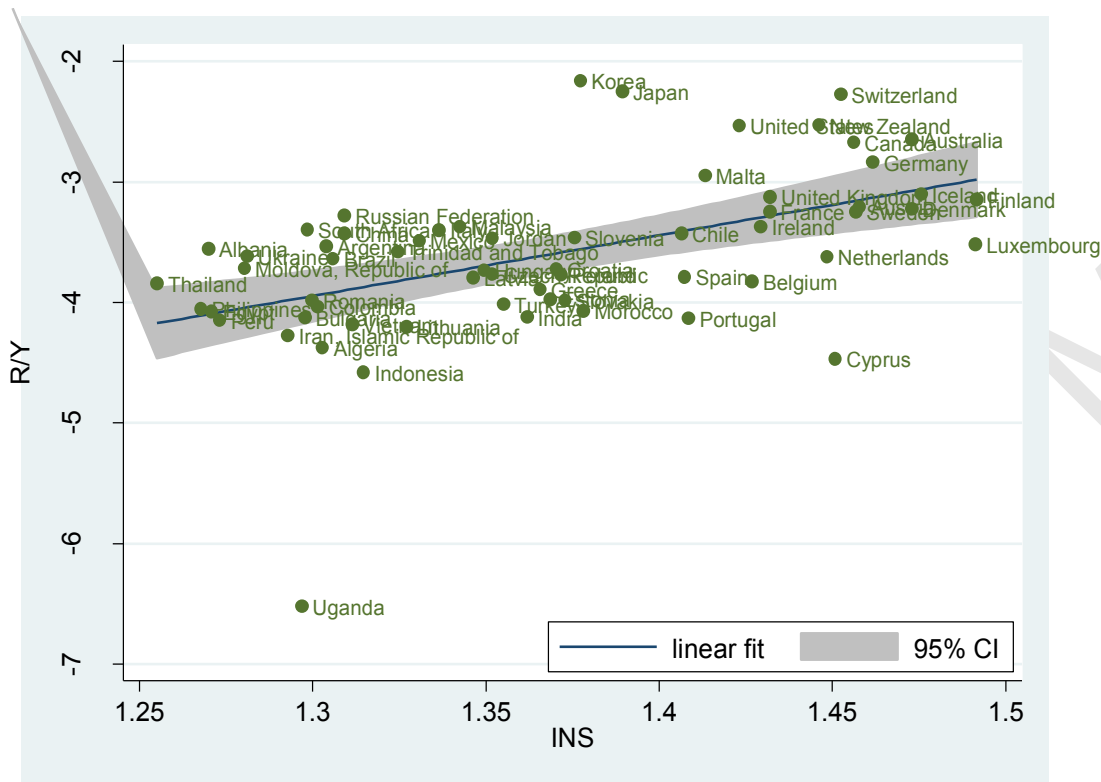


Figure 1.5: Scatter Plot of Innovation (R/Y) and Institutional Quality (INS)

Second, the cognitive dimension of institutions consists of the knowledge and skills possessed by the people in a particular society. In relation to the title, such skill refers to the ability to establish and operate a new business. Within countries, some knowledge becomes institutionalized, and certain information becomes part of the shared social knowledge. For instance, knowledge about establishing a new business may be widely dispersed in some countries, whereas in other countries, citizens may face difficulty in establishing businesses due to a lack of such information. Thus, the engines of information sharing among individuals in a society are social networks and social structures (Lee et al., 2011). Because sharing experience is part of the innovation input, countries with weak social ties (i.e., networks and structures) may suffer low R&D intensity or innovation activities.

From a broader perspective, the cognitive dimension of institutions also includes norms and trust, which are the core of social networks and social structures. Information sharing via networks occurs only when mutual trust exists. Trust is then closely related to norms, defined as the informal understandings that govern societal behavior. A civic-norm-guiding societal behavior is trustworthiness, which increases trust among individuals. Trust influences innovation through three mechanisms. First, cooperation needs trust. Higher mutual trust between firms enables information sharing and cooperation in innovative activity. Second, higher general trust in a society means less adverse behavior among its members. Thus, higher trust encourages inventors to invest in risky investments, such as innovations in the market. Third, higher trust lowers the monitoring costs for possible non-compliant partners and the need for written contracts. Hence, firms can allocate their finances to a more

productive purpose, such as innovation. Here, Figure 1.6 shows the countries overall informal institutions and its innovation level. From the figure, it also shows that countries with reputable informal institutions doesn't necessary to have a higher innovation level. However, some of the countries with high informal institutions such as Australia does have a higher innovation level compare to those countries with weaker informal institutions e.g Malaysia.

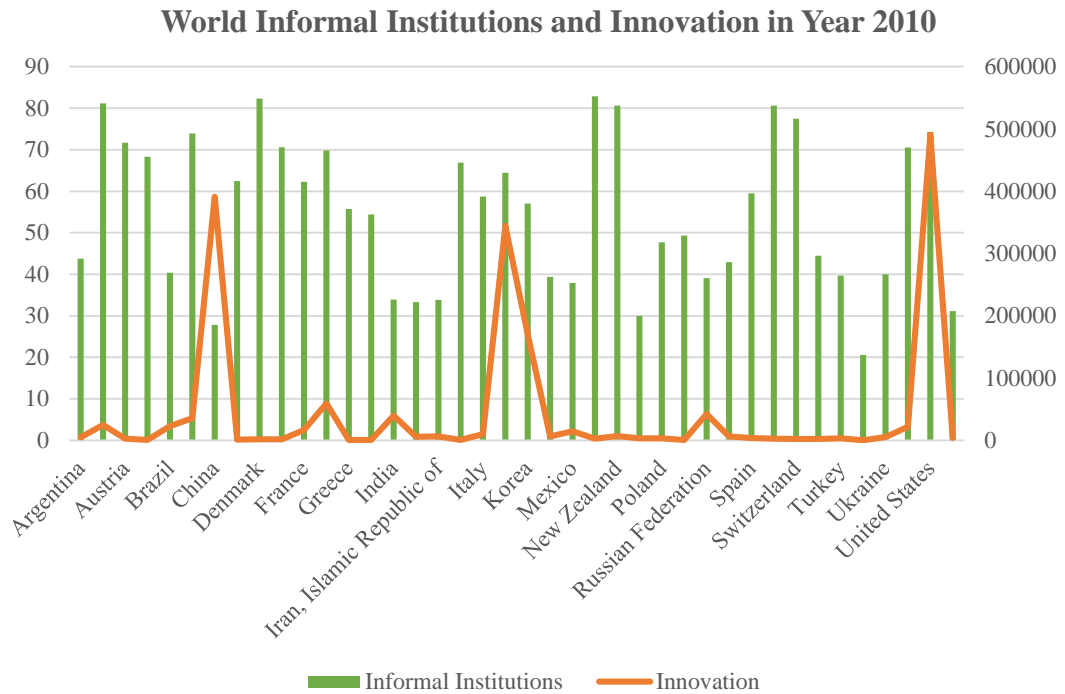


Figure 1.6: World Formal Institutions and Innovation 2010

To clarify the relationship between informal institutions and innovation, Figures 1.7 and 1.8 present the correlation test for informal institutions proxy by social capital (SC) and innovation. In Figures 1.7 and 1.8, strong correlation between innovation and social capital in both measure namely patent-labor ratio (P/L) and R&D expenditure (R/Y) is detected. Hence, these simple correlations suggest that social capital and countries innovation level does have a positive relationship.

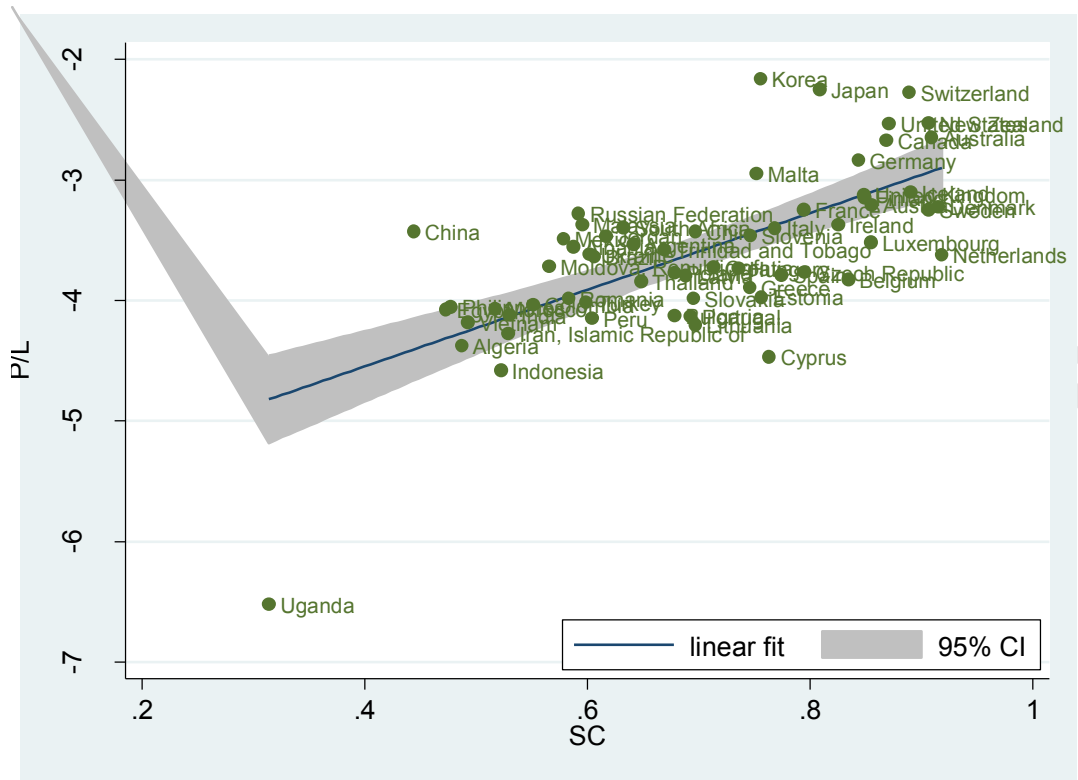


Figure 1.7: Scatter Plot of Innovation (P/L) and Social Capital (SC)

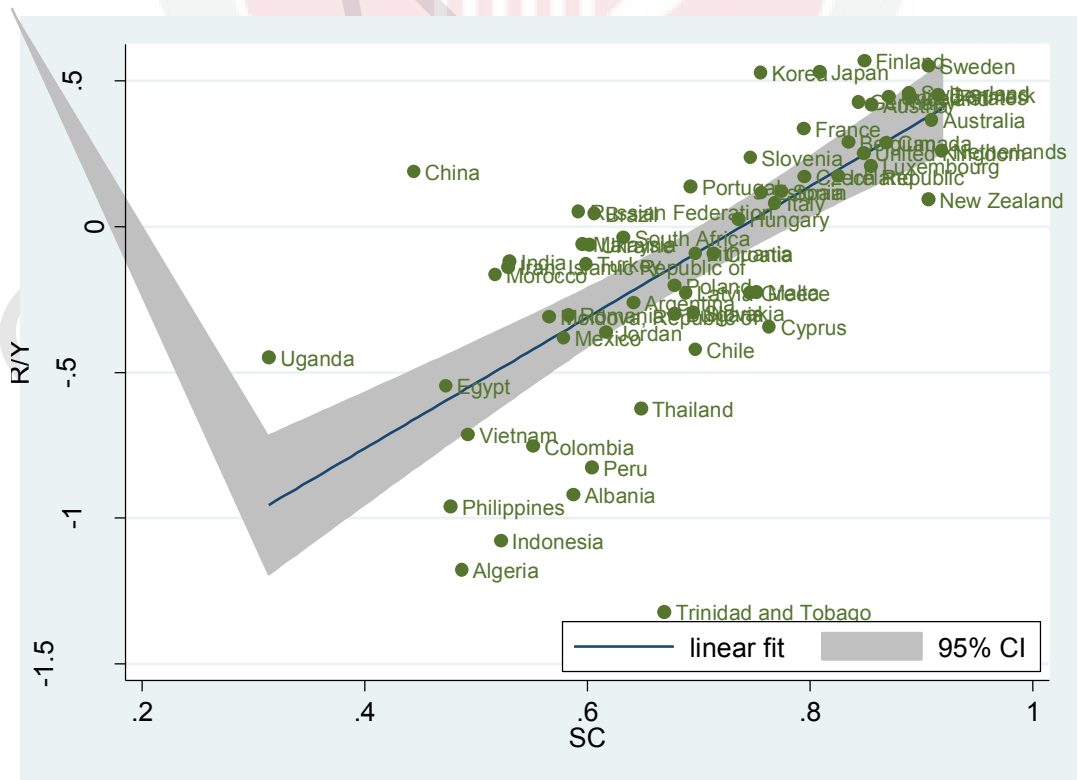


Figure 1.8: Scatter Plot of Innovation (R/Y) and Social Capital (SC)

Lastly, the normative dimension of institutions measures the degree to which a society admires entrepreneurial activity and values creative and innovative thinking. Here, it refers to the value perception of a society regarding innovative activity. In this view, entrepreneurs may not be motivated primarily by pecuniary incentive but driven by personality and social perceptions. To be precise, the need to achieve, for example, a vision, power, leadership, a contribution, or a challenge, is viewed as a major factor that motivates a person to become involved in innovative activity. As a remark, this study will not engage in analysis of normative dimension of institutions to innovation due to its difficulty of measurement and time limitation.

As conclusion for this section, there are three dimensional effects of institutional quality on innovative activities. These three dimensional effects are then can be categories into two, namely formal institutions (regulatory dimension) and informal institutions (cognitive and normative dimension). In a formal institution that concern about legal and human rights will behave more protective toward copyright and legitimate issue which is crucial to the interest of inventor. On the other hand, in an informal institution that place high value on the formation of new ventures will encourage individual to involve in innovative activity. The innovation activity is also encouraged by mature informal institutions environment such as trust that smoothen innovation process. In that sense, the influence of institutions factor on innovation is depend on the value places by the society whether such value is protected by legal mean or in the form of consensus accepted by the community.

1.1.2 Financial Development and Innovation

In Schumpeterian economics, innovation performs an important function in economic growth, particularly through its role in promoting a creative destruction process. Nevertheless, a well-developed financial system is required to efficiently allocate finances to productive innovation activities. By definition, financial development occurs when financial instruments, markets, and intermediaries ameliorate in terms of the effects of information, enforcement and transaction cost. Thus, developed financial markets provide the ground for efficient allocation of credit that is put to the most productive use. Efficient financial allocation then funds efficient research and development and, hence, stimulates economic growth. Furthermore, greater access to external finance also encourages the entry of venture firms and their post-entry growth, which encourages market competition and forces old firms to innovate to survive.¹

The above discussion indicates that well developed financial system help early growth of new firms and facilitates the creative destruction process. However, numerous studies have attempted to challenge the positive finance-innovation relationship by suggesting that financial development might hinder innovative activities (Stiglitz, 1985; Hellwig, 1991; Rajan, 1992; Weinstein and Yafeh, 1998; Morck and Nakamura, 1999). In their perspective, credit markets favor investment in reputable and well-established firms rather than new or innovative firms because the risk of capital loss is

¹ The view of financial development helping to facilitate innovative activities is supported by works such as Rajan and Zingales (1998) and Aghion et al. (2007) and empirical analysis such as Ang and Madsen (2012).

lower. This behavior is then amplified by well-developed financial systems in which a firm's information is easy to acquire. As a result, developed financial markets contribute to the forming of a monopoly and discourage competition. These contradicting views on the finance-innovation relationship highlight the need for economists to review the theory beyond conventional wisdom and methods (e.g., the possibilities of a non-linear relationship between financial development and innovation). Furthermore, the role of institutional quality on finance-innovation relationship are also worth to mention in this section. That is, a developed financial market require a strong legal framework and enforcement to support. Sound legal framework would protect potential financiers against expropriation by entrepreneurs thus, enhancing the confident of investor in channeling their fund into risky innovative activities. Hence, a well-developed financial market must be associated with a strong institutional quality to have a beneficial impacts on it innovative sectors. Overall, the above discussion leads to the following research questions: First, does a non-linear relationship exist between financial development and innovation? Second, if it exists, does institutional quality play an important role in governing such relationship?

In answer these questions, this study formulates research objectives to answer the proposed questions. First, this study construct a non-linear finance-innovation framework to explain the current dispute in finance-innovation relationship. Second, the role of institutions in influencing the financial-innovation nexus is examined by imposing conditional hypothesis on finance-innovation relationship. Here, it hypothesize that the finance-innovation relationship is non-linear and that its variation across countries depends on the level and influence of institutional quality where it plays a role in governing the finance-innovation non-linear relationship. Specifically, reputable institutions in a country (e.g., efficient bureaucracy, sound legal system, low corruption) reduce risk and uncertainty in investment. Thus, better financial development promotes research and development (R&D) investment and, hence, innovative activity. In contrast, countries with weak institutions increase the risk of contract repudiation and uncertainty. Therefore, financial development might not significantly affect innovation activities in these countries. Nevertheless, as this relationship is hypothesize to be non-linear, the shape of the finance-innovation curve might vary with different settings of institutional quality.

As preliminary test, figures 1.9 and 1.10 present the correlation between financial development and innovation. Both figures show that financial development (private sector credit (PSC) and domestic credit (DC)) exhibit strong correlation with innovation outcome. This implies that countries with higher development of financial sector yield higher innovation outcome. The research question comes fourth on whether such relationship would turn to negative after certain level of financial development.



Figure 1.9: Scatter Plot of Innovation (P/L) and Private Sector Credit (PSC)

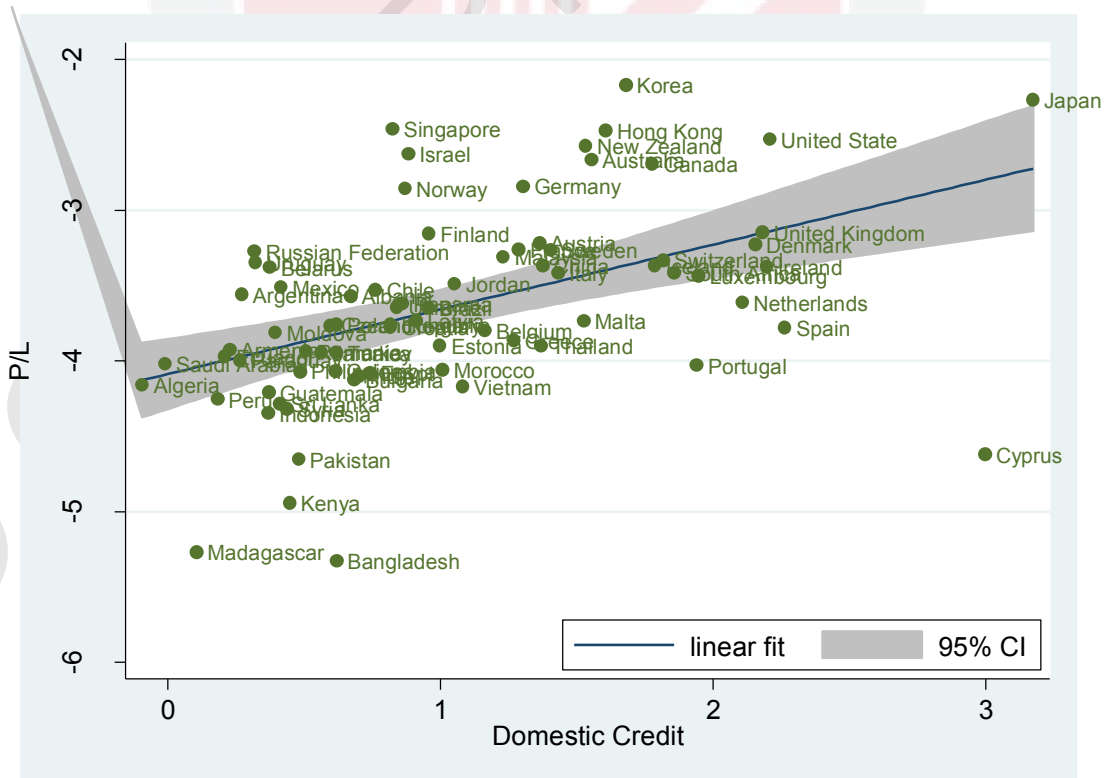


Figure 1.10: Scatter Plot of Innovation (P/L) and Domestic Credit (DC)

1.1.3 Segregated Financial Development and Innovation

Innovation is a high risk and involves a long, costly journey for the innovative firm to thrive in market competitions. These activities are crucial in the creative destruction process that forces firms to stay innovative². However, promoting innovation requires mechanisms that are able to efficiently channel resources to potentially innovative firms. This can be achieved by further development of the financial market, which ameliorates information accessibility, transaction cost and enforcement process. In work related to the finance-innovation relationship, most studies assume that different financial markets yield an unified impact on innovation activities. Nevertheless, the extreme assumption made by previous literature might not be true in two ways. First, different financial markets might have different behaviors in financing innovation activities. Second, firms might avoid raising funds through the equity market, as suggested by the pecking order theory. Thus, the role of the equity market in innovation might not be identical to that of the credit market.

In the credit-innovation nexus, most of the recent literature undermines the role of the credit market in a firm's innovation. However, this is only partially true, as most corporate behavior in seeking finance is subject to the proposition of the pecking order theory³. Hence, discounting the role of financial intermediaries in a financing firm's innovations seems inappropriate because their part in monitoring the innovation process is vital to an invention's success. This role is particularly important in developing countries, whose equity markets are less developed. In contrast, the credit market might also hinder innovation activity, as the development of the credit market can encourage monopolization; financial intermediaries discourage innovation to protect their existing customers.

On the other hand, previous literature on the equity-innovation nexus generally agrees on the critical role of the equity market in countries' innovation. This role is particularly significant in high tech industries characterized by high uncertainty and greater productivity, leading to higher stock prices when a successful invention is launched (Pastor and Veronesi, 2009). Thus, further development of the equity market will encourage firms to engage in innovation activities. However, this view is limited by the pecking order theory, as discussed above. Furthermore, the development of the equity market might encourage a corporate control market, in which unproductive firms are absorbed to reduce competitors in market, discouraging innovation.

Another issue related to the finance-innovation nexus is the role of market institutions in governing the relationship. Most works on the institutions-innovation nexus focus on the roles of governing institutions, reasoning that a reputable law structure minimizes the risk of contract repudiation and thus smoothes the finance-innovation mechanism. However, a firm's decision to engage in innovation is beyond consideration of monopoly power over successful new products. Other factors also

² As suggested by Schumpeter (1942) and Solow (1957).

³ Pecking order theory proposes that corporations prioritize their sources of financing: internal financing, debt and lastly, equity.

influence the decision, e.g., market opportunity and market stability. Therefore, we explore the role of market institutions in the finance-innovation relationship.

By compiling the existing theory on the finance-innovation nexus, it is not difficult to identify some important gaps in explaining the proposed relationship. First, the impact of financial markets on innovation is not unified. Second, the impact of the credit and equity markets on innovation is not linear. Third, countries with different market institutional quality might yield a different interpretation in explaining the finance-innovation nexus. Hence, the objective of this study is to examine the relationship between financial development and innovation using a non-linear approach. Specifically, financial development is segregated into two: credit market development and equity market development. After identifying the relationship, market institutions will be incorporated into the finance-innovation model to explore whether market institutions play any part in governing the relationship.

1.2 Problem Statement

The ultimate aim of this study is to examine the role of institutional quality and financial development on innovation. This research is inspired by the current discrepancy in world empirical data on innovation, financial development and innovation which shown inconsistency compared to the theory suggested in previous literature. Hence, this study draws five research questions. First, are social institution and governance institution yield identical impact toward innovation? Second, are finance-innovation relationship non-linear? Third, does different financial development-innovation relationship causes by different institutions establishment across countries? Fourth, does credit market and equity market yield an identical impact on countries innovation? Finally, does unbundled institutions play a roles in governing the credit-innovation and equity-innovation relationships.

Until recently, most of the literature on innovation has focused on its impact on economic growth and its determinants, such as foreign direct investment, trade openness, and human capital (Cheung and Lin, 2004; Dahlman, 1994; Romer, 1990; Blackburn et al., 2000; Tebaldi and Elmslie, 2008). Few studies have considered the importance of the institutional environment in innovation. Undoubtedly, research and development (R&D) expenditures and qualified labor are essential for initiating innovative activity. However, an equal amount of resources injected into different countries may yield different innovative gains. This is examined in Figure 1.1 and 1.2 where it clearly shows that United State is the countries that spend most on research and development but its recorded innovation activity in volume are incomparable to China. Some might argue that this phenomena might due to the nature of research conducted by these countries. For instance, China might have a greater volume of innovation compare to United State, but the research conducted by United State might be far more superior compare to China which require higher cost in initiating it. Nevertheless, the focus of this study is to focus on how institutions determine countries innovation activities. That is, to answer the question we raise up earlier, whether countries institutions matter to it innovation activities. While most of the current institution-innovation empirical evidence focuses on formal institutions (governance),

with little attention being paid to informal institutions (social capital).⁴ Social capital, such as trust, norms, and networks, is an important indicator for the initiation of innovative activity. Further examination of the impact of different institutional dimensions (e.g., governance and social capital) on innovative activity might explain why some countries tend to have low innovation activity and are even slow in terms of converging toward the world technology frontier.

Across the previous literature, the influence of institutional quality on innovation is often described as direct impact by current established literature. While traditional factors such as human capital have a direct implication on innovation, institutions impact tends to be more implicit. This study narrows this view to examine the transference effect of institutions to innovation through financial market. As discussed in the previous section, there are two strand of literature in defining the financial development-innovation relationship. First, financial development promotes innovative activity. Second, development of credit market discourages innovation. While both established literature have different view on this matter, there was a consensus between them which level of contract protection and its efficiency become the key indicator that direct the way of this relationship. Specifically, countries with strong legal institutions would promote innovation activities as it ensured financier to channel their fund to risky innovative activities. In contrast, countries with weak legal institutions might not benefit its innovative sector through developed financial market as investor's agenzized over contract repudiation. Hence, this study aims to answer such phenomena by questioning whether positive and negative financial development-innovation relationship is influenced by the level of institutional quality.

On the other hand, the role of credit market and equity market on countries innovation often treated as unified by previous literature. In reality, different structure of financial market would yield a different impact in determining innovation activities. First, the behavior of investors might be different for both financial market. Credit market which dominated by financial intermediaries hedge credit risk by requiring loan collateral. Investors in equity market concerns on firm's performance which is crucial for their return. Second, the behavior of firm. Firms might prefers credit market over equity market as raising fund through equity market would lose portion of their ownership as suggested in pecking order theory. Thus, the role of credit market and equity market might be varied in influencing countries innovation level. In addition, the investment decision are also influence by factors such as market stability, market regulation and business opportunity which is crucial determinants for their return. Hence, this study aims to answer whether market institutions play an important role in governing the finance-innovation relationship.

⁴ Such works include Wang (2013), who investigated the influence of institutional quality, particularly a political risk indicator, on innovation intensity. In his works, he used informal institutions indicators, such as latitude, ethnolinguistic diversity, crops, mortality, and engfrac, as an instrument for institutions. This setting of an econometric model implies that informal institutions have an impact on innovation only through formal institutions. Based on his empirical analysis, he found that institutions have a significant direct effect on R&D.

1.3 Objective of the Study

The aim of this study is to incorporate the roles of institutions on existing innovation theory to provide further understanding on the effect of institutions framework on innovative activity. Hence, this thesis is organized into three perspectives. First is the institutions theory that highlights the important of institutions environment as determinant of innovative activity. The second is finance-innovation theory which describes the important of financial market development in financing innovative activities. Finally, the roles of credit and equity market development in influencing innovation activities. Thus, the specific objectives of this study is as follow;

- 1) To examine the impacts of formal and informal institutions (both governance and social institutions) on innovative activities.
- 2) To investigate the role of institutional quality on finance-innovation nexus.
- 3) To identify the impact of unbundled market institutions on credit-innovation and equity-innovation nexus.

1.4 Significance of the Study

The first research objective in this study provides three essential contributions. First, few studies have regressed institutional quality factors on innovation, especially social institutions, because they are difficult to measure and quantify. Such rare literature includes Wang (2013), who used governance institution factors to explain cross-country innovation differences. In this study, we extend this view by decomposing the overall institutions' impact into governance institutions and social capital. The motivation for this research objective is to emphasize that the impact of institutions on innovation comes in two forms. A reputable law structure and efficient government encourage innovative activity, whereas social capital, such as trust, is an informal institution that also affects the initiation of innovative activities. Comparing the impacts of formal and informal institutions will extend the understanding of the role of social capital in innovation, i.e., whether it complements or substitutes formal institutions. Second, this study adopts the instrumental variable (IV) estimator to analyze the impact of institutions on other macroeconomic variables. This decision technically pronounces institution variables as endogenous in nature, which currently has been tested only in a small number of areas. Besides, this study employ social capital index assembled by Lee et.al (2011) which currently underutilizes in current research. Thus, used of this data set will contribute in the field of social capital analysis. Overall, examining the different dimensions of institutions' impact on innovation will fortify the currently established institution-innovation framework.

Next, the main contribution of the second research objective is to extend current understanding on finance-innovation nexus. It contributes to the literature in four ways. First, we develop a non-linear model to explain the finance-innovation nexus, which is currently unexplored in this line of work. Second, we use the dynamic panel system generalized method of moments (GMM) to estimate the impact of institutional quality on the finance-innovation relationship. The use of lagged level regressors as the instrument resolves the possible endogeneity problem in the model. Third, this study uses the Lind and Mehlum (2010) U-test to validate the non-linear relationship. Currently, the conventional method for validating a non-linear regression is known to falsely infer a non-linear relationship when the true relationship is convex but monotone. Lind and Mehlum's (2010) U-test jointly tests whether the relationship between the dependent and threshold variable is increasing at low values and decreasing at high values within samples. Thus, it avoids misleading inference if the estimated extremum point is too close to the end point of the data range.

The third objective of this study aims to segregate the role of different financial market on innovation. Currently, the main weakness of finance-innovation nexus is the assumption for financial development namely all financial market yield an identical impact on countries innovation level. By segregating financial market (credit market and equity market), it will enable identification on which financial markets plays more prominent role in determining innovation activities. Besides, this study also hypothesize that credit-innovation and equity-innovation relationship are both non-linear to address the current disarray in these relationships from previous literature. In addition, the fifth research objective for this study is to examine the role of market institutions on financial-innovation mechanism. Currently, most institutions theory focus on governance institutions rather than market institutions. Here, this study aims to signify the role of market institutions in governing financial-innovation relationship which undermine by current literature. Fulfillment of this objective would explain why countries with well-developed financial market (credit or equity) does not associate with high level of innovation activities.

1.5 Organization of Study

This study is organized as follow: Chapter 1 discusses the background, objective and significance of the study in drawing out the recent issues on the roles of institutions in influencing innovative activity. Chapter 2 describes the related literature and theoretical framework that serve as the foundation for this study. Chapter 3 presents the methodology and economic modeling used in the analysis which includes data collection and econometric methods. Chapter 4 presents the estimated result aim to provide an empirical explanation to the proposed hypothesis. Finally, chapter 5 discusses the conclusion and policies implication of this study.

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LIST OF PUBLICATIONS

List of Publications

- 1) Lee, W. C. & Law, S. H., 2017. Roles of formal institutions and social capital in innovation activities: A cross-country analysis. *Global Economic Review*.
- 2) Law, S. H., Lee, W. C., & Nirvikar, Singh., 2017. Revisiting the finance-innovation nexus: Evidence from a non-linear approach. *Journal of Innovation and Knowledge*.





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