Determinants of Firm Innovation in Indonesia: The Role of Institutions and Access to Finance

Edo Mahendra

Ubaidillah Zuhdi

Ratnawati Muyanto

University of Oxford

Tokyo university of Science

International Labour Organisation

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Edo Mahendra[1x], Ubaidillah Zuhdi[2], Ratnawati Muyanto[3]

[1] Department of International Development, University of Oxford, 3 Mansfield Road, Oxford, OX1 3TB, United Kingdom, edo.mahendra@wolfson.ox.ac.uk
[2] Department of Industrial Administration, Tokyo University of Science, 2641 Yamazaki, Noda-shi, Chiba-ken 278-8510, Japan; School of Business and Management, Institut Teknologi Bandung, Jl. Ganesha No. 10, Bandung 40132, Indonesia, ubaidillah.zuhdi@gmail.com
[3] International Labour Organization, Indonesia, Gedung Menara Thamrin Lt.22, Jl MH Thamrin Kav.3, Jakarta, 10250, ratnawati@ilo.org

[x] Corresponding Author

Abstract:

This paper investigates the determinants of firm innovation in Indonesia. We focus on the impact of institutions and access to finance on innovative activities of Indonesian firms. We employ the quality of local regulations index constructed by the Indonesia's Regional Autonomy Watch (KPPOD) as an exogenous measure of institutions. For firm level variables, we use the World Bank Enterprise Surveys (WBES) for Indonesia. We analyse (i) the determinants of product innovation, and (ii) the determinants of innovative activities by constructing a composite index comprising two dimensions of innovation: product innovation (registered patents) and process innovation (quality certification and use of foreign-licensed technology). We contend that our flexible approach is more appropriate to analyse firm innovation determinants in developing countries such as Indonesia.

We merge KPPOD and WBES data for the econometric analyses, and conduct binary logit, ordered logit, and poisson regressions. Controlling for firm characteristics and industry fixed-effects, we find that better institutional quality at the local level is associated with more innovation. We also find evidence that firms experiencing major obstacle in access to finance are less likely to innovate. We demonstrate that access to finance is more critical for small and medium enterprises (SMEs) whereas institutional quality is more important for large firms. We unveil further finding that the positive impact of better institutions on innovation is asymmetrically distributed. Better local institutional quality disproportionately benefits non-constrained firms. The policy implication of our findings is that improving institutional quality alone is not sufficient. Without significant progress in reducing frictions in the credit market by lowering asymmetric information in the credit market, better institutional quality will lead to greater innovation gap. We argue that a well-balanced 'policy mix' aiming for stronger local institutional quality and better access to finance is necessary both to promote innovation and to lower innovation gap.

Keywords: Access to Finance, Firm innovation, Innovation Determinants, Innovation Gap, Institutions

1. Introduction

Innovation is the engine of economic growth. The role of innovation is even more critical once a country transforms as emerging economies since innovation is one of the key factors to prevent a country falling into middle-income trap. Indonesia, as a rapidly developing economy, is on its way to leap forward to become a global economic powerhouse. However, without proper attention given to identify the impediments of innovative activities, Indonesia may eventually hit the ceiling, and fail to avoid the middle-income trap. The literature focusing on the identification of the determinants of firm innovation, with a specific focus on Indonesia, is still strikingly thin. Moreover, most empirical studies have largely ignored the role of external factors influencing firm innovative activities. We try to fill this research gap by conducting an Indonesian-specific study on the determinants of innovation at the firm level.

We analyse how institutional quality and access to finance can affect firm innovation in a country with relatively low research and development spending like Indonesia. World Bank data for 2009 showed that the ratio of expenditures for research and development (public and private sector) to total GDP in middle income countries was 1.17% while Indonesia's ratio was only 0.08%. We define innovation as product and process innovation. We use local regulations to measure institutional quality since Indonesia is now under a decentralised system where regional innovation system can boost firm innovation. Literature points out that regional innovation system can promote firm innovation as the result of interaction of different aspects like entrepreneurship, creativity, and politics. Another factor that is the focus of our paper is access to finance because it determines firm behaviour and decision to engage in innovative activities

One factor augmenting firm innovation is the firm location in such an area where the institutions supporting innovative process exist. One particular region can be more competitive than other regions due to the positive arrangement of innovative networks and institutions interacting with innovative outputs of regional firms (Cooke, 2001). Dean (2000) argued that robust commercial banking system is a pre-condition for successful innovation system such as the Silicon Valley. Rowen (2000) identified that for firms located in Silicon Valley, one of the most important factors for successful regional innovation system is a favourable rule of the game where laws, regulations, and conventions are well governed and induce positive influence to firms. Due to the positive externality of innovation, regulations can also be utilised to even recover the R&D investment of business (Helm, 2006). Huo and Feng (2010) showed that socio-political coordination intensifies the reciprocal sharing of innovation which, at the expense of job-creation, increases productivity returns.

The literature on firm innovation determinants have traditionally focused more on firm characteristics. As for higher level factors, the emphasis has also been more on industrial-level determinants such as market structure. Other external factors such as institutions and access to finance have been largely ignored until recently. This negligence is quite surprising since institutions shape the business environment where firms located and access to finance is crucial as external sources of capital –these are critical for firm activities, innovative activities included. In this paper, we contribute to the literature by showing the empirical evidence of the complex interplay between institutions, access to finance, and firm innovation, as well as how they influence innovation gap among different type of firms.

We structure this paper as following: In section 2, we discuss the literature review on how institutions can influence firm innovation and how difficulty in access to finance can discourage firms to engage in R&D activity. In section 3, we summarise the position of Indonesia's innovation in a comparative perspective. Section 4 describes the development of local regulations in Indonesia. Section 5 discusses access to finance in Indonesia in comparison with several comparable countries. In section 6, we describe the data used for the regression analyses as we merge the data from World Bank and KPPOD (Indonesia's Regional Autonomy Watch) as well as the econometric strategies we pursue. In section 7, we present and discuss the results of our empirical exercise. Finally, section 8 concludes.

2. Literature Review

Research on innovation determinants have traditionally put more emphasis on the firm-level determinants of innovation. Proxies for firm knowledge, capabilities, skills, and resources are normally used for the analysis of factors that determine firm innovative activities (Fagerberg, 2005). One of the most common research topic is the relationship between firm size, market structure, and innovation (Acs and Audretsch, 1987). It is so because the research on firm innovation determinants has its root on Schumpeterian tradition in which the main hypothesis is that large firms in monopolistic markets are the engines of innovation (Schumpeter, 1942). Accordingly, most empirical studies on firm innovation as surveyed by Cohen (2010) have focused more on the influence of firm and industrial characteristics on firm innovative activities. Meanwhile, other external factors such as institutions have been largely neglected in the empirical studies of firm innovation determinants.

Only a few studies have investigated the impact of other external factors such as institutions on innovation at the firm level. One recent attempt to fill the research gap is Blind (2012) who developed the theoretical framework on how regulations, as an institutional set-up, affect firm innovation. He argued that different types of regulations (economic, social, and institutional) have different effects on innovation. Thus it is important to differentiate the type of regulations in empirical analysis. Another recent attempt to integrate institutions as innovation determinants is provided by Srholec (2011). He argued that innovation is, in principle, a multilevel phenomenon, hence it is necessary to incorporate higher-level factors (external/environment factors) including institutions in the analysis of determinants of firm innovation. Finally, Tebaldi and Elmslie (2013) argued that cross-country analyses in the relationship between institutions and innovation are lacking in the literature, and thus provided an estimate on how institutions affect innovation at the country level.

How do we define and measure institutions? The widely accepted definition of institutions is provided by North (1990) who explained that "institutions are the rules of the game in a society or, more formally, are the humanly devised constraints that shape human interaction". It is clear from the definition that the objective of institutions is to establish 'constraints'. Acemoglu and Robinson (2008) proposed three important dimensions of institutions in which "setting constraints" is one of them. The goal of setting constraints is to influence incentives. It is thus natural to argue that institutions shape incentives –which obviously include the incentives to engage in innovative activities. Surprisingly, this theoretical derivation is heavily under-researched.

Measuring institutions is not an easy task since each country or region may have different understanding and perceptions on what institutions are. Nevertheless, it is possible to measure it with some proxies such as property rights (Knack and Keefer, 1995), corruption level (Mauro, 1995), political constraints (Henisz, 2000), or a constructed aggregate index (Rodrik et.al., 2004). Glaeser et.al. (2004) provided a survey on some common proxies for measuring institutions.

Before Srholec (2011) and Blind (2012), the studies on the role of institutions in the economy have put more emphasis on economic development such as growth or investment. As such, the majority of studies focus more to disentangle the impact of institutions on economic performance of countries. Most studies have found the significant effect of institutions on economic performance. Knack and Keefer (1995) showed that property rights, as a proxy for institutions, has a positive impact on economic growth. Mauro (1995) found that corruption, as an inverse proxy for quality of institutions, lowers economic growth through investment channel. Another indicator for institutions, entry barriers, are also found to have negative associations with economic performance (Djankov et.al., 2002). Regarding the endogeneity issue, Acemoglu et.al. (2001) demonstrated that the causality runs from institutions to economic performance, hence providing the evidence that the relationship between institutions and economic performance is not merely correlation.

Regulations can also be an appropriate measure of institutions. Anderlini et.al. (2013) demonstrated the theoretical exposition that explains the link between legal system and innovation in which more rigid legal system is supportive at early stages of technological development. Meanwhile, some empirical studies have used regulations measures and analyse their effects on economic performance. Djankov et.al. (2002) found that heavier regulations of entry (entry barriers) are detrimental to a country's economic performance. More efficient business regulations are also found to promote growth (Djankov et.al., 2006). Effectiveness of regulations also matters. Jalilian et.al. (2007) defined quality of regulations as determined by the efficiency and quality of regulations, and demonstrated a strong causal link between these measures of effectiveness of regulation and growth.

With regards to innovation, most innovation determinants studies have emphasized more on the role of innovation policies instead of regulations. Dolfsma and Seo (2013) provided the typology of innovation policy and its theoretical relationship with innovation. In addition, 'policy mix' of innovation policy is an important concept that is argued to influence innovation activities (Flanagan, et.al., 2011). Nevertheless, innovation policy is a more fluid concept, and does not necessarily capture the full extent of institutions. Innovation policy, as any other policies, is the implementation of laws and regulations and is executed following the rules stipulated in laws and regulations.

The relationship between regulations, as a measure of institutions, and firm innovation has been largely ignored in empirical innovation studies until recently. Existing studies, however, have focused more on specific regulations i.e. technical regulations related to standards and compliance procedures in specific industries. Chataway et.al. (2006) analysed regulations in agro- and bio-technology, and argued that more discriminating regulatory environment supports innovation. As for the case of pharmaceutical industry, more demanding regulatory intervention is good for innovation (Abraham and Davis, 2007). Most of these studies follow case study approach. Eventhough case study is laudable for its richness in detailed analysis, it lacks external validity, hence any generalisation based on case studies approach is limited. There are only few exceptions in major publications such as Prieger (2002) who conducted large-N analysis to investigate the effect of the Federal Communications Commission (FCC) regulation on innovation in the US telecommunication industry.

Due to more data availability, more recent studies on institutions and innovation have been able to work with large-N analysis that allows for some degree of generalisation of results – thus, providing a stronger claim on external validity. At the country level analysis, Tebaldi and Elmslie (2013) found that institutions explain much of the variations of innovation across countries. Using OECD countries as the sample, Blind (2012) showed that the effect of regulations on innovation are mixed –depending on the type of regulations. On the other hand, structure of government i.e. decentralisation level is not found to be a robust predictor of innovation (Taylor, 2007). Using multilevel analyses, Srholec (2011) found that democratic institutions are correlated with firm innovation whereas tax regimes with high marginal rates are associated with less firm innovation. In this paper, our measure of institutions is the quality of local regulations in which entry barriers are one of its sub-components. Therefore, our measure of institutions is in a similar vein with Jalilian et.al. (2007) and Djankov et.al. (2002). Theoretically, our measure of regulations is within the concept of 'economic regulation' as defined by Blind (2012).

Another external factor which we focus on this paper is access to finance. Similar to institutions, the role finance in innovation empirics has been largely unexplored. In fact, O'Sullivan (2010) surveyed that the empirical literature on innovation has so far neglected the relationship between finance and innovation which is interesting since Schumpeter himself argued that the creation of credit is essential in spurring innovation, putting emphasis on the critical role of commercial banks. There is an ample literature, however, on the role of access to finance on investment activities. Hubbard (1998) surveyed the literature on the relationship between capital market imperfections and investment by firms, and explained that the evidence pointed to the significant role of financial constraints faced by firms and

capital investment. Most empirical studies on access to finance have also been more focused on firm growth. Levine (2005) and Beck (2008) provided the surveys on the literature on finance and growth –including growth at the firm level. Akin to firm investment, notwithstanding the issue of causality and the fact that most finance and growth empirical studies are done at the macro or industry level, they demonstrated that finance, including access to finance, matters for firm growth. Therefore, we view that the neglect on the role of access to finance in innovation studies as surprising because, like any other firm decision on resources allocation, firm financial capability and constraints should matter for innovation-related capital allocation. In other words, innovative activity is simply a type of capital and resources allocation by the firms.

Financing innovative activities is not easy. Although as we argued above that innovation is basically just another type of capital allocation by firms, such activity has several differences with typical firm investment activities. Hall and Lerner (2010) explained that one important feature of innovative activities, which is normally classified under R&D spending, is that they have a considerably large uncertainty in their outputs. Although the level of uncertainty and the probability of failure decrease overtime as the innovation projects nearing completion, innovative activities are at the higher-end of the probability in experiencing failure compared with other investment activities in general. If we include quality of institutions in the calculus, then developing countries are disproportionately worse off. Notwithstanding the perverse impact of frictions in the credit markets, worse institutional quality surrounding the firm business environment increases the uncertainty of innovative activities. Hence, a firm under such condition may find it difficult to secure capital resources to finance innovation.

Why does access to finance matter for innovation? In theory, there are three possible explanations on why firms fail to secure financing and thus facing obstacles in access to finance for their innovation (Hall and Lerner, 2010): (i) asymmetric information between business (inventor/entrepreneur) and investor, (ii) moral hazard on the part of business due to separation of ownership and management, and (iii) tax considerations that drive a wedge between external finance and finance by retained earnings. In accordance with the context of this paper, the first explanation on asymmetric information between potential creditors and debtors is more relevant. Frictions in the credit market result in higher costs of borrowing charged by creditors such as commercial banks. Such frictions are caused by asymmetric information existing in the credit market. If the information asymmetries are large enough, it may eventually lead to the condition where financial institutions set very high costs of borrowing which make it difficult for firms to secure financing. Moreover, in this case, firms which are relatively more dependent on external financing to finance their innovation are disproportionately affected. In other words, frictions in the credit markets due to asymmetric information may lead to less firm innovation.

Although the major literature on access to finance and innovation in general has been quite lacking, some studies have researched on the role of specific types of financing on innovation such as venture capital. Florida and Kenney (1988) argued for the prominent role of venture capital in spurring innovation in new high technology businesses. Kortum and Lerner (2000) found that venture capital financing has been supportive in promoting product innovation as measured by patented inventions in the United States. However, it seems that such type of financing (venture capital) is more apparent in the case of US. Even in the developed parts of Europe, venture capital financing that supports innovative firms has not relatively been that prominent and that Europe is way behind their cross-Atlantic counterpart (Murray and Lott, 1995; Bottazzi and Da Rin, 2002). As for the case of developing countries, with much limited pool of financial resources available, the access and availability to venture capital is severely limited. In fact, in the analysis of venture capital funding determinants, Jeng and Wells (2000) could only use 21 sample of developed countries in their analysis, leaving out developing countries.

Most developing countries have underdeveloped financial systems. In this group of countries, the majority of countries are bank-based economies (Demirguc-Kunt and Levine,

1999). Indonesia is classified as bank-based economy (Demirguc-Kunt and Maksimovic, 2002). In such case, the issue of access to finance is a more traditional one. Since the market-based financial system is still relatively thin in Indonesia, Indonesian firms who need financing are largely dependent on loans provided by commercial banks. As we discuss in section 5, in this type of financing, interest rates as well as institutional infrastructure of the credit markets such as creditors protection and information are critical to reduce frictions in the financial intermediation processes that may lead to higher costs of borrowing.

Amidst the general lack of research in the literature on access to finance and innovation, some studies have attempted to fill the gap. Gorodnichenko and Schnitzer (2013) provided the theoretical explanations on why firms lacking access to finance are less likely to engage in innovative activities. They also showed empirically that financially constrained domestic firms are unambiguously restrained to innovate. For innovation in ICT industry, a market-based financial system, including a well-developed venture capital market, is essential in smoothing financial intermediation and to provide access to finance for firm innovation (Houben and Kakes, 2002). Hyytinen and Toivanen (2005) showed that financial constraints are detrimental for innovation, and that government intervention to address the perverse impact of imperfect credit markets is necessary to promote firm innovative activities.

Nevertheless, most research on access to finance and firm innovation has focused more on OECD countries, and that studies focusing on developing countries have largely been non-existent (Gorodnichenko and Schnitzer, 2013). Some notable exceptions, nonetheless, exist. For instance, Sharma (2007) showed that financial development matters in supporting firm innovation in developing countries. Meanwhile, Ayyagari et.al. (2011) found that access to finance, as measured by indicators of possession of various credit lines and borrowing, for firms in developing countries is associated with more innovative activities. Finally, Gorodnichenko and Schnitzer (2013) analyse the data for Eastern Europe and former Soviet Union which are composed mostly with developing countries. In general, however, there is still a large research gap on the role of access to finance on firm innovation.

Quality of institutions and access to finance are not independent in influencing innovation. Hyytinen and Toivanen (2005) showed the empirical evidence supporting the hypothesis that government intervention helped to address credit market imperfections due to financial frictions. In addition, Morck et.al. (2000) demonstrated that quality of institutions explain why the allocation of capital flows toward growth potential firms and away from firms with less potentials. This evidence shows that the effect of better institutional quality may not be the same for firms facing obstacles in access to finance vis-a-vis those who are able to obtain external financing.

On the one hand, in a well-developed financial system and minimal frictions in its credit market, smaller firms may benefit more from financial development since financial innovations in the credit market may moderate the collateral requirement which disproportionately benefit smaller firms (Sharma, 2007). In this scenario, SMEs are thus better off from larger pool of financial resources available. Benfratello et.al. (2008) showed that banking development supports innovation, and that smaller firms and sectors that are more dependent on external financing are disproportionately benefited.

On the other hand, the significant presence of SMEs also mean that the costs of gathering credit quality information are relatively higher since smaller firms tend to have much less sophisticated reporting on their performances. Accordingly, this may result in the greater degree of asymmetric information in the credit market. Hence, in this scenario, smaller firms are disproportionately worse off. Herrera and Minetti (2007) showed that the extend of banks having more information regarding the credit quality of debtors is positively associated with firm innovation.

Our discussions have shown that quality of institutions and access to finance matter for firm innovation. We expect that better local institutional quality, as proxied by local regulations, is associated with more innovation. Furthermore, we hypothesize that firms facing obstacles in

access to finance are less likely to involve in innovative activities. Finally, due to the presence of significant frictions in the credit markets in Indonesia as well as lack of institutional quality in the financial markets (as discussed in section 5), firms not facing obstacles in access to finance are more likely to benefit more from better institutional environment, thus leading to larger gap in innovative capabilities between constrained vs non-constrained firms due to the asymmetric impact of local institutions towards firms that are more able in dealing with formalities including the capability to provide information in credit quality. In relation to that, we thus expect that for larger firms, quality of regulations matters more for their innovation whereas for smaller firms (SMEs), access to finance is a more relevant issue.

3. Innovation Performance in Indonesia: A Comparative View

This section discusses the position of Indonesia's innovation in the world. To do so, we conduct a comparative analysis approach. We pick three major developing Southeast Asian countries: Malaysia, Thailand, and Philippines, and two economically powerful Asian countries: China and India, as comparison countries. According to Schwab and Martin (2012), innovation is one of the pillars of global competitiveness. Innovation as a competitiveness pillar is defined by several components. These components are (i) capacity for innovation, (ii) quality of scientific research institutions, (iii) company spending on research and development (R&D), (iv) university-industry collaboration in R&D, (v) government procurement of advanced technology products, (vi) availability of scientists and engineers, (vii) Patent Cooperation Treaty (PCT) patent applications, and (viii) intellectual property protection. Schwab and Martin (2012) have used these eight components to contruct the innovation index for the global competitiveness index (GCI) of the World Economic Forum. For our analysis, we look into the innovation score of the GCI and the capacity for innovation (component (i)) to see how Indonesia fares in comparison with other comparable countries. Our time frame for the analysis is this section is 2005-2011.
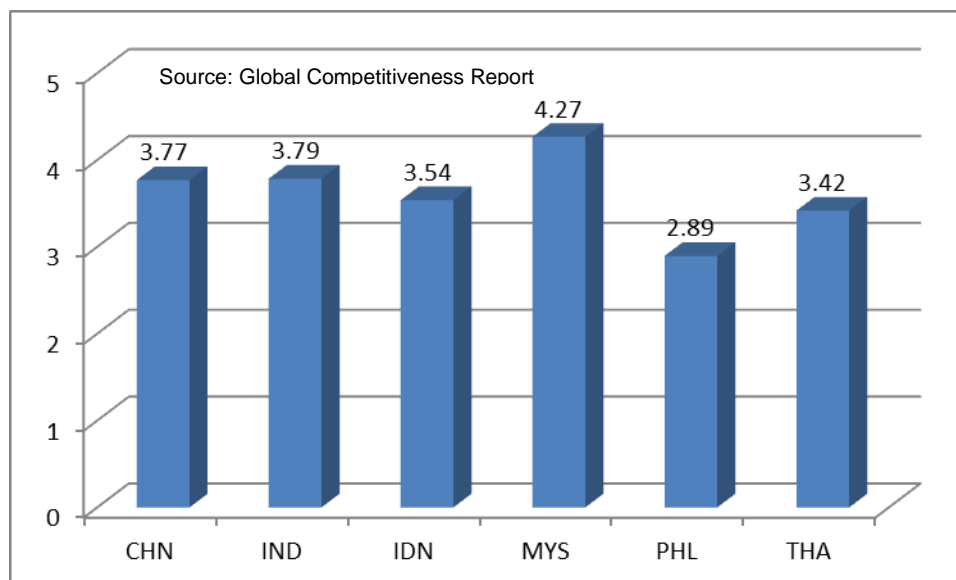
Figure 1. GCI-Innovation Component Score (average, 2005-2011)

We start by analysing how innovation in general in Indonesia compares with the aforementioned countries. We use innovation-part of GCI where the score ranges from 1 to 7 (higher score means better). As we can see in figure 1, in comparison to other major developing Asian countries, Indonesia scores quite well. Compared to other major developing Southeast Asian countries, only Malaysia posts higher score on innovation –and

thus Indonesia is better compared to Thailand and Philippines. Nevertheless, Indonesia is still slightly left behind China and India –the two rising superpowers of Asia.

The average score, however, does not tell much about the progress of innovation performance of these countries. To see how innovation has progressed in Indonesia, we set the year 2005 as our base year (2005=100). Therefore, we can further analyse whether innovation progress in Indonesia has outperformed its comparable countries in Asia. Figure 2 displays even rosier picture than figure 1. Between 2005 and 2011, innovation in Indonesia has been growing quite remarkably –beaten only by China which grew very strongly. As we can see, some countries like India and Philippines have shown decelerating trend in their innovation performance according to Global Competitiveness report. Hence, figure 1 and 2 provide an optimistic overview of innovation performance in Indonesia. Although the average innovation performance of Indonesia since 2005 only put Indonesia in the mid-table, the trend in 2005-2011, nonetheless, displays encouraging positive signal on the progress of Indonesia's innovation performance.
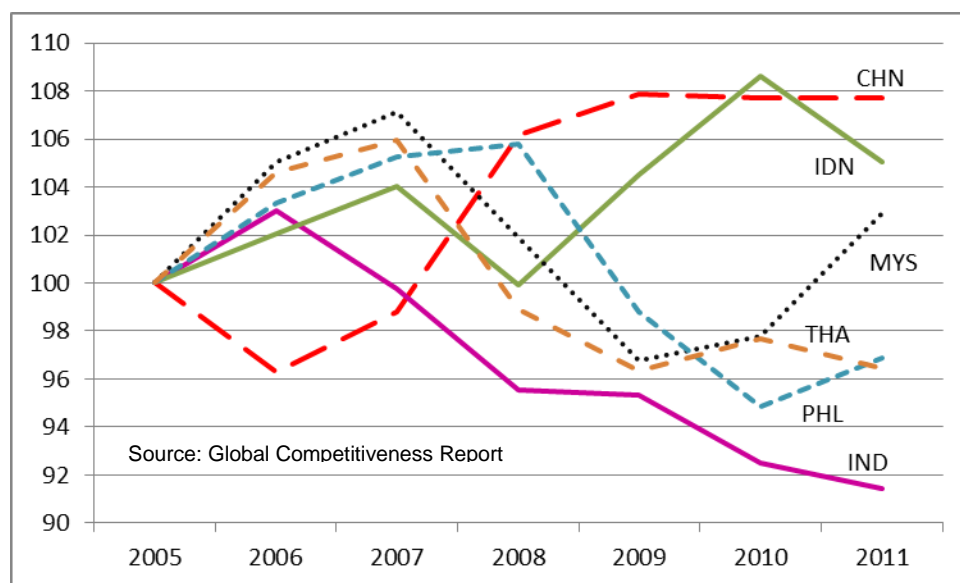

Figure 2. Progress of GCI-Innovation Component Score (2005=100)

The GCI pillars are interretaled with one another. For example, according to Schwab and Martin (2012), innovation cannot be separated from the availability of well-educated and trained workforce. Countries with better educated citizens are more likely to have greater capacity to innovate. Thus, more quality in the human capital provides the necessary condition for innovation. To know how human capital and innovation relate, we look into the GCI scores for 'higher education and training' pillar and plot them with the 'capacity for innovation' scores of the innovation pillar. 'Capacity for innovation' index scores range from 1 (companies obtain technology exclusively from licensing or imitating foreign companies) to 7 (companies obtain technology by conducting formal research and pioneering their own new products and processess). Hence, higher scores imply more capability of the private sector to conduct innovative activities in-house whereas lower scores indicate higher dependency of the private sector on foreign sources.

Figure 3 plots the relationship between innovation capacity and higher ecudation and training. Malaysia is a prime example of success. In accordance with better human capital quality, the private sector in Malaysia has a relatively robust innovation capacity –which means their innovation activities are more domestically resourced. On the other hand, China and India have relatively strong scores on capacity for innovation index amidst relatively mediocre

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scores on higher education and training. Therefore, China and India are the instances where innovation activities are mostly done through licensing or imitation. As for Indonesia, given the fact that it has the lowest position on human capital while able to score at the mid-table for innovation capacity, it gives the signal that Indonesia's capacity for innovation is more similar to China and India. In other words, the capacity for innovation in Indonesia is more likely to come from licensing or imitation instead of originally resourced innovative activities. The ideal path is definitely to follow Malaysia. In other words, better quality in higher education and training should be prioritised to boost in-house and original innovation.
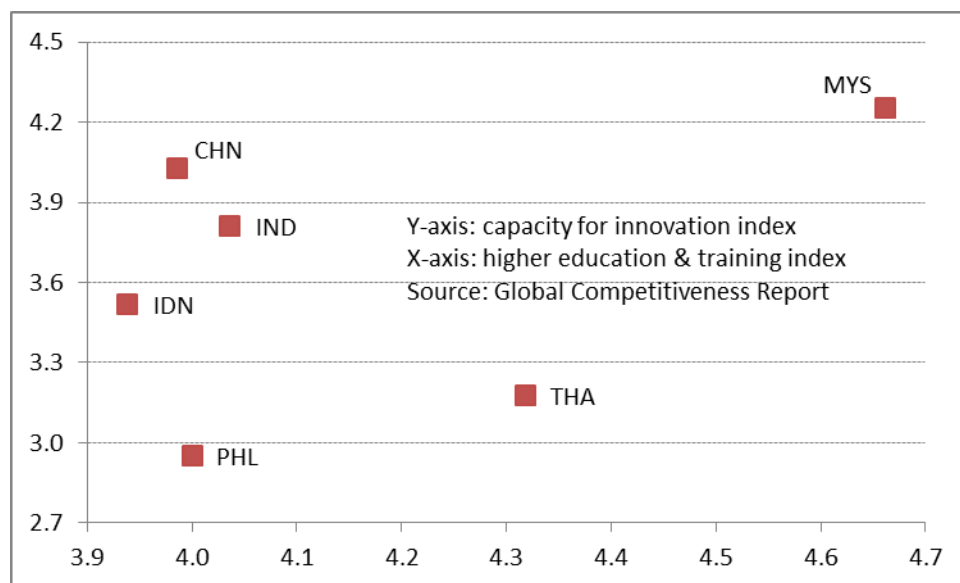
Figure 3. Innovation Capacity & Human Capital (average, 2005-2011)

This section reviews the state and development of innovation performance in Indonesia over the 2005-2011 period. In general, Indonesia's innovation performance has been relatively well positioned against other major developing Asian economies (figure 1). In fact, encouraging sign is clearly visible since Indonesia, together with China, are the two economies in our sample countries that recorded strong progress in innovation performance, especially in the last three year (figure 2). Nevertheless, there is no room for complacency. Innovation capacity in Indonesia mostly has not been based on original research nor domestic in-house innovation due to Indonesia's relatively weak human capital (figure 3). Accordingly, there are two options that Indonesia can opt for the future. First option is to follow China and India path where innovation is mostly done through imitation. Second option is to follow Malaysia path where original innovative activities flourish. The first option may provide instant benefits in the short- and medium-run. However, it seems that the second option may deliver more promising economic and social returns in the future.

4. The Development of Local Regulatory Quality in Indonesia

Having implemented a big-bang decentralisation system since 2001 by the enactment of Law Number 22 and 25 in 1999 on Administration and Financial Decentralisation, district governments in Indonesia have received significant authority to enact local regulations based on local needs (Butt, 2010). Those laws have mandated district authorities to perform various administrative functions with such low local own revenues. Consequently, this condition triggers district governments to charge high local user-charges and levies to fill the gap of their fiscal capacity critical to perform delegated service deliveries. On the other hand, businesses have submitted complaints about burdensome local taxes and user-charges set by district government. Moreover, local governments tend to accumulate local revenues

rather than boost economic activity through business-friendly regulations. Thus, it discourages potential investors who want to keep distance from illegal and excessive charges or levies (Brodjonegoro, 2004).

Quality of local regulations in a decentralized system has become important as an indicator of local government's policy framework to develop local economic activity. Complicated and confusing local regulations are obstacles to local businesses as these lead to uncertainties and restrict market access and trade (KPPOD, 2011). The major regulatory problem in Indonesia's business activity is overlapped functions of several business permits. For instance, trading permit has similar information as business registration (TDP) permits. However, both permits are required for different practical purposes such as SIUP which is for bank application and TDP which is for participation in government tender. [1] These complicated regulations are intended for local revenue generation "without providing protection, control, or associated administration services, and often without fully analysing the impact of a license on firm behaviour" (Asia Foundation, 2007). A study by KPPOD (2005) also highlighted corruption of government and lack of transparency as major problems for business of all sizes. Businesses evaluated that there was lack of transparency on tenders and lack of fairness in decision making related to business activity. LPEM-FEUI (2007) reported that 41% of respondents had to conduct face-to-face meetings with Provincial Ministry of Justice following more delegation of authority to Kanwil [2] at the provincial level.

The absence of national regulation on closed-list of local user-charges and taxes encourages local governments to enact regulations distorting business activity. According to KPPOD, in 2005 local regulations have been more accommodative for business activity considering that 30% of local regulations could potentially distort business activity in 2001. The proportion of acceptable local regulations in 2004 was 58%. In 2005, it has risen to 83% for clarity of fees and 78% for clarity of procedure. Local regulations that were detrimental for business activity has also declined, from 12% of regulations in 2004 to only 10% in 2005. The misuse of such great authority to charge taxes and user-charges has urged the national government to launch the revision of Law No.34/2000 on local taxes and user-charges. The positive list of regional taxes and user-charges (Law No.28/2009) may reduce the national government's burden in reviewing local regulations. This law also mandated levies that have previously been under the authority of central government to be decentralised at the district level.

Local regulation quality in Indonesia has been evaluated annually by KPPOD since 2001 when decentralisation system began. The KPPOD's quality of local regulations index is composed of 14 variables: (i) relevance of legal references, (ii) up-to-date legal references in use, (iii) legal completeness, (iv) disconnection of objective and substance, (v) clarity of objects, (vi) clarity of subjects, (vii) clarity of rights and obligations of fee payers and local governments, (viii) clarity of standards on time, costs and procedures, or rate structure and standards, (ix) conformity between philosophy and principles of levies, (x) national economic integrity and the principle of free internal trade, (xi) healthy competition, (xii) negative economic impact, (xiii) obstacles to public access and public interest (e.g. environment), and (xiv) violations of governmental authority. Variable 1-3 are grouped in legality sub-component, variable 4-9 are grouped in substance sub-component, and variable 10-14 are grouped in principle sub-component. Judicial problems receive the lowest weight (15%) since the impact of legality issues on businesses is less likely to be bigger than the economic

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[1] SIUP (Surat Ijin Usaha Perdagangan) is trade permit that is intended for trading company. TDP (Tanda Daftar Perusahaan) is company registration card.
[2] After Indonesian decentralization system kicked off, some functions of national offices have been delegated to offices at provincial level as sub-coordinated structure not as an independent local body (Kanwil).

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impact of principle and substance sub-components. Substance and principle sub-components have bigger weights: 35% and 50%, respectively.

Since the econometric analyses of this paper use the 2007 index published by KPPOD (2007), it is fruitful to probe a little deeper on the details of the 2007 quality of local regulations index. The quality of local regulations index analysed local regulations mostly dealing with licenses and permits. In total, there were 932 local regulations that were assessed in 2007 (figure 4).

Local Regulations Analyzed by KPPOD by Issue-Areas (N=932)

1%
7%
16%
76%

- Licences & Permits
- Flow of Goods & Services
- Labour
- Others

Source: KPPOD (2007)
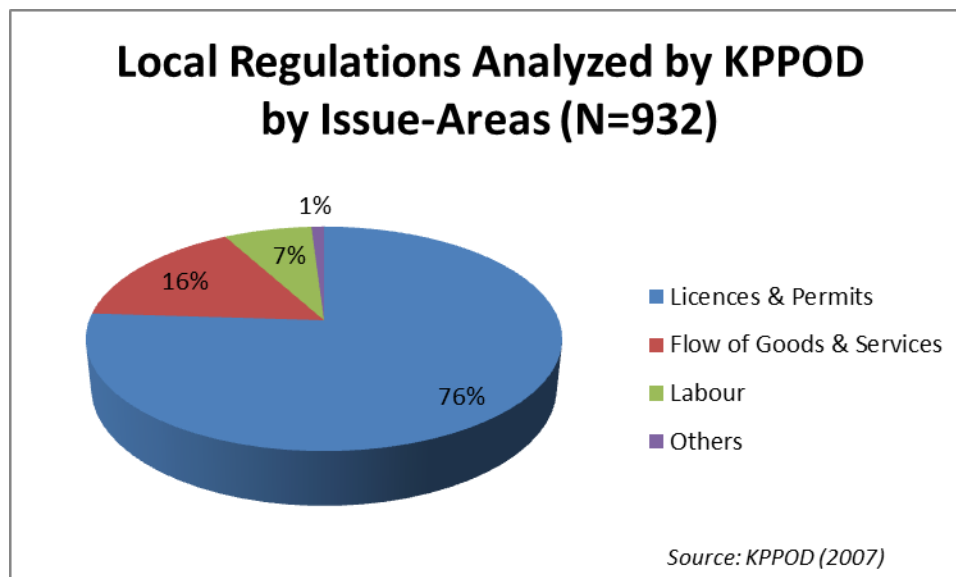
Figure 4. Quality of Local Regulations Index: Distribution of Issue Areas of Regulations

KPPOD (2007) reported that among the 14 variables of local regulation index, the top three nuisances came from the following variables:

- Clarity of time, procedures, costs of bureaucratic paper-works e.g. licensing process (approximately 70% of local regulations in the sample have obscurity on this matter).
- Relevance of judicial references e.g. local regulations do not refer to laws or higher-regulations (approximately 32% of local regulations in the sample have this problem).
- Coherence in philosophy and principle of taxes and other non-taxes retribution e.g. local regulations related to local taxes and non-taxes retribution do not adhere to the general classification of retribution stipulated by the higher law (approximately 28% of local regulations in the sample have this issue).

KPPOD (2011) found that around 39% of local regulations still contain problems of substances. The major problem of 245 reviewed districts is mainly on the lack of clarity on business procedures, time standards and rates of charges; the second problem is lack of clarity of rights and obligations of fee payers. However, the year 2011 has shown improvement of regulatory quality compared to 2007 when the major problem of clarity of business procedure was still about 70% of the reviewed local regulations from 243 districts.

Above all, Indonesia has made progressive business reforms at the local level as argued by the study of Sub-National Doing Business Report in Indonesia (World Bank and International Finance Corporation, 2012). It showed that the average time to start a business and deal with construction permits have been reduced by more than 25% since 2010. Hence, it was 13 days faster and 8% cheaper to do business in major fourteen cities in Indonesia in 2012 than in 2010. Such reform occured due to the simplification of local licensing requirements, establishment of one-stop-shop, introduction of statutory time limits, and elimination of or

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reduction in fees for local licenses since 2010. Such reform represented some improvement of business-friendly regulations enactment at the local level.

5. Access to Finance in Indonesia: A Comparative View

This section discusses the state of access to finance in Indonesia. We focus on the recent development of financing to the private sector in Indonesia. Similar to section 3, our strategy is by comparing Indonesia with comparable countries. We choose three major developing Southeast Asian countries: Malaysia, Thailand, and Philippines as well as two developing Asian economic powerhouses: China and India to see how Indonesia fares in comparison.

There are two main dimensions that relate to access to finance which we look into. First dimension is the interest rate. This dimension is important to look at since interest rate is, in principle, the 'price' of borrowing. Higher interest rates indicate that lenders such as financial institutions view lending activities as riskier. We focus on the lending rate indicator as it is the most relevant interest rate measure related to financial intermediation. The second dimension is institutional infrastructure. More specifically we are interested to see how information and legal infrastructure in the financial sector that facilitate lending are related to the function of financial intermediation by financial institutions i.e. banks.
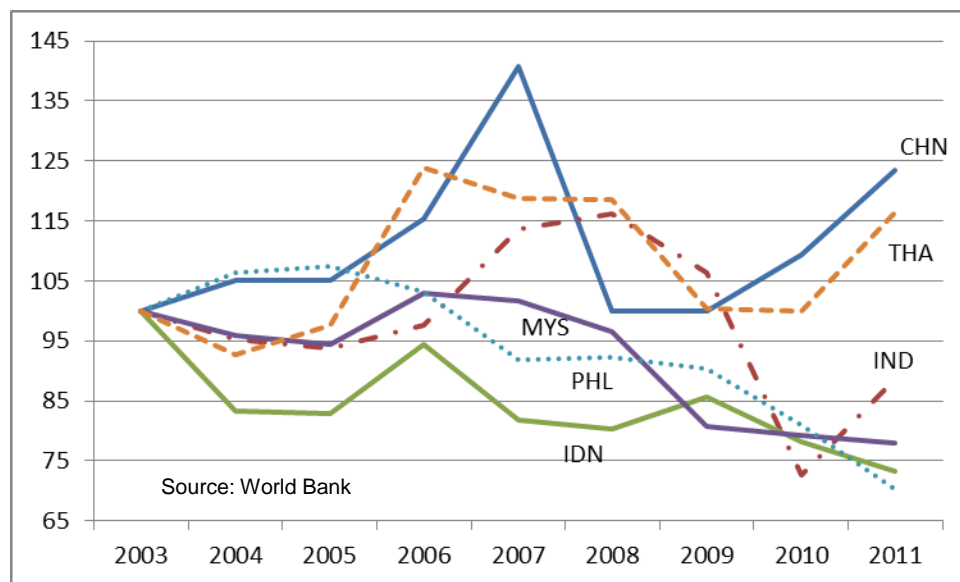

Figure 5. Lending Rate (2003=100)

First exhibit is to compare Indonesia's lending rate with our select countries. Cross-country comparison of lending rates is not a straightforward exercise. Each country may have its own terms and conditions attached to the rates, thus cross-national comparability is limited. However, we can compare the trend and pattern of lending rate across countries overtime. As such, we set 2003 as our base-year, and standardise the lending rate for each country to 100. Figure 5 shows that Indonesia has experienced a decline in its lending rate relative to others. As expected, China tops the list since this may reflect the direction of China to prevent its overheating in recent period. On the other hand, together with the Philippines, Indonesia as of 2011, bottoms the list. This gives the hint that the 'price' for borrowing in Indonesia has decreased substantially between 2003 and 2011. Likewise, this condition is likely to provide the space necessary to promote more lending activities by financial institutions in Indonesia.

However, merely looking into lending rate does not provide us with an accurate state of the costs of borrowing. In order to take macroeconomic stability such as inflation rate into

account, we use real lending rate for the second exercise. This indicator shows the real costs of borrowing. As shown in Figure 6, China and Malaysia have the lowest real lending rate with each country experienced less than 2% average real lending rate. Between 2003 and 2011, the average real lending rate in Indonesia is 3.34%. This indicates that the real cost of borrowing in Indonesia is quite competitive in comparison with other major Asian countries.
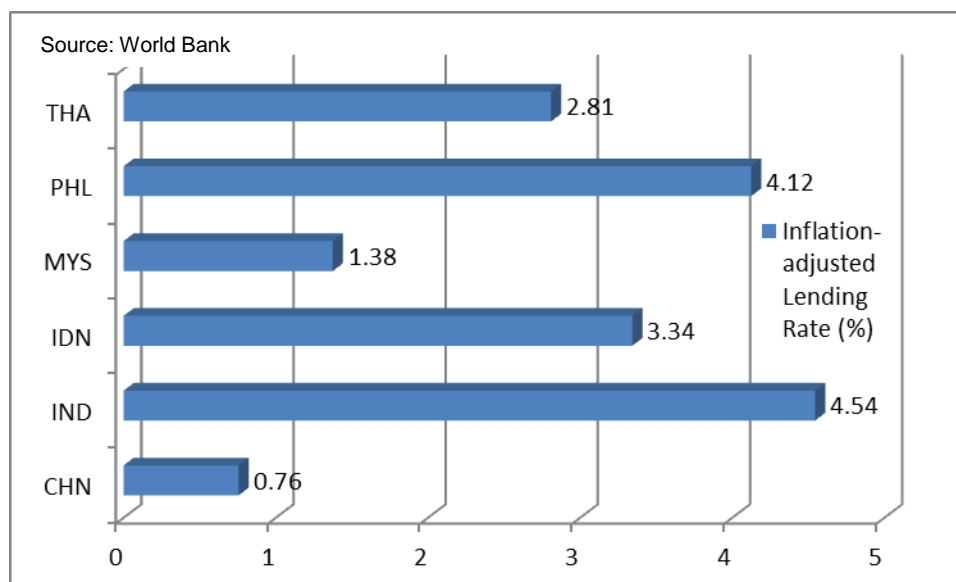
Figure 6. Real Lending Rate (average, 2003-2011)

The last exercise with the interest rate dimension is to look into interest rate spread. We define interest rate spread as nominal lending rate minus the deposit rate. In principle, this indicator is used to see how financial institutions i.e. banks place the 'premium' on their lending activities. The wider the spread is, the larger the premium. If banks perceive larger risk in giving out lending, the premium will be larger. Figure 7 shows that Malaysia and the Philippines have experienced a sharp decline in interest rate spread in 2009-2011. In contrast, Indonesia experienced a staggering level of interest rate spread during 2007-2011.

When making decisions on loans, banks are concerned with two factors: (i) the interest rate received on the loan, and (ii) the riskiness of the loan (Stiglitz and Weiss, 1981). As figure 5 shows, the lending rate in Indonesia, in general, has been in a declining trend. However, for developing countries, barriers in access to finance are likely to root in transaction costs due to informational asymmetries such as adverse selection. Mahendra (2009) argued that domestic financing in Indonesia has been sub-optimal due to financial frictions in the credit market. These frictions lead to higher premium charged by banks in Indonesia. Figure 7 confirms Mahendra (2009) by showing that the interest rate spread between 2007 and 2011 for Indonesia has been staggering. This reflects a lingering relative high 'price' in taking loans in Indonesia. As consequence, this friction in the credit market may act as an impediment in financial intermediation in Indonesia.
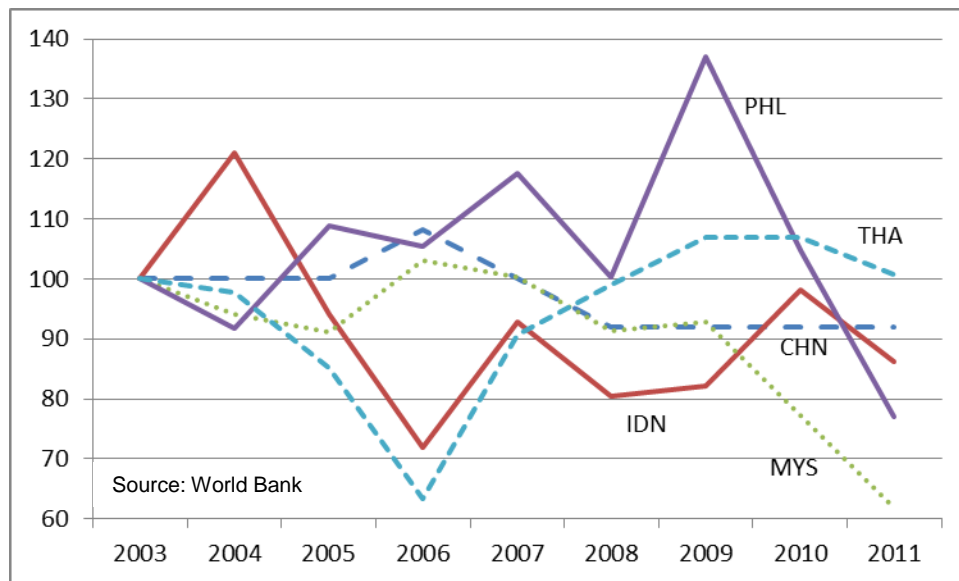
Figure 7. Interest Rate Spread (2003=100)

So far, we have seen that costs of borrowing in Indonesia are still staggering, even compared with other strongly growing Asian economies. The next question is what may explain this phenomenon? We turn to our second dimension: institutional infrastructure. We rely on two financial infrastructure indicators developed by World Bank for the analysis. The first indicator is strength of legal rights index. This indicator measures "the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and thus facilitate lending".[3] This index ranges from 1 to 10 where higher scores indicate better laws that facilitate lending activities.

The second indicator is credit depth of information index. This indicator measures "the rules affecting the scope, accessibility, and quality of credit information available through public or private credit registries".[4] This index ranges from 0 to 6. Higher scores indicate that more credit information are available that help banks in making lending decisions, thus facilitate lending activities. These two indices are institutional infrastructure that may help to lessen financial frictions in the credit market. Higher scores in these indices mean that the country has the necessary tools to reduce information asymmetries in the credit markets. As consequence, we can expect that strong legal rights index as well as high credit depth of information index are associated with more credits flowing to the real sector.

Figure 8 shows that the two indices are associated with the size of credits flowing to the real sector. Certainly, there are many factors that explain size of credits in a country's economy. It is possible that a country has low scores on these indices but still record a large credit share to GDP. This might due to directed (government-facilitated) lending or interest rate subsidies directed to specific groups in the economy or even over-reliance on external (foreign) financing. Either way, better institutional infrastructure in the financial sector should provide the necessary ground for credit expansion.

As shown in figure 8, in 2004-2011, Indonesia is lagging behind in domestic credit provided by the banking sector (the size of the bubble). Even the Philippines has slightly higher domestic credit to GDP (49.38% compared with only 40.83% for Indonesia). In general,

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[3] http://data.worldbank.org/indicator/IC.LGL.CRED.XQ?page=1
[4] http://data.worldbank.org/indicator/IC.CRD.INFO.XQ?page=1

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countries with higher scores in institutional infrastructure indices tend to have larger amount of credit provided by their banks. Indonesia has the lowest average score of the two indices. On the other hand, Malaysia is the prime example of success in our exercise. Having strong institutional infrastructure in their financial sector has provided Malaysia with the necessary platform to support the flow of credit to their private sector.
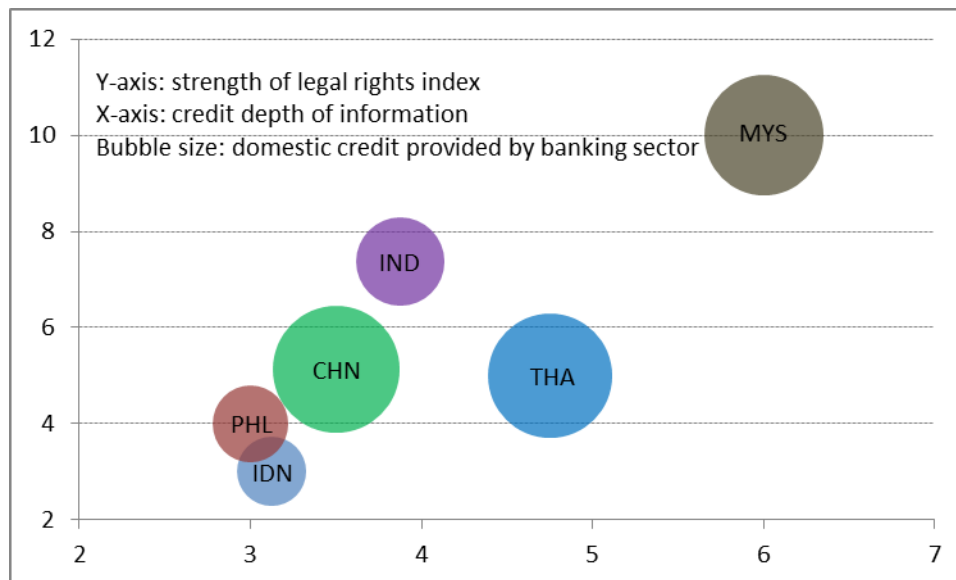
Figure 8. Institutional Infrastructure & Domestic Credit (average, 2004-2011)

This section shows that Indonesia is not yet well-positioned compared with other major emerging Asian countries in access to finance. We show that costs of borrowing in Indonesia are still relatively staggering in the region amidst declining nominal lending rate. This reflects the lingering frictions in the Indonesian financial markets due to asymmetric information problem. Such obstacle is rooted in the lack of quality in institutional infrastructure in the financial sector as displayed by weak legal rights and limited credit information. Compared to other countries in our sample, Indonesia ranks last in institutional infrastructure in the financial sector. These problems lead to sub-optimal domestic financing in Indonesia which manifests in a comparatively low credit penetration to the real sector of the economy.

6. Data and Method

To answer our research questions, we opt for firm-level data analysis utilising the World Bank Enterprise Surveys (WBES) micro dataset. The survey for Indonesia was conducted between August 2009 and January 2010 and focused to capture various factors that shape and influence business environment. The surveys asked business owners and top managers detailed questions regarding their establishments as well as their perceptions on business climate faced by the establishments. The surveys targeted manufacturing and services industries. Unfortunately, for Indonesia the WBES has only been conducted once in 2009. Thus, the WBES micro data for Indonesia is basically cross-sectional, limiting the ability for us to exploit the richness of information from a panel data set-up. The survey for Indonesia was able to cover 1,444 firms with most firms classified as small- and medium-sized enterprises (SMEs). Using a stratified random sampling strategy, WBES Indonesia 2009 gather firm level data for 9 provinces with more than half are located in Java.

To analyse the role of institutions, we use the 2007 Local Economic Governance Surveys conducted by the Indonesia's Regional Autonomy Watch (KPPOD). The survey was conducted at the district level, covering 243 districts from 15 provinces. Similar to WBES, the KPPOD survey sample is also skewed towards SMEs. We match the WBES and KPPOD

surveys data by provinces. Our matched data end up with only six provinces: Bali, Jawa Barat, Jawa Tengah, Jawa Timur, Sumatera Utara, and Sulawesi Selatan. In other words, 3 other provinces of the WBES surveys (Banten, Lampung, and DKI Jakarta) have to be dropped. Ideally, the matching procedure should be done at the district level since KPPOD data are produced at this level. However, the WBES firm identifier is only at the province level. Another option is to use the original firm survey of KPPOD. Unfortunately, the KPPOD surveys' questionnaires do not ask about firm innovative activities, hence it is not workable for our analysis. Finally, since services industry may have different innovation pattern and determinants, we decide to limit our analysis only for manufacturing firms. This decision is further supported by the fact that one of our dependent variables, patents registration, is more relevant for manufacturing firms.

Archibugi and Pianta (1996) argued that patents and innovations surveys are good proxies for firm technological activities. Meanwhile, Kleinknecht et.al. (2002) surveyed the strengths and weaknesses of five different measures of innovative activities. They showed that R&D and patents (two of the most commonly used indicators) are not necessarily the best indicators to measure innovation activities, and advised researchers to use innovation indicator that suits the research question and level of analysis. Accordingly, we decide to apply a more flexible strategy in measuring innovation activities. Our dependent variables are (i) a broad measure of innovation, and (ii) a proxy for product innovation. Several empirical studies on innovation have adopted the broad and flexible measure strategy. Bartel et.al. (2007) used the count of computer numerically controlled (CNC) machines owned by firms in valve manufacturing industry as a measure of innovation. Meanwhile, Bloom and Van Reenen (2007) developed an innovative survey to measure innovation management practices. Mairesse and Mohnen (2010) provided the definitive survey on various innovation indicators applicable for empirical analysis.

Such strategy is likely to be more appropriate for developing countries as opposed to other traditional measures of innovation such as R&D expenditures (Gorodnichenko et.al., 2010). Moroever, since the economies of developing countries, and in fact our sample, are mostly composed of SMEs, traditional innovation measures may not capture appropriately the innovation activities of SMEs (Hoffman et.al., 1998). Developing countries indeed have different types of innovation as opposed to developed countries where for developing countries, innovation is mostly conducted not at the technological frontier, and is a mixed-baggage of original innovation as well as adoption and imitation of various types of product and process innovation (Segerstrom, 1991; Ayyagari et.al., 2011).

Our approach in constructing a broad measure of innovation is inspired by Lall (1992) where he proposed a broad index to measure firm technological capabilities. In this paper, we try to capture both product innovation and process innovation in a single index. Given the limited scope of innovative activities included in the 2009 Indonesia WBES, we only use 3 indicators: product innovation (patents) and process innovation (ISO certification and licensed foreign technology).

For the empirical analysis, we basically run two separate group of regressions. One group of regressions has product innovation (patents) as its dependent variable. Since the patents variable is binary, we employ logit regressions with the following specification:

$$Patents_{ijp} = \begin{cases} 1, & if \ \pi_{ijp}^* > 0 \\ 0, & if \ \pi_{ijp}^* \leq 0 \end{cases} \qquad (1)$$

Here we assume that a firm follows a profit-maximising strategy in which it will engage in product innovation (registering for patents) if the benefits exceed the cost. Thus, a firm i in industry j in province p will have a registered patent if the economic profit π^* is positive.

Hence, $Patents_{ijp}$ is a binary variable that equals one if a firm has at least one registered patent in any country. We further assume that π^* is a function of firm, industry, and province characteristics and that it is not directly observable so that:

$$\pi^*_{ijp} = \beta X_{ijp} + Acc\_Fin_{ijp} + Reg_p + \lambda_j + \varepsilon_{ijp} \tag{2}$$

Therefore, we can write that the probability of a firm to have at least one registered patent (product innovation) as follows:

$$\Pr(Patent_{ijp} = 1) = Pr\left(Acc\_Fin_{ijp} + Reg_p + \beta X_{ijp} + \lambda_j + \varepsilon_{ijp} > 0\right) \tag{3}$$

Where X_{ijp} is a vector of firm characteristics (control variables), λ_j are industry fixed-effects, and ε_{ijp} are unobserved firm, industry, and province characteristics. Access to finance (Acc_Fin_{ijp}) and quality of local regulations (Reg_p) are our variables of interest. We assume that ε_{ijp} is logistically distributed, so that we employ logit regressions. Detailed description of the variables, their sources, and summary statistics are displayed in appendix.

Our second dependent variable is innovation index that measures firm innovative activities. We adopt the broad measure approach of technological capabilities index theoretically developed by Lall (1992), and implemented by Wignaraja (2002). However, given the limited set of questions on firm innovative activities in our data set, we do not follow the normalisation procedure and opt instead for a simple counting procedure. In addition to patent, we incorporate a measure whether a firm has an internationaly-recognised quality certification (ISO) and if a firm uses technology licensed from a foreign-owned company excluding office software (foreign technology). These two additional measures are also binary variables that equal to one if a firm has each of the measure. We then construct an innovation index by adding up each innovative activities. Thus, our innovation index ranges between 0 (no innovation) and 3 (all three innovation activities). Accordingly, we can regard the innovation index as an ordinal variable in which higher scores indicate more expansive innovative activities, and estimate ordered logit regressions where for an *m*-alternative ordered model, we define:

$$\pi_{ijp} = z \quad if \alpha_{z-1} < \pi^*_{ijp} \leq \alpha_z, \; z = 1, \dots, m$$

$$Innov\_Index_{ijp} = \begin{cases} m, & if \; \pi^*_{ijp} > \alpha_z \\ 1, & if \; 0 < \pi^*_{ijp} \leq \alpha_z \\ 0, & if \; \pi^*_{ijp} \leq 0 \end{cases} \tag{4}$$

Where *m*, the maximum alternative, in our case is 3 (firm is engaged in all three type of innovative activities). We also assume that a firm follows profit-maximising behaviour in which firm chooses to engage in more expansive innovative activities if it sees larger economic profits in doing so. Thus, we can write the probability of a firm to engage in innovative activities (innovation index) as the following:

$$\text{Pr}(Innov\_Index_{ijp} = z) = \text{Pr}\left(\alpha_{z-1} < Acc\_Fin_{ijp} + Reg_p + \beta X_{ijp} + \lambda_j + \varepsilon_{ijp} \le \alpha_z\right) \quad (5)$$

We also assume that ε_{ijp} has logistic distribution, and run ordered logit models. We employ the same set of regressors with the product innovation regressions.

For the innovation index analysis, we also consider alternative specifications. Recall that our innovation index is constructed via simple counting procedure, hence it is plausible to regard the variable as a count data since our dependent variable is basically a count of firm innovative activities. Therefore, we extend our analysis by running poisson regressions to enrich our inferences as well as robustness checks. Finally, we estimate different regressions for firms differentiated by sample: small and medium enterprises (SMEs) vs large firms. SMEs and large firms may have different pattern of their innovation determinants –in our case, they are institutions and access to finance (Acs and Audretsch, 1988).

One challenge for our analysis is to infer causality running from our variables of interest (access to finance and quality of local regulations) to innovation. There are two sources of issues that may limit our capacity to address causality. First is reverse causality. This problem is less pronounced for quality of local regulations. We can confidently say that it is very unlikely that firm innovative activities could affect the quality of local regulations. In fact, this index is constructed based on legal analysis which strengthens its exogeneity. On the other hand, it is possible that innovative activities influence firm's access to finance. If a firm innovative activities are run inefficiently, it may lead the firm to face problems in securing external financing. The second issue is even more important: omitted variable bias. It is likely that there are unobserved factors that affect both our dependent variables (innovation measures) and main explanatory variables (access to finance and quality of local regulations).

The first-best strategy to tackle causality problem is by finding an instrument –especially for access to finance variable. However, we are unable to find convincing instrument for access to finance that is not correlated with the error term. The problem is magnified by the fact that our data is cross-section. This limits the space to address any endogeneity issue that would otherwise have been provided if we have a panel data setup by controlling for any time-invariant factors and unobservables or by employing dynamic panel analyses. Therefore, we follow the second-best approach. First is by introducing a variable that controls for a firm initial condition (initial size). In addition, we also control for firm characteristics (age, human capital, and foreign ownership) that may correlate with access to finance. Finally, we also incorporate industry fixed-effects to control for any unobserved factors at the industry level.

Although it is not ideal, by controlling for firm initial condition, firm idiosyncratic characteristics, and industry fixed-effects, it may moderate the endogeneity issue for access to finance. As for quality of local regulations, we believe that the endogeneity problem is much less pronounced. As shown by Almeida and Fernandes (2008) who analyse the effect of openness on technological innovations in developing countries, we can still derive robust estimates even if the data setup is cross-section by nature. In the same vein, Ayyagari et.al. (2011) also argued that cross-sectional analysis can still provide useful explanations on the linkages between innovation determinants and innovative activities. We believe that our novel approach focusing on local institutions and access to finance may at least give useful insights for policymakers on the important role of local regulatory quality and access to finance in spurring innovation.

7. Results

Before we discuss the results of our empirical analyses, we shall start with a brief look into the general characteristics of our data. We have two dependent variables: (i) registered patents as a measure of product innovation, and (ii) an innovation index as a measure of innovative activities. Since product innovation is one of the foci in this paper, we thus

exclude firms in the services and trade industries. In this paper, we only analyse firms in manufacturing. Our full sample is comprised with 856 firms distributed over 7 different sectors in manufacturing (figure 9). Over 30% of the firms are in food industry and for other sectors, the distribution is quite well-balanced.
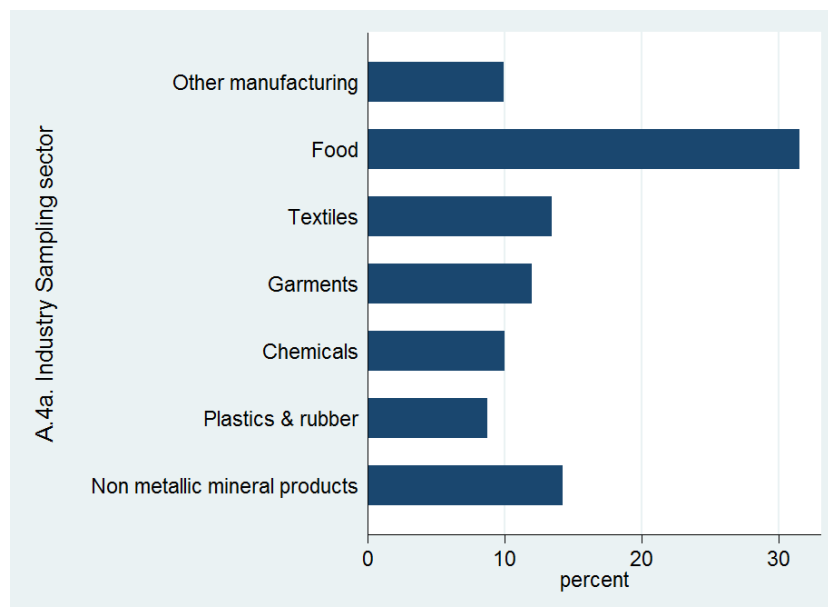

Figure 9. Firm Distribution by Industry

Regarding the location of the firms, they are mostly located in Java (>80%). Jawa Barat is where the majority the firms are located (30.02%), followed by Jawa Tengah and Jawa Timur with 25.82% and 25.12%, respectively. We have 3 non-Java provinces in our sample: Bali, Sulawesi Selatan, and Sumatera Utara.

On the distribution of the quality of local regulations index, the three provinces in Java also top the table with Jawa Timur comes top as the province with the highest score in quality of local regulations index (86.32). Jawa Tengah and Jawa Barat follow suit with 85.77 and 85.20, respectively. Bali turns out to be the province with the worst score on the quality of local regulations index (80.97). This makes the difference between the best performing province (Jawa Timur) and the worst performing province (Bali) only 5.35 points. The other two non-Java provinces come next with 84.23 (Sulawesi Selatan) and 83.10 (Sumatera Utara). The stark difference on the quality of local regulations index between Java and non-Java provinces may reflect the discrepancy of institutional quality among these regions. At least in our sample, we find that provinces in Java have relatively better institutional quality than non-Java ones. Table 1 displays the scores of the quality of local regulations index for each province as well as the distribution of firms by province.

Literature has shown that human capital matters for innovation. Therefore, firms with better human capital are more likely to engage in innovative activities. Our sample supports this claim. Figure 10 shows that firms with higher skills (both managers and workers are more skilled) are more likely to involve in innovative activities. Similar pattern is also apparent in product innovation. Firms with educated managers and workers also tend to have more registered patents (figure 11). These findings are evident across provinces, and that such gap due to differences in firm human capital is starker in provinces located in Java.

Table 1. List of Provinces, Sample of Firms, and Quality of Local Regulations Index

Province	Firm Sample (N)	Firm Sample (% of total)	Quality of Local Regulations Index (averages of regencies & districts)
Bali	50	5.84%	80.97
Jawa Barat	257	30.02%	85.20
Jawa Tengah	221	25.82%	85.77
Jawa Timur	215	25.12%	86.32
Sulawesi Selatan	55	6.43%	84.23
Sumatera Utara	58	6.78%	83.10
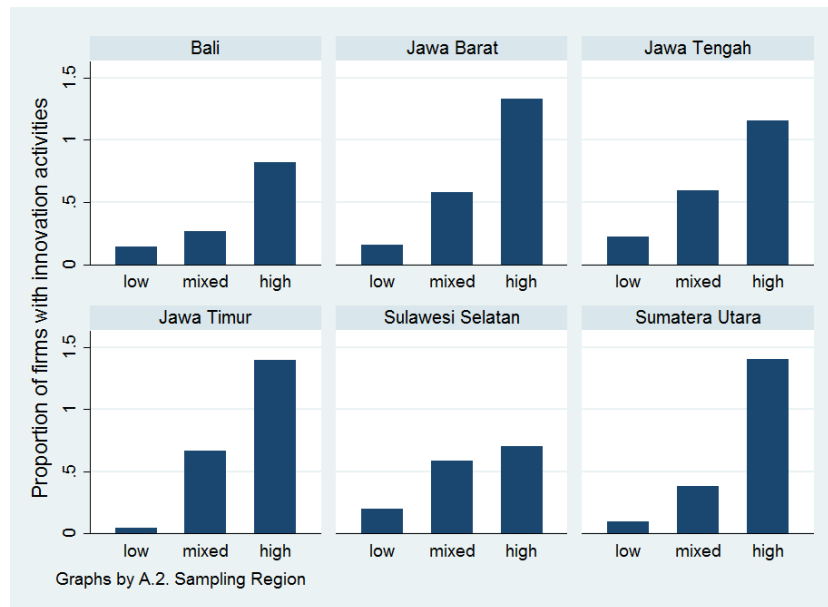
Figure 10. Innovation Index & Firm Human Capital

Finally, as discussed in the literature review, theory also states that firm size matters for access to finance. Larger firms are more likely to acquire external financing than the lower ones. Smaller firms may lack the collateral or quality credit information necessary to obtain loans from commercial banks. Moreover, larger firms may have the capacity to raise external funds not only from banks (credit markets), but also from financial markets such as the capital or bond markets. Certainly, larger firms can also have difficulties in securing external finance, especially when they are overtly leveraged or lack quality governance. Nevertheless, under normal condition, we can expect to find more smaller firms face obstacles in access to finance than larger firms. In table 2, we do a cross-tabulation between firm size and access to finance. We find that only 15% of large firms report access to finance as major obstacle. In contrast, 55% of small firms mention access to finance as their major obstacle. As we can see, the proportion of firms reporting access to finance as major obstacle grows by firm size. In total, we have 41% firms facing major obstacle in access to finance –thus providing a relatively well-balanced sample for our econometric analyses.
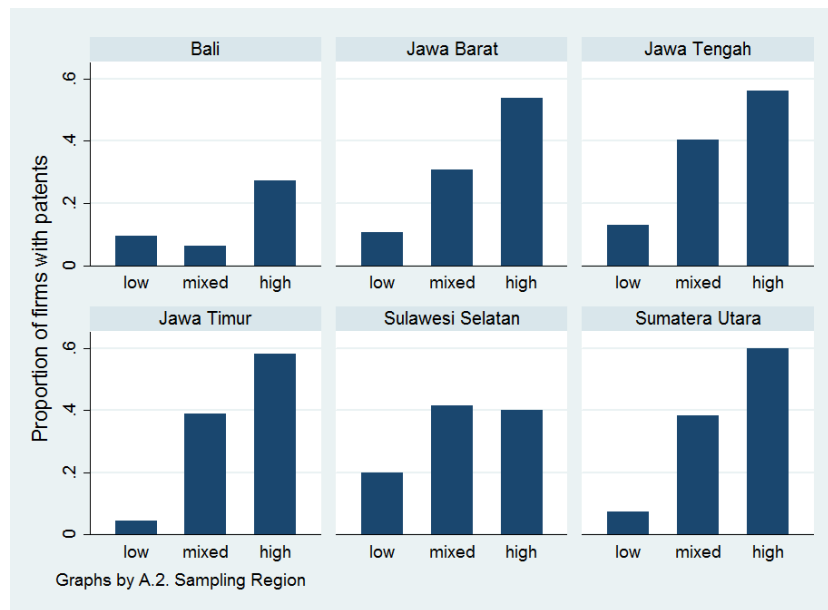
Figure 11. Product Innovation and Firm Human Capital

Table 2. Cross Tabulation: Firm Size & Access to Finance

Province	Access to Finance is No Major Obstacle	Access to Finance is Major Obstacle	Total
Small (5-19)			
Frequency	170	208	378
Row Percentage	45%	55%	100%
Medium (20-99)			
Frequency	129	77	206
Row Percentage	63%	37%	100%
Large (>99)			
Frequency	150	26	176
Row Percentage	85%	15%	100%
Total			
Frequency	449	311	760
Row Percentage	59%	41%	100%

In the subsequent sub-sections, we shall discuss the results of our econometric analyses. We start with the product innovation regressions. Then, we move on to innovation index regressions with ordered logit model. Accordingly, we also provide alternative estimates for the innovation index with poisson regressions. Following that, we perform separate regressions for SMEs and large firms to see how access to finance and quality of local institutions may have different influences within each group. Finally, we discuss the adjusted predictions from access to finance and quality of local regulations index controlling for other variables as well as their interaction term.

7.1 Product Innovation Estimates

In this sub-section, we discuss the regression results for product innovation. That said, we use patent registration as a proxy for product innovation. Our dependent variable is thus a binary data equals to 1 if a firm owns at least one patent registered in any country, and 0 if otherwise. Therefore, we opt for a binary logit model. Table 3 displays the results. We perform four separate regressions with different modification for each estimate. For every regression, we control for several firm characteristics. Namely, we control for firm size, firm age, firm human capital, and firm's foreign ownership level (for detailed description of variables, see appendix). We also include a control for firm initial condition (firm initial size). We believe this is necessary since given the cross-sectional nature of our data, we are not able to control for time-invariant firm characteristics. However, following Almeida and Fernandes (2008) and Ayyagari et.al. (2011), such cross-sectional design does not necessarily reduce the message of the results and policy implications. In fact, we go further by also incorporating a measure of firm initial size as an additional control variable. We also conduct estimates controlling for industry fixed-effects for robustness checks. All regressions are estimated with robust standard errors.

In the baseline regressions, estimation (1) shows that quality of local regulations and access to finance influence product innovation. We present our results in odd ratios to ease interpretation. We find that having access to finance as major obstacle reduces the probability for firm to have product innovation by 41%. Meanwhile, better quality of local regulations is associated with 19% probability to have product innovation. All effects are significant at 5% level. Most control variables have the expected signs and significance levels. As we can see, larger firms are more likely to have product innovation. Likewise, older firms and better human capital owned by firms are associated with more likelihood to engage in product innovation. The results from estimation (1) confirm our hypotheses that obstacles in access to finance are negatively associated with innovation and that better quality of local regulations is associated with more product innovation.

In estimation (2), we introduce an interaction term of access to finance and quality of local regulation index. We centre the quality of local regulation index to ease interpretation since our empirical model is basically non-linear. Hence, our institutional quality indicator can now be interpreted as a centred-variable. In other words, we can interpret the results as the effect when quality of local regulations index falls below or goes above the average score. Introduction of the interaction term does not change the individual effect of our main explanatory variables. We still find that having access to finance as major obstacle is associated with 40% less likelihood to have product innovation. Meanwhile, we also find that firms located in provinces with better institutional environment are associated with more product innovation. Interestingly, we find that the interaction term is significant. Given that our empirical model is non-linear, we cannot directly interpret the magnitude of the interaction term from the odd ratio. However, we can say that the positive effect of better quality of local regulations is moderated by access to finance. More specifically, firms facing access to finance as major obstacle are disproportionately and negatively affected by better institutional quality. This result gives the hint that the positive impact of better local institutional quality is not symmetrically distributed. That is, firms with access to finance reap most of the benefits of better local institutional quality. We shall further explore this interesting finding later in this section.

Estimation (1) and (2) do not control for industry-specific characteristics. It is likely that different industry has idiosyncratic characteristics that may explain their product innovation. We introduce industry fixed-effects in estimation (3) and (4). As we can see the results do not change that much. The estimated effects and significance are robust.

Table 3. Determinants of Product Innovation

Dependent Variable: 0=Firm does not have any registered patent; 1=Firm has registered patent	Baseline Logit				Industry Fixed-Effect Logit			
	(1)		(2)		(3)		(4)	
	Odds Ratio	Robust Standard Errors	Odds Ratio	Robust Standard Errors	Odds Ratio	Robust Standard Errors	Odds Ratio	Robust Standard Errors
Main Explanatory Variables:								
Obstacles in Access to Finance	0.586**	(0.136)	0.607**	(0.138)	0.589**	(0.137)	0.609**	(0.139)
Quality of Local Regulations (Level)	1.186**	(0.089)			1.168**	(0.088)		
Quality of Local Regulations (Centred)			1.266***	(0.115)			1.245**	(0.114)
Quality of Local Regulations (Centred) X Obstacles in Access to Finance			0.743**	(0.111)			0.748*	(0.114)
Control Variables:								
Initial Size	1.001	(0.001)	1.001	(0.001)	1.001	(0.001)	1.001	(0.001)
Size	2.206***	(0.344)	2.175***	(0.339)	2.282***	(0.362)	2.260***	(0.360)
Age	1.028***	(0.010)	1.029***	(0.010)	1.029***	(0.010)	1.029***	(0.010)
Workers + Managers Average Educational Attainment	1.537***	(0.243)	1.536***	(0.244)	1.527***	(0.241)	1.528***	(0.242)
Share of Foreign Ownership	1.511	(0.569)	1.564	(0.593)	1.526	(0.587)	1.575	(0.609)
Intercept	1.66e-08***	(1.06e-07)	0.0355***	(0.012)	4.88e-08***	(3.16e-07)	0.0260***	(0.013)
Observations	687		687		687		687	
Log Likelihood	-306.4		-305.1		-301.5		-300.3	
Level-2 Standard Deviation (Random Parts)	-		-		-		-	
McFadden Adjusted R2	0.21		0.21		0.20		0.19	

Robust standard errors in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.10$

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7.2 Innovative Activities Estimates

In this sub-section, we analyse how access to finance and quality of local regulations affect innovative activities. As we have discussed in section 6, we construct an innovation index to proxy innovative activities. In principle, the index attempts to capture both product innovation and process innovation. Therefore, we aim to capture a more comprehensive measure of firm innovative activities. Registered patents remain as the indicator of product innovation. We introduce two measures to proxy process innovation. First is the use of internationally recognised quality certification such as ISO certificates. We code 1 if a firm owns any and 0 if otherwise. The second measure is the use of technology licensed from a foreign-owned company, excluding office software. Similar to quality certification, we also code 1 if the firm owns any foreign-licensed technology, and 0 if otherwise. To construct the innovation index, we sum up these three indicators. We do not perform any standardisation since all indicators are binary. Hence, the lowest score is 0, which means the firm does not engage in any innovation while 3 is the highest score which means the firm has all three types of innovative activities. We conduct ordered logit regressions since the construction of our innovation index can be regarded as ordinal data.

Our regressions for innovation index follow the same strategy as product innovation regressions. We use the same control variables and also introduce industry fixed-effects (table 4) . Surprisingly, as displayed in estimation (5), we do not find any significant effect of access to finance and quality of regulations on innovative activities amidst expected signs. Other controls, however, remain significant. In fact, firm initial size which is not found to be significant in product innovation regressions is now significant albeit its negligible effect. The presence of foreign ownership in a firm is also found to be significant. We find that firms with more than 10% foreign ownership are 3.43 times more likely to engage in innovative activities. Above all, these results from estimation (5) give the hint that quality of local regulations and access to finance are more important for innovation output (product innovation) but not necessarily critical for innovation input (process innovation).

Estimation (5), nonetheless, does not take into account the possibility that the effect of local regulations index only comes jointly with access to finance. Estimation (6) explores such possibility using the same strategy as estimation (2) in product innovation regressions. As we can see, we now find that quality of local regulations matters for innovative activities. However such effect is not independent –it comes along with the interaction term. This finding further confirms the hypothesis that the positive effect of better institutional quality is asymmetrically distributed. Firms which face no obstacles in access to finance are much better off from improved local institutional quality.

Interestingly, we still do not find any significant impact of access to finance in estimation (6). Although the the direction is still as expected, we cannot reject the null hypothesis of significant effect. One possible explanation for this is that access to finance matters more for innovation output (product innovation). Our proxy for product innovation is registered patents. Such innovative activity is likely to be much costly to finance as opposed to process innovation (quality certificates or usage of foreign-licenced technology). Therefore, it is likely that the non-significance of access to finance in estimation (6) is driven by the process innovation parts of the index. Involvement in process innovation is likely to be cheaper to finance, thus it is likely that firms facing access to finance as major obstacle can still bear the costs of either acquiring international quality certification or foreign-licensed technology. However, if it comes to product innovation such as patents, financing becomes a significant issue. This explains why access to finance is significant in product innovation regressions while they are not found to be significant in innovation index regressions.

We also check the robustness of our findings by incorporating industry fixed-effects. As shown in estimation (7) and (8) in table 4, controlling for industry fixed-effects do not alter the results –except for the significance level of the interaction term which is now at 10%.

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Table 4. Determinants of Innovative Activities: Logistic Regressions

Dependent Variable: 0=Firm involves in no innovative activities; 1=Firm involves in one innovative activities; 2=Firm involves in two innovative activities; 3=Firm involves in 3 innovative activities: product innovation (patents) & process innovation (ISO & use of foreign technology)	Baseline Ordered Logit				Industry Fixed-Effect Ordered Logit			
	(5)		(6)		(7)		(8)	
	Odds Ratio	Robust Standard Errors	Odds Ratio	Robust Standard Errors	Odds Ratio	Robust Standard Errors	Odds Ratio	Robust Standard Errors
Main Explanatory Variables:								
Obstacles in Access to Finance	0.728	(0.156)	0.755	(0.159)	0.744	(0.162)	0.771	(0.165)
Quality of Local Regulations (Level)	1.118	(0.077)			1.113	(0.077)		
Quality of Local Regulations (Centred)			1.201**	(0.096)			1.190**	(0.096)
Quality of Local Regulations (Centred) X Obstacles in Access to Finance			0.724**	(0.108)			0.739*	(0.114)
Control Variables:								
Initial Size	1.001**	(0.000)	1.001**	(0.000)	1.001**	(0.000)	1.001**	(0.000)
Size	3.239***	(0.502)	3.181***	(0.491)	3.290***	(0.515)	3.250***	(0.507)
Age	1.022***	(0.008)	1.023***	(0.008)	1.023***	(0.008)	1.024***	(0.008)
Workers + Managers Average Educational Attainment	1.849***	(0.264)	1.873***	(0.272)	1.835***	(0.265)	1.857***	(0.273)
Share of Foreign Ownership	3.425***	(1.244)	3.603***	(1.322)	3.493***	(1.258)	3.665***	(1.338)
Observations	686		686		686		686	
Log Likelihood	-482.2		-480.4		-477.6		-476.1	
Level-2 Standard Deviation (Random Parts)	-		-		-		-	
McFadden Adjusted R2	0.23		0.23		0.23		0.22	

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.10

7.3 Innovative Activities Estimates: Alternative Econometric Estimations

In the previous sub-section, we estimate the innovative activities regressions using ordinal logit. Recall that our innovation index is basically a count index. We code 0 if a firm does not engage in any innovative activities while we code 3 if a firm is involved in all three types of innovative activities. Thus, we basically count the number of innovative activities performed by a firm. If we consider our innovation index as a count variable, then we can perform poisson regressions which can also act as robustness checks for our innovation index ordered logit regressions. Figure 12 depicts the distribution of our innovation index scores. It does seem to have a poisson distribution.
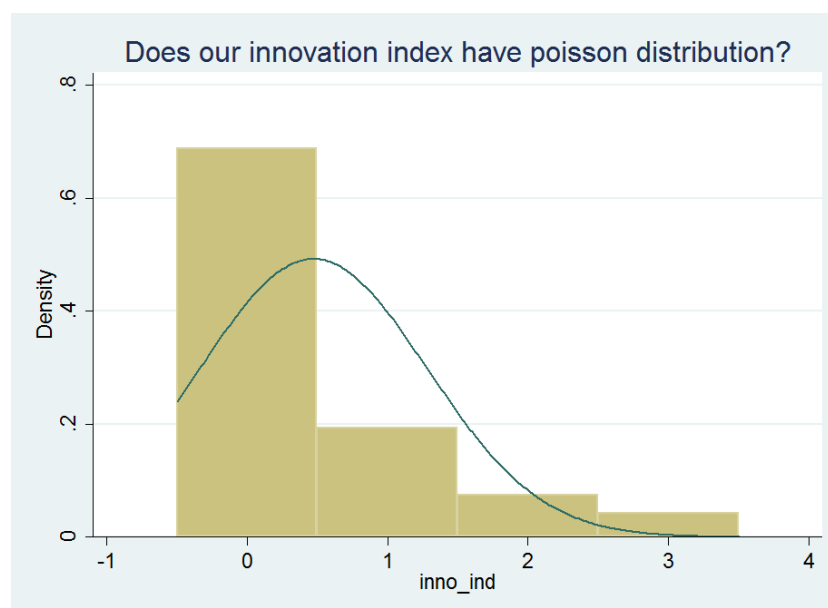
Figure 12. Distribution of Innovation Index Scores

Table 5 displays the results from our possion regressions estimates. For baseline regressions as shown in estimation (9) and (10), we find similar results to the estimates using ordered logit. We still find no evidence of any individual effect from access to finance and quality of local regulations in estimation (9). On the other hand, as shown in estimation (10), we also still find that firms located in a province with above average local institutional quality are more likely to have more innovative activities. Finally, we still find the evidence that firms facing access to finance as major obstacle are disproportionately worse off in better local institutional quality environment.

Once we control for industry fixed-effects, our poisson regressions estimates show significant effects of access to finance as depicted in estimation (11) and (12) of table 5. Estimation (11) shows that firms facing financial obstacles have 16% less likelihood to engage in more types of innovative activities. Estimation (12) displays that the negative effect of access to finance as major obstacle is still robust even after following the inclusion of the interaction term. Hence, the results of estimation (12) mimics the findings found in product innovation regressions. For all estimates, we conduct overdispersion tests that support the hypothesis of the appropriability of our possion regression estimates.

We show in this sub-section that access to finance matters for innovative activities. There is also evidence that firms without problems in access to finance are better off in a better local institutional environment, confirming the asymmetric effect of institutional quality depending on firm capability to gain access to external financial resources.

Table 5. Determinants of Innovative Activities: Poisson Regressions

Dependent Variable: 0=Firm involves in no innovative activities; 1=Firm involves in one innovative activities; 2=Firm involves in two innovative activities; 3=Firm involves in 3 innovative activities: product innovation (patents) & process innovation (ISO & use of foreign technology)	Baseline Poisson				Industry Fixed-Effect Poisson			
	(9)		(10)		(11)		(12)	
	Incidence-Rate Ratio	Robust Standard Errors	Incidence-Rate Ratio	Robust Standard Errors	Incidence-Rate Ratio	Robust Standard Errors	Incidence-Rate Ratio	Robust Standard Errors
Main Explanatory Variables:								
Obstacles in Access to Finance	0.808	(0.113)	0.825	(0.106)	0.838**	(0.063)	0.850**	(0.070)
Quality of Local Regulations (Level)	1.058	(0.046)			1.058	(0.049)		
Quality of Local Regulations (Centred)			1.113**	(0.054)			1.109*	(0.068)
Quality of Local Regulations (Centred) X Obstacles in Access to Finance			0.794***	(0.063)			0.807***	(0.066)
Control Variables:								
Initial Size	1.000	(0.000)	1.000	(0.000)	1.000	(0.000)	1.000	(0.000)
Size	2.212***	(0.217)	2.172***	(0.208)	2.190***	(0.136)	2.163***	(0.139)
Age	1.009***	(0.004)	1.010***	(0.004)	1.011***	(0.003)	1.011***	(0.003)
Workers + Managers Average Educational Attainment	1.493***	(0.129)	1.494***	(0.128)	1.498***	(0.168)	1.499***	(0.169)
Share of Foreign Ownership	1.565***	(0.197)	1.618***	(0.201)	1.575***	(0.088)	1.617***	(0.117)
Test for Overdispersion (prob > chi2)	593.02	(0.992)	634.66	(0.882)	-		-	
Observations	686		686		686		686	
Log Likelihood	-494.9		-492.6		-472.3		-470.4	
McFadden Adjusted R2	0.25		0.25		-		-	

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.10

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7.4 Do SMEs and Large Firms Differ?

Firms may have different pattern on their innovation determinants depending on their size (Acs and Audretsch, 1988). Nevertheless, such claim is not universal as Van Dijk et.al. (1997) argued that the conclusion that firm innovation determinants differ between small and large firms obtained by Acs and Audretsch (1988) is country specific. In the case of US, Acs and Audretsch (1988) found systematic differences in the determinants of innovation between small and large firms. In contrast, in the case of Netherlands, Van Dijk et.al. (1997) did not find any systematic differences of innovation determinants between small and large firms. In this sub-section, we explore the case for Indonesia.

Table 6. Small-Medium Firms vs Large Firms Estimates

Dependent Variable: 0=Firm does not have any registered patent; 1=Firm has registered patent	Binary Logit			
	(13)		(14)	
	SMEs		Large Firms	
	Odds Ratio	Robust Standard Errors	Odds Ratio	Robust Standard Errors
Main Explanatory Variables:				
Obstacles in Access to Finance	0.580**	(0.159)	0.720	(0.326)
Quality of Local Regulations (Centred)	1.169	(0.117)	1.485**	(0.269)
Quality of Local Regulations (Centred) X Obstacles in Access to Finance	0.864	(0.153)	0.606	(0.197)
Observations	531		156	
Log Likelihood	-201.0		-99.6	
McFadden R2	0.16		0.05	

Dependent Variable: 0=Firm involves in no innovative activities; 1=Firm involves in one innovative activities; 2=Firm involves in two innovative activities; 3=Firm involves in 3 innovative activities: product innovation (patents) & process innovation (ISO & use of foreign technology)	Poisson			
	(15)		(16)	
	SMEs		Large Firms	
	IRR	Robust Standard Errors	IRR	Robust Standard Errors
Main Explanatory Variables:				
Obstacles in Access to Finance	0.734	(0.142)	0.960	(0.156)
Quality of Local Regulations (Centred)	1.078	(0.077)	1.116*	(0.070)
Quality of Local Regulations (Centred) X Obstacles in Access to Finance	0.997	(0.129)	0.759***	(0.067)
Observations	531		155	
Log Likelihood	-280.0		-210.4	
McFadden R2	0.14		0.04	

Robust standard errors in parentheses; ***$p<0.01$, **$p<0.05$, *$p<0.10$
Other controls include initial size, age, workers+managers average educational attainment, and share of foreign ownership.

To disentangle the possibility that SMEs and large firms have different innovation determinants, we run separate regressions for each group. The regression models are the same with previous regressions in which we also include the firm characteristics as control variables. Table 6 provides the results. We start with product innovation determinants. Estimation (13) shows the results for SMEs firm sample whereas estimation (14) displays the results for large firms. As expected, access to finance is a more relevant issue for SMEs. Estimation (13) presents that SMEs facing major obstacle in access to finance are 42% less likely to have product innovation. Meanwhile, quality of local institutions does not seem to have significant impact on SMEs product innovation. This result indicates that financial constraint is a bigger issue for SMES to engage in product innovation. Since product innovation is costly, SMEs may need significant amount of external financing to support the activity. Because SMEs are more likely to have access to finance as their major obstacles, such financial constraints affect negatively on SMEs ability to engage in product innovation. Meanwhile, to explain the non-significant effect of quality of local regulations index , it may be the case that SMEs do not fully enjoy the positive impact of better institutional quality of their business environment. It is possible that better local institutional quality which often translates into more formality does not necessarily help SMEs because they are less likely to have the resources capability to reap the benefit from better institutional quality.

Estimation (14), on the other hand, shows that quality of local regulations is critical for larger firms. Our model estimates that large firms located in provinces with above average regulatory quality have 49% more probability to engage in product innovation. Earlier we discuss that the majority of large firms in our sample (85%) do not regard access to finance as major obstacle. This is confirmed by estimation (14) where we do not find significant effect of obstacles in access to finance. Our previous regressions using all sample show that firms not facing obstacles in access to finance are disproportionately better off from better institutional quality. The results of estimation (14) confirm this argument. Larger firms face less problems in access to finance, and thus the positive impact of better quality of local regulations is mostly enjoyed by large firms. One possible explanation for this is that larger firms are more prepared and have more institutional capabilities to reap the benefit of better institutional quality of the business environment. Product innovation is not cheap investment. Therefore, businesses need to be sure that the perverse risks coming from external factors are minimal. Local regions with better institutional quality provide a more supportive business environment for firms to engage in product innovation. Moreover, better institutional quality provides a greater degree of certainty for businesses which is supremely important for firm decision whether to innovate or not. This explains why the quality of local regulations index is positive and significant for large firms regressions.

We perform the same exercise for innovation index as dependent variable. As displayed in estimation (15), we do not find significant effects of neither access to finance nor quality of local regulation for SMEs. This finding explains that the non-significant results of our main variables of interest (access to finance and quality of local regulations) in both ordered logit and poisson regressions using all sample are driven by SMEs firm sample. It is possible that an SME engages only in process innovation activities (ISO and foreign technology) while not involves at all in product innovation. This likely cheaper innovative activity may not imply the necessity of external factors such as access to finance or quality of local regulations. In other words, other firm characterictics (size, age, human capital, and foreign ownership) are already sufficient to explain variances in innovative activities of SMEs. In fact, these variables -not shown in table 6- are indeed significant in estimation (15).

Finally, estimation (16) provides the results for large firms innovation index regression. The quality of local regulations still matters however only after taking into account access to finance. Consistent with previous results, better local institutional quality is associated with more innovative activities. However, unlike estimation (14), in estimation (16) we now find that the interaction term is significant with a negative sign. This indicates that access to finance matters for large firms if they want to engage in multiple innovative activities. Large

firms that face access to finance as major obstacle are less likely to engage in more innovative activities. A better local institutional quality increases the gap of innovative activities between large firms that have problems in obtaining external financing and those large firms which face no financial constraints. One possible explanation is that an additional innovative activity means extra costs for the firms. As more innovative activities imply larger financial resources to be allocated to such activities, large firms with limited financial resources and obstacles to obtain external financing are less likely to enjoy the positive impact of better institutional quality on innovation. These large firms are strained due to financial constraints they face, even if they are large firms, hence the gap of innovative activities between large firms with no financial constraints vis-a-vis those with obstacles in access to finance increases when local institutional quality improves.

7.5 Unbundling the Effect of Local Institutional Quality & Access to Finance

In this sub-section, we unbundle the effect of local institutional quality and access to finance. We compute the adjusted predictions of different categories of local institutional quality and access to finance. To do this, we create a categorical measure of local institutional quality (above average, average, and below average). If the score of quality of local regulations index is more than 1 point below mean value, we code it as "below average". Likewise, if the score is more than 1 point above mean value, it is coded as "above average". Finally, if the score lies within -1 and 1, we code it as average.

Table 7 displays the adjusted predictions for product innovation and innovative activities regressions. The table is basically a 3X2 matrix in which quality of local regulations have 3 classifications (above average, average, and below average) while access to finance have 2 classifications (access to finance is not major obstacle and access to finance is major obstacle). For product innovation, we can see from table 7 where firms that face no obstacles in access to finance and are located in province with above average quality of regulations have 41% probability to have product innovation. In the other extreme, firms that face access to finance as major obstacle and are located in province with below average quality of regulations only have 19% chance to have product innovation. Interestingly, the lowest change of having product innovation comes from a conditon where a firm is located in province with above average quality of local regulations but faces major obstacle in access to finance (11% chance). This indicates that better institutional quality asymmetrically benefits firms with better access to finance. Consequently, the gap in product innovation between financially constrained firms and not financially constrained firms increases as institutional quality improves.

We also observe similar pattern for innovative activities. Firms located in province with above average quality of local regulations and no obstacles in access to finance have 78% chance to engage in innovative activities. On the other hand, below average quality of local regulations and major obstacles in access to finance only yield 39% chance to involve in innovative activities. Akin to estimates on product innovation, firms facing major obstacle in access to finance and yet located in province with above average quality of local regulations are the worst off ones with only 17% probability of engaging innovative activities.

Another evidence that we can draw from table 7 is that improving access to finance gives more significant impact on innovation in terms of magnitude. We also see that the innovation gap between firms with problems in access to finance and those without such problems grows as institutional quality improves. It ranges from 3x difference for product innovation (0.09 row difference to 0.30) and 4x difference for innovative activities (0.15 row difference to 0.61). Quality of local regulations is important, but it seems more urgent to remove obstacles and barriers in access to finance since the estimated magnitude is much greater. Removal of barriers to finance also reduces the asymmetrical effect of better institutional quality. In any case, the first-best condition is, as expected, to have better institutional quality and no obstacles in access to finance -a virtuous joint-impact.

Table 7. Adjusted Predictions of Quality of Local Regulations & Access to Finance

Province	Product Innovation			Innovative Activities		
	Access to Finance is Not Major Obstacle	Access to Finance is Major Obstacle	Row Difference	Access to Finance is Not Major Obstacle	Access to Finance is Major Obstacle	Row Difference
Above Average Quality of Regulations	0.41	0.11	0.30	0.78	0.17	0.61
Average Quality of Regulations	0.34	0.14	0.20	0.65	0.26	0.39
Below Average Quality of Regulations	0.28	0.19	0.09	0.54	0.39	0.15
Average of Column Differences	0.07	-0.04	---	0.12	-0.11	---

All adjusted predictions (margins) are significant at 1% level.

Product innovation is estimated with binary logit. Innovation activities index is estimated with poisson regression.

The predicted average marginal effects are estimated controlling for initial size, size, age, workers+managers average educational attainment, share of foreign ownership, industry fixed-effects, and interaction term between quality of regulations and access to finance.

8. Conclusions

Our empirical analyses provide robust evidence on the positive impact of better local institutional quality, as measured by local regulations, and access to finance on innovation. Both variables are universally significant in influencing product innovation. Meanwhile, for total innovative activities that measure both product and process innovation, the results are dependent on model specification. However, we obtain significant results for innovative activities once we control for industry fixed-effects and perform poisson regression (innovation index as a count variable). We also show that access to finance and quality of regulations matter differently for firms of different size. The former is critical for SMEs whereas the later is more relevant for large firms. We have also provided an exercise to unbundle the varying implications of access to finance and quality of local regulations under different scenarios.

Regarding causality, we believe our estimates for quality of local regulations do not suffer from reverse causality. It is unlikely for firm innovation to influence quality of local regulations. Moreover, the quality of local regulations index is constructed based on legal analysis. This approach shares the spirit of Romer and Romer (2010) who propose the use of careful and rigorous desk-study on taxation policies based on narrative/documents records. They argue that such approach lessens the omitted variable bias and weak exogeneity problem. Nevertheless, we do admit that unobserved firm characteristics might drive the results of access to finance. Unfortunately, due to the cross-sectional nature of our data, we are not able to control for any time-invariant firm unobserved characteristics to reduce any potential endogeneity problem with access to finance. We do, however, attempt to ameliorate the problem by controlling for firm initial size as well as other firm characteristics as control variables. We also perform several robustness checks by controlling for industry fixed-effects and running alternative econometric estimates for innovation activities. Although these strategies do not fully eliminate the endogeneity problem, they do help to ameliorate such problems, and thus give meaningful and robust estimates and associations (Almeida and Fernandes 2008; Ayyagari et.al., 2011).

The results of this paper also have critical policy relevance. We show that external factors i.e. access to finance and institutional quality matter for innovation. However, the relationship is more complicated than it looks. We find that better institutional quality supports innovation disproportionately for firms not facing obstacles in external financing. The innovation gap between firms facing obstacles in finance and those that are not financially constrained becomes larger as institutional quality improves. The policy implication of this finding is that simply aiming at improvement in institutional quality is not a first-best policy option.

Our investigation unveils that the effects of access to finance and quality of regulations differ by firm size. Access to finance is more relevant for SMEs whereas institutional quality matters more for large firms. Although better institutional quality and no obstacles in access to finance is the ideal conditon in which policymakers need to aim, our empirical exercises show that the matter is more complicated. We show that improving access to finance has a greater magnitude to improve the probability for firms to engage in innovative activities. In addition, improvement in access to finance also reduces the innovation gap between firms that face obstacles to obtain external financing vs firms with no financial constraints.

We do not argue that institutional quality is less important. It is critical and it has a positive impact on innovation. However, if the goal is both to boost innovation and to reduce innovation gap among firms, then improving access to finance is supremely critical. Improvement in institutional quality without any significant removal of barriers to obtain external financing will lead to larger innovation gap. Thus, the policy goal to increase the quality of local regulations and to reduce frictions in the credit markets by reducing the sources of asymmetric information may well be a virtuous policy-mix to promote innovation and to ensure that as many firms as possible engage in innovative activities.

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Appendix

Description of Variables & Summary Statistics

Variable	Source	Obs.	Mean	Std. Dev.	Min	Max
Patents (1=if the establishment has at least one patent registered in any country; 0=otherwise)	World Bank Enterprise Survey (2009)	849	0.25	0.43	0	1
Quality Certification (1=if the establishment has internationally recognised quality certification such as ISO; 0=otherwise)		856	0.11	0.31	0	1
Foreign Technology (1=if the establishment uses technology licensed from a foreign-owned company excluding office software; 0=otherwise)		854	0.11	0.32	0	1
Innovation Index (0=Firm involves in no innovative activities; 1=Firm involves in one innovative activities; 2=Firm involves in two innovative activities; 3=Firm involves in 3 innovative activities: product innovation (patents) & process innovation (ISO & use of foreign technology))		848	0.47	0.81	0	3
Initial Size (number of full-time employees at start-up)		823	48.26	140.64	1	1800
Size (1=small (5-19); 2=medium (20-99); 3=large (>99))		856	1.68	0.80	1	3
Age (age of establishment as of 2009)		838	17.95	12.04	2	97
Workers Average Educational Attainment (0=nine years of education or less; 1 = beyond nine years of education)		823	0.30	0.46	0	1
Top Managers Average Educational Attainment (0=secondary school or lower; 1=vocational school or tertiary education)		851	0.38	0.49	0	1
Workers + Managers Average Educational Attainment (0=low; 1=mixed; 2=high)		819	0.69	0.79	0	2
Share of Foreign Ownership (0=less than 10%; 1=above 10%)		853	0.06	0.24	0	1
Obstacles in Access to Finance (1=if access to finance is the establishment's biggest obstacle; 0=otherwise)		760	0.41	0.49	0	1
Quality of Local Regulations (0-100; larger score indicates better quality)	KPPOD Local Economic Governance Survey (2007)	856	85.18	1.34	80.97	86.32

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Correlation Matrix

	Initial Size	Size	Age	Education (Workers+Managers)	Foreign Ownership	Quality of Local Regulation	Obstacles in Access to Finance
Initial Size	1						

Size	0.4619	1					
	(0.00)	---					
Age	0.1365	0.2539	1				
	(0.00)	(0.00)	---				
Education (Workers+Managers)	0.3125	0.6123	0.0993	1			
	(0.00)	(0.00)	(0.00)	---			
Foreign Ownership	0.1503	0.2936	-0.0263	0.297	1		
	(0.00)	(0.00)	(0.45)	(0.00)	---		
Quality of Local Regulation	0.0089	0.0099	0.0631	-0.013	-0.0251	1	
	(0.80)	(0.77)	(0.07)	(0.71)	(0.46)	---	
Obstacles in Access to Finance	-0.1875	-0.3276	-0.0664	-0.3175	-0.1433	0.1531	1
	(0.00)	(0.00)	(0.07)	(0.00)	(0.00)	(0.00)	---

Note: Significance levels are in parentheses