

# **Social Capital and Firm Innovation: Evidence from Cooperative Banking in Korea**

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## **Abstract**

This study investigates the link between social capital and firm innovation by examining the cooperative banking channel in Korea. Social capital has a positive impact on the activities of cooperative banks, thus fostering innovation in regional firms. We first confirm a positive association between social capital and firm innovation in Korea, and find that firms located in provinces with higher social capital innovate more. We then show that social capital positively influences firm innovation mainly through the cooperative banking channel. Further, we demonstrate that the cooperative banking channel is more pronounced in regions where cooperative banks are riskier, human capital is less, and commercial banking is less developed. (JEL Z13, G21, O16, O31, P13)

**Keywords:** Social Capital; Firm Innovation; Cooperative Banking Channel.

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## 1. Introduction

Social capital has been broadly defined as the advantages that accrue to people through membership in certain communities (Bourdieu, 1986). Since the seminal works of Banfield (1958), Putnam (1993), and Fukuyama (1995), many economists have considered the notion of social capital in explaining a wide range of economic phenomena, such as productivity, growth, and firm performance (Beugelsdijk and Van Schaik, 2005; Coleman, 1988; Guiso et al., 2004; Helliwell, 1996; Helliwell and Putnam, 1995; Knack and Keefer, 1997; Zak and Knack, 2001). In particular, the accumulation of knowledge and the resultant increase in innovation output have been shown to be related to the level of social capital, acting as an important mechanism through which the economic growth of a country is promoted (Akcomak and Ter Weel, 2009; Baba and Walsh, 2010; Eiteneyer et al., 2019; Kim and Kang, 2014; Reiche et al., 2009).

Although various studies show that social capital alleviates barriers hindering innovation, there is still controversy about the specific barrier that social capital lowers (Dakhli and De Clercq, 2004; Kaasa et al., 2007; Knack and Keefer, 1997; Laursen et al., 2012). On the one hand, Dakhli and De Clercq (2004) and Laursen et al. (2012) claim that social capital promotes community networks, thus facilitating the sharing of technological information among the members of the community. On the other hand, Knack and Keefer (1997) argue that higher levels of social capital imply lower monitoring costs of misconduct of other partners, thereby enabling firms to devote more time and money to innovative activities.

In this regard, this study investigates the channel through which social capital enhances a firm's innovation output. Specifically, we focus on the causal relationship between social capital and banking activities, as a channel through which social capital promotes firm innovation. The

level of social capital may be positively correlated with banking activities of a region, because a financial contract is one of the most trust-intensive activities (Guiso et al., 2004). Further, considering that long-term financing is a vital factor for the success of innovative firms, active bank lending leads to higher firm innovation (Lerner et al., 2011).

Moreover, we conjecture that this channel would be more evident in cooperative banking, which indicates retail and commercial banking organized on a cooperative basis (Maroor, 2013). According to the International Cooperative Alliance (ICA), a cooperative bank is defined as an autonomous association of persons united voluntarily to meet their common economic, social, and cultural needs and aspirations through a jointly-owned and democratically-controlled enterprise. As cooperative banks are relatively small and community-based, their activities are less subject to formal regulations<sup>1</sup> and more affected by informal network and social norms (Jin et al., 2017). Therefore, the level of social capital of a region would be pivotal for the region's cooperative banking activities. Also, it is known that active relationship banking, which could be potentially provided by cooperative banks, is a key factor for the success of innovation projects (Hombert and Matray, 2017). Thus, this study examines whether social capital promotes a region's cooperative banking activities, and thereby fosters firm innovation.

Using Korea's social capital measure (i.e., *SocCap*) for each province and pooled cross-sectional firm data, we first confirm the positive association between social capital and firm innovation, before examining the validity of the cooperative banking channel. We find evidence supporting the causal link between social capital and firm innovation: firms located in a province

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<sup>1</sup> For example, in Korea, the maximum loan-to-value ratio allowed to cooperative banks is 50%, whereas the ratio for commercial banks is 40%.

with higher social capital innovate more than those located in a province with lower social capital. Next, we run a set of regressions to verify the effectiveness of the cooperative banking channel. We show that social capital positively influences a region's cooperative banking activities, which, in turn, promotes innovation among regional firms. We also show that the coefficients of *SocCap* lose their statistical significance when a cooperative banking activity variable is included in the regression. The results strongly support the effectiveness of the cooperative banking channel, while indicating no direct effect of social capital on innovation. Indeed, our findings remain intact when we employ alternative measures for regional social capital and firm innovativeness to check the robustness.

Moreover, we extend our analyses by considering variables related to bank risk, human capital, and commercial banking development. Consistent with our expectations, the cooperative banking channel is more prominent in regions where cooperative banks are riskier, human capital is less, and commercial banking is less developed. First, we find that the impact of social capital is strong when the cooperative bank risks are high. This result implies that banks operating in riskier conditions could benefit more from the support of regional communities. We also find that social capital has a significant impact on firms in low human capital regions, indicating social capital functions as a substitute for human capital in innovation activities. Finally, we find that an increase in commercial banking size reduces the impact of social capital on firm innovation. This can indicate that when commercial banks provide sufficient funds to firms, the role of cooperative banks in supplying money to local firms becomes less crucial.

Our study contributes to the literature on social capital and corporate innovation in two ways. First, we conduct a comprehensive investigation into how social capital is contingent on a firm's innovativeness. Although it has been argued that the level of social capital is a crucial factor

for firm innovation (Akcomak and Ter Weel, 2009; Baba and Walsh, 2010; Eiteneyer et al., 2019; Kim and Kang, 2014; Reiche et al., 2009), there has been no clear explanation about how social capital affects the innovation performance of a firm. Thus, our study fills the research void by providing direct empirical evidence on the effectiveness of the cooperative banking channel.

Second, our work extends prior findings on social capital and firm innovation in developed economies to the context of emerging economies. Specifically, we focus on the Korean economy because Korea—a representative of emerging countries—has ideal settings for examining the impact of social capital on firm innovation. Most of all, Korean society has long been demonstrated its collaborative culture, based on strong social trust and tie (Hong and Kim, 1998; Kim and Finch, 2002). This feature makes the country an especially interesting research target for investigating the role of social capital. In addition, Korea is one of the most innovative countries, ranking first in the Bloomberg Innovation Index since 2014. As innovation is essential for the long-term economic growth of countries (Baer, 2012; Hall et al., 2005; Kogan et al., 2017; Schumpeter, 1934; Solow, 1957), the accomplishments of highly innovative Korean firms provide strong motivation to explore the cause. Finally, Korea’s largely bank-based financial system facilitates the analysis of the cooperative banking channel. Thus, by analyzing Korean firms, our study presents the important role of social capital in firm innovation in the emerging market context.

The remainder of this paper is organized as follows: Section 2 reviews the related literature and develops the study’s hypotheses. Section 3 explains the study’s data and empirical methodology. Section 4 presents the results. Finally, Section 5 concludes the paper.

## **2. Related Literature and Hypotheses Development**

## 2.1 Social Capital

Social capital has been widely interpreted as the opportunities accruing to people through the membership of communities (Bourdieu, 1986). Coleman (1990) describes social capital as resources, including trust and norms that emerge from social relationships. Putnam (1993) highlights social capital as having several features of a social organization—trust, norms, and informal networks—that facilitate coordination and cooperation for mutual benefit within a society. Although the definition of social capital is slightly different, both Coleman (1990) and Putnam (1993) refer to trust and civic norms as manifestations of social capital.

Specifically, after the seminal works of Banfield (1958), Putnam (1993), and Fukuyama (1995), social capital has been identified as an important factor in producing various economic outcomes. For example, Helliwell and Putnam (1995) demonstrate that social capital is an important determinant of economic growth, identifying the link between social capital and the regional wealth levels in Italy. Knack and Keefer (1997) and Zak and Knack (2001) also provide evidence that high levels of social capital are positively correlated with economic growth, even after controlling for other exogenous factors. La Porta et al. (1997) document a strong correlation between the trust level of a country and the presence and success of large organizations, including the government, civic associations, and corporations. Furthermore, a growing body of literature claims that high levels of social capital, based on generalized trust, result in the development of financial markets. Guiso et al. (2004) argue that social capital facilitates financial developments, including the use of checks, investment in stock, and access to institutional credit. According to Mistrulli and Vacca (2015) and Jin et al. (2017), firms and banks that are located in areas with higher social capital suffer less from the negative impacts of the financial crisis. Ostergaard et al. (2015) also show that social capital improves the survival rate of the Norwegian savings banks,

which are banks governed by their stakeholders.

## **2.2 Social Capital and Firm Innovation**

In addition to the economic variables mentioned in the previous section, firm innovation is also widely known to be influenced by social capital (Akcomak and Ter Weel, 2009; Baba and Walsh, 2010; Eiteneyer et al., 2019; Kim and Kang, 2014; Reiche et al., 2009), and a considerable strand of literature empirically supports this causal relationship. Dakhli and De Clercq (2004) demonstrate the positive impact of social trust and associational activities on firm innovation. Moreover, based on a sample of manufacturing firms in Spain, Molina- Morales and Martinez-Fernandez (2010) find a strong association between district affiliation, social capital, and innovation. Kaasa et al. (2007) show that social capital and institutional quality are the determinants of innovation, as well as research and development (R&D) and human capital. Further, Luk et al. (2008) assess the benefits of social capital in enhancing firms' administrative and product-related innovativeness, in institutional contexts of a transition economy and a market economy.

As innovation is a key driver for the long-term economic growth of countries (Baer, 2012; Hall et al., 2005; Kogan et al., 2017; Schumpeter, 1934; Solow, 1957), clarifying the link between social capital and firm innovation is especially important. However, while social networking and ties are prevalent in the emerging economies due to strong collectivistic cultures (Acquaah, 2007), there have been few studies investigating the link between social capital and firm performances in those countries (Peng and Luo, 2000). In this regard, by using the data of the Korean economy, we confirm whether the causal link between social capital and firm innovation also exists in the

context of emerging economies.

Furthermore, testing the impact of social capital on innovation performance in Korea's context would be especially interesting, for the following reasons. First, historically, cooperation and collective altruism on the basis of social trust have played a significant part in the Korean economy. For example, a voluntary association called "Gye" has served the role of a cooperative and self-sufficient informal money-lending community—pooling financial resources from its associates—for thousands of years, when financial institutions did not exist (Hong and Kim, 1998). Further, the gold collection campaign—initiated voluntarily by Korean citizens during the 1997 Asian financial crisis—well-illustrates such a feature of Korean society. The campaign collected a huge amount of gold, almost 10% of the value of the government's bailout loan to the International Monetary Fund, substantially contributing to overcoming the national crisis (Kim and Finch, 2002). Second, Korea is one of the most innovative countries in the world, ranking first in the Bloomberg Innovation Index for six straight years since 2014. Considering that Korea's innovativeness was a key driver of its rapid economic growth in the past decades, certain features of Korean society may have contributed to the growth by fostering Korean firms' innovation.

Therefore, we first examine whether firms in Korea with higher levels of social capital show better innovation performance than those with lower levels of social capital.

**Hypothesis 1: *Social capital promotes firm innovation.***

### **2.3 Cooperative Banking Channel**

Although various studies show that social capital lowers barriers hindering firm innovation,



there is still controversy about the specific barrier that social capital lowers. On the one hand, some scholars argue that social capital promotes a region's social network, thus helping people to share different ideas and information related to technology (Dakhli and De Clercq, 2004). As the main source of innovation is knowledge flows among individuals, firms, and regions (Anselin et al., 1997; Audretsch and Feldman, 1996; Romer, 1986), social capital could be an important indirect source of innovation (Maskell, 2000). On the other hand, other researchers contend that high levels of social capital imply low possibilities of misconduct or non-fulfilment by other partners (Knack and Keefer, 1997), thereby enabling firms to devote more time and money to innovation activities. Moreover, because investors in regions with high levels of social capital would be less risk averse, they may invest more in risky projects, including R&D (Akcomak and Ter Weel, 2009).

Against this background, our objective is to examine the channel through which social capital spurs firm innovation. We suggest a novel channel—the cooperative banking channel—in which social capital has a positive association with cooperative banking activities of a region, thereby promoting regional firm innovation. This channel may be valid for the following reasons.

First, social capital is positively associated with a region's banking activities, because credit—an exchange of a sum of money today for a promise to pay back in the future—is an ultimate trust-intensive activity (Guiso et al., 2004). Furthermore, we posit that the impact of social capital on banking activities would be stronger in cooperative banking than in commercial banking. Cooperative banking indicates retail and commercial banking for the improvement of communities' economic, social, and cultural conditions, based on regional and social ties (Maroor, 2013). Cooperative banks are less subject to formal monitoring, while their operations are restricted to the counties where they are located. Due to these characteristics, cooperative banking is typically more related to informal regional networks and norms, and thus social capital has the potential to

play a more direct role in cooperative banking than commercial banking (Jin et al., 2017). That is, residents in a high social capital area would be more willing to put their money in their cooperative bank accounts than those in a low social capital area. Moreover, the higher the level of regional social capital, the more cooperative banks trust their borrowers or entrepreneurs during the process of making lending decisions.

Second, active relationship banking provided by cooperative banks may help regional firms obtain long-run, stable funding, which is a key success factor for innovation (Hombert and Matray, 2017; Lerner et al., 2011). Although mitigating the funding gap for R&D investment is crucial for innovative firms, it is widely known that innovation activities, including R&D, are difficult to finance in a freely competitive market place (Arrow, 1962; Eiteneyer et al., 2019; Levin et al., 1987; Mansfield et al., 1981; Nelson, 1959). Specifically, innovative small and medium-sized enterprises (SMEs) experience high costs of capital due to information asymmetry and moral hazard problems (Hall and Lerner, 2010). Furthermore, R&D investments typically need long-term financing, that is, while R&D costs are expensed immediately, their benefits are unlikely to be visible even after several years of investment (Meulbroek et al., 1990). In this respect, cooperative banking may play a crucial role in boosting regional innovative outcomes by supplying timely, cheap, and patient capitals to local entrepreneurs. Indeed, according to the Industrial Bank of Korea (2019), in 2018, 67.6% of Korean SMEs that received loans from non-bank financial institutions, including cooperative banks, responded that they use non-bank financial institutions because the loan screening of those institutions is less tight than that of commercial banks. Moreover, the average interest rate of cooperative banks is similar to that of commercial banks, while it is cheaper

than that of other non-bank financial institutions.<sup>2</sup> Due to these benefits, the cooperative banking business in Korea has dramatically expanded over the past few years, accounting for 15.8% of total SME loans in 2019. Figure 1 demonstrates the share of cooperative bank SME loans among the total SME loans, as well as the growth rates of SME loans from cooperative banking and commercial banking.<sup>3</sup>

**[Insert: Figure 1]**

Ultimately, the long-term investments made by cooperative banks in high social capital areas would lead to better innovative outcomes of regional firms. In particular, Korea's largely bank-based financial system is an ideal setting for an experiment on the validity of the cooperative banking channel. Although Korea is usually ranked high on most financial development measures (Demirguc-Kunt and Levine, 2004), it has been argued that the Korean financial system is heavily skewed toward the banking sector (Binh et al., 2006). For instance, stocks comprise less than 10% of Korean households' financial assets, while bank deposits make up more than 50%. Thus, we expect that this channel would be effective in Korea, which leads to the following hypothesis.

***Hypothesis 2: Social capital promotes firm innovation through the cooperative banking channel.***

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<sup>2</sup> As of 2019, the average interest rate of the cooperative bank is 4.47% for community credit cooperatives and 4.61% for credit unions. This is similar to the average rate of commercial banks (3.46%) and is far below that of savings banks (7.49%).

<sup>3</sup> Improvement in the financing conditions of small and medium-sized manufacturing firms arguably helps fill the R&D funding gap, even though there is no evidence that cooperative bank SME loans have been directly invested in R&D projects.

### 3. Data and Empirical Methods

#### 3.1 Data and Variable Description

##### *3.1.1 Measuring social capital*

The literature of social capital has widely used the score of generalized trust in World Value Survey (WVS) as a proxy for social capital (La Porta et al., 1997; Ostergaard et al., 2015; Zak and Knack, 2001). The rationale for using this measure is that the benefits of social capital can arise only when social capital has an impact on expectations related to trust and civic norms (Fukuyama; 1995; Granovetter, 1985).

Although WVS is the most widely used data to measure social capital for both cross-country and province-level analyses (Ostergaard et al., 2015), WVS is not stratified at the province-level in Korea. Thus, we employ an alternative measure from the Social Survey conducted by Statistics Korea. Specifically, following Knack and Keefer (1997), instead of generalized trust, we focus on the question of the survey that asks about the belief in the level of adherence to the civic norms among society members.<sup>4</sup> It would be an appropriate measure for social capital because civic norms comprise a major component of social capital and are linked with economic outcomes in the same ways as trust. As Coleman (1990) noted, cooperative norms act as constraints on self-interest. To the extent that civic norms effectively constrain opportunism, the costs of monitoring and enforcing contracts are likely to be lower, raising the payoffs on many

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<sup>4</sup> There is a survey in Korea, Korean General Social Survey (KGSS), that asks about people's generalized trust levels in a similar way to WVS and provides regional information in Korea. However, KGSS divides Korea into only 12 regions (i.e., Seoul, Busan, Daegu, Incheon, Gwangju, Daejeon, Ulsan, Gyeonggi, Gangwon, Chungcheong, Jeolla, Gyeongsang, and Jeju), not 16 regions, which might not be sufficient to reflect each region's characteristics. In this regard, we employ the KGSS dataset only for the robustness check in Section 4.

investments and other economic transactions (Knack and Keefer, 1997).

In this regard, our *SocCap* is constructed based on the response to the following statement in the Social Survey: “most members in the society follow social norms.” Respondents could choose a number that ranged from one (i.e., strongly agree) to five (i.e., strongly disagree). The individual scores were then averaged by each province, and the average value was deducted from five, implying that a larger score indicated a higher level of social capital. Moreover, social capital is generally viewed as a cultural variable that is inherited in a society, and thus, changes only slowly over time (Knack and Keefer, 1997). Therefore, we calculated the time-invariant *SocCap* based on the survey conducted in 2001, which explains the innovation performance of firms in the subsequent period.<sup>5</sup>

### **3.1.2 Innovation measure**

Following empirical literature on firm innovation (Acharya et al., 2014; Cao et al., 2013), we use patent count data from the Korean Innovation Survey (KIS) conducted by the Science and Technology Policy Institute (STEPI)—which stores pooled cross-section data—for 2002, 2005, 2008, 2010, 2012, 2014, and 2016.<sup>6</sup> Although we could not exactly identify firm names from the data, KIS data includes various firm characteristics information, including the number of patents, R&D expenditure, asset size, age, industry, and province in which the firm is located, for each year.

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<sup>5</sup> To confirm the validity of our social capital measure, we aggregate regional social capital scores at the national level with the Social Survey data conducted in 2001, 2005, and 2010, respectively. We then compare them with the average trust scores of Korea, which are calculated by WVS Wave 4 (1999-2004), Wave 5 (2005-2009), and Wave 6 (2010-2014), and the pair-wise correlation between the two scores is positive but insignificant (0.078). Nevertheless, it is important to note that the sample periods of each survey are not exactly matched, and that only three sample periods are available for the calculation of correlation coefficient.

<sup>6</sup> Although our firm list for measuring regional innovation performances is not a population data, STEPI randomly samples the list of manufacturing firms based on the Census on Establishment every survey year. Thus, we believe that there will be no selection bias in our sample firm list.

Thus, using the KIS dataset, we could examine the impact of the regional social capital level on firm innovation performance, after controlling firm- and province-specific characteristics as well as time dummies.<sup>7</sup>

### ***3.1.3 Cooperative banking activities***

In our analyses, we separately examine the impacts of social capital on both credit and deposit of cooperative banking activities. We define cooperative banks as community credit cooperatives and credit unions in Korea. This classification is reasonable, considering that both institutions state that they aim to contribute to the development of local communities on the basis of the members' common bonds (Community Credit Cooperatives Act, 2017; Credit Unions Act, 2015) and they are the members of the ICA.<sup>8</sup> Specifically, we calculate the logged values of total deposits and loans per capita by province, using the cooperative banking data obtained from the Financial Statistics Information System (FISIS) of the Financial Supervisory Service.

### ***3.1.4 Control variables***

We control for both firm- and region-level characteristics in the analyses of the link between social capital and firm innovation. Moreover, we control for only the region-level variables when testing the relationship between social capital and regional cooperative banking activities. This is because the firm-level characteristics have the potential to affect the innovation performance of firms but not province-level banking activities. *Age*, *Size*, and *R&D* from the KIS

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<sup>7</sup> When conducting analyses using a pooled cross-section data, we should consider year effects to account for unobservable time-specific characteristics (Wooldridge, 2002).

<sup>8</sup> Although agricultural, fisheries, and forestry cooperatives are also members of ICA, their objective is to improve the status of members in certain industries, such as agriculture, fishery, and forestry. We exclude these institutions in our analyses because our goal is to identify the impact on the activities of cooperative banks on a regional basis.

data are used for firm-level control variables. *Age* indicates the age of a firm; *R&D* is the logarithm of R&D expenditure; and *Size* is calculated as the logarithm of total sales. We also measure regional characteristic variables, including *PostEduc*, *Income*, *Deposit<sup>Commercial</sup>*, and *Loan<sup>Commercial</sup>*, by matching firm location obtained from the KIS data to the province-specific values. *PostEduc* refers to a dummy variable and equals one if the percentage of people who received post-secondary education in province *j* is above the median, and zero otherwise; *Income* is calculated as the logarithm of gross regional domestic product per capita; and *Deposit<sup>Commercial</sup>* and *Loan<sup>Commercial</sup>* are measured as the logarithms of total commercial bank deposits and loans per capita, respectively. The regional education level and gross regional domestic product data are collected from Statistics Korea, and the commercial banking data are gathered from FISIS.

### ***3.1.5 Sample period***

We analyze the impact of *SocCap*, measured as of 2001, on the innovation performance of regional firms and cooperative banking activities in the subsequent years. However, as stated earlier, KIS provides regional firm data for its 7 survey years. Thus, sample periods for the impact on regional innovation performance only include KIS' survey years (i.e., 2002, 2005, 2008, 2010, 2012, 2014 and 2016), whereas those for the impact on cooperative banking activities include all the subsequent 17 years (i.e., 2001 to 2017) since 2001.

### ***3.1.6 Variable description***

In Panel A of Table 1, we report *SocCap* values across 16 provinces in Korea. The values of *SocCap* in most provinces, 13 provinces among 16, are less than three, indicating that overall there are more respondents who disagreed with people's compliance with social norms. Also, Panel A shows that Jeonnam Province has the highest value of *SocCap* (3.11), while Jeju Province has

the lowest (2.89).

### [Insert: Table 1]

Panel B of Table 1 presents the regional distribution of the numbers of patents applied for by our sample firms (i.e., *Innov*) each year. It is noteworthy that there is a large difference in the number of patents in each province. For instance, in 2016, the difference between the province with the largest number of patents (Gyeonggi Province, 397) and the province with the smallest number (Jeju Province, 2) is 395. This large deviation between provinces suggests that various regional-level characteristics should be controlled in the analyses of the following sections.

Summary statistics for all the firm- and province-level variables are reported in Panel C of Table 1. Appendix A provides definitions of these variables in greater detail. The 10<sup>th</sup> percentile of the dependent variables (i.e.,  $\ln(1+Innov)$ ,  $Deposit^{Cooperative}$ , and  $Loan^{Cooperative}$ ) are all larger than or equal to zero, because they are left-censored at zero. The number of observations for firm-level variables is 20,096, indicating that the sample includes 2,871 firms on average every survey year. The number of observations for province-level variables is only 272<sup>9</sup>, far less than the number for firm-level, because there are 16 provinces in Korea and our data period of the province-specific information is 17 years (i.e., from 2001 to 2017).

## 3.2 Empirical Methods

Our first hypothesis concerns the causal relationship between the level of social capital and

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<sup>9</sup> FISIS does not provide the capital ratio of cooperative banks for 2007, and thus the sample size of *CapRatio* (introduced later in Section 4.3.1) is 256, which is 16 less than the observations of other province-level variables.



regional firm innovation. Specifically, we model the following regression:

$$\ln(1 + Innov)_{ijkt} = \beta_1 SocCap_j + \beta_2' X_{it-1} + \beta_3' Y_{jt-1} + \alpha_t + \gamma_k + \varepsilon_{ijkt}, \quad (1)$$

where  $\ln(1 + Innov)_{ijkt}$  is the logarithm of one plus the patent count of firm  $i$  located in province  $j$  and belonging to industry  $k$  in year  $t$ ;  $SocCap_j$  is the level of social capital in province  $j$  calculated from the Social Survey conducted in 2001;  $X_{it-1}$  is a vector of the firm characteristics mentioned in the prior section;  $Y_{jt-1}$  is a vector of the province-level control variables;  $\alpha_t$  and  $\gamma_k$  are year and industry fixed effects based on two-digit Korean Standard Industrial Classification codes, respectively; and  $\varepsilon_{ijkt}$  is the error term. As *Hypothesis 1* predicts that higher levels of social capital will foster firm innovation, we expect the estimated coefficient of  $\beta_1$  to be positive (i.e.,  $\beta_1 > 0$ ).

We then verify the effectiveness of cooperative banking channel through which social capital promotes firm innovation. In particular, *Hypothesis 2* is tested by the following set of regression models:

$$Banking_{jt}^{Cooperative} = \beta_1 SocCap_j + \beta_2' Y_{jt-1} + \alpha_t + \varepsilon_{jt}; \quad (2)$$

$$\begin{aligned} \ln(1 + Innov)_{ijkt} = & \delta_1 Banking_{jt-1}^{Cooperative} + \delta_2 SocCap_j + \delta_3' X_{it-1} + \delta_4' Y_{jt-1} \\ & + \alpha_t + \gamma_k + \varepsilon_{ijkt}, \end{aligned} \quad (3)$$

where  $Banking_{jt}^{Cooperative}$  is the logarithms of total deposits and loans of cooperative banks located in province  $j$  in year  $t$  (i.e.,  $Deposit_{jt}^{Cooperative}$  and  $Loan_{jt}^{Cooperative}$ ), and all other variables are identical to those in Regression (1). Our empirical strategy consists of the following two steps. First, Regression (2) examines a causal link between social capital and cooperative

banking activities of a region, and we expect that social capital has a positive impact on cooperative banking activities in Regression (2) (i.e.,  $\beta_1 > 0$ ). Then, in Regression (3), we include both *Banking<sup>Cooperative</sup>* and *SocCap* as explanatory variables, thus investigating the relationship between cooperative banking activities and firm innovation ( $\delta_1$ ), as well as the direct impact of social capital on firm innovation ( $\delta_2$ ). As we hypothesized that the cooperative banking channel is valid, regional cooperative banking that is activated by social capital would have a positive influence on firm innovation (i.e.,  $\delta_1 > 0$ ). If the coefficient of *SocCap* in Regression (2) and that of *Banking<sup>Cooperative</sup>* in Regression (3) are both positive, we can conclude that the cooperative banking channel effectively works in Korea. Furthermore, in addition to the effectiveness of the cooperative banking channel, we can also check whether social capital directly affects firm innovation (i.e.,  $\delta_2 > 0$ ).

Throughout Regressions (1) to (3), the Tobit model is used to estimate the coefficients, because the dependent variables (i.e.,  $\ln(1 + Innov)_{ijkt}$  and *Banking<sup>Cooperative</sup><sub>jt</sub>*) are all left-censored at zero. We control for year and industry fixed effects in Regressions (1) and (3) to account for any unobservable year- and industry-specific endogenous influences, and we control for year fixed effects in Regression (2) to account for any year-specific endogenous influences. Moreover, standard errors are clustered at the industry-year level in Regressions (1) and (3), and at the year level in Regression (2). Finally, we exploit one year-lagged controls in all regressions to mitigate a potential reverse causality problem.

#### 4. Empirical Results

#### 4.1 The Impact of Social Capital on Firm Innovation through the Cooperative Banking Channel

Table 2 presents the simple relationship between social capital and firm innovation, before verifying the cooperative banking channel. In Column (1), we estimate the effect of social capital level on firms' innovation output, including firm-level control variables only. Although *SocCap* shows a negative coefficient ( $-0.245$ ), the t-value is relatively small ( $-0.55$ ), implying that the coefficient is not statistically significant. When province-specific characteristics are included in Column (2), the coefficient of *SocCap* turns positive ( $1.483$ ) and statistically significant at the 1% level ( $t = 2.68$ ). Thus, we find that firms in provinces with higher social capital produce more innovation output than those in provinces with lower social capital do. Further, *R&D*, *Size*, *PostEduc*, and *Loan<sup>Commercial</sup>* all show positive coefficients, which is in line with our expectation that greater R&D expenditure, bigger firm size, higher education level, and more commercial bank loans to regional firms will lead to a higher success probability of regional firms' innovation projects. Moreover, the coefficients of *Age*, *Income*, and *Deposit<sup>Commercial</sup>* are negative, although *Income* is not statistically significant ( $t = -0.94$ ). These results can be interpreted as indicating that young and newly established firms make more innovation efforts than old firms do, and that the increase in commercial bank deposits is related to a decrease in the amount of investment in innovation by firms.

**[Insert: Table 2]**

In Tables 3 and 4, we demonstrate how social capital affects firm innovation, by examining the cooperative banking channel. Table 3 shows the extent to which social capital influences cooperative banking activities. Specifically, Table 3 Columns (1) and (2) show the estimation

results when the dependent variable is  $Deposit^{Cooperative}$ , whereas Columns (3) and (4) show the results when the dependent variable is  $Loan^{Cooperative}$ . We find that the coefficients of  $SocCap$  on both  $Deposit^{Cooperative}$  and  $Loan^{Cooperative}$  are positive and statistically significant, regardless of whether the province-specific controls are included.<sup>10</sup> That is, cooperative bank deposits and loans are positively affected by the level of social capital, consistent with the findings of extant studies (Guiso et al., 2004; Ostergaard et al., 2015).

**[Insert: Table 3]**

Next, we focus on whether cooperative banking activities that are fostered by the regional social capital have a significant impact on firm innovation. In Table 4, we show the results of Regression (3), in which the cooperative banking variable (i.e.,  $Deposit^{Cooperative}$  or  $Loan^{Cooperative}$ ) is included as an explanatory variable in addition to  $SocCap$ . The results indicate that both cooperative banking variables are positive and statistically significant at the 1% level, except in Column (4), where the coefficient shows statistical significance at the 5% level. Combining the results in Tables 3 and 4, we can conclude that social capital significantly fosters regional cooperative banking activities, and thereby results in better innovation output. In other words, the cooperative banking channel is effective in Korea. We also find that the coefficients of  $SocCap$  lose their statistical significance in Table 4, while being marginally significant only in Column (1). Thus, social capital influences firms' innovation performance mainly through the cooperative banking channel, whereas it has little direct impact on innovation.

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<sup>10</sup> We also estimate the coefficients of  $SocCap$  when the dependent variable is regional commercial banking activities (i.e.,  $Deposit^{Commercial}$  and  $Loan^{Commercial}$ ). In untabulated results, we observe the impact of  $SocCap$  on commercial banking is either negative ( $Deposit^{Commercial}$ ) or insignificant ( $Loan^{Commercial}$ ). The results confirm that social capital play a more direct role in cooperative banking than commercial banking (Jin et al., 2017).

[Insert: Table 4]

## 4.2 Robustness Checks

To show the robustness of our findings, we exploit the alternative measures of regional social capital and the innovativeness of a firm: first, we calculate *Trust* using the KGSS dataset that measures the generalized trust levels of 12 sub-regions in Korea; second, we run our regression models using an innovation input variable (i.e., *R&D*), instead of an output variable (i.e.,  $\ln(1+Innov)$ ).

Panel A of Table 5 shows the results of estimations where *SocCap* is replaced by *Trust*. The results indicate the positive impact of *Trust* on firm innovation, as well as the validity of the cooperative banking channel. This suggests that the choice of a dataset for social capital does not make difference to the results of our analyses. In addition, in Panel B, we note that our story that social capital promotes innovation activities mainly through the cooperative banking channel does not change, even when the measure of firm innovation is substituted to an innovation input variable. In sum, these test results help present a solid relationship between social capital and firm innovation, and confirm the validity of the cooperative banking channel.

[Insert: Table 5]

## 4.3 When Does the Cooperative Banking Channel Become More Prominent?

Further, we provide evidence concerning the settings in which the cooperative banking

channel would be more noticeable: first, we conjecture that the impact of social capital on cooperative banking is more pronounced when cooperative banks operate in riskier conditions; second, we examine whether social capital functions as a complement or substitute for human capital in firm innovation; and finally, we focus on the difference in the effect of social capital based on the development of commercial banking in a region.

#### ***4.3.1 The impact of bank risks on cooperative banking activities***

Ostergaard et al. (2015) report that regional banks operate with lower levels of equity capital when they are patronized by the local community. This is because the network and support of the community could offset the community-based institution's unfavorable condition in raising deposits (Ostergaard et al., 2015). That is, banks that operate in riskier conditions could benefit more from regional social capital. Furthermore, as social capital also helps banks overcome adverse selection problems, high social capital banks can operate more aggressively, typically retaining less equity capital (Jha and Chen, 2015). Thus, we posit that the impact of social capital on cooperative banking activities—both deposits and loans—is more pronounced when the cooperative bank risks are higher.

To examine the effect of bank risks, we note two representative bank ratios—the bank capital ratio and nonperforming loan (NPL) ratio, which are related to the capital adequacy and credit soundness of a bank, respectively. Using these ratios, we construct dummy variables that measure the level of bank risks: *CapRatio* equals one if the average value of the capital ratio of cooperative banks in province  $j$  is above the median, and zero otherwise; and *NPLRatio* equals one if the average value of nonperforming loan ratio of cooperative banks in province  $j$  is above the median, and zero otherwise. By adding an interaction term (i.e.,  $SocCap \times CapRatio$  or

$SocCap \times NPLRatio$ ) in Regression (2), we can then capture the effect of cooperative bank risks in the relation between social capital and banking activities.

Table 6 presents the results of the estimation examining the role of bank risks. When the bank risk measure is  $CapRatio$  (i.e., Panel A), the estimated coefficients of the interaction variables on  $Deposit^{Cooperative}$  and  $Loan^{Cooperative}$  are all negative, regardless of whether province-level controls are added. The coefficients are also statistically significant at the 1% level, except in Column (1). Furthermore, when the risk proxy is  $NPLRatio$ , the coefficients of the interaction variables are all positive. Considering that the lower capital ratio and higher NPL ratio represent higher risks in terms of bank stability, the estimated results are in line with our expectation.

**[Insert: Table 6]**

#### ***4.3.2 The relationship between social and human capital: complement or substitute?***

Next, we investigate the relationship between social and human capital. Social and human capital can interact in two ways—as complements or substitutes. On the one hand, the positive impact of human capital, including the level of education, can be reinforced by social capital (Andrews, 2011; Miguelez et al., 2011; Schuller, 2001). The accumulation of human capital may help strengthen trust among society members, and thus, a local entrepreneur can draw on social trusts to induce stronger support from regional cooperative banks. On the other hand, social and human capital can be viewed as substitutes for each other (Boxman et al., 1991; Meier et al., 2016). In this viewpoint, social capital is a positive environment factor, thus making human capital less crucial to the organizational performance. For example, managers would invest fewer resources in obtaining human capital when a high level of social capital effectively fosters regional cooperative banking that substantially mitigates funding gap for the success of innovative projects.

Thus, we test two opposing hypotheses by including an interaction term composed of social and human capital (i.e.,  $SocCap \times HumCap$ ) in Regression (1). For the variable indicating the level of human capital, we use *PostEduc*—which is also used as a control in testing *Hypotheses 1* and 2—and *SchoolYear* (i.e., a dummy variable that equals one if the average number of years of schooling in province  $j$  is above the median, and zero otherwise).

In Table 7, we find that the coefficients of the interaction variables are all negative. Panel A presents the estimated coefficients of  $SocCap \times PostEduc$ , and they are negative and statistically significant at the 5% level in both Columns (1) and (2). Moreover, in Panel B, the size and t-value of the estimation become larger, showing statistical significance at the 1% level. Therefore, the results consistently indicate that social capital acts as a substitute for human capital, rather than a complement.

**[Insert: Table 7]**

#### ***4.3.3 Commercial banking development and the impact of social capital on firm innovation***

Finally, we estimate how the effect of social capital on innovation changes under high and low levels of commercial banking development. Cooperative banking reportedly supports the financial system by financing sectors and projects where finance from commercial banks is not readily available (Schmidt, 2009). Therefore, if local firms could successfully receive loans from the commercial banking system, the impact of cooperative banking would be relatively weak. In this regard, we expect that the positive influence of social capital on firm innovation, which occurs primarily through the cooperative banking channel, decreases in the region where commercial banking is more developed.



Using the data on commercial bank deposits and loans, we construct dummy variables that equal one if the commercial banking size in province  $j$  is above the median, and zero otherwise (i.e.,  $High\_Deposit^{Commercial}$  and  $High\_Loan^{Commercial}$ ). After including the interaction term composed of the variables of social capital and commercial banking size, we examine whether the impact of social capital changes according to the commercial banking development of a province.

Table 8 shows the result of the estimation where the interaction term is added in Regression (1). Consistent with our expectation, we find that an increase in the deposits and loans in commercial banking reduces the impact of social capital on firm innovation. Specifically, in both Panels A and B, the coefficients of the interaction variable are significantly negative, although the estimated coefficient in Column (1) of Panel B is only marginally significant ( $t = -1.83$ ). Thus, when commercial banking provides sufficient funds to local firms, the supporting role of cooperative banking in financial system becomes less crucial, decreasing the impact of social capital on firm innovation.

**[Insert: Table 8]**

## **5. Concluding Remarks**

This study contributes to the literature on social capital and firm innovation by examining the cooperative banking channel in Korea—which is a representative of emerging economies and has ideal settings for the natural experiment—wherein social capital has a positive association with regional cooperative banking, and an active cooperative banking system in turn enables firms to

obtain long-run, stable investment for their innovation. Specifically, using *SocCap* for each province and pooled cross-sectional firm data, we first provide evidence supporting the causal link between social capital and firm innovation: firms located in high social capital provinces show more innovation outcomes than those in low social capital provinces. We then examine the effectiveness of the cooperative banking channel. We find that social capital fosters regional cooperative banking, which subsequently boosts innovation output of regional firms. Thus, our empirical findings suggest that the cooperative banking channel works effectively in Korea, while no direct impact of social capital on firm innovation is observed.

Furthermore, we show the regional settings in which the cooperative banking channel becomes more prominent: first, the effect of social capital on cooperative banking activities is stronger in cooperative banks with higher risks; second, social capital functions as a substitute for human capital in innovation, and thus, the impact of social capital is more pronounced in provinces where human capital is less accumulated; finally, the role of social capital in enhancing innovation is less critical in provinces where commercial banking is more developed.

Overall, our study clarifies the link between social capital and firm innovation by verifying the cooperative banking channel.

## Appendix A: Variable Definition

Variable	Definition
<b><u>Firm-level Variables</u></b>	
<i>Age</i>	The age of firm <i>i</i> in year <i>t</i> (source: KIS).
$\ln(1+Innov)$	The logarithm of one plus <i>Patent</i> , where <i>Patent</i> is the total number of patents applied for by firm <i>i</i> in year <i>t</i> (source: KIS).
<i>R&amp;D</i>	The logarithm of total R&D expenditure of firm <i>i</i> (source: KIS).
<i>Size</i>	The logarithm of total sales of firm <i>i</i> (source: KIS).
<b><u>Province-level Variables</u></b>	
<i>CapRatio</i>	Capital ratio of cooperative banks in province <i>j</i> ; used as a dummy variable equaling one if its average value is above the median, and zero otherwise (source: FISIS).
<i>Deposit<sup>Commercial</sup></i>	The logarithm of total deposits per capita of commercial banks located in province <i>j</i> (source: FISIS).
<i>Deposit<sup>Cooperative</sup></i>	The logarithm of total deposits per capita of cooperative banks located in province <i>j</i> (source: FISIS).
<i>High_Deposit<sup>Commercial</sup></i>	Total deposits per capita of commercial banks located in province <i>j</i> ; used as a dummy variable equaling one if it is above the median, and zero otherwise (source: FISIS).
<i>High_Loan<sup>Commercial</sup></i>	Total loans per capita of commercial banks located in province <i>j</i> ; used as a dummy variable equaling one if it is above the median, and zero otherwise (source: FISIS).
<i>Income</i>	Gross regional domestic product per capita of province <i>j</i> (source: Statistics Korea).
<i>Loan<sup>Commercial</sup></i>	The logarithm of total loans per capita of commercial banks located in province <i>j</i> (source: FISIS).
<i>Loan<sup>Cooperative</sup></i>	The logarithm of total loans per capita of cooperative banks located in province <i>j</i> (source: FISIS).
<i>NPLRatio</i>	Nonperforming loan ratio of cooperative banks in province <i>j</i> ; used as a dummy variable equaling one if the average value is above the median, and zero otherwise (source: FISIS).
<i>PostEduc</i>	Percentage of people who received post-secondary education in province <i>j</i> ; used as a dummy variable equaling one if it is above the median, and zero otherwise (source: Statistics Korea).
<i>SchoolYear</i>	Number of years of schooling in province <i>j</i> ; used as a dummy variable equaling one if the average value is above the median, and zero otherwise (source: Statistics Korea).
<i>SocCap</i>	The social capital measure for each province <i>j</i> ; calculated as five minus the average score to the statement, “most members in the society follow social norms,” in province <i>j</i> (source: Social Survey).
<i>Trust</i>	The social capital measure for each province <i>j</i> ; calculated as the average score to the statement, “our society is highly reliable,” in province <i>j</i> (source: Korea General Social Study).

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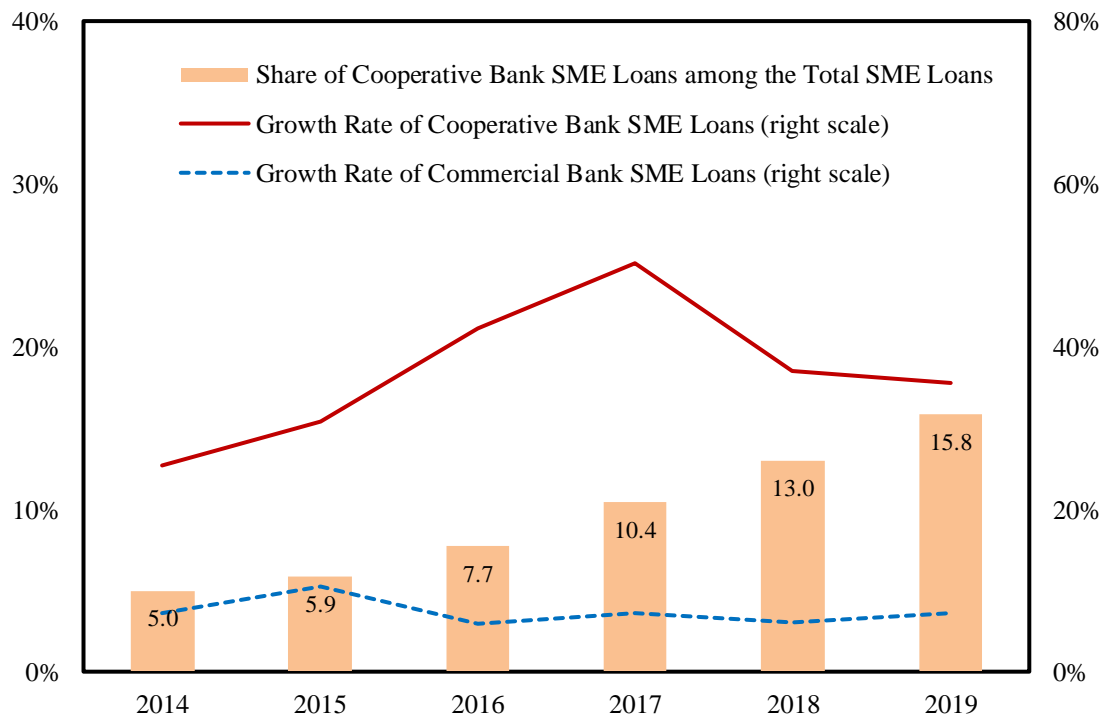
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**Figure 1: The Share of Cooperative Bank SME Loans and the Growth Rates of SME Loans from Cooperative Banking and Commercial Banking**

This figure shows the share of cooperative bank SME loans among the total SME loans, as well as the growth rates of SME loans from cooperative banking and commercial banking, from 2014 to 2019. The total SME loans include loans from commercial banks, cooperative banks, and other non-bank financial institutions, including savings banks and Korea Postbank.



Source: The Bank of Korea.



**Table 1: Summary Statistics**

This table shows the descriptive statistics of *SocCap*, *Innov*, and other important variables used in our sample. Panel A presents the value of the *SocCap* variable by each province. Panel B describes the regional distribution of the numbers of patents applied for by our sample firms (i.e., *Innov*) each survey year provided by KIS. Panel C shows the descriptive statistics of the full sample—both firm- and province-level variables—used in our analyses. All detailed variable definitions are provided in Appendix A.

**Panel A: Social Capital by Province**

Province	<i>SocCap</i>
Seoul	2.93
Busan	2.95
Daegu	2.94
Incheon	2.92
Gwangju	2.93
Daejeon	2.91
Ulsan	2.97
Gyeonggi	2.93
Gangwon	2.98
Chungbuk	3.01
Chungnam	3.00
Jeonbuk	2.98
Jeonnam	3.11
Gyeongbuk	2.96
Gyeongnam	2.94
Jeju	2.89
Max	3.11
Min	2.89
Average	2.96

**Panel B: The Numbers of Patents Applied for by Local Firms by Year**

Province	<i>Innov</i>							Total
	2005	2005	2008	2010	2012	2014	2016	
Seoul	209	123	179	140	90	169	65	975
Busan	50	47	109	41	22	68	65	402
Daegu	124	98	36	36	75	90	175	634
Incheon	17	24	61	83	47	55	63	350
Gwangju	5	3	24	20	20	16	34	122
Daejeon	48	31	26	83	25	67	42	322
Ulsan	8	12	2	17	6	10	38	93
Gyeonggi	427	527	192	418	282	427	397	2,670
Gangwon	2	7	1	56	8	8	15	97
Chungbuk	80	43	21	50	45	29	50	318
Chungnam	23	49	40	123	79	48	93	455
Jeonbuk	12	8	11	15	20	17	45	128
Jeonnam	7	5	15	19	6	25	17	94
Gyeongbuk	41	34	26	98	51	45	49	344
Gyeongnam	45	65	64	120	35	31	50	410
Jeju	0	4	1	3	0	1	2	11
Max	427	527	192	418	282	427	397	2,670
Min	0	3	1	3	0	1	2	10
Total	1,098	1,080	808	1,322	811	1,106	1,200	7,425

### Panel C: Full Sample

Variable	Count	Mean	Standard Deviation	10 <sup>th</sup> percentile	Median	90 <sup>th</sup> percentile
<b><u>Firm-level Variables</u></b>						
<i>Age</i>	20,096	15.383	18.476	5.000	13.000	28.000
<i>ln(1+Innov)</i>	20,096	0.156	0.399	0.000	0.000	0.693
<i>R&amp;D</i>	20,096	3.778	2.334	0.000	3.932	6.621
<i>Size</i>	20,096	8.326	1.579	6.217	8.007	10.309
<b><u>Province-level Variables</u></b>						
<i>CapRatio</i>	256	0.500	0.501	0.000	0.500	1.000
<i>Deposit<sup>Commercial</sup></i>	272	3.165	1.021	2.156	2.944	4.478
<i>Deposit<sup>Cooperative</sup></i>	272	0.931	0.699	0.242	0.734	1.881
<i>High_Deposit<sup>Commercial</sup></i>	272	0.500	0.501	0.000	0.500	1.000
<i>High_Loan<sup>Commercial</sup></i>	272	0.500	0.501	0.000	0.500	1.000
<i>Income</i>	272	10.013	0.397	9.515	9.996	10.519
<i>Loan<sup>Commercial</sup></i>	272	3.339	1.059	2.215	3.111	5.078
<i>Loan<sup>Cooperative</sup></i>	272	0.678	0.575	0.169	0.484	1.449
<i>NPLRatio</i>	272	0.500	0.501	0.000	0.500	1.000
<i>PostEduc</i>	272	0.500	0.501	0.000	0.500	1.000
<i>SchoolYear</i>	272	0.500	0.501	0.000	0.500	1.000
<i>SocCap</i>	272	2.959	0.048	2.912	2.945	3.005
<i>Trust</i>	272	0.502	0.126	0.292	0.493	0.643

**Table 2: The Effect of Social Capital on Firm Innovation**

This table shows the impacts of regional social capital on firm innovation. The dependent variable is  $\ln(1+Innov)$ , and the independent variables are *SocCap*, a set of firm-level characteristics (i.e., *Age*, *R&D*, and *Size*), and a set of province-level characteristics (i.e., *PostEduc*, *Income*, *Deposit<sup>Commercial</sup>*, and *Loan<sup>Commercial</sup>*). A detailed description of these variables is provided in Appendix A. We include year and industry fixed effects in all regressions. In each column, the coefficients are estimated using the Tobit model. Standard errors are clustered at the industry-year level. The numbers in parentheses are t-statistics. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	$\ln(1+Innov)$	
	(1)	(2)
<i>SocCap</i>	-0.245 (-0.55)	1.483*** (2.68)
<i>Age</i>	-0.005*** (-3.46)	-0.006*** (-3.74)
<i>R&amp;D</i>	0.268*** (16.05)	0.265*** (16.04)
<i>Size</i>	0.110*** (7.61)	0.114*** (7.81)
<i>PostEduc</i>		0.030*** (4.46)
<i>Income</i>		-0.049 (-0.94)
<i>Deposit<sup>Commercial</sup></i>		-0.193** (-2.26)
<i>Loan<sup>Commercial</sup></i>		0.141* (1.91)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Pseudo R-squared	0.155	0.156
Observations	20,096	20,096

**Table 3: The Effect of Social Capital on Cooperative Bank Activities**

This table shows the impacts of regional social capital on the activities of cooperative banks. The dependent variable is  $Deposit^{Cooperative}$  in Columns (1) and (2) and  $Loan^{Cooperative}$  in Columns (3) and (4). The independent variables are  $SocCap$  and a set of province-level characteristics (i.e.,  $PostEduc$ ,  $Income$ ,  $Deposit^{Commercial}$ , and  $Loan^{Commercial}$ ). A detailed description of these variables is provided in Appendix A. We include year fixed effects in all regressions. In each column, the coefficients are estimated using the Tobit model. Standard errors are clustered at the year level. The numbers in parentheses are t-statistics. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	$Deposit^{Cooperative}$		$Loan^{Cooperative}$	
	(1)	(2)	(3)	(4)
$SocCap$	0.526** (2.34)	1.521*** (3.21)	0.465*** (3.35)	1.227*** (5.13)
$PostEduc$		0.022*** (3.63)		0.019*** (4.08)
$Income$		-0.235*** (-15.37)		-0.143*** (-12.32)
$Deposit^{Commercial}$		-0.007*** (-11.39)		-0.005*** (-7.24)
$Loan^{Commercial}$		0.004*** (9.94)		0.003*** (5.81)
Year Fixed Effects	Yes	Yes	Yes	Yes
Pseudo R-squared	0.297	0.496	0.403	0.599
Observations	272	272	272	272

**Table 4: Social Capital, Cooperative Bank Activities, and Firm Innovation**

This table shows the impacts of regional social capital and cooperative banking activities on firm innovation. We use all the variables presented in Table 2, as well as  $Deposit^{Cooperative}$  in Columns (1) and (2) and  $Loan^{Cooperative}$  in Columns (3) and (4) presented in Table 3. We include year and industry fixed effects in all regressions. In each column, the coefficients are estimated using the Tobit model. Standard errors are clustered at the industry-year level. The numbers in parentheses are t-statistics. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Variable	ln(1+Innov)			
	(1)	(2)	(3)	(4)
$Deposit^{Cooperative}$	0.093*** (3.02)	0.149*** (3.31)		
$Loan^{Cooperative}$			0.120*** (2.92)	0.140** (2.47)
$SocCap$	-0.824* (-1.67)	0.858 (1.46)	-0.777 (-1.58)	0.959 (1.62)
$Age$	-0.005*** (-3.45)	-0.006*** (-3.73)	-0.005*** (-3.46)	-0.006*** (-3.74)
$R\&D$	0.267*** (16.01)	0.265*** (16.08)	0.267*** (16.01)	0.265*** (16.06)
$Size$	0.110*** (7.57)	0.113*** (7.76)	0.110*** (7.59)	0.113*** (7.78)
$PostEduc$		0.019*** (2.71)		0.021*** (2.98)
$Income$		-0.027 (-0.50)		-0.032 (-0.60)
$Deposit^{Commercial}$		-0.145* (-1.71)		-0.139 (-1.59)
$Loan^{Commercial}$		0.160** (2.15)		0.133* (1.80)
Year Fixed Effects	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes
Pseudo R-squared	0.155	0.157	0.155	0.157
Observations	20,096	20,096	20,096	20,096

**Table 5: Robustness Checks**

This table shows the results of robustness tests using substitutive measures for our key variables. In Panel A, the tests are performed using the alternative measure of social capital, *Trust*, calculated by the KGSS dataset. In Panel B, the tests are performed using an innovation input variable (i.e., *R&D*), instead of an output variable (i.e.,  $\ln(1+Innov)$ ). A detailed description of these variables is provided in Appendix A. We include year fixed effects in all regressions, and industry fixed effects in all firm-level regressions. In each column, the coefficients are estimated using the Tobit model. Standard errors are clustered at the year level for province-level regressions and at the industry-year level for firm-level regressions. The numbers in parentheses are t-statistics. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% levels, respectively.

**Panel A: Alternative Social Capital Measure**

Variable	$\ln(1+Innov)$		$Deposit^{Cooperative}$		$Loan^{Cooperative}$	
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Trust</i>	0.492*** (3.43)	1.006*** (5.81)	1.678*** (15.57)	1.445*** (16.75)	1.089*** (10.79)	0.972*** (12.20)
<i>Age</i>	-0.005*** (-3.32)	-0.006*** (-3.71)				
<i>R&amp;D</i>	0.268*** (16.04)	0.264*** (16.10)				
<i>Size</i>	0.108*** (7.51)	0.113*** (7.73)				
<i>PostEduc</i>		0.026*** (4.12)		0.026*** (5.76)		0.021*** (4.58)
<i>Income</i>		0.005 (0.09)		0.002 (0.12)		0.019 (1.27)
$Deposit^{Commercial}$		-0.345*** (-3.66)		-0.006*** (-8.93)		-0.004*** (-5.89)
$Loan^{Commercial}$		0.316*** (3.68)		0.002*** (5.54)		0.001*** (3.37)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	No	No	No	No
Pseudo R-squared	0.155	0.158	0.381	0.564	0.471	0.650
Observations	20,096	20,096	288	272	288	272

**Panel B: Alternative Firm Innovativeness Measure**

Variable	<i>R&amp;D</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Deposit</i> <sup>Cooperative</sup>			0.205*** (3.60)	0.206** (2.18)		
<i>Loan</i> <sup>Cooperative</sup>					0.269*** (3.53)	0.266** (2.26)
<i>SocCap</i>	0.372** (2.25)	0.654* (1.91)	0.133 (0.75)	0.457 (1.33)	0.139 (0.79)	0.459 (1.32)
<i>Age</i>	0.002 (1.42)	0.002 (1.42)	0.002 (1.45)	0.002 (1.46)	0.002 (1.43)	0.002 (1.44)
<i>Size</i>	0.567*** (9.31)	0.564*** (9.19)	0.562*** (9.19)	0.562*** (9.17)	0.562*** (9.19)	0.563*** (9.18)
<i>PostEduc</i>		0.062*** (4.16)		0.051*** (2.86)		0.051*** (2.87)
<i>Income</i>		-0.144 (-1.30)		-0.107 (-0.98)		-0.106 (-0.96)
<i>Deposit</i> <sup>Commercial</sup>		0.207 (1.26)		0.231 (1.40)		0.261 (1.56)
<i>Loan</i> <sup>Commercial</sup>		-0.240 (-1.64)		-0.174 (-1.17)		-0.209 (-1.43)
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R-squared	0.126	0.128	0.127	0.129	0.126	0.129
Observations	20,096	20,096	20,096	20,096	20,096	20,096



**Table 6: The Impact of Bank Risks on Cooperative Banking Activities**

This table shows the impacts of regional social capital on cooperative banking activities with regard to bank risks. We use all the variables presented in Table 3, as well as *CapRatio* and its interactions with *SocCap* in Panel A; and *NPLRatio* and its interactions with *SocCap* in Panel B. We include year fixed effects in all regressions. In each column, the coefficients are estimated using the Tobit model. Standard errors are clustered at the year level. The numbers in parentheses are t-statistics. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% levels, respectively.

**Panel A: Capital Ratio**

Variable	<i>Deposit<sup>Cooperative</sup></i>		<i>Loan<sup>Cooperative</sup></i>	
	(1)	(2)	(3)	(4)
<i>SocCap</i>	1.238*** (2.75)	4.650*** (4.84)	1.187*** (4.16)	4.306*** (5.30)
<i>CapRatio</i>	3.271 (1.42)	11.717*** (4.42)	3.672** (2.59)	10.986*** (4.83)
<i>SocCap</i> × <i>CapRatio</i>	-1.158 (-1.50)	-3.910*** (-4.39)	-1.265*** (-2.65)	-3.655*** (-4.81)
<i>PostEduc</i>		0.038*** (4.01)		0.034*** (4.21)
<i>Income</i>		-0.289*** (-10.17)		-0.190*** (-6.97)
<i>Deposit<sup>Commercial</sup></i>		-0.151 (-1.34)		-0.215** (-2.50)
<i>Loan<sup>Commercial</sup></i>		-0.310*** (-4.93)		-0.158*** (-3.45)
Year Fixed Effects	Yes	Yes	Yes	Yes
Pseudo R-squared	0.289	0.628	0.380	0.764
Observations	256	256	256	256

**Panel B: Nonperforming Loan Ratio**

Variable	<i>Deposit</i> <sup>Cooperative</sup>		<i>Loan</i> <sup>Cooperative</sup>	
	(1)	(2)	(3)	(4)
<i>SocCap</i>	0.075 (0.15)	0.735 (1.43)	-0.368 (-0.86)	0.346 (1.01)
<i>NPLRatio</i>	-3.433 (-1.03)	-3.406* (-1.91)	-4.796* (-1.91)	-4.528*** (-3.32)
<i>SocCap</i> × <i>NPLRatio</i>	1.115 (1.01)	1.102* (1.80)	1.576* (1.89)	1.483*** (3.21)
<i>PostEduc</i>		0.026*** (3.30)		0.022*** (3.66)
<i>Income</i>		-0.283*** (-11.92)		-0.187*** (-9.50)
<i>Deposit</i> <sup>Commercial</sup>		-0.064 (-0.62)		-0.128* (-1.70)
<i>Loan</i> <sup>Commercial</sup>		-0.335*** (-5.45)		-0.181*** (-4.18)
Year Fixed Effects	Yes	Yes	Yes	Yes
Pseudo R-squared	0.291	0.611	0.395	0.733
Observations	272	272	272	272

**Table 7: The Role of Social Capital as a Substitute for Human Capital**

This table shows the relationship between social and human capital in firms' innovation activities. We use all the variables presented in Table 2, as well as *PostEduc* and its interactions with *SocCap* in Panel A; and *SchoolYear* and its interactions with *SocCap* in Panel B. We include year and industry fixed effects in all regressions. In each column, the coefficients are estimated using the Tobit model. Standard errors are clustered at the industry-year level. The numbers in parentheses are t-statistics. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% levels, respectively.

**Panel A: Post-Secondary Education Ratio**

Variable	ln(1+ <i>Innov</i> )	
	(1)	(2)
<i>SocCap</i>	1.216*** (2.63)	1.266** (2.53)
<i>PostEduc</i>	7.929** (2.56)	7.572** (2.20)
<i>SocCap</i> × <i>PostEduc</i>	−2.647** (−2.51)	−2.528** (−2.16)
<i>Age</i>	−0.005*** (−3.62)	−0.006*** (−3.70)
<i>R&amp;D</i>	0.266*** (16.14)	0.266*** (16.10)
<i>Size</i>	0.113*** (7.76)	0.113*** (7.75)
<i>Income</i>		−0.050 (−0.93)
<i>Deposit</i> <sup>Commercial</sup>		0.038 (0.56)
<i>Loan</i> <sup>Commercial</sup>		−0.036 (−0.54)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Pseudo R-squared	0.156	0.156
Observations	20,096	20,096

**Panel B: Average Number of Years of Schooling**

Variable	$\ln(1+Innov)$	
	(1)	(2)
<i>SocCap</i>	1.562*** (3.02)	1.702*** (3.18)
<i>SchoolYear</i>	15.937*** (4.29)	15.115*** (3.97)
<i>SocCap</i> $\times$ <i>SchoolYear</i>	-5.382*** (-4.27)	-5.108*** (-3.96)
<i>Age</i>	-0.006*** (-3.66)	-0.006*** (-3.78)
<i>R&amp;D</i>	0.266*** (16.14)	0.265*** (16.12)
<i>Size</i>	0.113*** (7.76)	0.114*** (7.77)
<i>Income</i>		-0.075 (-1.44)
<i>Deposit</i> <sup>Commercial</sup>		0.056 (0.84)
<i>Loan</i> <sup>Commercial</sup>		-0.045 (-0.67)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Pseudo R-squared	0.156	0.156
Observations	20,096	20,096

**Table 8: Commercial Banking Development and the Impact of Social Capital on Firm Innovation**

This table shows the change in the impact of social capital on innovation under high and low levels of commercial banking development. We use all the variables presented in Table 2, as well as  $High\_Deposit^{Commercial}$  and its interactions with  $SocCap$  in Panel A; and  $High\_Loan^{Commercial}$  and its interactions with  $SocCap$  in Panel B. We include year and industry fixed effects in all regressions. In each column, the coefficients are estimated using the Tobit model. Standard errors are clustered at the industry-year level. The numbers in parentheses are t-statistics. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5%, and 10% levels, respectively.

**Panel A: Commercial Bank Deposits**

Variable	$\ln(1+Innov)$	
	(1)	(2)
$SocCap$	0.054 (0.12)	1.656*** (3.12)
$High\_Deposit^{Commercial}$	17.593*** (3.48)	20.147*** (3.74)
$SocCap \times High\_Deposit^{Commercial}$	-5.996*** (-3.48)	-6.913*** (-3.76)
$Age$	-0.005*** (-3.39)	-0.005*** (-3.60)
$R\&D$	0.267*** (16.04)	0.265*** (16.19)
$PostEduc$	0.111*** (7.65)	0.115*** (7.90)
$Size$		0.027*** (3.92)
$Income$		-0.252*** (-4.14)
$Loan^{Commercial}$		-0.036 (-1.49)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Pseudo R-squared	0.156	0.157
Observations	20,096	20,096

## Panel B: Commercial Bank Loans

Variable	$\ln(1+Innov)$	
	(1)	(2)
<i>SocCap</i>	-0.360 (-0.75)	1.713*** (3.01)
<i>High_Loan</i> <sup>Commercial</sup>	8.824* (1.82)	21.389*** (3.90)
<i>SocCap</i> × <i>High_Loan</i> <sup>Commercial</sup>	-3.028* (-1.83)	-7.340*** (-3.93)
<i>Age</i>	-0.005*** (-3.27)	-0.005*** (-3.53)
<i>R&amp;D</i>	0.269*** (16.15)	0.265*** (16.23)
<i>PostEduc</i>	0.109*** (7.58)	0.114*** (7.91)
<i>Size</i>		0.028*** (4.49)
<i>Income</i>		-0.250*** (-4.01)
<i>Deposit</i> <sup>Commercial</sup>		-0.037 (-1.52)
Year Fixed Effects	Yes	Yes
Industry Fixed Effects	Yes	Yes
Pseudo R-squared	0.155	0.158
Observations	20,096	20,096