Received: 18 July 2017 | Accepted: 5 April 2018

DOI: 10.1111/jpet.12305

WILEY JOURNAL OF PUBLIC ECONOMIC THEORY

ARTICLE

Growth strategy with social capital, human capital and physical capital—Theory and evidence: The case of Vietnam

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Funding information

Vietnam National Foundation for Science and Technology, Grant/Award Number: 502.01-2017.12

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In this paper, we develop a theoretical model to explain the impact of social capital (defined at the firm level) on individual firm performance and derive a critical optimal threshold for firms to invest in social capital. The theoretical model we propose reveals how social capital, human capital, and physical capital simultaneously affect firm performance under the main assumption of a decreasing function of social capital on unit cost of physical capital. Our theoretical model is then estimated using unique firm-level longitudinal data from Vietnam for the period 2005–2015. Using a control function approach in a quantile regression framework, we attempt to establish the causal impact of social capital on firm performance. Our empirical results point to a range of revenue in which investment in social capital is efficient and to evidence suggesting that the role of social capital decreases when firms become richer.

1 | INTRODUCTION

The concept of *capital* does not simply stand for physical capital; it also implies nonphysical resources such as *human capital* in the form of managerial talent as well as education, training, and professional ability of the workers in enterprises (Crook et al., 2011; Roca-Puig, Beltran-Martin, & Cipres, 2011). Likewise, the concept of *social capital* underlies social relationships matter in the sense that they can have a positive impact on the wealth of society and its members, that is, individuals, households, and firms, by reducing transaction costs, facilitating collective actions, and lowering opportunistic behavior (Servaes & Tamayo, 2017). During the past few decades, social capital has become an area of active research, first in social sciences stemming from pioneering works by Coleman (1988), Putnam, Leonardi, and Nanetti (1993), Helliwell and Putnam (1995), and Granovetter (1985, 1995), and later in economics (e.g., Andriani & Christoforou, 2016; Barr, 1998; Fafchamps, 1998; Glaeser, Laibson, and Sacerdote, 2002; Grootaert, 1998; Lund & Fafchamps, 1997; Narayan & Pritchett, 1997). In fact, one could trace the origin of this concept back as early as 1937 to Ronald Coase in his seminal work, "The Nature of the Firm", in which he concluded that a firm consists of "the system of relationships which comes into existence when the direction of resources is dependent on an entrepreneur" (pp. 41-42), or to the studies by Arrow (1972) showing how social connections can compensate for expensive formal structures in facilitating financial transitions, and by Kreps, Milgrom, Roberts, and Wilson (1982) on how increased interaction facilitates cooperation. More recently, social capital has become a popular concept with policy makers in both developed and developing countries (OECD, 2002; World Bank, 2011).

In the earlier literature, social capital is often defined for a community, society, and/or country as a whole and typically is measured by the civic engagement of the population or the willingness of people in a society to trust each other. Putnam (1993, 2000), for example, finds a high and positive correlation between various proxies for civic engagement and economic performance across regions of Italy. Helliwell and Putnam (1995) showed that there is a strong convergence of per capita income among the Italian regions during the 1960s and 1970s. The more social capital a region has, the faster convergence is, leading to a higher equilibrium income level. La Porta, Lopez de Silanes, Shleifer, and Vishny (1997) use average individual survey responses to country level from the World Values Survey to explore the relation between social capital and economic outcomes, and find that trust is related to growth in gross domestic product, the size of the largest firms in the economy, tax compliance, and the lack of corruption. More recent studies have attempted to link aggregate-level social capital to individual households. For example, Guiso, Sapienza, and Zingales (2004) report that social capital level in an area could influence behavior of households with respect to use of checks, less investment in cash and more in stocks, higher access to institutional credit, and less use of informal credit.

In the more recent economics literature, social capital has been defined for individuals and firms. Previous studies on how social capital helps agricultural traders overcome transaction costs in three African countries by Fafchamps and Minten (1999, 2001) are the pioneering attempts to measure social capital and estimate its impacts at individual and firm levels. In these studies, social capital, proxied by business contacts, is used by traders to overcome transaction costs through a reduction in information and search costs and through substitution for poor market institutions. In our empirical analysis, we also use contacts as proxy for social capital at the firm level.

Theoretically, the early work by Glaeser et al. (2002) is perhaps the first paper that formally treats social capital at the individual level. In this model, investing in social capital is treated as an investment decision for social capital accumulation, similar to investment in physical and human capital. Our theoretical model differs from Glaeser et al. (2002) in at least two fundamental aspects. First, we explicitly model why social capital is needed, and second, we identify the critical threshold that firms need to invest in social capital. In doing so, we have attempted to address Solow's (1995) criticism of the earlier social capital literature that "there needs to be an identifiable process of investment that adds to the stock of social capital, and possibly a process of depreciation that subtracts from it."

Social capital has also been defined for firms and corporations in previous studies and as one of the major elements that supports entrepreneurs in improving their production and facilitating business activities. Leana and van Buren (1999) coined the term organizational social capital to denote "a resource reflecting the character of social relations within the firm." Indeed, social capital accelerates firms' access to resources that are not under their control through providing a finer grained information set (Uzzi, 1997) and/or giving much information about new innovation (Burt, 1987) and potential employees (Burt, 1992; Fernandez, Castilla, & Moore, 2000). Therefore, firms could reduce transaction costs and achieve higher profitability levels (Appold, 1995; Billand, Bravard, Chakrabarty, & Sarangi, 2016; Dev, 2016; Fujita & Thisse, 2002; Sabel, 1989; Scott, 1988).

There are game-theoretic models that incorporate social capital. Amen (2001) pointed out the potential trade-off between sustainability of self-enforcement and the magnitude of gains from trade in social contacts based on an infinitely repeated multiplayer prisoners dilemma. The paper showed that inclusive social capital could combine both low enforcement cost and high gains from trade. Similarly, Routledge and Amsberg (2003) used the structure of the prisoners dilemma to describe the trade progress between two people and introduced a theoretical growth model in which they defined and characterized social capital as a social structure that facilitates cooperative trade in equilibrium. The key assumption of their model is that technological innovation that drives growth involves a reallocation of labor that affects social capital. The connections between growth, labor mobility, and social capital are explored by the combination of a trading model and a growth model. Karlan (2005), on the other hand, attempted to measure social capital to predict financial decisions using an experiment in which a trustworthy person (i.e., higher social capital) is less likely to default.

Empirically, there are a number of studies that attempt to link social capital and corporate performance. The studies by Fafchamps and Minten (1999, 2001) suggest that social capital could have large and significant impact on firm performance. Mazzola and Bruni (2000), by estimating the probability of success of post-entry performance of new firms in southern Italy, also found that inter-firm linkages enhance the ability of firms to get the subcontracts. Lins, Servaes, and Tamayo (2017) used corporate social responsibility (CRS) intensity as proxy for social capital and found that corporations that have higher CRS experienced higher profitability and growth and had stock returns that were 4–7 percentage points higher than low CRS firms with low social capital. These authors note that, by investing in social capital, firms earn the trust of their stakeholders, thereby enhancing cooperation, potentially leading to better economic outcomes for the firm. It should also be noted that establishing causality between social capital and firm performance is challenging and the documented links in the literature have been questioned by Servaes and Tamayo (2017). In our paper, we rely on a longitudinal data set and use a control function approach to deal with the issue of endogeneity to overcome the above critique.

In emerging and developing markets, the issue of social capital is particularly relevant for private firms, especially small and medium-sized enterprises (SMEs). These firms often have to operate in a market that is characterized by poor institutions, high level of market imperfection, and corruption. To our best knowledge, this study is an initial attempt to investigate the effect of social capital on firm productivity using a panel database from a biannual Survey of Small and Medium Scale Manufacturing Enterprises in a developing country, Vietnam. Our empirical findings are guided by a theoretical model in which there exists a value of total saving, above which the investment in social capital is efficient. In addition, lower value of required total saving will associate with lower level of investment in social capital. Our theoretical model also shows that the steady state of the optimal path of total saving when a firm invests in social capital is always higher than the steady state of the optimal path without social capital. However, the role of social capital weakens or even becomes insignificant in the case of rich firms that harvest large revenues each year.

The main contributions of this paper are twofold. First, we present a theoretical growth model which shows that when a firm has enough saving it will invest in social capital. However, in the long term firms cannot only consider their social ties. Second, the empirical results confirm the existence of a threshold for saving when a firm wants to invest in social capital. They also confirm that the role of social capital is not significant when a firm has large saving and will instead focus on investment in physical capital. Using a control function approach in a quantile regression framework we attempt to establish a causal impact of social capital on firm performance.

The paper is organized as follows. Section 2 discusses the theoretical model, analyzes the link between social capital and growth, and shows the conditions that promote firms to invest in social capital. Section 3 presents the data source used in our paper as well as the empirical model and its results. Section 4 summarizes and concludes.

2 | THEORETICAL MODEL

2.1 | Model

In our model, there is a representative agent who not only consumes but also produces. She/he maximizes her/his intertemporal utility:

$$\max_{\{c_t\}} \sum_{t=0}^{\infty} \beta^t u(c_t),$$

where c_t denotes her/his consumption at date t, $\beta \in (0,1)$ is the discount factor, u is a strictly concave, strictly increasing function. The constraints for this agent are, for any period t:

$$c_t + S_{t+1} \leq F(k_t, L_t) + (1-\delta^k)p_t k_t,$$

where $\delta^k \in [0,1]$ is the physical capital depreciation rate, S_{t+1} is the saving at period t, k_t is the physical capital bought in period $t-1$ and used as input at period t, and L_t is labor. Capital and labor are used to produce the consumption good of period t. The technology used for that is represented by the production function F. This function is strictly concave, strictly increasing, and has $F(0, L) = 0$. For simplicity, we assume exogenous labor supply and full employment of labor. Hence, the production function does not involve labor and we will write $F(K_t)$ instead of $F(K_t, L_t)$. Finally, p_t is the unit cost (in terms of consumption good) of the physical capital. The saving S_{t+1} is decomposed in Z_{t+1}, which is the amount devoted for the purchase of the physical capital k_{t+1}, and in m_t, which is the amount devoted for the social contacts. Hence,

$$S_{t+1} = Z_{t+1} + m_t.$$

The constraints become

$$c_t + Z_{t+1} + m_t \leq F(k_t, L_t) + (1-\delta^k)p_t k_t.$$

Why is social capital useful? Assume that the consumer (who is also the producer of the consumption good) has on hand a quantity Z of savings (in terms of consumption goods). The quantity of physical capital she/he gets is $k = \frac{Z}{p}$. The unit cost p of capital changes with the social contacts. We assume that this unit cost p is a decreasing function of the social capital σ.

We can also interpret slightly differently the role of social capital. Suppose the firm wants to get a loan to buy a quantity of physical capital k with a saving Z. Let q denote the price of physical capital. If r is the interest rate, we then have $q(1+r)k = Z$. The unit cost of physical capital now is $p = q(1+r)$. In the presence of social capital, the interest r varies. Eventually it is negative (this corresponds to a subsidy from the government) and p is lower than the market price q. We assume the interest rate is a decreasing function of social capital.

The framework of our model is the Ramsey model (Ramsey, 1928). In this benchmark model, saving is used to purchase the capital good. Extensions of the Ramsey model can be found for instance in Bruno, Le Van, and Masquin (2009), or in Le Van, Saglam, and Turan (2016). In Bruno et al. (2009), saving is split in two parts: investment in physical capital and investment in technology capital. The latter is used to improve the total factor productivity (TFP). In Le Van et al. (2016), one part of saving is as usual, to buy physical capital, but the other part is "to fight" the fixed costs of the production technology.

In our model, the second part of the saving, m_t, is devoted for the social capital in order to lower the investment cost. That makes the difference between our present paper and the ones cited above.

For simplicity, we assume $p = \frac{1}{\sigma}$ and hence $Z = \frac{k}{\sigma}$.

We now suppose that with an amount m, the consumer will get a social capital $\sigma = \gamma(m)$ where γ is a nondecreasing function.

Let S_{t+1} be the total saving at period t, that is,

$$S_t = Z_{t+1} + m_t,$$

and θ_t is the share of this saving devoted to Z_{t+1}. Then,

$$Z_{t+1} = \theta_t S_{t+1},$$

$$m_t = (1-\theta_t)S_{t+1}, \theta_t \in [0,\ 1],$$

$$p_t = \frac{1}{\sigma_t}.$$

The constraints for the consumer can be written as

$$c_0 + S_1 \leq F(k_0) + (1-\delta^k)p_0 k_0,$$

$$c_{t+1} + S_{t+2} \leq F(k_{t+1}) + (1-\delta^k)\frac{k_{t+1}}{\sigma_t}, \text{ for } t \geq 0,$$

$$\leq F(\sigma_t\theta_t S_{t+1}) + (1-\delta^k)\theta_t S_{t+1},$$

where

$$\sigma_t = \gamma(m_t) = \gamma((1-\theta_t)S_{t+1}).$$

Since the consumer maximizes utility based on the stream of consumption goods, the first step is to maximize, at each period t, the income of the consumer. At $t+1$, the consumer will choose the share θ for physical capital that maximizes the income, that is,

$$\max\left\{F(\sigma\theta S_{t+1}) + (1-\delta^k)\theta S_{t+1} : \sigma = \gamma\left((1-\theta)S_{t+1}, \theta \in [0,1]\right)\right\}.$$

Let

$$H(S) = \max\left\{F(\sigma\theta S) + (1-\delta^k)\theta S : \sigma = \gamma((1-\theta)S), \theta \in [0,1],\right\}.$$

The problem of the social planner now becomes:

$$\max \sum_{t=0}^{\infty} \beta^t u(c_t)$$

under the constraints

$$c_0 + S_1 \leq F(k_0) + (1-\delta^k)p_0 k_0,$$

$$c_{t+1} + S_{t+2} \leq H(S_{t+1}).$$

Remark 1. If we go back to the initial production function which also uses labor as input, then at any period t, the output y_t is

$$y_t = F(\sigma_t Z_{t+1}, L_t), \tag{1}$$

where σ_t is the social capital, $Z_{t+1} = \theta_t S_{t+1}$ is the investment in physical capital, and L_t is the labor.

In the static case we will write

$$y = F(\sigma Z, L). \tag{2}$$

In a general framework, if $\mathcal{F}$ denotes the production function, we should write

$$y = \mathcal{F}(\sigma, k, L), \tag{3}$$

where σ is the social capital, k is the quantity of physical capital, and L is labor.

2.2 | When does the firm invest in social capital?

In this section, we will show that there exists a critical value S^c such that if $S < S^c$, then the firm will not invest in social capital and when $S > S^c$, it will. We assume for simplicity that $\delta^k = 1$ (full depreciation of physical capital), and

$$\gamma(m) = 1, \text{ if } m \leq \hat{m},$$

$$\text{and } \gamma(m) = a(m - \hat{m}) + 1, a > 0, \text{ when } m > \hat{m}.$$

The parameter a measures the efficiency of the technology γ.

Let us consider again the function H:

$$H(S) = \max\{F(\sigma\theta S) : \theta \in [0,\ 1], \sigma = \gamma((1-\theta)S)\}.$$

First, observe that, from the maximum theorem, H is increasing. We can write

$$H(S) = \max\{F(\gamma((1-\theta)S)\theta S) : \theta \in [0,\ 1]\}.$$

Let $\theta(S)$ denote the solution to this problem. We will show there exists a critical value S^c of the saving such that $1 - \theta(S) = 0$ (no investment in social capital) if $S < S^c$, and $1 - \theta(S) > 0$ (investment in social capital) if $S > S^c$.

It is obvious that $\theta(S)$ actually solves the problem:

$$\max\{\gamma((1-\theta)S)\theta : \theta \in [0,\ 1].$$

Let $\Psi(S) = \gamma((1-\theta(S))S)\theta(S)$. We will show that the critical value S^c is the unique solution to the equation $\Psi(S) = 1$, and $\Psi(S) < 1 \Leftrightarrow S < S^c, \Psi(S) > 1 \Leftrightarrow S > S^{Sc}$.

Proposition 1.

(i) *There exists $S^c > \hat{m} + \frac{1}{a}$ such that $1 - \theta(S) = 0$ for $S < S^c$ and $1 - \theta(S) > 0$ for $S > S^c$.*

(ii) *Moreover, when a increases then S^c decreases, and when $\hat{m}$ increases then S^c increases.*

Proof. See Appendix A. ■

Comment 1. (i) When the social capital technology is more efficient, the critical value S^c decreases. (ii) It is natural that when the threshold of the technology γ increases, the critical value S^c becomes larger.

Recall $\sigma(S) = \gamma((1-\theta(S))S)$. The main purpose of Proposition 2 which follows is to show that, under some additional assumptions on the production function F, we have the property that the influence of social capital becomes very small when the firm has a very high saving. The output is mainly based, in this case, on physical capital. Such a function F exists (see Comment 2).

Proposition 2.

(i) *Assume $\frac{F(x^2)}{x}$ is an increasing function for $x > 0$. Then $\frac{\sigma(S)}{F(\sigma(S)\theta(S)S)}$ is a decreasing function for $S > S^c$.*

(ii) *Assume $\frac{F(x^2)}{x} \to +\infty$ when $x \to +\infty$. Then $\frac{\sigma(S)}{F(\sigma(S)\theta(S)S)} \to 0$ when $S \to +\infty$.*

Proof. See Appendix B. ∎

Comment 2.

- Observe that the output is given by $y = F(\sigma k)$. Given k, since F is concave, the ratio $F(\sigma k)/\sigma$ decreases when σ increases.
- Assume that F is differentiable. We will show that the condition "$\frac{F(x^2)}{x}$ is an increasing function for $x > 0$" is equivalent to "the elasticity of F is greater than $\frac{1}{2}$".

  Let $G(x) = \frac{F(x^2)}{x}$. If G is increasing, its derivative must be positive. We have

$$G'(x) = \frac{2x^2F'(x^2) - F(x^2)}{x^2} > 0,$$

  that is, for any $x > 0$,

$$\frac{F(x^2)}{x^2} < 2F'(x^2).$$

  Equivalently, for any $x > 0$

$$\frac{F(x)}{x} < 2F'(x) \Leftrightarrow \frac{1}{2} < \frac{d\ln(F(x))}{d\ln(x)}.$$

  Here is a function F, which satisfies the assumption of Proposition 2: $F(x) = Ax^{\alpha}, \alpha > \frac{1}{2}$.
- The interpretation of Proposition 2 is that the role of the social capital becomes very small when the firm becomes very rich.

Comment 3. To summarize:

- In our theoretical model, we assume that the social capital is larger than 1 (by a normalization, the social capital equals 1 when there is no investment for the social ties) if the investment for it is larger than some value $\hat{m}$. Since the firm uses its saving for the purchase of both capitals, physical and social capital, and since the physical capital is a necessary input while the social capital is not, there exists a critical value S^c (larger than $\hat{m}$) of the saving above which the firm will invest in social capital.
- Observe that the output depends on the "effective" capital which is σZ where σ is the social capital and Z is the investment for physical capital. If the elasticity of the "effective" capital in the production function is larger than 0.5 than the role of the social capital diminishes when the saving increases. If this elasticity is lower than 0.5, then the role of the social capital increases with the saving.

2.3 | Growth and social capital

In this section, we study the contribution of social capital to output growth of the firm. Assume that the function F is Cobb–Douglas, $F(k) = Ak^{\alpha}$ with $\alpha \in (0,\ 1)$, and the utility function u satisfies the additional assumptions that it is twice continuously differentiable and satisfies the Inada condition $u'(0) = +\infty$.

Let $\bar{S}$ be defined by $A\alpha\bar{S}^{\alpha-1} = \frac{1}{\beta}$. This $\bar{S}$ is the steady state, to which the optimal path will converge when the firm never invests in social capital.

Let $\{S^*_{t+1}\}_{t\geq 0}$ denote the optimal sequence of the total saving.

- We want to find conditions under which the firm will invest in social capital after some date T when it has enough saving.
- We show when the efficiency parameter a is very high the impact of the social capital is very strong and the output may grow without bound.

- In the second step, the role of the social capital is small compared to the one of the physical capital.

The different steps will be as follows:

- Show that the optimal path $(S_t^*)_{t\geq 1}$ is monotonic (Lemma 1) and cannot converge to 0 (Lemma 3).
- Firm will invest after some date T (Lemma 2).
- The optimal saving will converge to a steady state which is higher than the steady state without social capital (Lemma 4).
- Finally, under some additional assumptions, the optimal output of the firm will grow without bound and the influence of social capital on the output goes to zero (Theorem 2).

We have the following preliminary results.

Lemma 1. *The optimal path* (S_t^*) *is monotonic.*

Proof. From what we wrote above, for $t > 0$, the model can be stated as:

$$\max \sum_{t=1}^{\infty} \beta^t u(H(S_t) - S_{t+1}),$$

$$\text{s.t. } \forall t > 0,\ 0 \leq S_{t+1} \leq H(S_t).$$

Since H is increasing and $\frac{\partial^2 u}{\partial S_t \partial S_{t+1}} > 0$, we apply the result in Amir (1996). ∎

Lemma 2. *Assume* $\bar{S} > S^c$ *(this case happens when* $\hat{m}$ *is small or/and* a *is high). Then there exists* T *such that* $1 - \theta(S_T^*) > 0$*, that is, the firm will invest in social capital at date* T*.*

Proof. If the firm never invests in social capital then the optimal path (S_t^*) will converge to $\bar{S}$. Since $\bar{S} > S^c$, there exists a date T with $S_T^* > S^c$. From Proposition 1, the firm will invest at T in social capital. ∎

Lemma 3. *The optimal path* (S_t^*) *cannot converge to zero.*

Proof. See Appendix C. ∎

Lemma 4. *Let* $\bar{S}$ *denote the steady state of the optimal path of total saving when the firm never invests in social capital, and* $\tilde{S}$ *denote the steady state (if it exists) of the optimal steady state of the optimal path with social capital. Then* $\tilde{S} > \bar{S}$*.*

Proof. See Appendix D. ∎

From these lemmas we obtain the main result of this paper.

Theorem 1. *Assume* $S^c < \bar{S}$*. Then there exists* T *such that* $1 - \theta(S_t^*) > 0, \forall t \geq T$*, that is, the firm will invest in social capital after date* T*. Either the optimal path will converge to infinity (growth without bound) or to a steady state higher than the one without social capital.*

Proof. Since the optimal sequence (S_t^*) is monotonic and cannot converge to zero, there exists T such that $S_t^* > S^c$ for any $t \geq T$. The remaining claims follow Lemmas 1–4. ∎

We now give conditions for which the optimal paths (S_t^*) will grow without bound.

Theorem 2. *Assume* $\bar{S} = (A\alpha\beta)^{\frac{1}{1-\alpha}} > \hat{m}$ *and* $\alpha > \frac{1}{2}$*.*

(i) *Then there exists* $\bar{a}$ *such that if* $a > \bar{a}$ *then* $S_t^* \to +\infty$ *when* $t \to +\infty$*.*

(ii) *The ratio* $\frac{\sigma_t^*}{H(S_t^*)}$ *decreases when* t *increases and converges to zero when* t *goes to infinity.*

Proof.

(i) The idea is to prove when a is large enough, the equation $H'(S) = \frac{1}{\beta}$ has no solution, that is, there is no steady state for the optimal (S_t^*). Hence this one will converge to infinity. We have

$$H(S) = A\left(\frac{a}{4}\right)^{\alpha}\left(S + \frac{1}{a} - \hat{m}\right)^{2\alpha},$$

and hence

$$H'(S) = 2\alpha A\left(\frac{a}{4}\right)^{\alpha}\left(S + \frac{1}{a} - \hat{m}\right)^{2\alpha - 1}.$$

Since $\tilde{S} > \bar{S}$, we have

$$H'(S) > 2\alpha A\left(\frac{a}{4}\right)^{\alpha}\left(\bar{S} - \hat{m}\right)^{2\alpha - 1},$$

which converges to infinity when a converges to infinity.

(ii) The statement follows (i) and Proposition 2. ∎

Comment 4. First, when $\alpha > \frac{1}{2}$, the function H (indirect production technology) has increasing returns. If $\alpha > \frac{1}{2}$ and the TFP A is sufficiently large or the threshold $\hat{m}$ is small, then the economy which uses social capital optimally grows without bound if the social capital technology is sufficiently efficient. Second, the role of social capital diminishes when the revenue becomes very large.

3 | EMPIRICAL EVIDENCE IN THE VIETNAMESE CONTEXT

3.1 | Data and descriptive statistics

In our empirical analysis, we use unique longitudinal enterprise data for Vietnam for the period from 2005 to 2015. Vietnam is a developing country characterized by a phenomenal growth of private firms since the promulgation of the Enterprise Law in 2000. According to the Vietnam General Statistics Office, most Vietnamese enterprises are SMEs. In 2016, there were nearly 500,000 SMEs that account for 97% of the number of registered businesses in Vietnam and employ 51% of the workforce. The data we use in our analysis is the biannual Survey of Small and Medium Scale Manufacturing Enterprises (SME survey), which was collected biennially from 2005 to 2015 with funding from the Danish International Development Agency. The survey was designed and implemented jointly by the Development Economics Research Group at the University of Copenhagen, UNU-WIDER, and two local research institutes, the Central Institute for Economic Management and the Institute of Labour Science and Social Affairs. The survey is conducted in 10 provinces of Vietnam, and provides information for about 2,500 firms.

Typically, social capital is rarely covered in traditional firms/business surveys or household surveys. Previous studies on social capital have to rely on specifically designed surveys such as the World Bank Survey on measuring social capital. Fortunately, one of the distinctive features of Vietnam's SME survey is that it contains a number of interesting questions about social capital. In particular, it asks about the number of ties and contacts, and distinguishes between different types, that is, relations with customers, suppliers, banks, politicians, and civil servants. In our empirical analysis, similar to Fafchamps and Minten (1999, 2001) we employ the number of contacts as a measure of social capital. The SME survey also collects a battery of information about all aspects of business activities such as enterprise history, production characteristics, investments, assets, liabilities, credits, economic constraints, potential, and so on.

We construct a firm-level panel data set of SMEs in Vietnam from 2005 to 2015 that covers a wide range of business information such as firm revenue, physical assets, total labor cost, total number of professional workers, and total people with whom the surveyed enterprise has regular contact in business activities. In terms of the variable of interest,

TABLE 1 Descriptive statistics of variables used in analysis

Variable	Mean	Standard Deviation	Min.	Max.	N
Real firm revenue (million VND - price 2010)	73.483	887.581	0.07	82686.703	12169
Real fixed asset (million VND - price 2010)	99.255	397.547	0.024	22518.484	12169
Real labor cost (million VND - price 2010)	943.003	9523.368	0.004	677338.75	12169
Number of professional workers (100 people)	0.031	0.064	0	2.98	12169
Number of contacts that firm has (hundred people)	0.368	0.700	0	50.31	12169
== 1 if firm participates in an association	0.107	0.308	0	1	12169
Education attainment of firm manager	2.617	1.078	1	4	12169

we use the regular contacts of firms as a measure of social capital. This include contacts with business people, bank officials (both formal and informal creditors), and politicians and civil servants. In the survey, to qualify as a contact, these people have to maintain a contact with the firm at least once during every 3-month period.

3.2 | Empirical specification

To examine the empirical relationship between social capital and firm performance as proposed by the theoretical model in the previous section, we construct an econometric model in which firm revenue depends on physical capital, human capital, and our variable of interest, the number of social contacts that each firm has. Other control variables, such as firms' industry, business location, and year effects are also included.

The following baseline model derives from Equation 3 in Remark 1 of Section 2:

$$\begin{aligned} lnRevenue = {} & \beta_0 + \beta_1 lnAssets + \beta_2 lnLabor + \beta_3 Pro\_Labor + \beta_4 TotalContact \\ & + \beta_5 sector + \beta_6 rural + \beta_7 year + u, \end{aligned}$$

where dependent variable *lnRevenue* is measured as the logarithm of the total firm revenue in the end of previous year of the survey time.

In our theoretical model above, in addition to the two main determinants of firm productivity—namely, physical capital and human capital—social capital has a role to play to influence the performance of firms which could be measured by the number of social contacts (considered as a principal form of social capital). In general, firm productivity is positively influenced by all these factors; we should expect that the sign of all coefficients is significantly larger than zero. In our empirical model, physical capital is measured by the logarithm of total assets, denoted by *lnAssets*, human capital is measured by the logarithm of total labor cost, denoted by *lnLabor*, and the number of total professional employees, denoted by *Pro_Labor*. *TotalContact* measures firm's social capital, that is, the total number of contacts a firm has. Total revenue, total assets, and total labor cost are divided by the deflator of each year, using base year 2010. Therefore, those variables are considered as real terms. Besides, information related to industry sectors, firm location (urban or rural areas), and surveyed years are also included as control variables. It should be noted that there are two types of provinces in which the survey was conducted. Table 1 shows descriptive statistics of specified variables.

As indicated previously, Servaes and Tamayo (2017) has pointed to the difficulty in establishing causal relationship between social capital and firm performance in the presence of endogeneity. In our analysis, we use the control function method recently summarized in Wooldridge (2015) to deal with the issue of the potential endogeneity of the number of social contacts when estimating the baseline model. We adopt the control function method rather than the more typical instrumental variables (IV) or two-stage least squares approach. The control function method is inherently an IV method. Its implementation assumes the availability of variables which do not appear in the equation to be estimated, that is, excluded instrumental variables, and which explains the variation of the endogenous explanatory variable, here number of social contacts. The exogenous variation induced by excluded instrumental variables provides separate variation in the residuals obtained from a reduced form, and these residuals serve as the control functions.

By adding appropriate control functions, which are usually estimated in the first stage, the endogenous explanatory variable becomes appropriately exogenous in the second stage equation. Accordingly, the control function method allows testing the endogeneity of the explanatory variable by using a simple Hausman (1978) test that compares OLS and 2SLS, and this test can be easily made robust to heteroskedasticity and serial correlation in a panel data setting.

The control function approach has been extended to the quantile regression method in the presence of endogenous explanatory variables by Lee (2007), and the quantile regression method to panel data by Koenker (2004). Recently, Bache, Dahl, and Christensen (2013) have investigated the performance of the estimators usually proposed to estimate quantiles from panel data in the presence of endogenous explanatory variables. They show that, although based on assumptions that may seem restrictive as to the data-generating process, the correlated random effects approach of Mundlak (1978) performs very well using a simulation study. Only the total sample size seems to matter, and there is no incidental parameters curse as in fixed-effects estimation. Appendix E details the implementation of the control function method.

As proposed by the theoretical model, social ties only impact the performance of certain firms whose revenue is larger than a critical value. To explain, we suggest that since efficient social capital always requires a fixed cost, if firm saving is not large enough the firm could not invest in and accumulate its social capital, or the social capital that the firm achieves could not support its performance. Simultaneously, it should be noted that the higher the revenue a firm reaches the larger saving it could make; as a result, only firms that meet a certain saving proportion could employ social capital as a determinant of growth. In general, we believe that social capital in particular should not be considered as real capital in the meaning that the firm's productivity cannot be improved by using social capital as a sole input.

In order to examine whether or not the link between social capital and firm revenue is nonlinear, as well as to detect thresholds, the log value of firm revenue is regressed on the variable of social capital and other control variables, using quantile regression methods. Quantile regression is often used to conduct inference about conditional quantile functions. While the method of least squares estimates the conditional mean of the response variable given certain values of the predictor variables, the quantile regression method offers a mechanism for estimating models for the conditional median function and the full range of other conditional quantile functions. By supplementing the estimation of conditional mean functions with techniques for estimating an entire family of conditional quantile functions, quantile regression is capable of providing a more complete statistical analysis of the stochastic relationships among random variables. Based on quantile regression, we could detect critical values of total revenue such that social capital solely has an efficient impact on firms whose revenue is between these values.

We present the baseline model in Appendix E. This framework can be extended to the estimation of conditional quantiles instead of conditional expectation in order to investigate the impact of social capital on quantiles of the conditional distribution of firm profitability (Lee, 2007).

3.3 | Empirical results

Using data from the Survey of Small and Medium Scale Manufacturing Enterprises in Vietnam, we estimate Equation 1 to investigate the hypothesis about the impact of social capital on firm performance, using the control function to deal with the issue of endogeneity of the chosen measure of social capital. Tables 2 and 3 report the results of the estimations involved in the first and second steps of control function approach. The first column of each table reports the results of the estimation of the conditional expectation of firm revenue (in logs) as described in Equation 1, while the other columns report the results of the estimation of the same equation for various quantiles. The results reported in Table 2 show the relevance of the choice of the two instrumental variables: firm participation in a business association (*associationD*), and the highest educational level of firm representative (*mng_edu*). The coefficients are generally statistically significantly different from zero. The rank condition involved in implementing the control function approach is thus satisfied. Moreover, the coefficients associated to residuals from first step estimation are also significantly different from zero in most cases, as shown in Table 3. *TotalContact*, therefore, appears to be endogenous in most estimated relationships. As pointed out in Appendix E, the control function method makes it possible to obtain a measure of the impact of total contact on the revenue of the firm, which is no longer influenced by the endogeneity of *TotalContact*.

TABLE 2 The impact of social capital on firm performance

	(1) RE	(2) QR01	(3) QR02	(4) QR03	(5) QR08	(6) QR09	(7) QR13	(8) (QR14)	(9) (QR50)	(10) (QR98)	(11) (QR99)
Total Contact	1.480***	−15.046*	−6.191*	−3.857	−0.577	0.768	2.006	2.696**	2.419***	0.455*	0.233
	(0.229)	(8.630)	(3.503)	(3.359)	(2.020)	(1.660)	(1.249)	(1.216)	(0.833)	(0.244)	(0.188)
lnAssets	0.161***	0.052***	0.068***	0.071***	0.085***	0.084***	0.094***	0.093***	0.144***	0.326***	0.337***
	(0.008)	(0.018)	(0.014)	(0.011)	(0.008)	(0.008)	(0.009)	(0.008)	(0.011)	(0.026)	(0.032)
lnLabor	0.613***	0.946***	0.871***	0.839***	0.791***	0.777***	0.747***	0.731***	0.662***	0.488***	0.491***
	(0.015)	(0.049)	(0.032)	(0.032)	(0.024)	(0.021)	(0.017)	(0.017)	(0.020)	(0.039)	(0.045)
Pro_Labor	0.517	0.688**	0.810***	1.032***	0.825**	0.604*	0.502	0.419	1.037*	2.371	6.374**
	(0.353)	(0.288)	(0.238)	(0.317)	(0.367)	(0.348)	(0.376)	(0.409)	(0.584)	(2.266)	(2.500)
Rural area	0.030	0.207*	0.179***	0.163***	0.136***	0.103***	0.052	0.029	−0.013	−0.017	−0.039
	(0.020)	(0.115)	(0.066)	(0.054)	(0.049)	(0.040)	(0.035)	(0.033)	(0.030)	(0.079)	(0.096)
Residuals	−1.443***	15.065*	6.211*	3.876	0.579	−0.766	−1.982	−2.675**	−2.332***	−0.336	−0.137
	(0.230)	(8.633)	(3.503)	(3.357)	(2.021)	(1.663)	(1.246)	(1.217)	(0.887)	(0.230)	(0.131)
m_resid	0.109***	0.085**	0.055	0.045	0.112***	0.108***	0.102***	0.098***	0.101***	−0.091	0.006
	(0.027)	(0.037)	(0.034)	(0.038)	(0.035)	(0.030)	(0.028)	(0.030)	(0.031)	(0.079)	(0.073)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted/Pseudo R^2	0.770	0.491	0.497	0.499	0.504	0.505	0.508	0.509	0.535	0.511	0.500
No. of observations	12,169	12,169	12,169	12,169	12,169	12,169	12,169	12,169	12,169	12,169	12,169

Note. Beta coefficients; Standard errors in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

TABLE 3 Step 1. Regression of social capital on exogenous variables

	(1) RE	(2) QR01	(3) QR02	(4) QR03	(5) QR08	(6) QR09	(7) QR13	(8) (QR14)	(9) (QR50)	(10) (QR98)	(11) (QR99)
AssociationD	0.070***	0.011***	0.010	0.010**	−0.014***	0.013***	0.012***	0.012**	0.021***	0.123	0.897
	(0.025)	(0.005)	(0.007)	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)	(0.008)	(0.289)	(0.816)
Mng. Education	0.024***	−0.000	0.001	0.001	0.003**	0.004***	0.005***	0.005***	0.007***	0.131***	0.156**
	(0.005)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.035)	(0.069)
lnAsset	0.012**	0.001	0.001	0.001	0.002**	0.002**	0.003***	0.004***	0.008***	0.033	0.024
	(0.005)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.023)	(0.040)
lnLabor	0.037***	0.005***	0.007***	0.008***	0.010***	0.010***	0.011***	0.011***	0.019***	0.062**	0.114**
	(0.006)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.031)	(0.047)
Pro_Labor	0.530**	0.021	0.030	0.067	0.145***	0.143***	0.133***	0.130**	0.409***	8.223***	10.011***
	(0.250)	(0.067)	(0.065)	(0.068)	(0.039)	(0.037)	(0.049)	(0.054)	(0.099)	(2.996)	(3.254)
Rural area	0.010	0.013***	0.017***	0.015***	0.020***	0.021***	0.023***	0.023***	0.027***	−0.070	−0.109
	(0.015)	(0.004)	(0.005)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.086)	(0.162)
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	12,191	12,191	12,191	12,191	12,191	12,191	12,191	12,191	12,191	12,191	12,191

Note. Beta coefficients; Standard errors in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

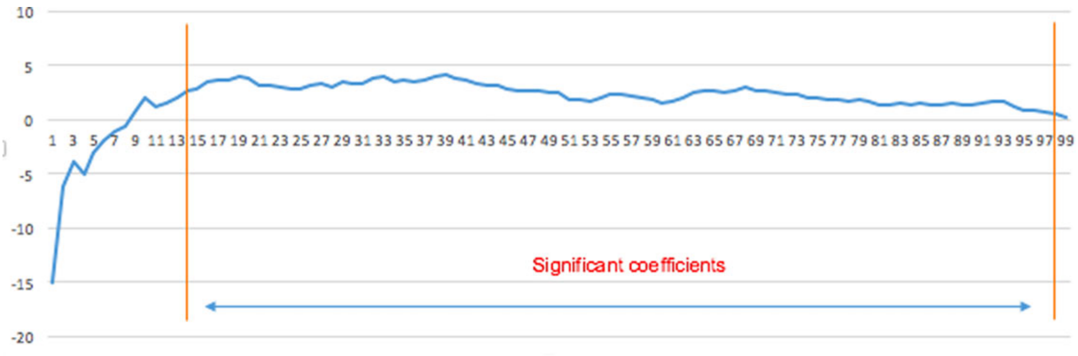

FIGURE 1 The coefficients of social capital at each quantile range

In general, the result of the random effect model confirms the impact of social capital on firm performance. At first glance, in line with physical capital and human capital, the number of contacts in business activities normally has a positive impact on firm revenue: The magnitude of coefficients of *TotalContact* in random effect model is 1.48 and significant at 1% level. However, the impacts of social capital on each quantile of firm revenue are different. It should be noted that quantile regression is more robust to outliers than random effect regression, and in the case of the relationship between social capital and firm revenue the median estimate is not similar to the point estimated by random effect method.

When we used quantile regression method to estimate the impact of social capital on firm performance, the magnitudes and the *p*-values of coefficients of *TotalContact*classify firms into five groups. In the case of the 2% of firms that have the lowest revenue, the coefficient of social capital is significantly negative, that is, investment in social capital is certainly harmful to the performance of these low-saving firms, and therefore to improve performance these firms should allocate their resources to physical capital and human capital but not to social capital. In quantile ranges from 3% to 8%, the impact of social capital is still negative; however, the coefficient looses its significance. The coefficient of social capital turns to be positive from the quantile 9% but remains insignificant until quantile 14%. Social capital only facilitates firm performance in the range from 14% to 98%. In the case of the top 1% of the Vietnamese richest firms, social capital does not have any significant effect at all.

Considering the case of firms in the quantile range from 14% to 98%, the magnitudes of significant coefficients of social capital are not similar. Figure 1 shows that the coefficient of social capital slightly increases from 2.696 at the quantile of 14% and peaks at 4.06 at the quantile of 39%. After this peak, it slowly declines despite the rise in firm revenue. In other words, social capital plays a considerable role in firm development; however, when the firm becomes richer, the impact of social capital turns to be weakened.

The econometric results generally confirm our theoretical outcomes. There exist a lower bound (of 14%) and an upper bound (of 98%) such that outside these bounds the investment in social capital is inefficient; meanwhile, the role of social capital decreases as a firm achieves higher and higher levels of revenue. The latter finding could be explained because firms with higher revenue often invest more in advanced technology. Thus, the role of social capital is clearly reduced. The simultaneous impact of social capital and technology on firm performance should be examined more in future research on this field.

Additionally, it could be said that small-scale economies like Vietnam largely depend on social capital building among entities, given that 85% of Vietnamese SMEs employ their social capital as a useful tool to facilitate their organization. However, the role of social capital could vary among economies with different scales. It is, therefore, necessary for future studies to examine the relationship between social capital and firm performance using data of other economies to determine the impact thresholds of social capital in different contexts.

4 | CONCLUSION

This paper has explored the potential impact of the number of contacts in business activities on firm performance, and how and under which conditions firms should invest in their social capital. The empirical results were guided by a theoretical model that analyzed the contribution of social capital to economic growth and allowed us to make progress along two lines. First, we have shown that, if the saving is not large enough, if its equivalent to the revenue is very modest, the investment of the firm in social capital is not efficient. Second, we have found out that social capital only has a certain effect on firm revenue, that is, in the long term, firms cannot only consider their social ties; they also need to improve other types of capital such as physical capital, human capital, as well as other resources at the same time in order to improve their own capacity, and, consequently, expand their potential customer base and prospective market. In other words, if an entrepreneur is satisfied with his business in a local area and does not have any plan to develop more, such as expanding his commodity and/or his business into other neighborhoods, social capital will only help him to a certain extent. When his firm develops to a certain level (that is, when it achieves a certain revenue), he cannot rely on social capital as a sole source to reach higher productivity.

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How to cite this article: Le Van C, Nguyen AN, Nguyen N-M, Simioni M. Growth strategy with social capital, human capital and physical capital—Theory and evidence: The case of Vietnam. *Journal of Public Economic Theory*. 2018;1–20. https://doi.org/10.1111/jpet.12305

APPENDIX A

Proof of Proposition 1. *Let* $G(S,\theta) = \gamma((1-\theta)S)\theta$ *and* $Z(S) = \max\{G(S,\theta) : \theta \in [0,1]\}$.

Proof of (i):

- *We first show that when* $S \leq \hat{m} + \frac{1}{a}$ *then* $\theta(S) = 1$ *(no investment in social capital).*

(1) *If* $S \leq \hat{m}$, *then* $(1-\theta)S \leq \hat{m}$ *for any* $\theta \in [0,\ 1]$. *In this case* $G(S,\theta) = \theta \Rightarrow Z(S) = 1, \theta(S) = 1$ *and* $1 - \theta(S) = 0$ *(the firm will not invest in social capital).*

(2) *Now consider the case* $S > \hat{m}$.

- *(a)* $\theta \geq 1 - \frac{\hat{m}}{S}$ *or equivalently* $(1-\theta)S \leq \hat{m}$. *In this case,* $G(S,\theta) = \theta \Rightarrow Z(S) = 1, \theta(S) = 1$ *and* $1 - \theta(S) = 0$.
- *(b) Let* $0 \leq \theta \leq 1 - \frac{\hat{m}}{S}$. *The maximum cannot be obtained with* $\theta(S) = 0$ *since if it is true then* $Z(S) = 0$. *If the solution* $\tilde{\theta}$ *is interior, that is,* $\tilde{\theta} \in (0, 1 - \frac{\hat{m}}{S})$, *then we get* $\tilde{\theta} = \frac{1}{2}(1 - \frac{\hat{m}}{S}) + \frac{1}{2aS}$. *(This value is obtained by writing* $\frac{\partial G}{\partial \theta}(S,\theta) = 0$*). It is smaller than* $1 - \frac{\hat{m}}{S}$ *if, and only if,* $S > \hat{m} + \frac{1}{a}$.
Hence if $S \leq \hat{m} + \frac{1}{a}$ *then* $\tilde{\theta} = 1 - \frac{\hat{m}}{S}$. *In this case* $\gamma((1-\tilde{\theta})S)\tilde{\theta} = \tilde{\theta} = 1 - \frac{\hat{m}}{S}$. *It is smaller than the value we obtained in (a). Hence,* $1 - \frac{\hat{m}}{S}$ *cannot be* $\theta(S)$. *We can summarize at this stage that* $S \leq \hat{m} + \frac{1}{a} \Rightarrow Z(S) = 1, \theta(S) = 1, 1 - \theta(S) = 0$.
- *Now, assume* $S > \hat{m} + \frac{1}{a}$. *Again,* $\theta(S) > 0$. *If it is strictly smaller than 1, then* $\theta(S) = \tilde{\theta} = \frac{1}{2}(1 - \frac{\hat{m}}{S}) + \frac{1}{2aS}$. *(This value is obtained by writing* $\frac{\partial G}{\partial \theta}(S,\theta) = 0$*). We have*

$$G(S,\tilde{\theta}) = \Psi(S) = \frac{a}{4S}\left[S + \frac{1}{a} - \hat{m}\right]^2$$
$$= \frac{a}{4}\left[S + 2(\frac{1}{a} - \hat{m}) + (\frac{1}{a} - \hat{m})^2\frac{1}{S}\right].$$

We have

$$\Psi'(S) = \frac{a}{4S^2}\left[S^2 - (\frac{1}{a} - \hat{m})^2\right].$$

Since $S > \hat{m} + \frac{1}{a}$, *we have* $\Psi'(S) > 0$. *It is obvious that* $\Psi(+\infty) = +\infty$. *When* $S \to \hat{m} + \frac{1}{a}$, *we have* $\Psi(S) \to \frac{1}{a\hat{m}+1} < 1$. *Hence there exists a unique* $S^c > \hat{m} + \frac{1}{a}$ *such that* $\Psi(S^c) = 1$. *For* $\hat{m} + \frac{1}{a} < S < S^c$ *we have* $\Psi(S) < 1$. *Since* $G(S,1) = 1$, $\theta(S)$ *cannot* *be less than 1. Hence $\theta(S) = 1$ and $Z(S) = 1$. For $S > S^c$, we have $\Psi(S) > 1$ and hence $Z(S) > 1$ with $\theta(S) = \tilde{\theta} = \frac{1}{2}(1 - \frac{\hat{m}}{S}) + \frac{1}{2aS}$. One can easily check that $\theta(S) < 1$.*

Proof of *(ii)*

Observe that $S > \hat{m} + \frac{1}{a} \Rightarrow S + \frac{1}{a} - \hat{m} > 0$. We then get

$$\frac{\partial \ln(\Psi)}{\partial a}(S) = \frac{1}{a} - \frac{2}{a^2}\left[\frac{1}{S + \frac{1}{a} - \hat{m}}\right]$$

$$= \frac{1}{a}\left[S - (\frac{1}{a} + \hat{m})\right] \times \frac{1}{S + \frac{1}{a} - \hat{m}} > 0,$$

$$\frac{\partial \ln(\Psi)}{\partial \hat{m}} - \frac{2}{S + \frac{1}{a} - \hat{m}} < 0.$$

The graph of the function $\Psi(S) - 1$ shifts up when a increases. Hence S^c, which is the unique solution to $\Psi(S) - 1 = 0$, decreases when a increases. Now, when $\hat{m}$ increases, the graph of $\Psi(S) - 1$ shifts down and S^c increases. ■

APPENDIX B

Proof of Proposition 2.

(i) *For $S > S^c$, we have*

$$\theta(S) = \frac{1}{2}(1 - \frac{\hat{m}}{S}) + \frac{1}{2aS}$$

$$\sigma(S) = a\left[(1 - \theta(S))S - \hat{m}\right] + 1$$

$$= \frac{a}{2}(S + \frac{1}{a} - \hat{m})$$

$$\text{and } F(\sigma(S)\theta(S)S) = H(S)$$

$$= F\left(\frac{a}{4}(S + \frac{1}{a} - \hat{m})^2\right).$$

Therefore, $\frac{\sigma(S)}{F(\sigma(S)\theta(S)S)}$ is a decreasing function for $S > S^c$.

(ii) *When $S \to +\infty$, then $\theta(S) = \frac{1}{2}(1 - \frac{\hat{m}}{S}) + \frac{1}{2aS} \to \frac{1}{2}$ and $\frac{\sigma(S)}{S} = \frac{a((1-\theta(S))S - \hat{m}) + 1}{S} \to \frac{a}{2}$. Hence $\frac{\sigma(S)}{F(\sigma(S)\theta(S)S)}$ is equivalent to $\frac{aS}{2F(\frac{aS^2}{4})}$ and converges to 0.* ■

APPENDIX C

Proof of Lemma 3. *We have the Euler equation*

$$\forall t,\ u'(H(S_t^*) - S_{t+1}^*) = \beta u'(H(S_{t+1}^*) - S_{t+2}^*)H'(S_{t+1}^*).$$

Let us compute $H'(0)$. It is obvious that $H(0) = 0$. We have

$$H'(0) = \lim_{S \to 0} \frac{H(S)}{S} = \lim_{S \to 0} AS^{\alpha-1}[\gamma((1 - \theta(S))S)\theta(S)]^{\alpha}.$$

When S is close to zero $\gamma((1-\theta(S))S) = 1$ and $\theta(S) = 1$. Hence $\lim_{S\to 0} \frac{H(S)}{S} = +\infty$. Consider again the Euler equation. If S_t^* converges to zero, then, there exists T such that, for any $t > T$, $\beta H'(S_{t+1}^*) > 1$. This implies

$$u'(c_t^*) = u'(H(S_t^*) - S_{t+1}^*) > u'(c_{t+1}^*) = u'(H(S_{t+1}^*) - S_{t+2}^*), \forall t \geq T.$$

Equivalently, $c_{t+1}^* > c_T^* > 0$, for any $t > T$. However, if S_t^* goes to zero then c_t^* goes to zero too. We get a contradiction which ends the proof. ■

APPENDIX D

Proof of Lemma 4. *The steady states $\bar{S}$ and $\tilde{S}$ are respectively defined by $F'(\bar{S}) = H'(\tilde{S}) = \frac{1}{\beta}$. Observe that $F(S) = AS^\alpha$ and $H(S) = AS^\alpha\Psi(S)^\alpha$. We then have*

$$\frac{1}{\beta} = A\alpha\bar{S}^{\alpha-1} = A\alpha\tilde{S}^{\alpha-1}[\Psi(\tilde{S})^\alpha + \tilde{S}\Psi(\tilde{S})^{\alpha-1}\Psi'(\tilde{S})].$$

Since $\Psi(\tilde{S}) > \Psi(S^c) = 1$, $\Psi' > 0$, we have $\bar{S}^{\alpha-1} > \tilde{S}^{\alpha-1}$ or equivalently $\tilde{S} > \bar{S}$. ■

APPENDIX E

Implementation of the control function method

The baseline model, or

$$\begin{aligned} lnRevenue = \beta_0 &+ \beta_1 lnAssets + \beta_2 lnLabor + \beta_3 Pro\_Labor + \beta_4 TotalContact \\ &+ \beta_5 sector + \beta_6 rural + \beta_7 year + u, \end{aligned}$$

can be expressed as

$$y_{1it} = z'_{1it}\beta_1 + \alpha_1 y_{2it} + \eta_t + c_{1i} + u_{1it}, \tag{E1}$$

where

- y_{1it} = the revenue of firm i at time t (in logarithms),
- z_{1it} = the vector of total assets, total labor cost (in logarithms), and total number of professional labor of firm i at time t. They are assumed to be strictly exogenous,
- y_{2it} = total contact, the endogenous explanatory variable,
- η_t = a time t effect,
- c_{1i} = firm i fixed effect, and
- u_{1it} = the classical two-sided error term.

Let $z_i = (z_{i1}, \ldots, z_{iT})$ denote the matrix of the observed strictly exogenous variables (conditional on c_{1i}) for firm i. Note that z_{1it} is part of z_{it}, that is, we can write z_{it} as $z_{it} = (z'_{1it}, z'_{2it})$ where z_{2it} denotes a vector of instrumental variables including (i) a dummy variable of whether firm participates in a business association and (ii) the highest educational level of firm representative, that are excluded from Equation E1. That is, here,

- $z_{2it} = (associationD, mng\_edu)$.

In the control function approach, it is assumed that the reduced form of the endogenous explanatory variable y_{2it} is a linear projection in the population, or

$$y_{2it} = z'_{1it}\delta_1 + z'_{2it}\delta_2 + c_{2i} + u_{2it}. \tag{E2}$$

The classical rank condition of identification in IV estimation can now be written as $\delta_2 \neq 0$. Equation E2 can be also written as

$$y_{2it} = z'_{it}\delta + c_{2i} + u_{2it}. \tag{E3}$$

Equation E3 can be estimated using classical fixed-effect estimator, but this approach prevents the use of any time-invariant regressors in this equation. This is a well-known limitation of this estimator. Moreover, if we are willing to assume that c_{2i} and z_{it} are correlated, we can use the correlated random effect estimator proposed by Mundlak (1978). This estimator is based on the assumption that

$$c_{2i} = \bar{z}'_i\lambda + a_{2i}, \tag{E4}$$

where $\bar{z}_{ji} = T^{-1}\sum_{t=1}^{T} z_{jit}$. Then, plugging Equation E4 into Equation E2, this latter becomes

$$y_{2it} = z'_{it}\delta + \bar{z}'_i\lambda + v_{2it}, \tag{E5}$$

where $v_{2it} = a_{2i} + u_{2it}$. This equation can be estimated either by pooled ordinary least squares (OLS) or random-effect estimator as $\mathbb{E}(a_{2i} + u_{2it}|z_{it}) = 0$. It should be noted that (i) this approach is equivalent to fixed-effect estimation, (ii) it makes it possible to estimate the effect of time invariant variables, and (iii) a simple test of correlation between c_{2i} and z_{it} can be performed testing $H_0 : \lambda = 0$.

Endogeneity of y_{2it} arises if and only if u_{1it} in Equation E1 is correlated with u_{2it} in Equation E2. Thus, we can write the linear projection of u_{1it} on u_{2it} in error form as

$$\begin{aligned} u_{1it} &= \theta u_{2it} + e_{1it} \\ &= \theta(v_{2it} - a_{2i}) + e_{1it}, \end{aligned} \tag{E6}$$

where $\theta = \mathbb{E}(u_{2it}u_{1it})/\mathbb{E}(u_{1it}^2)$ is the population regression coefficient. By definition, $\mathbb{E}(u_{2it}e_{1it}) = 0$ and $\mathbb{E}(z_{it}e_{1it}) = 0$, because u_{1it} and u_{2it} are both uncorrelated with z_{it}.

Plugging Equation E6 into Equation E1, this latter becomes

$$\begin{aligned} y_{1it} &= z'_{1it}\beta_1 + \alpha_1 y_{2it} + \eta_t + c_{1i} + \theta(v_{2it} - a_{2i}) + e_{1it} \\ &= z'_{1it}\beta_1 + \alpha_1 y_{2it} + \theta v_{2it} + \eta_t + (c_{1i} - \theta a_{2i}) + e_{1it} \\ &= z'_{1it}\beta_1 + \alpha_1 y_{2it} + \theta v_{2it} + \eta_t + c_{0i} + e_{1it}, \end{aligned} \tag{E7}$$

where we now view v_{2it} as an additional explanatory variable in Equation E1. We can deal with the potential correlation between the fixed effect c_{0i} and this additional variable in a similar way we have done in Equation E2, by assuming that

$$c_{0i} = \alpha_0\bar{v}_{2i} + a_{2i}, \tag{E8}$$

where $\bar{v}_{2i} = T^{-1}\sum_{t=1}^{T} v_{2it}$.

Finally, plugging Equation E8 into Equation E7, we get the “augmented” equation

$$y_{1it} = z'_{1it}\beta_1 + \alpha_1 y_{2it} + \theta v_{2it} + \alpha_0\bar{v}_{2i} + \eta_t + a_{1i} + e_{1it}, \tag{E9}$$

where, now, $\mathbb{E}(a_{1i} + e_{1it}|y_{2it}) = 0$. This equation can be estimated using either pooled OLS or random effect estimator.

To sum up, estimation of the impact of social capital on firm profitability can be performed in two steps:

(1) Estimate the reduced form (E5) for y_{2it}, using pooled OLS. Obtain the residuals $\hat{v}_{2it}$ for all (i, t) pairs and calculate $\bar{v}_{2i} = T^{-1} \sum_{t=1}^{T} v_{2it}$.

(2) Estimate the augmented regression model (E9), using random effect estimator. Testing endogeneity of y_{2it} is now equivalent to testing $H_0 : \theta = 0$ using a robust t-statistics.

The preceding framework can be extended to the estimation of conditional quantiles instead of conditional expectation in order to investigate the impact of social capital on quantiles of the conditional distribution of firm profitability (Lee, 2007). Estimation can be performed in two steps:

(1) Obtain the estimated residuals $\hat{v}_{2it}$ for all (i, t) pairs, by a linear quantile regression of y_{2it} on z_{it} and $\bar{z}_i$. Then calculate $\bar{v}_{2i} = T^{-1} \sum_{t=1}^{T} v_{2it}$.

(2) Estimate the linear quantile regression of y_{1it} on z_{1it}, $\hat{v}_{2it}$, and $\bar{v}_{2i}$, using the estimated residuals $\hat{v}_{2it}$ in place of the unobserved v_{2it}.

Because of the two-step procedure, the standard errors in the second step are known to be incorrect. Murphy and Topel (1985) proposed a general method of calculating the correct asymptotic covariance matrix for the second step estimators. But this method entails complicated calculations. Instead, we prefer therefore to estimate the standard errors in the second step using the bootstrap technique, that is to say by resampling the firms a large number of times. This number can be fixed following Davidson and MacKinnon (2000).