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CONNECTED LENDING AND AGGREGATE PRODUCTIVITY

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ABSTRACT. The issue of connected lending is shown to be prevalent in many countries. This paper documents that in cross-country data connected lending is negatively associated with aggregate output and aggregate productivity. A model incorporating connected lend is presented and used to quantitatively study the effect of connected lending on aggregate productivity. The results show that connected lending has a moderately negative effect on aggregate productivity and can be better explained by the crony view than the information view. This implies that special connections between firms and banks generally do not reduce the asymmetric information between them.

JEL Classification*:** O1, O4 ***Keywords: financial intermediaries, productivity.

Introduction

Connected lending occurs when financial intermediaries grant loans to some firms based on their special connections but not on firm characteristics. Bualek (2000) argues that the founders of most Thai commercial banks established their banks in order to channel loans to their own non-bank businesses. When connected lending arises, resources are not allocated to their best uses. Restuccia and Rogerson (2008) show that resource misallocation can considerably decrease aggregate output and aggregate productivity. Since connected lending can cause resource misallocation, connected lending can severely and adversely affect aggregate productivity.

There is actually some evidence of the relationship between connected lending and aggregate productivity in the cross-country data. The World Bank Business Environment Survey (WBES) which was conducted in 2000 has a survey question related to the issue of connected lending. In the survey, firms are asked how problematic the need for special connections with banks or financial institutions is for the operation and growth of their businesses. The variable takes a value between one and four. One means no obstacle, two means minor obstacle, three means moderate obstacle, and four means major obstacle. So, the higher the value means the more of an obstacle the issue is and thereby means the more prevalence of connected lending. The need for special connections variable taken from the WBES, therefore, can be used as a measure of connected lending.

Figure 1 plots real gross domestic product (GDP) per worker obtained from Caselli (2005) against the country average of the need of special connections, which is a measure of connected lending. As can be seen from the figure, the issue of connected lending is negatively associated with aggregate output.

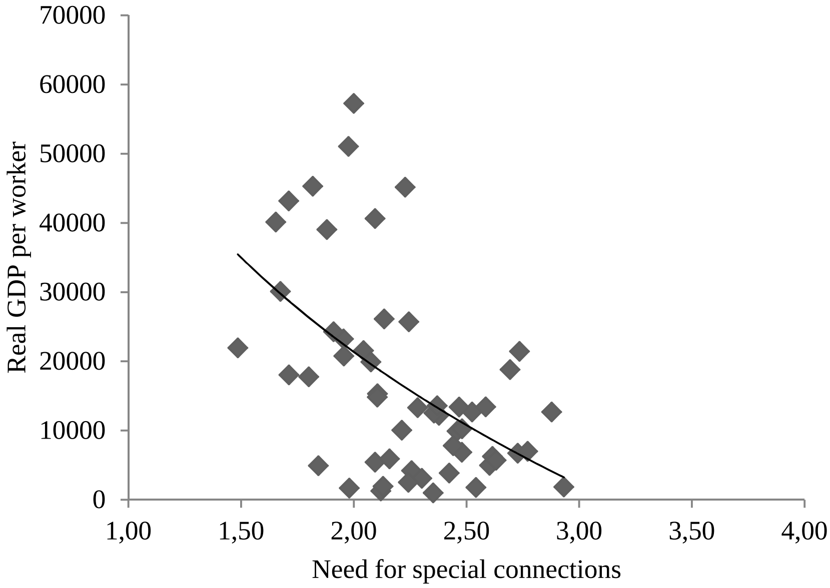

Figure 1. Inverse relationship between connected lending and aggregate output
Notes: Need for special connection is the country average of firm responses to the question "How problematic the need for special connections with banks or financial institutions is for the operation and growth of its business?" taken from the WBES. Real GDP per worker is obtained from Caselli (2005).

Figure 2 plots total factor productivity (TFP) obtained from Caselli (2005) against the country average of the need of special connections, which is a measure of connected lending. As can be seen from the figure, the issue of connected lending is negatively associated with aggregate productivity.

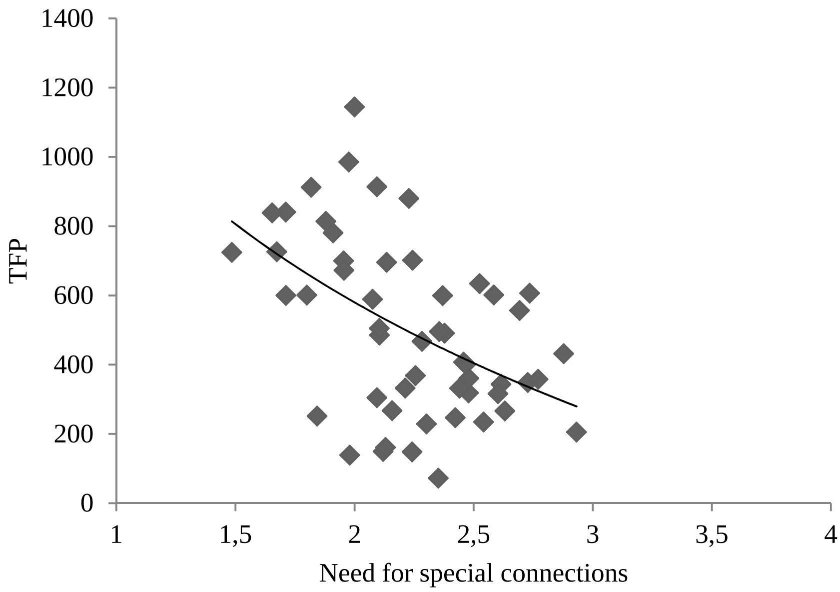

Figure 2. Inverse relationship between connected lending and aggregate productivity
Notes: Need for special connection is the country average of firm responses to the question "How problematic the need for special connections with banks or financial institutions is for the operation and growth of its business?" taken from the WBES. TFP is Total Factor Productivity obtained from Caselli (2005).

This paper uses a model economy embedding connected lending to quantitatively evaluate the impact of connected lending on aggregate productivity. The model incorporates entrepreneurship, financial frictions, and connected lending into an otherwise standard neoclassical model. In the model, individuals choose whether to become an entrepreneur operating an individual specific technology or to become a worker supplying labor for a wage. This occupation choice allows for endogenous entry and exit decisions in production, which are important sources of resource misallocation. Individuals differ in their productivity, wealth, and special connection status. Individuals' wealth is determined endogenously by their forward-looking saving decisions. The financial frictions are modeled as collateral constraints. Entrepreneurs with special connections face a more relaxed collateral constraint compared to those without special connections. These collateral constraints and the differentiation in these constraints among entrepreneurs limit efficient reallocation of resources across entrepreneurs. The model is then calibrated using data on standard macroeconomic aggregates, establishment size distribution, establishment dynamics, the concentration of income in the population, and firms' external financing.

Economies in this study differ from one another in their degrees of connected lending. There are several ways to model the differentiation in collateral constraints between entrepreneurs with and without special connections. One way is to loosen the collateral constraint faced by entrepreneurs with special connections but tighten the collateral constraint faced by entrepreneurs without special connections. This way of modeling allows the external finance to GDP ratio to be kept roughly constant in order to isolate the effect of connected lending. Another way is to tighten the collateral constraint faced by entrepreneurs without special connections but hold fixed the other. This way of modeling is consistent with the crony view which recognizes that banks may grant loans based on special connections but not on firm characteristics, and channel funds away from unconnected entrepreneurs to connected entrepreneurs. The other way is to loosen the collateral constraint faced by entrepreneurs with special connections but hold fixed the other. This way is consistent with the information view in which asymmetric information problems between banks and firms may be reduced when they have special connections.

The result shows that an increase in the severity of connected lending moderately decreases aggregate productivity given that the external finance to GDP ratio remains roughly constant. The experiment along the line of the crony view also causes a decrease in aggregate productivity. Different from the trend shown in *Figure 2*, the experiment along the line of the information view, however, does not cause a decrease in aggregate productivity. This, therefore, indicates that connected lending can be better explained by the crony view than the information view.

The remainder of the paper is organized as follows. Section 1 reviews some related literature. Section 2 describes the model. Section 3 calibrates the benchmark model economy to the U.S. economy and analyzes the quantitative effects of connected lending on aggregate productivity. The last section concludes.

1. Literature Review

In the literature on cross-country income differences accounting, it is widely accepted that differences in aggregate productivity play an important role in explaining income differences. It is believed that more than half of income differences result from differences in aggregate productivity. In Caselli (2005), differences in aggregate factors can explain not more than 40 percent of income differences. In this class of literature, another term frequently used in place of aggregate productivity or efficiency is a measure of ignorance. The reason for this term is that, when we only use aggregate factor quantities, we basically ignore many characteristics including disaggregated ones which can also significantly affect national income. Introducing disaggregated components into income differences accounting exercises is thus a promising way to improve the explanatory power of models and to acquire a better understanding of why income differs enormously across countries.

Differences in aggregate productivity can arise from distortions at the disaggregated or idiosyncratic level. One of the most promising disaggregate distortions is resource misallocation. In a frictionless economy, capital would always be allocated to its best use. Restuccia and Rogerson (2008) show that, in an economy with idiosyncratic distortions in the form of investment wedges or taxes, capital is misallocated across plants which are heterogeneous in productivity, and aggregate productivity thereby decreases significantly. Such distortions and resource misallocation could be caused by an imperfection in the financial system. Ideally, financial intermediaries allow better capital allocations. In reality, we frequently observe departures from this ideal situation. Comparable firms in different financial systems might face different difficulties in obtaining external finance. Greenwood, Sanchez, and Wang (2010) show that, in an economy where financial intermediaries face costly monitoring technology, deserving firms having high expected productivity are underfunded while undeserving firms having low expected productivity are overfunded compared to those in a frictionless economy.

Differences in investment distortions across firms in Greenwood et al. (2010) originate from the costly monitoring technology of financial intermediaries, and different firms face different distortions because they are different in their productivity. In reality, investment distortions may differ due to other factors which are not relevant to productivity. Their counterfactual experiment shows that, if Thai financial intermediaries attain the best monitoring technology, Thailand’s output per worker would increase by just about 10 percent. In contrast, the U.S. output per worker in would increase by around 25 percent if the U.S. financial intermediaries also attain the best monitoring technology. Because it is hard to believe that Thai financial market is more developed than that of the U.S., there must be some other aspects of financial market imperfection which play an important role in generating differences in investment distortions across firms.

Connected lending might play an important role in generating idiosyncratic investment distortions faced by firms. Financial intermediaries may extend loans to some firms based on their connections but not on firm characteristics. Most large Thai firms and banks are controlled by a handful number of families and are connected by shareholding or personal relationship. Charumilind, Kali, and Wiwattanakantang (2006) found that Thai firms which are connected to prominent families have better access to long-term loans than firms without such connections. Since an investment is better facilitated by long-term loans, firms with better access to such loans should be more capable to acquire capital. Thus, firms having the same characteristics except connections may end up with different amounts of capital. Charumilind *et al.* (2006) also show that connected firms have total assets and sales much more than unconnected ones. Connected lending is also prevalent in many other countries including Mexico and Russia. La Porta, Lopez-De-Silanes, and Zamarripa (2003) found that in Mexico connected loans have longer maturities than unconnected ones. Also, Leaven (2001) found that many Russian firms are shareholders of the banks that grant their loans, some firms are even the major shareholders of such banks, and such firms get preferential loan volumes.

2. Model

This paper uses a model economy along the lines of Buera and Shin (2013) to allow for establishment-level heterogeneity. The economy has an individual-specific technology and an imperfect credit market. The credit market imperfection is modeled as a collateral constraint on loan size that is proportional to an individual's wealth. In addition to the credit market imperfection, this economy also has connected lending which will be discussed in detail below.

There is a measure N of infinitely-lived individuals. They are heterogeneous in their productivity, wealth, and special connections with financial intermediaries. Individuals' wealth is determined endogenously by their forward-looking saving decisions. Productivity, z, follows a stochastic process. Specifically, individuals keep their productivity from one period to the next period with probability γ. With probability $1-\gamma$, an individual draws a new productivity level from the invariant distribution $\mu(z)$. The parameter γ, therefore, controls the persistence of the productivity process. Buera, Kaboski, and Shin (2011) interpret shocks to this process as changes in market conditions which affect the profitability of entrepreneurial ability or replacements of one generation by its offspring that does not share the same ability. An individual's special connection status, $s \in \{C, N\}$, follows a two-state Markov chain process. An individual with special connections in the current period, $s = C$, remains connected in the next period, $s' = C$, with probability ρ_C, and becomes unconnected, $s' = N$, with probability $1-\rho_C$. An individual without special connections in the current period remains unconnected in the next period with probability ρ_N, and becomes connected with probability $1-\rho_N$.

In any given period, individuals choose their occupation: whether to become a worker or to become an entrepreneur. Their occupational choices are based on the relative benefits which depend on their productivity and their access to loans. Access to loans is limited by individuals' wealth because loan contracts may not be perfectly enforceable, and by individuals' special connections with financial intermediaries. This results in an endogenous collateral constraint. Also, one entrepreneur can operate only one establishment in a given period. There is no market for managers or entrepreneurial ability. The way an establishment is modeled is taken from the span of control of Lucas (1978).

2.1. Preferences

Individuals' preferences in period t over contingent plans for the sequence of consumption are described by the expected utility function

$$E_t \sum_{i=t}^{\infty} \beta^{i-t} u(c_i),$$

where $u(c) = \frac{c^{1-\sigma}-1}{1-\sigma}$, $\beta \in (0,1)$ is the discount factor, σ is the coefficient of risk aversion and the reciprocal of the elasticity of intertemporal substitution. The expectation is over the realization of productivity, z, which depends on the probability of maintaining the productivity from one period to the next, γ, and on the distribution of new productivity draws, $\mu(z)$, and the realization of special connection status, s, which depends on the parameters of the Markov chain process, ρ_C and ρ_N.

2.2. Technology

At the beginning of each period, an individual with productivity z and wealth a chooses whether to become a worker earning a wage w or become an entrepreneur operating a business. An entrepreneur with productivity z who uses k units of capital and hires l units of labor produces output according to the production function

$$y = zf(k,l) = zk^{\alpha}l^{\theta},$$

where $\alpha, \theta \in (0,1)$ and $\alpha + \theta \in (0,1)$, which governs the degree of returns to scale in variable factors at the establishment level.

2.3. *Credit market*

Individuals have access to a financial intermediary which receives deposits and lend to entrepreneurs. The interest rate is r and the depreciation rate of capital is δ. The user cost of capital, therefore, is $R = r + \delta$.

Borrowing is limited to be within a period, that is, $a \geq 0$, and is limited by a collateral constraint. For individuals without any special connections with financial intermediaries, the borrowing requires collateral of $\frac{1}{\lambda_N}$ of the loan size. The capital rental of an individual without a special connection is therefore constrained to $k \leq \lambda_N a$. On the other hand, individuals with special connections face a more relaxed collateral constraint, that is, $\frac{1}{\lambda_C} < \frac{1}{\lambda_N}$ or $\lambda_C > \lambda_N$. The capital rental of an individual with a special connection is therefore constrained to $k \leq \lambda_C a$. This formulation of credit market imperfections is analytically tractable and can be motivated as arising from a limited enforcement problem. Buera and Shin (2013) argue that this collateral constraint can be derived from the following imperfect enforcement problem. Consider an individual with wealth a deposited in the financial intermediary. Assume that such individual rents k units of capital. Then that individual may choose to abscond, taking $\frac{1}{\lambda}$ of the capital. The only punishment is that such individual will lose the deposited wealth but will not be excluded from any economic activities in the future. In the equilibrium, the financial intermediary will lend only to the extent that no individual will renege on the contract. This implies a collateral constraint $\frac{k}{\lambda} \leq a$ or $k \leq \lambda a$.

2.4. *Individuals' problem*

An individual in period t seeks to solve the following problem:

$$\max_{\{c_i, a_{i+1}\}_{i=t}^{\infty}} E_t \sum_{i=t}^{\infty} \beta^{i-t} u(c_i)$$
$$s.t.\, c_i + a_{i+1} \leq \max\{w_i, \pi(a_i, z_i, s_i; r_i, w_i)\} + (1 + r_i)a_i, \forall i \geq t,$$

taking a_t, z_t, s_t and the sequence of interest rates and wages $\{r_i, w_i\}_{i=t}^{\infty}$ as given. $\pi(a_i, z_i, s_i; r_i, w_i)$ is the profit from operating a business. The indirect profit function is defined as:

$$\pi(a, z, s; r, w) = \max_{l, k \leq \lambda_s a} \{zk^{\alpha}l^{\theta} - (r + \delta)k - wl\},\ s = C, N,$$

The factor demand functions are denoted by $l(a, z, s; r, w)$ and $k(a, z, s; r, w)$. Note that profit and factor demand functions depend on wealth a because of the collateral constraint.

The individuals' problem can be rewritten in the recursive form. The value of the problem for an individual prior to the occupational choice, $v(a, z, s)$, is the maximum over the value of being a worker and the value of being an entrepreneur. The value function, therefore, can be written as follows:

$$v(a,z,s) = \max\{v^W(a,z,s), v^E(a,z,s)\}, \tag{1}$$

where $v^W(a,z,s)$ and $v^E(a,z,s)$ are the values of being a worker and an entrepreneur, respectively. These functions are defined as:

$$\begin{aligned} v^W(a,z,s) = \ &\max_{c,a'}\{u(c) \\ &+ \beta[\rho_C 1_C + (1-\rho_N)(1-1_C)]\left[\gamma v(a',z,C) + (1-\gamma)\int v(a',\tilde{z},C)\,\mu(\tilde{z})d\tilde{z}\right] \\ &+ \beta[(1-\rho_C)1_C + \rho_N(1-1_C)]\left[\gamma v(a',z,N) \right. \\ &\left. + (1-\gamma)\int v(a',\tilde{z},N)\,\mu(\tilde{z})d\tilde{z}\right]\} \\ &s.t.\, c + a' \le w + (1+r)a, \end{aligned} \tag{2}$$

$$\begin{aligned} v^E(a,z,s) = \ &\max_{c,a'}\{u(c) \\ &+ \beta[\rho_C 1_C + (1-\rho_N)(1-1_C)]\left[\gamma v(a',z,C) + (1-\gamma)\int v(a',\tilde{z},C)\,\mu(\tilde{z})d\tilde{z}\right] \\ &+ \beta[(1-\rho_C)1_C + \rho_N(1-1_C)]\left[\gamma v(a',z,N) \right. \\ &\left. + (1-\gamma)\int v(a',\tilde{z},N)\,\mu(\tilde{z})d\tilde{z}\right]\} \\ &s.t.\, c + a' \le \pi(a,z,s;r,w) + (1+r)a, \end{aligned} \tag{3}$$

where 1_C is an indicator function which equals 1 if $s = C$, and 0 otherwise. Note that the value of being a worker, $v^W(a,z,s)$, not only depends on wealth a but also on productivity z and special connection status s because they may be utilized at a later date. After the occupational choice has been made, an individual chooses consumption c and the next period's wealth a' to maximize the current period utility and the continuation value subject to the budget constraint. Since an individual will face an occupational choice again, the continuation value takes the form of $v(a',z',s')$, where $z' = z$ with probability γ, $z' = \tilde{z}$ drawn from $\mu(\tilde{z})$ with probability $1-\gamma$, $s' = C$ with probability ρ_C if $s = C$ and with probability $1-\rho_N$ if $s = N$, and $s' = N$ with probability ρ_N if $s = N$ and with probability $1-\rho_C$ if $s = C$.

2.5. Stationary competitive equilibrium

Definition. A stationary competitive equilibrium is composed of an invariant joint distribution of wealth, productivity, and special connection status $g(a,z,s)$, occupational choice function $o(a,z,s)$, policy functions $c(a,z,s)$, $a'(a,z,s)$, $k(a,z,s)$, $l(a,z,s)$, and prices w, r, and R such that:

1) Given w, r, and R, the individual policy functions $o(a,z,s)$, $c(a,z,s)$, $a'(a,z,s)$, $k(a,z,s)$, $l(a,z,s)$ solve (1), (2), and (3);
2) Financial intermediaries make zero profit, i.e., $R = r + \delta$;
3) Capital and labor markets clear,

$$\int k(a,z,s)dG(a,z,s) = \int a'(a,z,s)dG(a,z,s),$$
$$\int l(a,z,s)dG(a,z,s) = \int_{(a,z,s)\in\{o(a,z,s)=W\}} dG(a,z,s).$$

By Walras' law, this implies goods market clearing;

4) The joint distribution of wealth, productivity, and special connection status is a fixed point of the mapping:
$g(a,z,s) = \Big[\rho_C\gamma\int_{a'(\tilde{a},z,C)=a} g(\tilde{a},z,C)d\tilde{a} + \rho_C(1-\gamma)\mu(z)\iint_{a'(\tilde{a},\tilde{z},C)=a} g(\tilde{a},\tilde{z},C)d\tilde{a}d\tilde{z} + (1-\rho_C)\gamma\int_{a'(\tilde{a},z,N)=a} g(\tilde{a},z,N)d\tilde{a} + (1-\rho_C)(1-\gamma)\mu(z)\iint_{a'(\tilde{a},\tilde{z},N)=a} g(\tilde{a},\tilde{z},N)d\tilde{a}d\tilde{z}\Big]1_C + \Big[\rho_C\gamma\int_{a'(\tilde{a},z,C)=a} g(\tilde{a},z,C)d\tilde{a} + \rho_C(1-\gamma)\mu(z)\iint_{a'(\tilde{a},\tilde{z},C)=a} g(\tilde{a},\tilde{z},C)d\tilde{a}d\tilde{z} + (1-\rho_C)\gamma\int_{a'(\tilde{a},z,N)=a} g(\tilde{a},z,N)d\tilde{a} + (1-\rho_C)(1-\gamma)\mu(z)\iint_{a'(\tilde{a},\tilde{z},N)=a} g(\tilde{a},\tilde{z},N)d\tilde{a}d\tilde{z}\Big](1-1_C),$
where 1_C is an indicator function which equals 1 if $s = C$, and 0 otherwise.

2.6. *Special case*

In this section, a special case when $\alpha + \theta = 1$ and there is no occupational choice, i.e., the number of workers is constant, is considered. The market clearing conditions therefore become

$$\int k(a,z,s)dG(a,z,s) = \int a'(a,z,s)dG(a,z,s) \equiv K,$$
$$\int l(a,z,s)dG(a,z,s) = L,$$

where L is the number of workers.

Since $\alpha + \theta = 1$ which means the production function exhibits constant returns to scale, the optimal amount of capital is a corner solution and equal to $k^* = \lambda_s a$, $S = C, N$, if the entrepreneur decides to operate. The optimal amount of labor is $l^* = \left(\frac{z(1-\alpha)}{w}\right)^{\frac{1}{\alpha}} k^*$. The profit equals to $\max\{\alpha\left(\frac{z(1-\alpha)}{w}\right)^{\frac{1}{\alpha}} - R, 0\}\lambda_s a$, $S = C, N$. The productivity cutoff point, therefore, is $z^* = \left(\frac{R}{\alpha}\right)^{\alpha}\left(\frac{w}{1-\alpha}\right)^{1-\alpha}$, which is independent of a and s. Only entrepreneurs with $z \geq z^*$ will operate and hire factors of production. The individual output of an active entrepreneur is $y^* = z^{\frac{1}{\alpha}}\left(\frac{1-\alpha}{w}\right)^{\frac{1-\alpha}{\alpha}}\lambda_s a$. Define the share of wealth held by an entrepreneur with productivity z as $\varpi(z) \equiv \frac{1}{K}\int ag(a,z)\,da$. Aggregate output equals to

$$Y = \iiint y(a,z,s)g(a,z,s)dadzds = [p\lambda_C + (1-p)\lambda_N]\left(\frac{1-\alpha}{w}\right)^{\frac{1-\alpha}{\alpha}}\int_{z*}^{\infty} z^{\frac{1}{\alpha}}\int ag(a,z)dadz = [p\lambda_C + (1-p)\lambda_N]\left(\frac{1-\alpha}{w}\right)^{\frac{1-\alpha}{\alpha}} K\int_{z*}^{\infty} z^{\frac{1}{\alpha}}\varpi(z)dz.$$

where $p = \frac{1-\rho_N}{2-\rho_C-\rho_N}$. The labor market clearing condition can be written as

$$L = \iiint l(a,z,s)g(a,z,s)dadzds = [p\lambda_C + (1-p)\lambda_N]\left(\frac{1-\alpha}{w}\right)^{\frac{1}{\alpha}}\int_{z*}^{\infty} z^{\frac{1}{\alpha}}\int ag(a,z)dadz = [p\lambda_C + (1-p)\lambda_N]\left(\frac{1-\alpha}{w}\right)^{\frac{1}{\alpha}} K\int_{z*}^{\infty} z^{\frac{1}{\alpha}}\varpi(z)dz.$$

Using the above equation, the aggregate output can be rewritten as

$$Y = [p\lambda_C + (1-p)\lambda_N]^{\alpha} \left(\int_{z*}^{\infty} z^{\frac{1}{\alpha}} \varpi(z) dz\right)^{\alpha} K^{\alpha} L^{1-\alpha}.$$

Aggregate productivity, therefore, depends on the weighted average of the collateral constraint parameters λ_C and λ_N, which is closely related to the external finance to GDP ratio. Given the weighted average of λ_C and λ_N, the aggregate productivity, however, does not depend on the combination of λ_C and λ_N. This might be because the optimal individual output of an entrepreneur is linear in λ_s, $S = C, N$, when constant returns to scale are assumed. Given the aggregate capital stock, a change in the combination of λ_C and λ_N maintaining their weighted average will not affect the aggregate output but will only result in a change in the allocation of output between two types of entrepreneurs. In order that connected lending can affect aggregate productivity, the production function should not exhibit constant returns to scale but decreasing returns to scale. By assuming decreasing returns to scale, the optimal individual output is no longer linear in λ_s, $S = C, N$. Specifically, the corner solution is $y^* = (\lambda_s a)^{\frac{\alpha}{1-\theta}} z^{\frac{1}{1-\theta}} \left(\frac{\theta}{w}\right)^{\frac{\theta}{\alpha}}$, $S = C, N$. This will allow the combination of λ_C and λ_N to affect aggregate productivity even if their weighted average is constant. Once decreasing returns to scale are assumed in order to allow connected lending to affect aggregate productivity, the productivity cutoff point is no longer independent of a and s causing the solution to be more complicated. A numerical method, therefore, will be used.

3. Quantitative analysis

In this section, the model economy is first calibrated to the U.S. economy, which is considered a relatively undistorted economy, and the collateral constraint parameters, λ_C and λ_N, are then adjusted to make the external finance to GDP ratio match that of Thai economy. Since there is no reliable data on connected loans, λ_C and λ_N cannot be pinned down by calibration. V various combinations of λ_C and λ_N which yield approximately the same external finance to GDP ratio, therefore, are considered. In particular, the parameters governing collateral constraints faced by entrepreneurs without and with connections are varied while all parameters governing preferences, technology, productivity process, and special connection status process are held fixed. As a result, economies differ from one another only in their degrees of connected lending. By maintaining this assumption, the impact of connected lending on aggregate productivity can be isolated.

3.1. Parameterization

The parameters are chosen so that the model economy matches key aspects of the U.S. economy. Specifically, standard macroeconomic aggregates, establishment size distribution, establishment dynamics, and firms' external financing are the targets.

The distribution $\mu(z)$ is assumed to be a Pareto distribution with the probability density function $\eta z^{-(\eta+1)}$. This assumption implies the establishment size distribution exhibits a thick right rail, which is a prominent feature of the data, and the parameter η governs the thickness of the tail.

Since the U.S. economy is considered relatively undistorted, connected lending is assumed to be negligible in the U.S. economy. Specifically, all entrepreneurs are assumed to face the same collateral constraint regardless of connections, that is, $\lambda \equiv \lambda_C = \lambda_N$. The values for eight parameters: the subjective discount factor β; the reciprocal of the intertemporal elasticity of substitution σ; two technological parameters α, θ; the depreciation rate δ; two parameters governing productivity process γ, η; and the parameter describing collateral constraints λ, are needed to be specified.

Following the standard in the literature, the one-year depreciation rate δ is set to 0.058 and the intertemporal elasticity of substitution σ is set to 1.5. α and θ are chosen so that $\alpha + \theta = 0.79$ and $\frac{\alpha}{\alpha+\theta}$ matches the aggregate capital share of 1/3. The remaining parameters are calibrated to match four relevant moments in the U.S. data: the annual real interest rate; the employment share of top decile of establishments; the annual exit rate of establishments; and the ratio of external finance to GDP. The target annual real interest rate is set to 4 percent. The target employment share of the top decile of establishments is 67 percent as reported by Buera and Shin (2013). The target annual exit rate of establishments is 10 percent which is approximately the annual job destruction rate in the U.S. manufacturing factor reported by Davis, Haltiwanger, and Schuh (1996). The ratio of external finance to GDP is targeted at 1.85, which is the midpoint of a narrow measure of external finance to GDP ratio defined as private credit to GDP ratio (1.35) and a broad measure defined as private credit and stock market capitalization to GDP ratio (2.35). Table 1 shows the values of these moments generated from the calibrated model and in the U.S. data.

Table 1. Calibration and parameterization

	U.S. data	Model	Parameter
Interest rate	0.04	0.04	$\beta = 0.92$
Top 10-percentile employment share	0.67	0.68	$\eta = 4.2$
Exit rate	0.10	0.10	$\gamma = 0.895$
Ratio of external finance to GDP	1.85	1.84	$\lambda = 17$

Source: Author's calculations.

Even though all of the above moments are jointly determined by all parameters, each moment is mainly influenced by one parameter. The real interest rate is primarily affected by the discount factor β via saving decisions. The employment share is mainly determined by the distribution of entrepreneurial ability. In particular, the tail of the employment distribution is primarily associated with the tail of the ability distribution which is determined by η. A smaller η or a thicker tail of the ability distribution is associated with a higher employment share of the top establishments. The exit rate is mainly influenced by γ which governs the persistence of the ability process. The external finance to GDP ratio is primarily affected by the parameter describing the collateral constraint λ. A more relaxed collateral constraint is generally associated with a higher external finance.

When considering the Thai economy, the values for two additional parameters, ρ_C and ρ_N, which governs special connection status process are needed to be specified. Since there is no reliable data on connected lending and special connections with financial intermediaries, $\rho_C = 1 - \rho_N$ is set to 0.22, which is the fraction of firms connected to the top 20 wealthiest families reported by Charumilind et al. (2006). λ_C and λ_N are set to match the ratio of external finance to GDP. The ratio of external finance to GDP is targeted at 1.71, which is the midpoint of a narrow measure of external finance to GDP ratio defined as private credit to GDP ratio (1.37) and a broad measure defined as private credit and stock market capitalization to GDP ratio (2.04).

3.2. Results

In this section, the effect of connected lending on aggregate productivity is quantified. The collateral constraints faced by entrepreneurs with and without connections are no longer the same. In particular, the parameter governing the collateral constraint faced by entrepreneurs with special connections λ_C is raised and the parameter governing the collateral constraint faced by entrepreneurs without special connections λ_N is lowered in such a way that the external finance to GDP ratio remains approximately the same.

Table 2 shows how aggregate productivity responds to changes in the collateral constraint parameters, λ_C and λ_N. Note that a higher λ_C means a more relaxed collateral constraint faced by entrepreneurs with special connections while a lower λ_N means a tighter collateral constraint faced by entrepreneurs without special connections. The aggregate TFP is measured relative to the value in the benchmark case, when $\lambda_C = \lambda_N$.

Table 2. Model predictions

Parameter	Ratio of external finance to GDP	Top 20-percentile income share	TFP
$\lambda_C = 11, \lambda_N = 11$	1.71	0.33	1.0000
$\lambda_C = 13, \lambda_N = 9$	1.72	0.33	0.9982
$\lambda_C = 15, \lambda_N = 7$	1.72	0.33	0.9894
$\lambda_C = 21, \lambda_N = 5$	1.70	0.34	0.9868
$\lambda_C = 50, \lambda_N = 3$	1.69	0.34	0.9775

Notes: TFP or aggregate productivity is normalized by the level when $\lambda_C = \lambda_N = 11$. Note that a higher λ_C means a more relaxed collateral constraint faced by entrepreneurs with special connections while a lower λ_N means a tighter collateral constraint faced by entrepreneurs without special connections.
Source: Author's calculations.

As can be seen from *Table 2*, connected lending has a moderately negative effect on aggregate productivity. A disparity in collateral constraints across groups of entrepreneurs results in a lower aggregate TFP. This is consistent with the stylized fact earlier presented in Figure 1. The result, therefore, suggests that aggregate productivity can be improved by reducing connected lending. To reduce connected lending, Dheera-aumpon (2013) suggests that the control rights of banks' controlling owners should be decreased.

3.3. Alternative experiment

The experiment conducted in the previous section assumes that the economy is closed. Since Thailand is generally considered a small open economy, another experiment assuming the economy is small and open is performed. Specifically, the real interest rate is fixed. The result in *Table 3* indicates that connected lending still can affect aggregate productivity.

Table 3. Model predictions – Small open economy

Parameter	Ratio of external finance to GDP	Top 20-percentile income share	TFP
$\lambda_C = 13, \lambda_N = 13$	1.72	0.32	1.0000
$\lambda_C = 14, \lambda_N = 12$	1.70	0.32	0.9779

Notes: TFP or aggregate productivity is normalized by the level when $\lambda_C = \lambda_N = 13$. Note that a higher λ_C means a more relaxed collateral constraint faced by entrepreneurs with special connections while a lower λ_N means a tighter collateral constraint faced by entrepreneurs without special connections.
Source: Author's calculations.

The experiment in the previous section also tries to maintain the external finance to GDP ratio by increasing λ_C and lowering λ_N at the same time. Since an increase in λ_C can be interpreted as a reduction in the asymmetric information problem between firms and banks, an increase in λ_C can be considered a change along the line of the information view. The information view suggests that banks can learn a substantial amount of information about firms having special connections with them. Banks may place their executives on the boards of their borrowing firms so that they can gain more information about the firms or even exert control over them. From the information view, the asymmetric information problems between banks and firms may be reduced when they have special connections. Also, since a decrease in λ_N can be interpreted as a barrier preventing unconnected entrepreneurs from accessing the pool of funds, a decrease in λ_N can be considered a change along the line of the crony view. From the crony view, connections between firms and banks may be established irrespective of firm characteristics. Connections may be built between firms and banks owned by families and friends, and loans may be granted based on connections but not on firm characteristics. In order to channel funds away from unconnected entrepreneurs to connected entrepreneurs, they might tighten the collateral constraints of the unconnected. The experiment in the previous section, therefore, consists of changes along the lines of both views.

Table 4 shows the result of an experiment along the line of the crony view. In particular, the parameter governing the collateral constraint faced by entrepreneurs without special connections λ_N is lowered but the parameter governing the collateral constraint faced by entrepreneurs with special connections λ_C is held fixed. Note that a lower λ_N means a tighter collateral constraint faced by entrepreneurs without special connections. As can be seen from the table, an increase in the collateral requirements faced by entrepreneurs without special connections leads to a decrease in the external finance to GDP ratio, aggregate output, and aggregate TFP.

Table 4. Model predictions – Crony view

Parameter	Ratio of external finance to GDP	Top 20-percentile income share	Output	TFP
$\lambda_C = 11, \lambda_N = 11$	1.71	0.33	1.0000	1.0000
$\lambda_C = 11, \lambda_N = 9$	1.71	0.33	0.9879	0.9922
$\lambda_C = 11, \lambda_N = 7$	1.69	0.33	0.9790	0.9855

Notes: TFP and output are normalized by the corresponding levels when $\lambda_C = \lambda_N = 11$. Note that a lower λ_N means a tighter collateral constraint faced by entrepreneurs without special connections.
Source: Author's calculations.

Table 5 shows the result of an experiment along the line of the information view. In particular, the parameter governing the collateral constraint faced by entrepreneurs with special connections λ_C is raised but the parameter governing the collateral constraint faced by entrepreneurs without special connections λ_N is held fixed. Note that a higher λ_C means a more relaxed collateral constraint faced by entrepreneurs with special connections. A more relaxed constraint is consistent with a less severe asymmetric information problem.

Table 5. Model predictions – Information view

Parameter	Ratio of external finance to GDP	Top 20-percentile income share	Output	TFP
$\lambda_C = 11, \lambda_N = 11$	1.71	0.33	1.0000	1.0000
$\lambda_C = 12, \lambda_N = 11$	1.71	0.33	0.9994	1.0008
$\lambda_C = 13, \lambda_N = 11$	1.72	0.33	0.9920	1.0008

Notes: TFP and output are normalized by the corresponding levels when $\lambda_C = \lambda_N = 11$. Note that a higher λ_C means a more relaxed collateral constraint faced by entrepreneurs with special connections.
Source: Author's calculations.

As can be seen from the *Table 5*, a decrease in the collateral requirements faced by entrepreneurs with special connections leads to a decrease in aggregate output and an increase in the external finance to GDP ratio and aggregate TFP. This, however, is different from the fact that connected lending is generally associated with a lower aggregate TFP as shown in *Figure 2*. This, therefore, indicates that connected lending is more consistent with the crony view than the information view. This is consistent with the result of Charumilind et al. (2006). They show that special connections between Thai firms and Thai banks do not reduce the asymmetric information problem between them. The effect of a relaxing in λ_C on TFP is weaker than that of a tightening in λ_N,. It might be because a relaxing in the collateral constraint benefits entrepreneurs with binding constraints, but a tightening of the constraint hurts not only those with binding constraints but also those with near binding collateral constraints.

Conclusions

In this paper, connected lending is incorporated into an economic model and the effect of connected lending on aggregate productivity is quantified. Connected lending is found to have a moderately adverse impact on aggregate productivity. It is also documented that in cross-country data the issue of connected lending has negative associations with aggregate output and aggregate productivity. Along with the stylized facts documented in this paper, the results of the experiments also indicate that connected lending is described better by the crony view compared to the information view. The results, therefore, indicate that special connections between firms and banks generally do not reduce the asymmetric information problems between them.

There, however, are some limitations of this study. The model can generate only moderate reductions in aggregate output and aggregate productivity. A possible direction for future research may involve a more complicated collateral constraint and a more complicated process for the special connection status in order to enhance the adverse impact of connected lending.

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