Financial Development and the Product Cycle

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Abstract

I develop a simple framework to study the effect of financial institution differences on the product cycle. I consider the problem faced by a Northern final-good producer that provides headquarter services but needs to acquire an intermediate input from a supplier located either in the North or the South to complete production. North and South differ in their level of financial development. I find that financial institution differences are enough to generate a product cycle in which new goods, more headquarter services intensive, are produced in the North and as goods become more standardized their production is offshored to the South. Moreover, I show that when Southern financial institutions improve, more production is located in the South and, more importantly, the effect of financial development on offshoring is larger, the more R&D-intensive the industry is. I also provide empirical evidence consistent with the model.

Keywords: Financial development, product cycle, outsourcing

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1 Introduction

Goods can either be entirely produced inside a country or production can be fragmented across countries. Vernon (1966), in a seminal paper, argues that these two production strategies just reflect different stages in the natural cycle of products. In the product cycle, as described by Vernon, goods are created and initially produced in rich countries until they become more standardized and their assembly can be shifted to lower-cost countries.

Anecdotal evidence indirectly supports the product cycle hypothesis and illustrates that this fragmentation of production is indeed taking place. For example, Feenstra (1998) cites Tempest (1996) who observes that even though the design and marketing of Barbie dolls is made in United States, assembly is made in Indonesia, Malaysia and China that obtain the raw materials from Taiwan and Japan. Feenstra also cites Tisdale (1994) who documents the outsourcing strategy of Nike. Nike also keeps the design and marketing units in United States but the shoes and clothes are manufactured by the 75,000 workers employed in independent factories in Asia.

Since financial development is an important determinant of firms behavior, as emphasized by King and Levine (1993) and Rajan and Zingales (1998) among others, it seems relevant to ask which is the effect of financial institution differences on the outsourcing strategy of Northern firms and on the product cycle dynamics. To answer these questions I need a model which contains elements of both international trade and corporate finance.

Antràs (2005) considers the choice of a Northern firm that needs to acquire an input from a supplier to complete production. He assumes that there exist contractual differences between firms across countries (contracts are complete only if both firms belong to the same country) and shows that a product cycle emerges where production is kept in the North when goods are new and it is shifted to the South when they become standardized.

My model uses a framework similar to Antràs (2005) but introduces differences in financial institutions across countries. The Northern final-good producer provides headquarter services but needs an input to complete production. She can acquire this intermediate input from a supplier located either in the high-wage and financially developed North or in the low-wage and financially underdeveloped South.

The supplier needs to pay a fixed cost to enter into the relationship but she has no money and has to fund this fixed cost with a transfer from the final-good producer and a loan from a local bank. Financial institution differences across countries affect the size of the loan that the bank offers to the supplier. That is, in more financially developed countries, the supplier receives, *ceteris paribus*, a larger loan from the bank.

Once the fixed cost is paid, the supplier and the final-good producer make their investment choices, which are noncontractible, and after headquarter services and intermediate inputs are combined, the good is sold and revenues, which are contractible, are divided according to the optimal sharing rule chosen by the final-good producer ex-ante.

That is, when the Northern final-good producer contacts with a supplier, she extends a take-it-or-leave-it offer consisting of an ex-ante transfer to help the supplier cover the fixed cost and a share of ex-post revenues to give incentives to the supplier to make the right investment choice.

Since the Southern supplier is financially constrained, the final-good producer cannot make the ex-ante transfer as low as she would like and, in order to extract more surplus from the supplier, the final-good producer distorts the contract by offering the Southern supplier a lower share of the ex-post revenues. Therefore, one result of the paper is that differences in financial institutions translate in different optimal contracts. Nonetheless, the contract is optimal and, as it is well known in the contract theory literature, taking financial institutions as given, the more important is the investment of one party, the larger the share of revenues going to that party is.

In section 2, I prove that these financial institution differences across countries are enough to generate a product cycle where the final-good producer prefers to keep production in the North when the good is new (intermediates are not very important) and it is transferred to the South when the good becomes more standardized (intermediate inputs are more relevant). The intuition is that when the good is new, the final-good producer prefers not to distort the optimal contract to take advantage of the lower-cost South but she finds worthy to offshore production in the South when the contribution of intermediate inputs to the final good is larger (or the good is more standardized). I show that when financial institutions improve more production is located in the South and, more importantly, the effect of financial development on offshoring is larger, the less standardized the good is.

In section 3, I demonstrate, for completeness, that all the results derived in partial equilibrium go through when wages are endogenized. The main contribution of this section is to illustrate that relative Northern wage decreases when Southern financial institutions improve and it reduces the effect of financial development on offshoring.

In section 4, I emphasize the importance of having endogenous contracts. I consider two exogenous sharing rules to exemplify that one could obtain very different and counterfactual results if one is allowed to arbitrarily choose these ex-post sharing rules.

In section 5, I describe the main empirical prediction of the model which says that the effect of financial development on offshoring is larger, the more R&D-intensive the industry is. I also prove that my results generalize to one North and multiple South's and this generalization allows me to test the prediction of the model by using a cross-section of countries. In the empirical analysis I use the number of goods (5-digit SITC) that a country exports to the United States in each industry (3-digit NAICS) as a proxy of offshoring and domestic credit to private sector over GDP as a measure of financial development. I find that the prediction of the model is confirmed in the data and it is robust to different specifications and definitions of financial development.

This paper relates to the literature on the product cycle and offshoring. It includes Krugman (1979), Antràs and Helpman (2003) and Antràs (2005). My model is similar to Antràs (2005), the main difference being that I consider differences in financial institutions across countries as the source of the product cycle (instead of assuming differences in the contractual framework) and that I assume that contracts can be written contingent on revenues. Therefore, I can derive the optimal contract that the final-good producer offers to the supplier that, as I have pointed out above, it is a crucial feature of the model. Moreover, Bernanke and Gertler (1989) and Kiyotaky and Moore (1997) provide microfoundations to the collateral constraint which I interpret as an indicator of the stage of development of financial institutions. This paper also relates to the growing literature on the impact of financial development on trade. It includes Kletzer and Bardhan (1987), Matsuyama (2007), Manova (2007) and Antràs and Caballero (2007) among others. My model shares with them the idea that financial development can translate into comparative advantage but the aim of this paper is to study how financial development affects the optimal location of production and changes the product cycle dynamics which is not the goal of any of these papers.

2 A Model of the Product Cycle with Financial Institutions Differences

2.1 Setup

The world consists of two countries: North and South. Labor is the unique factor of production and it cannot move across borders. There is a unit measure of consumers with the following preferences

$$U = \int_0^N \log \left[\int_0^{n_j} x_{j(i)}^{\alpha} di \right]^{\frac{1}{\alpha}} dj, \ 0 < \alpha < 1$$

where $x_{j(i)}$ is total consumption of variety i in industry j, N is the number of industries in the economy and n_j is the number of varieties in industry j which will be endogenously determined in Section 3. The elasticity of substitution between varieties is 1/(1-α) and it is one between industries. The demand faced by the producer of variety i in industry j is given by

$$x_{j(i)} = \Delta p_{j(i)}^{-\frac{1}{1-\alpha}} \ where \ \Delta = \frac{1}{N} \frac{E}{\int_0^{n_j} p_{j(i')}^{-\frac{\alpha}{1-\alpha}} di'}$$

where E is world income and each firm takes Δ as given.

The final-good producer needs headquarter services (h) and intermediate inputs (m) to produce one unit of the final good. The production function is

$$x_{j(i)} = \left(\frac{h_{j(i)}}{1 - z_j} \right)^{1-z_j} \left(\frac{m_{j(i)}}{z_j} \right)^{z_j}$$

where z_j represents the relative intensity of intermediate inputs in the production of the final good in industry j. I interpret z_j as an indicator of standardization of the good. The higher is z_j, the less important headquarter services (design, marketing,...) are and therefore the more standardized the good is. I also interpret z_j as the R&D-intensity of industry j.

Headquarter services, which are provided by the final-good producer, must be produced in the North and a worker is needed to produce one unit of headquarter services. Intermediate inputs, which are produced by the supplier, can also be produced in the South and the unit cost is one worker, the same in both countries.

The final-good producer (F) needs to pay a fixed cost (e.g. patent) and then she contacts with a supplier (S) located either in the North or the South. This supplier must also pay a fixed cost to enter into the relationship (e.g. a relationship-specific machine) and she funds it with a loan (D) from a local bank and a transfer from the final-good producer. After these fixed costs have been paid, each party makes, non-cooperatively, its investment decision. Finally, the final-good is produced and revenues are shared.

Financial institution differences affect the size of the loan that the supplier can obtain from the bank through the fraction of pledgeable income. Since Southern financial institutions are less developed, the Southern supplier can pledge a lower fraction of their future revenues and she has to rely more on the ex-ante transfer of the final-good producer to cover the fixed cost.

The setting is one of complete contracting. I assume that investment choices (i.e. headquarters services and intermediate inputs) are not contractible, but revenues are contractible. We can think that there is moral hazard in the investment phase, but once the inputs are produced, both parties observe revenues and, therefore, contracts can be written contingent on them. The final-good producer makes a take-it-or-leave-it offer to the supplier in the first period consisting of an ex-ante transfer (T) which can be positive or negative and an ex-post sharing rule of revenues (β).[1][2]

The model is summarized in figure 1.

[1] I only consider linear contracts but this assumption could be rationalized by citing Holmstrom and Milgrom (1987) who show that in a dynamic moral-hazard problem linear contracts are indeed the optimal contracts.

[2] In Appendix E I show that the main results of the paper go through when I consider a more general setup with a larger set of feasible contracts.

2.2 Outsourcing decision

In this section I consider the choice of a final-good producer of variety i in industry j who needs to buy an input from an independent supplier. This supplier can be found either in the North where wages are w^N or in the South where wages are w^S but financial institutions are less developed.

2.2.1 Southern supplier

The problem of the final-good producer in the first period is[3]

$$
\begin{aligned}
& Max_{\{\beta,T,D\}}\ \beta R - w^N h - T - f_F && (1)\\
s.t.\ T + D &\geq f_S && (2)\\
PS &\equiv T - f_S + (1-\beta)R - w^S m \geq 0 && (3)\\
D &\leq \theta\left[(1-\beta)R - w^S m\right] && (4)\\
R &= \Delta^{1-\alpha}\left(\frac{h}{1-z}\right)^{\alpha(1-z)}\left(\frac{m}{z}\right)^{\alpha z} && (5)\\
h\ and\ m\ chosen\ at\ t &= 1 && (6)
\end{aligned}
$$

That is, the final-good producer chooses the terms of the contract (an ex-ante transfer (T) and an ex-post sharing rule (β)) and, indirectly, the size of the loan that the supplier obtains to maximize her profits (1) subject to the budget constraint of the supplier (2), the participation constraint of the supplier (3) where the outside option is normalized to zero, the collateral constraint (4), the revenues function (5) which follows from the production function and the demand derived above and, lastly, the final-good producer takes into account that the investment choices will be made in the next period (6).

The main difference between this paper and the other related literature is the introduction of the collateral constraint that reflects differences in financial institutions. It says that the bank lends to the supplier, at most, a fraction θ of her future revenues. The lower is θ, the weaker Southern financial institutions are. This constraint could be rationalized, along the lines of Bernanke and Gertler (1989), by saying that Southern banks have worse information about the balance sheets of their clients and they require more collateral (future profits) to lend money to the supplier. Therefore, this collateral constraint can be interpreted as a reduced-form solution to this asymmetric information problem.

In the second period, the final-good producer chooses headquarters services to maximize her own profits $\beta R - w^N h$. Similarly, the supplier chooses intermediate inputs to maximize her own profits $(1-\beta)R - w^S m$.

[3] For simplicity, the gross interest rate is normalized to one.

Optimal contract In the first period, the final-good producer solves

$$\begin{aligned} & Max_{\{\beta,T,D\}}\ \beta R - w^N h - T - f_F \\ s.t.\ T + D &\geq f_S \\ D &\leq \theta\left[(1-\beta)R - w^S m\right] \\ PS &\equiv T - f_S + (1-\beta)R - w^S m \geq 0 \\ R &= \Delta^{1-\alpha}\left(\frac{h}{1-z}\right)^{\alpha(1-z)}\left(\frac{m}{z}\right)^{\alpha z} \\ w^N h &= \alpha(1-z)\beta R \\ w^S m &= \alpha z(1-\beta)R \end{aligned}$$

The final-good producer would like to extract all the profits of the supplier (i.e. make PS = 0) but she cannot do it because it would violate the budget constraint of the supplier (i.e. $T + D < f_S$ if PS = 0). It follows that the budget constraint and the collateral constraint bind in equilibrium, PS>0 and the problem simplifies to

$$Max_{\{\beta\}}\pi^S = \Delta\frac{\beta\left[1-\alpha(1-z)\right] + \theta(1-\beta)\left[1-\alpha z\right]}{\left[\alpha\left(\frac{\beta}{w^N}\right)^{1-z}\left(\frac{1-\beta}{w^S}\right)^{z}\right]^{-\frac{\alpha}{1-\alpha}}} - f_F - f_S \tag{7}$$

Lemma 1 *$\beta^S(\theta, z)$ is the unique solution to (7) and $\beta^S(\theta, z)$ is weakly (strictly if z>0) decreasing in θ and strictly decreasing in z.*[4]

2.2.2 Northern supplier

The difference is that variable costs of the northern supplier are w ^{N} but the Northern supplier is not financially constrained in the first period (i.e. $\theta = 1$)[5].

The problem of the final-good producer if she contracts with a Northern supplier is

$$Max_{\{\beta\}}\pi^N = \Delta\frac{\beta\left[1-\alpha(1-z)\right] + (1-\beta)\left[1-\alpha z\right]}{\left[\alpha\left(\frac{\beta}{w^N}\right)^{1-z}\left(\frac{1-\beta}{w^N}\right)^{z}\right]^{-\frac{\alpha}{1-\alpha}}} - f_F - f_S \tag{8}$$

The optimal sharing rule is[6] $\beta^N(z) = \frac{(1-\alpha z)(1-z) - \sqrt{(1-\alpha+\alpha z)z(1-\alpha z)(1-z)}}{1-2z}$

[4] $\beta^S(\theta) = \frac{(1-\alpha z)[1-\theta-\alpha(1-z)(1+\theta)] + \sqrt{(1-\alpha z)\left\{(1-\theta)^2(1-2\alpha+\alpha z)+\alpha^2(1-z)\left[\left[(1+\theta)^2(1+z(1-\alpha+\alpha z))\right]-4\theta\right]\right\}}}{2[1-\theta-\alpha+(1+\theta)\alpha z]}$

[5] That is, I set, without loss of generality, $\theta = \theta^S < \theta^N \equiv 1$.

[6] This expression is the same as the one derived in Antràs and Helpman (2004) with the only difference that I define z as their 1-η.

Lemma 2 *$\beta^N(z)$ is decreasing in z, $\beta^N(z) = \beta^S(\theta = 1, z)$ and $\beta^N(z) \leq \beta^S(\theta, z)$ (with inequality if z>0).*

Proof It follows from the fact that the optimal β is independent of wages and $\frac{\partial \beta^S(\theta)}{\partial \theta} < 0$ if z>0.

In figure 2 I represent the optimal sharing rules (β) for different levels of financial development (θ). We can see that β is decreasing in z. This is a well known result in the contract theory literature and it says that you want to give more incentives to the party whose investment is relatively more important. As z increases, intermediate inputs become more important and you want to give a higher share of the ex-post revenues (low β) to the supplier who produces these intermediate inputs.

The more interesting result is that β is decreasing in θ. The intuition is that when Southern financial institutions worsen (i.e. θ declines), the ex-ante transfer that the final-good producer has to make to the supplier increases and it translates into a lower ex-post share of revenues for the supplier (i.e. higher β). In other words, the final-good producer would always prefer to give a higher share of revenues to the Southern supplier but she cannot do it because she has to give her a higher ex-ante transfer to cover the fixed costs.

2.3 Optimal location

The final-good producer compares equations (7) and (8) and chooses to locate production in the South if and only if $\omega \equiv \frac{w^N}{w^S} \geq A(., \theta, z)$, where

$$A(., \theta, z) \equiv \frac{1-\beta^N}{1-\beta^S} \left(\frac{\beta^N}{\beta^S} \right)^{\frac{1-z}{z}} \left[\frac{\left(1-\beta^N\right)(1-\alpha z) + \beta^N \left[1-\alpha(1-z)\right]}{\theta \left(1-\beta^S\right)(1-\alpha z) + \beta^S \left[1-\alpha(1-z)\right]} \right]^{\frac{1-\alpha}{\alpha z}}$$

Note that as long as $\theta < 1$, $A(., \theta, z)$ is decreasing in z if z<$\widehat{z}$[7], $\lim_{z \to 0} A(., \theta, z) = +\infty$ and $\lim_{z \to 1} A(., \theta, z) = \frac{1-(1-\alpha)\theta}{\alpha} > 1$.

The fact that $A(., \theta, z) > 1$ means that since contracts are distorted in the South due to the weaker financial institutions, the final-good producer will require strictly lower wages in the South to offshore production. That is, if wages were the same in the North and South, production would always take place in the North.

Assumption A1 [8]

$\omega > \frac{1-(1-\alpha)\theta}{\alpha}$

[7] See Appendix B for the derivation of $\widehat{z}$.

[8] This assumption will be confirmed in the next section where I close the model in general equilibrium.

Proposition 1

i) Existence of product cycle: If A1 holds, there exists a unique $z^* \equiv A^{-1}(\omega)$ *such that* $\omega < A(., \theta, z)$ *when* $z<z^*$ *and* $\omega > A(., \theta, z)$ *when* $z>z^*$*.*

ii) Effect of financial development: If A1 holds, taking wages as given, z^* *is decreasing in* θ*.*

Proof See Appendix B

The first part of Proposition 1 says that there exists a unique $z^* \equiv A^{-1}(\omega)$ such that the final-good producer decides to buy the inputs from a Northern supplier if z $\in (0, z^*)$ and from a Southern supplier if z $\in (z^*, 1)$. The intuition is that the final-good producer faces a trade-off when choosing to locate production either in the high-wage but financially developed North or in the low-wage but financially underdeveloped South. A product cycle emerges because the final-good producer prefers to locate production in the North when the good is new and headquarter services are very important and she prefers to distort the optimal contract and take advantage of the low-wage South when the good matures and intermediate inputs become more important.

The second part means that the effect of financial development on offshoring is positive and, more importantly, this effect is larger, the more R&D-intensive (i.e. the lower z) the industry is. This result can also be seen in figure 3 where I represent how the optimal location of production changes with the financial development of the South. The intuition is that when Southern financial institutions improve, $A(., \theta, z)$ shifts down. Therefore, the Northern final-good producer requires a lower wage differential to outsource production abroad because the improvement of Southern financial institutions allows the Northern final-good producer to offer a less-distorted contract to the Southern supplier and it decreases the comparative advantage of the Northern supplier. Since wages are exogenously given, it implies that more production is located in the South. Furthermore, the new industries that outsource production to the South are more R&D-intensive (i.e. lower z).

Finally, note that if Southern financial institutions were as developed as Northern ones (i.e. $\theta = 1$), all production would be located in the South if we maintain assumption A1 because $\omega > 1 (= A(., \theta = 1, z))$.

3 General equilibrium effects

In this section I show that the results derived in partial equilibrium go through in general equilibrium. The main difference is that the effect of financial development on Southern outsourcing is reduced because relative Southern wage also increases in response to an improvement in Southern financial institutions.

3.1 Closing the model

I close the model by finding the equilibrium number of varieties in each industry and the equilibrium wages in the economy.

There is free-entry in each industry and therefore new firms enter until the profits of this marginal firm are equal to zero. Then, it follows that

$$n_j = \begin{cases} \left[\beta^N \left[1-\alpha(1-z)\right] + (1-\beta^N)(1-\alpha z)\right] \frac{E}{N(f_S+f_F)} & z \in (0, z^*) \\ \left[\beta^S \left[1-\alpha(1-z)\right] + \theta(1-\beta^S)(1-\alpha z)\right] \frac{E}{N(f_S+f_F)} & z \in (z^*, 1) \end{cases}$$

In equilibrium, the final-good producer has to let some rents to the Southern supplier because of the collateral constraint (i.e. PS > 0). In particular, the Southern supplier of variety i in industry j obtains $PS_{j(i)} = (1-\theta)(1-\beta^S)(1-\alpha z)\frac{E}{Nn_j}$.

If we denote F(z) as the fraction of industries with z<z^* and f(z) as its density function, then, total profits in the South are $\int_{z^*}^{1} (1-\theta)(1-\alpha z)\left[1-\beta^S(.,\theta,z)\right] Ef(z)dz$.

Noting that Northern firms do not make profits in equilibrium and defining $\varphi(a,b) \equiv \int_a^b (1-\alpha z)\left[1-\beta^S(.,\theta,z)\right] f(z)dz$, the goods market clearing condition becomes

$$(1-\theta)\varphi(z^*,1)E + w^S L^S + w^N L^N = E \tag{9}$$

where L^c is the supply of workers in country c and E is world income.

The labor demand of any Southern supplier of variety i in industry j is $m^S_{j(i)} w^S = \alpha z(1-\beta^S)\frac{E}{Nn_j}$, then, the labor market condition in the South is given by

$$\int_{z^*}^{1} \alpha z \left[1-\beta^S(.,\theta,z)\right] Ef(z)dz = w^S L^S \tag{10}$$

If we define $\xi(a,b) = \int_a^b \left[1-\beta^S(.,\theta,z)\right] zf(z)dz$, then, by plugging the labor market condition (10) into the goods market condition (9), we obtain

$$\frac{w^N}{w^S} = B(.,\theta,z^*) \equiv \frac{1-(1-\theta)\varphi(z^*,1)-\alpha\xi(z^*,1)}{\alpha\xi(z^*,1)}\frac{L^S}{L^N}$$

Note that $B(.,\theta,z^*)$ is increasing in z^*, $\lim_{z^*\to 1} B(.,\theta,z^*) = +\infty$, $\lim_{z^*\to 0} B(.,\theta,z^*) > 0$ and, $\frac{\partial B(.,\theta,z^*)}{\partial\theta} < 0$.

3.2 Effect of financial development

Summing up, we have two equations that determine the equilibrium values of $(z^*, \frac{w^N}{w^S})$.

$$\frac{w^N}{w^S} = A(.,\theta,z^*) \equiv \frac{1-\beta^N}{1-\beta^S}\left(\frac{\beta^N}{\beta^S}\right)^{\frac{1-z^*}{z^*}}\left[\frac{\left(1-\beta^N\right)(1-\alpha z^*)+\beta^N[1-\alpha(1-z^*)]}{\theta\left(1-\beta^S\right)(1-\alpha z^*)+\beta^S[1-\alpha(1-z^*)]}\right]^{\frac{1-\alpha}{\alpha z^*}}$$
$$\frac{w^N}{w^S} = B(.,\theta,z^*) \equiv \frac{1-(1-\theta)\varphi(z^*,1)-\alpha\xi(z^*,1)}{\alpha\xi(z^*,1)}\frac{L^S}{L^N}$$

Proposition 2 *w^N/w^S and z^* are decreasing in θ*

Proof See Appendix C

We can see the above result in figure (4). Intuitively, an improvement in Southern financial institution has two effects. First, it increase southern labor demand (i.e. $B(.,\theta,z)$ shifts down). Second, comparative advantage of the North is reduced because contractual distortions associated to the underdeveloped financial institutions of the South decrease. Thus, the final-good producer requires a lower wage differential to outsource production to the South (i.e. $A(.,\theta,z)$ shifts down). The total effect is that relative Southern wage rises but they do not increase enough to offset the gain in contractual efficiency and more production is located in the South.

4 Discussion of the model

A key of the model is to have endogenous contracts. In order to remark its importance I show, in this section, that if instead of allowing the final-good producer to choose the optimal sharing rule, I had assumed an exogenous sharing rule I could have obtained very different and counterfactual results.

One of the main equations of the model says that production is outsourced in the South whenever $w^N/w^S \geq A(.,\theta,z)$, where

$$A(.,\theta,z) \equiv \frac{1-\beta^N}{1-\beta^S}\left(\frac{\beta^N}{\beta^S}\right)^{\frac{1-z}{z}}\left[\frac{\left(1-\beta^N\right)(1-\alpha z)+\beta^N\left[1-\alpha(1-z)\right]}{\theta\left(1-\beta^S\right)(1-\alpha z)+\beta^S\left[1-\alpha(1-z)\right]}\right]^{\frac{1-\alpha}{\alpha z}}$$

.

First, let us assume that the final-good producer has to sign the same contract with the Northern and Southern supplier and it is a constant share of revenues (i.e. $\beta^N = \beta^S = \beta$). In this case $A(.,\theta,z) \equiv \left[\frac{(1-\beta)(1-\alpha z)+\beta[1-\alpha(1-z)]}{\theta(1-\beta)(1-\alpha z)+\beta[1-\alpha(1-z)]}\right]^{\frac{1-\alpha}{\alpha z}}$.

Note that $A(.,\theta,z)$ is decreasing in z, $\lim_{z\to 0}A(.,\theta,z) = +\infty$, $A(.,\theta,z=1) =$

$\left[\frac{(1-\beta)(1-\alpha)+\beta}{\theta(1-\beta)(1-\alpha)+\beta}\right]^{\frac{1-\alpha}{\alpha}} > 1$ and $\frac{\partial A(.,\theta,z)}{\partial\theta} < 0$. The properties of the $A(.,\theta,z)$ curve with these exogenous sharing rules are qualitatively the same and therefore all the results of the model would go through.

Then, consider a more extreme case where the final-good producer has to give almost all the revenues to the Northern supplier but she can keep almost all the revenues if the supplier is located in the South (i.e. $\beta^N = \varepsilon, \beta^S = 1-\varepsilon$ where $\varepsilon >$ 0 and small). In this case, $A(.,\theta,z) \equiv \left(\frac{1-\varepsilon}{\varepsilon}\right)^{\frac{2z-1}{z}} \left[\frac{(1-\varepsilon)(1-\alpha z)+\varepsilon[1-\alpha(1-z)]}{\theta\varepsilon(1-\alpha z)+(1-\varepsilon)[1-\alpha(1-z)]}\right]^{\frac{1-\alpha}{\alpha z}}$. Note that $A(.,\theta,z)$ is increasing in z, $\lim_{z\to 0} A(.,\theta,z) = 0$, $A(.,\theta,z=1) = \frac{1-\varepsilon}{\varepsilon}\left[\frac{(1-\varepsilon)(1-\alpha)+\varepsilon}{\theta\varepsilon(1-\alpha)+1-\varepsilon}\right]^{\frac{1-\alpha}{\alpha}} > 1$ and $\frac{\partial A(.,\theta,z)}{\partial\theta} < 0$. The difference is that $A(.,\theta,z)$ is now increasing in z instead of being decreasing. If we assume that $w^N/w^S <$ $A(.,\theta,z=1)$ then there exists $z^* \equiv A^{-1}\left(\frac{w^N}{w^S}\right)$ such that production is kept in the North for the most standardized goods (z>z^*) and it is outsourced in the South when they are new (z<z^*). Therefore, the model would counterfactually generate a reversed product cycle. Actually, in general equilibrium we would obtain $w^N/w^S > A(.,\theta,z=1)$ and there would not be a product cycle because no production of intermediate inputs would take place in the North. The intuition is that these exogenous sharing rules create contractual distortions that offset the ones generated by the financial underdevelopment of the South and the final-good producer always finds optimal to outsource production in the South.

These two examples show that these ex-post sharing rules play a critical role in the predictions of the model and we could generate any result if we could arbitrarily choose them. Therefore, it is important that these sharing rules are the result of an optimization problem and not exogenously given.

5 Empirical Evidence

5.1 Prediction of the model

In this subsection I describe the main empirical prediction of the model.

Prediction *The effect of financial development on Southern outsourcing is larger in industries with less standardized goods (more R&D-intensive).*

To see that, let us define an indicator function, M(z), that equals one if the good is outsourced in the South (i.e. $z > z^*$) and zero otherwise.

Then, M=$\int_0^1$M(z)dF(z) is a measure of Southern outsourcing.

Let us now assume that there two industries (A and B) with industry A having more standardized (higher z) goods than industry B. To be more precise, goods in industry i $\in \{A, B\}$ can be represented by the probability distribution function F_i(z), where F_A(z) first-order stochastically dominates F_B(z).

It follows from the definition of first-order stochastic dominance and Proposition 1 that $\frac{\partial M_B}{\partial\theta} \geq \frac{\partial M_A}{\partial\theta}$ and the prediction is verified.

Proposition 3 *If we have three countries: North (N), Developing Country (DC) and South (S) which differ in financial development ($\theta^N > \theta^{DC} > \theta^S$) and the final-good producer is located in the North, it must be the case that production is located in the North when $z<z_N$, is located in DC when $z \in (z_N, z_{DC})$ and it is located in S when $z>z_{DC}$. That is, there is no reversal of comparative advantage.*

Proof See Appendix D

Proposition 3 says that it is not possible that the good is first produced in a developing country, then in the South and then it comes back to the developing country when it is more standardized. In other words, there cannot be a reversal of comparative advantage as the good matures. It implies that the less standardized a good is, the more likely it is to be produced by (and exported to the North from) a financially developed country.

This proposition could be generalized to n countries allowing me to use a cross-section of countries to test the main prediction of the model. I next discuss my data sources and empirical strategy in detail.

5.2 Data

My proxy for outsourcing is the number of goods per industry that a given country exports to the North. The definition of a good is a 5-digit SITC and United States is treated as the North. I use trade data from the NBER.

The proxy for standardization is the use of R&D at the industry level in the United States. That is, I am assuming that the more R&D-intensive an industry is, the less standardized its goods are. This definition of standardization is very closely related to the model and it is also akin to the description of the product cycle in Vernon (1966). The definition of an industry is a 3-digit NAICS and data from R&D-expenditure at industry level in the United States is obtained from NSF.

As additional industry control variables I use dependence on external finance and asset tangibility. Dependence on external finance is defined as the share of investment that cannot be financed through the cash flows generated by the firm and asset tangibility is the share of plant, property and equipment in total assets. I obtain both measures from Braun (2003).

I also use the industry share (in value added terms) of each industry in each country as a control variable. This variable is constructed by using data from UNIDO.

My preferred definition of financial development is the share of domestic credit to private sector over GDP (*D Credit*) which I obtain from World Development Indicator (World Bank). As a robustness check, I use different definitions of financial development. *D Credit (2)* stands for private credit by deposit money banks and other financial institutions (% GDP), *Stock Mkt* is stock market capitalization (% GDP), *Repud* is risk of contract repudiation, *Exprop* is risk of expropriation and *Account* is accounting standards. The first two measures are obtained from Beck et al (2000) and the last three measures come from La Porta et al (1998). Although the exact definitions and sources can be found in the cited papers, I just want to remark that lower values in *Rep* and *Exprop* mean higher risks of contract repudiation and expropriation and higher values in *Account* mean better accounting practices. That is, for all the measures, higher values mean better financial institutions.

In Appendix A I report average US R&D-expenditure at industry level for 1999-2001 and the measures of dependence on external finance and asset tangibility. Unsurprisingly, the "computer and electronic products" industry is the most R&D-intensive and "wood products" and "beverage and tobacco products" are the less R&D-intensive ones and the different measures are correlated.

5.3 Empirical strategy

The baseline equation that I use to test the prediction of the model is

$$G_{ic} = \delta_i + \delta_c + \gamma FD_c RD_i + \epsilon_{ic} \tag{11}$$

where G_{ic} is the number of goods in industry i that country c exports to the US, FD_c is financial development of country c, RD_i is US-R&D expenditure in industry i, δ_i is a set of industry fixed effects and δ_c is a set of country fixed effects. All the variables are in logs and are the average for 1999-2001 except for risk of contract repudiation, risk of expropriation and accounting standards and external finance dependence and asset tangibility which are not available for this period.

The prediction of the model is $\gamma > 0$.

As a first informal check of the model, figures 5 and 6 show the relationship between financial development and the number of goods exported to the United States in the "computer and electronic products" and "textile, apparel and leather" industries, respectively. At first sight we can note that these figures are consistent with the model because the slope of the regression fit line is steeper in the "computer and electronic products" industry. That is, the effect of financial development is larger in the "computer and electronic products" industry which is more R&D-intensive than the "textile, apparel and leather" one.

5.4 Results and robustness checks

In Table 1 I report the results of running equation (11) by using country-fixed effects with robust standard errors in parentheses. In the different columns, I run the same regression but using different definitions of financial development. As it can be seen, the coefficient on the interaction term is positive and statistically significant for all the different definitions. Therefore, it says that the effect of financial development on offshoring is larger, the more R&D-intensive the industry is. Note that this effect is also economically significant. Take for example the coefficient on the first column. It means that if domestic credit increases by one percent, the number of goods in an industry in the 75th percentile of the R&D-intensity distribution that the average country exports to the United States increases by 0.78%, whereas it increases by 0.51% in an industry in the 25th percentile.

In Table 2 I check whether my results are being driven by the most R&D-intensive industries. To do that, I eliminate from the sample the three most R&D-intensive industries (i.e. NAICS 325 (chemicals), 334 (computer and electronic products) and 336 (transportation equipment)). In the top panel of Table 2 I report the coefficients for the whole sample (Table 1) and in the bottom one, the coefficients for the constrained sample. Note that the coefficients are larger and remain positive and statistically significant for the six different definitions of financial development.

In Table 3 I study whether my results are robust to including other industry controls. It could be argued (see for example Manova (2007)) that the omission of other industry variables such as dependence on external finance and asset tangibility is driving my results and that R&D-intensity is just a proxy of these omitted variables. In the top panel of Table 3 I repeat the previous results and in the bottom panel I include the interaction of financial development with these two additional industry controls. There are two interesting things to remark. First, the coefficient on the variable of interest is almost unchanged and it is positive and statistically significant in the different definitions of financial development. Second, the interaction of financial development with these two additional variables is statistically insignificant for all the definitions except for the interaction between accounting standards and dependence on external finance which has the expected positive sign. Therefore, R&D-intensity is not only still significant when other variables are included but it seems to be the relevant one.

In Table 4 I include a new variable to try to disentangle offshoring from Hecksher-Ohlin effects. That is, standard trade theory predicts that countries relatively abundant in one input (in this case, financial institutions) tend to export goods that intensively use this input. In order to partially address this concern I add a new variable that I label industry share. This variable is the share (in value added terms) of industry i in country c over all the manufacturing industries in country c. In the top panel of Table 4 I repeat again Table 1 and in the bottom panel I include this industry share variable. Note that the sample size falls a lot after including this new variable and for that reason the coefficients for the last three columns, where the sample size is very small, should be taken with a grain of salt. In the three first columns it can be seen that the coefficient on the interaction between financial development and R&D-intensity does not fall and it remains positive and statistically significant. Therefore, even though industry share is statistically significant, the coefficient on the variable of interest does not decrease.

In Table 5 I perform the last robustness check. In this table I consider the effects of ignoring the zeros (remember that my left-hand side variable is the (log) number of goods exported to United States by country and industry).

Helpman et al (2007) illustrate that there are a lot of zeros in the bilateral trade relationships and show that ignoring these zeros can generate significant biases in the coefficients of interest. In order to see whether ignoring the zeros affects my results, in Table 5 I run two different versions of equation (11) by running country-fixed effects in a Poisson specification with bootstrap standard errors in parentheses. The definition of financial development that I use is domestic credit. In the first column I report the coefficient when I ignore the zeros and in the second column I report the results when the zeros are taken into account. In the top panel I have the interaction between financial development and R&D-intensity, dependence on external finance and asset tangibility. By comparing both columns we can see that including the zeros does not dramatically change the coefficients. In the bottom panel I have as explanatory variable the interaction term and the industry share. Once again the coefficients are almost the same. The explanation for this negligible effect of the zeros is that a lot of countries trade with the United States and therefore I do not have a lot of zeros in the sample.

Summing up, in this empirical section I have shown that the effect of financial development on offshoring is larger, the more R&D-intensive the industry is. Therefore, the main prediction of the model is consistent with the data and it is robust to different specifications and definitions of financial development.

6 Concluding remarks

The trade literature has provided us with several explanations of the product cycle but the role of financial institutions has been largely ignored. In this paper I fill this gap by considering the problem faced by a Northern final-good producer that needs to buy an intermediate input from a supplier located either in the financially developed North or in the financially underdeveloped South.

I show that these financial institutions differences are enough to generate a product cycle where the production of new goods is kept in the North and production is outsourced in the South when the goods become more standardized.

In the empirical section I show, consistent with the model, that the effect of financial development on offshoring of production is larger, the more R&D-intensive the industry is. This result is robust to different specifications and definitions of financial development.

The model derived in the paper has abstracted from dynamic considerations and it would be interesting to consider a dynamic version of the model where the Southern supplier can also accumulate past rents and the Northern final-good producer when making her contracting choice takes into account the fact that the importance of the intermediate input will be growing over time.

7 Tables

Table 1: Effect of financial development on offshoring (1999-2001)

Dependent variable: Number of Goods Exported to US

	D Credit	D Credit(2)	Stock Mkt	Repud	Exprop	Account
Fin.Dev *R&D	0.09	0.10	0.06	0.49	0.63	0.34
	(0.01)	(0.01)	(0.01)	(0.05)	(0.01)	(0.04)
No. Observations	1690	1580	1275	656	656	551
R^2	0.46	0.48	0.48	0.77	0.78	0.77

Notes: The dependent variable is number of goods exported to the US for country and industry. D Credit is domestic credit to private sector (% GDP) from WDI. D Credit (2) is private credit by deposit money banks and other financial institutions (% GDP), Stock Mkt is stock market capitalization (% GDP) from Beck et al (2000). Repud is risk of contract repudiation, Exprop is risk of expropriation and Account is accounting standards from La Porta et al (1998). Each specification is a country-fixed effect regression with industry fixed effects. Heteroskedasticity consistent standard errors appear in parenthesis.

Table 2: Robustness check: dropping NAICS 325, 334 and 336

Dependent variable: Number of Goods Exported to US

	D Credit	D Credit(2)	Stock Mkt	Repud	Exprop	Account
Whole sample						
Fin.Dev *R&D	0.09	0.10	0.06	0.49	0.63	0.34
	(0.01)	(0.01)	(0.01)	(0.05)	(0.01)	(0.04)
No. Observations	1690	1580	1275	656	656	551
R^2	0.46	0.48	0.48	0.77	0.78	0.77
Dropping NAICS						
Fin.Dev *R&D	0.13	0.13	0.08	0.62	0.80	0.39
	(0.01)	(0.01)	(0.01)	(0.08)	(0.10)	(0.07)
No. Observations	1279	1200	981	512	512	413
R^2	0.50	0.51	0.51	0.78	0.78	0.79

Notes: The dependent variable is number of goods exported to the US for country and industry. D Credit is domestic credit to private sector (% GDP) from WDI. D Credit (2) is private credit by deposit money banks and other financial institutions (% GDP), Stock Mkt is stock market capitalization (% GDP) from Beck et al (2000). Repud is risk of contract repudiation, Exprop is risk of expropriation and Account is accounting standards from La Porta et al (1998). Each specification is a country-fixed effect regression with industry fixed effects. Heteroskedasticity consistent standard errors appear in parenthesis.

Table 3: Robustness check: Adding more industry variables

Dependent variable: Number of goods exported to US by industry

	D Credit	D Credit(2)	Stock Mkt	Repud	Exprop	Account
Fin.Dev *R&D	0.09	0.10	0.06	0.49	0.63	0.34
	(0.01)	(0.01)	(0.01)	(0.05)	(0.01)	(0.04)
No. Observations	1690	1580	1275	656	656	551
R^2	0.46	0.48	0.48	0.77	0.78	0.77
Fin.Dev *R&D	0.09	0.10	0.05	0.51	0.66	0.24
	(0.01)	(0.01)	(0.01)	(0.05)	(0.06)	(0.05)
Fin. Dev * Ext. fin.	-0.01	-0.02	0.10	0.50	0.44	0.92
	(0.08)	(0.09)	(0.07)	(0.52)	(0.65)	(0.42)
Fin. Dev * Tang.	-0.22	-0.24	-0.02	2.27	2.53	-0.94
	(0.28)	(0.31)	(0.21)	(1.71)	(2.08)	(1.50)
No. Observations	1690	1580	1275	656	656	551
R^2	0.44	0.46	0.47	0.75	0.77	0.77

Notes: The dependent variable is number of goods exported to the US for country and industry. D Credit is domestic credit to private sector (% GDP) from WDI. D Credit (2) is private credit by deposit money banks and other financial institutions (% GDP), Stock Mkt is stock market capitalization (% GDP) from Beck et al (2000). Repud is risk of contract repudiation, Exprop is risk of expropriation and Account is accounting standards from La Porta et al (1998). Ext. fin. is dependence on external finance, Tang is asset tangibility both from Braun (2003). Each specification is a country-fixed effect regression with industry fixed effects. Heteroskedasticity consistent standard errors appear in parenthesis.

Table 4: Offshoring vs Heckscher-Ohlin

Dependent variable: Number of goods exported to US by industry

	D Credit	D Credit(2)	Stock Mkt	Repud	Exprop	Account
Fin.Dev*R&D	0.09	0.10	0.06	0.49	0.63	0.34
	(0.01)	(0.01)	(0.01)	(0.05)	(0.01)	(0.04)
No. Observations	1690	1580	1275	656	656	551
R^2	0.46	0.48	0.48	0.77	0.78	0.77
Fin.Dev*R&D	0.09	0.10	0.07	0.25	0.34	0.16
	(0.01)	(0.01)	(0.01)	(0.07)	(0.08)	(0.06)
Industry share	0.17	0.19	0.17	0.21	0.21	0.18
	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)
No. Observations	656	653	606	382	382	308
R^2	0.53	0.52	0.54	0.80	0.81	0.86

Notes: The dependent variable is number of goods exported to the US for country and industry. D Credit is domestic credit to private sector (% GDP) from WDI. D Credit (2) is private credit by deposit money banks and other financial institutions (% GDP), Stock Mkt is stock market capitalization (% GDP) from Beck et al (2000). Repud is risk of contract repudiation, Exprop is risk of expropriation and Account is accounting standards from La Porta et al (1998). Industry share (Value added in industry j divided by value added in the manufacturing sector) comes from UNIDO. Each specification is a country-fixed effect regression with industry fixed effects. Heteroskedasticity consistent standard errors appear in parenthesis.

Table 5: Are zeros important?

Dependent variable: Number of goods exported to US by industry

	Without zeros	**With zeros**
Fin.Dev *R&D	0.11	0.11
	(0.02)	(0.02)
Fin.Dev *Ext. fin.	-0.003	-0.001
	(0.11)	(0.12)
Fin. Dev *Tang	0.51	0.55
	(0.28)	(0.27)
No. Observations	1690	2175
Fin. Dev *R&D	0.032	0.032
	(0.015)	(0.016)
Industry share	0.26	0.26
	(0.03)	(0.03)
No. Observations	655	761

Notes: The dependent variable is number of goods exported to the US for country and industry. Fin. Dev is domestic credit to private sector (% GDP) from WDI. Ext. fin. is dependence on external finance and Tang is asset tangibility both from Braun (2003). Industry share comes from UNIDO. Each specification is a Poisson regression with industry and country fixed effects. Bootstrap standard errors appear in parenthesis.

8 Figures

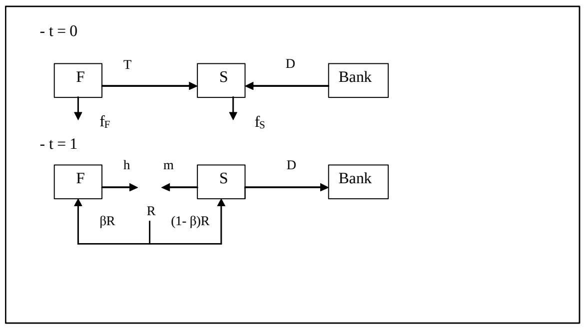

Figure 1: Timing of actions

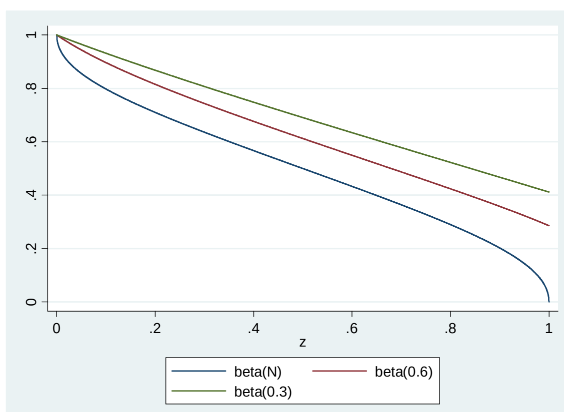

Figure 2: Optimal sharing rule

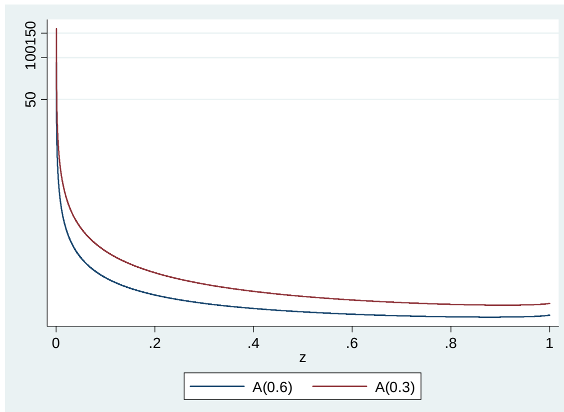

Figure 3: Outsourcing choice

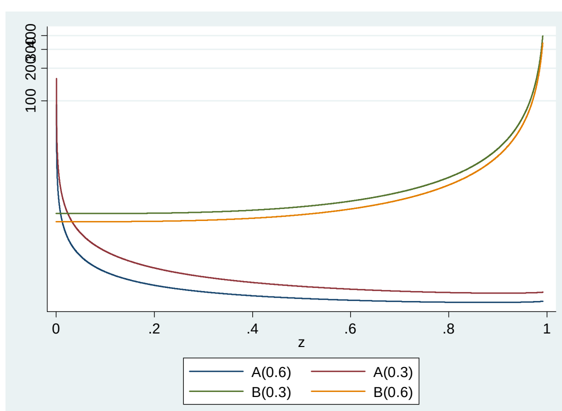

Figure 4: Effect of financial development on the product cycle

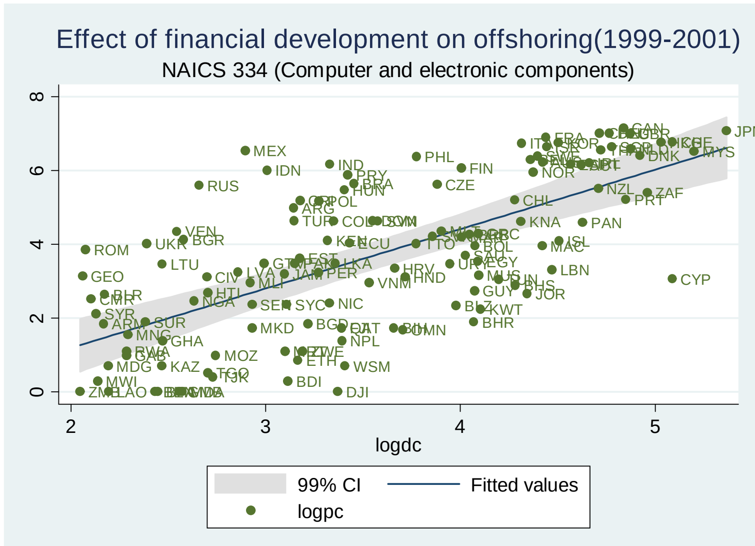

Figure 5: Effect of financial development on the electronics industry

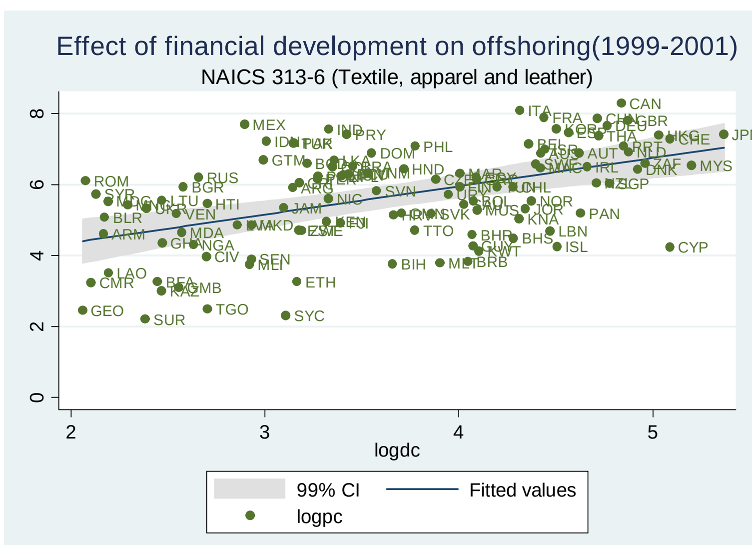

Figure 6: Effect of financial development on the textile industry

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10 Appendix

Appendix A: Industry-data

NAICS	Name	R&D	Ext. fin.	Tang.
311	Food	1475	0.136	0.377
312	Beverage and tobacco products	284	-0.187	0.250
313-316	Textile, apparel and leather	295	0.096	0.196
321	Wood products	119	0.284	0.379
324	Petroleum	837	0.188	0.487
325	Chemicals	19685	0.211	0.304
327	Nonmetallic mineral products	919	0.062	0.42
331	Primary metals	526	0.087	0.458
332	Fabricated metal products	1642	0.237	0.281
333	Machinery	6346	0.445	0.182
334	Computer and electronic products	42703	0.961	0.151
335	Electrical equipment. Appliances	4980	0.767	0.213
336	Transportation equipment	30005	0.306	0.254
337	Furniture and related products	278	0.235	0.263
339	Miscellaneous manufacturing	4887	0.470	0.188

Source: R&D data comes from National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development (1999, 2000 and 2001), Ext. fin. dep is dependence on external finance and Tang is asset tangibility both from Braun (2003).

Appendix B: Derivation of $\widehat{z}$ and proof of Proposition 1

In this appendix I derive $\widehat{z}$ and show why assumption A1 is enough to have uniqueness and z* decreasing in θ.

First, it is straightforward to check that $\frac{\partial A(z,\theta)}{\partial z} < 0$ if and only if r$(z,\theta,\alpha) > 0$ where

$$\text{r}(\text{z},\theta,\alpha) \equiv \ln\left[\kappa\left(\frac{\beta^N}{\beta^S}\right)^{\frac{\alpha}{1-\alpha}}\right] - \alpha z\left[\frac{\left(2\beta^N-1\right)}{\left(1-\beta^N\right)(1-\alpha z)+\beta^N[1-\alpha(1-z)]} - \frac{(1+\theta)\beta^S-\theta}{\theta\left(1-\beta^S\right)(1-\alpha z)+\beta^S[1-\alpha(1-z)]}\right]$$

where $\kappa \equiv \frac{\left(1-\beta^N\right)(1-\alpha z)+\beta^N[1-\alpha(1-z)]}{\theta\left(1-\beta^S\right)(1-\alpha z)+\beta^S[1-\alpha(1-z)]}$

Note that β^N goes to zero as z goes to one, therefore, $\lim_{z\to 1}$r(z,$\theta,\alpha) < 0$. However, it can be shown that there exists $\widehat{z} \in (0,1)$ such that r$(\widehat{z}\ ,\theta,\alpha) = 0$ and r$(\widehat{z}\ ,\theta,\alpha) > 0$ if z$<\widehat{z}$ and r$(\widehat{z}\ ,\theta,\alpha) < 0$ if z$>\widehat{z}$. It can also be derived that $\frac{\partial\widehat{z}}{\partial\theta} < 0$, $\frac{\partial\widehat{z}}{\partial\alpha} > 0$.

Given the properties of r(z,θ,α), it is clear that if A1 holds, there exists a unique z$^* \equiv A^{-1}(\omega) < \widehat{z}$.

Moreover, z$^* < \widehat{z}$ implies that $\frac{\partial A(.)}{\partial z}\ |_{z=z^*} < 0$. Then, $\frac{\partial z^*}{\partial\theta} = -\frac{\frac{\partial A(.)}{\partial\theta}|_{z=z^*}}{\frac{\partial A(.)}{\partial z}|_{z=z^*}} < 0$ because $\frac{\partial A(.)}{\partial\theta} < 0$ for all z.

Appendix C: Proof of Proposition 2

The first part of the proposition simply follows from the fact that $\frac{\partial A(,\theta,z)}{\partial\theta} < 0$ and $\frac{\partial B(.,\theta,z)}{\partial\theta} < 0$.

To prove the second part let us define $F(\theta,z^*) \equiv A(.,\theta,z^*) - B(.,\theta,z^*)$. Then, we must show that $\frac{\partial z^*}{\partial\theta} = -\frac{\frac{\partial F(\theta,z^*)}{\partial\theta}}{\frac{\partial F(\theta,z^*)}{\partial z^*}} < 0$. Given that $\frac{\partial A(,\theta,z^*)}{\partial z^*} < 0$ and $\frac{\partial B(.,\theta,z^*)}{\partial z^*} > 0$, $\frac{\partial z^*}{\partial\theta} < 0$ because $\left|\frac{\partial A(,\theta,z^*)}{\partial\theta}\right| > \left|\frac{\partial B(.,\theta,z^*)}{\partial\theta}\right|$.

Appendix D: Proof of Proposition 3

It is proved by contradiction.

Let us assume that S also produces the good when z=z$_0$ $\in$. Therefore, $\pi^S(\theta^S$,z$_0) > \pi^{DC}(\theta^{DC}$,z$_0)$.

It implies that $\frac{w^{DC}}{w^S} > A(.,\theta^{DC},\theta^S,z_0)$ where

$$A(.,\theta^{DC},\theta^S,z_0) \equiv \frac{1-\beta^{DC}}{1-\beta^S}\left(\frac{\beta^{DC}}{\beta^S}\right)^{\frac{1-z_0}{z_0}}\left[\frac{\theta^{DC}\left(1-\beta^{DC}\right)(1-\alpha z_0)+\beta^{DC}[1-\alpha(1-z_0)]}{\theta^S\left(1-\beta^S\right)(1-\alpha z_0)+\beta^S[1-\alpha(1-z_0)]}\right]^{\frac{1-\alpha}{\alpha z_0}}.$$

Similarly to Appendix B, it can be shown that $A(.,\theta^{DC},\theta^S,z)$ is decreasing in z if and only if $\widetilde{r}$(z,$\theta^{DC},\theta^S,\alpha) > 0$.

For simplicity, I assume that θ^{DC} and θ^S are such that $\widetilde{r}$(z,$\theta^{DC},\theta^S,\alpha) > 0$ for all z. Therefore, S must produce the good for all z$>z_0$, contradicting that DC produces the good for z$\in (z_N, z_{DC})$.

An analogous argument applies when comparing DC and N.

Thus, it confirms Proposition 3.

Appendix E: A more general model

In this appendix I show that the main results of the model go through when I consider a more general environment. In particular, I show that a modified version of Proposition 1 holds when a larger set of feasible contracts is allowed.

The first difference that I introduce is shocks after the investment choices are made. In particular, revenues are represented by the following equation where p is the probability of a bad shock that drives revenues to zero.

$$\widetilde{R} = \begin{cases} R = \Delta^{1-\alpha}\left(\frac{h}{1-z}\right)^{\alpha(1-z)}\left(\frac{m}{z}\right)^{\alpha z} & \text{with prob. 1-p} \\ 0 & \text{with prob. p} \end{cases}$$

I keep assuming that revenues are observable and therefore contracts can be written contingent on them, but the shock is not observable. That is, when revenues are zero, the parties do not know whether it was a bad shock or the other party did not make the investment.

I also introduce limited liability and limited commitment.

Therefore, the Northern final-good producer when contacting with a Southern supplier solves the following problem

$$Max_{\{h,m,G(\widetilde{R}),T,D\}} E\left[\widetilde{R} - G(\widetilde{R})\right] - w^N h - T - f_F$$

$$\begin{array}{rcll} st.T + D & \geq & f_S & \text{(BC)} \\ D & \leq & \theta\left[E\left[G(\widetilde{R})\right] - w^S m\right] & \text{(CC)} \\ PS & \equiv & T + E\left[G(\widetilde{R})\right] - w^S m - f_S \geq 0 & \text{(PC)} \\ PS & \geq & V_{default} & \text{(LC)} \\ G(\widetilde{R}) & \geq & w^S m \ \ \forall \widetilde{R} & \text{(LL)} \\ h & \in & \arg\max_{\widehat{h}} \left\{E\left[\widehat{R} - G(\widehat{R})\right] - w^N \widehat{h}\right\} & \text{(ICC-F)} \\ m & \in & \arg\max_{\widehat{m}} \left\{E\left[G(\widehat{R})\right] - w^S \widehat{m}\right\} & \text{(ICC-S)} \\ R & = & \Delta^{1-\alpha}\left(\dfrac{h}{1-z}\right)^{\alpha(1-z)}\left(\dfrac{m}{z}\right)^{\alpha z} & \end{array}$$

where (LC) and (LL) are the additional constraints. The first constraint, (LC), limited commitment, means that the final-good producer must make sure not only that the supplier has the right incentives to produce the intermediate inputs (m) but also that she wants to pay the fixed cost (f_s). That is, $V_{default}$ is what the supplier obtains if after receiving the ex-ante transfer decides not to pay the fixed cost and does not make any investment. (LL), limited liability, says that the supplier must receive, at least, her variable costs in the second period. In other words, the supplier cannot be forced to have negative profits.

I assume that contracts can be written contingent on revenues and take the following form ...

$$G(\widetilde{R}) = \begin{cases} \mu_R + (1-\beta)R \text{ if } \widetilde{R} = R \\ \mu_0 \qquad\qquad\quad \text{ if } \widetilde{R} = 0 \end{cases}$$

Given these contracts, the value for the supplier to default and not make any investment is $V_{default} = T + \mu_0$.

Then, the problem of the final-good producer becomes ...

$$\begin{aligned} & Max_{\{\mu_R,\mu_0,\beta\}}(1-p)(1-\alpha(1-z))\beta R - (1-p)\mu_R - p\mu_0 - T - f_F \\ st.0 \leq \; & T + \theta\left[(1-p)\mu_R + p\mu_0 + (1-\alpha z)(1-\beta)R\right] - fs && \text{(PC')} \\ \mu_R \geq \; & -(1-(1-p)\alpha z)(1-\beta)R && \text{(LL-R)} \\ \mu_0 \geq \; & \alpha z(1-p)(1-\beta)R && \text{(LL-0)} \\ \mu_R + (1-\alpha z)(1-\beta)R \geq \; & \mu_0 + \frac{f_s}{1-p} && \text{(LC)} \end{aligned}$$

In equilibrium (LL-0) and (LC) and (PC') bind and (LL-R) holds in inequality. The intuition is that the final-good producer wants to offer an, as low as possible, ex-post fixed payment to the supplier and it translates into an ex-post fixed payment when revenues are zero (μ_0) determined by the limited liability constraint (LL-0) and an ex-post fixed-payment when revenues are R (μ_R) determined by the limited commitment constraint (LC). In other words, the final-good producer must leave rents to the supplier when things go well (i.e. (LL-R) holds in inequality in equilibrium). The intuition for the binding (PC') is that the final-good supplier offers an ex-ante transfer as low as possible. Therefore, the ex-post fixed payments are ...

$$\begin{aligned} \mu_0 &= \alpha z(1-p)(1-\beta)R \\ \mu_R &= \frac{f_s}{1-p} - (1-(2-p)\alpha z)(1-\beta)R \end{aligned}$$

and the problem of the final-good producer reduces to ...

$$Max_{\{\beta\}}\widetilde{\pi}^S(\theta) = \Delta(1-p)^{\frac{1}{1-\alpha}} \frac{\left[1-\alpha(1-z)\right]\beta + \left[1-(2-\theta)\alpha z\right](1-\beta)}{\left[\alpha\left(\frac{\beta}{w^N}\right)^{1-z}\left(\frac{1-\beta}{w^S}\right)^z\right]^{-\frac{\alpha}{1-\alpha}}} - (2-\theta)f_s - f_F$$

It can be shown that $\beta^S(\theta, z)$ maximizes profits and it is decreasing in θ and in z if z$<\widetilde{z}(\theta,\alpha)$

Note also that the profits that the final-good producer obtains when contracting with a Northern supplier in this version are the same as the ones she obtained in the version in the text (where p≡0).

Finally, the final-good producer compares $\widetilde{\pi}^S(\theta)$ and $\pi^N = \widetilde{\pi}^S(\theta = 1)$ and chooses to locate production in the South if and only if

$$
\begin{aligned}
\frac{w^N}{w^S} &\geq \widetilde{A}(z,\theta) \equiv \frac{1-\beta^N}{1-\beta^S}\left(\frac{\beta^N}{\beta^S}\right)^{\frac{1-z}{z}} \kappa^{\frac{1-\alpha}{\alpha z}} \\
\text{where } \kappa &\equiv \frac{[1-\alpha(1-z)]\,\beta^N + [1-\alpha z]\,(1-\beta^N) + (1-\theta) f_s \varphi \left[\beta^{N(1-z)}(1-\beta^N)^z\right]^{-\frac{\alpha}{1-\alpha}}}{[1-\alpha(1-z)]\,\beta^S + [1-(2-\theta)\alpha z]\,(1-\beta^S)} \\
\text{and } \varphi &\equiv \left(\frac{w^N}{\alpha}\right)^{\frac{\alpha}{1-\alpha}} \frac{1}{\Delta(1-p)^{\frac{1}{1-\alpha}}}
\end{aligned}
$$

If $f_s > 0$ $\lim_{z\to 0} \widetilde{A}(z,\theta) = +\infty$, $\lim_{z\to 1} \widetilde{A}(z,\theta) = (2-\theta)\left[1 + \frac{(1-\theta)f_s\varphi}{1-\alpha}\right]^{\frac{1-\alpha}{\alpha}} > 1$, and $\widetilde{A}(z,\theta)$ is strictly decreasing in θ for all z and it is strictly decreasing in z if z<$\overline{z}$[9].

Proposition 1'

i) Existence of product cycle: If $f_s > 0$ and $\omega > \lim_{z\to 1} \widetilde{A}(z,\theta)$*, there exists a unique* $z^{**} \equiv \widetilde{A}^{-1}(\omega)$ *such that* $\omega < \widetilde{A}(.,\theta,z)$ *when* $z<z^{**}$ *and* $\omega > \widetilde{A}(.,\theta,z)$ *when* $z>z^{**}$*.*

ii) Effect of financial development: If $f_s > 0$ and $\omega > \lim_{z\to 1} \widetilde{A}(z,\theta)$*, taking wages as given,* z^{**} *is decreasing in* θ*.*

The proof of Proposition 1' is analogous to the proof of Proposition 1.

Therefore, I have shown that the main results of the model considered in the main text go through when a more general version of the model with a larger set of feasible contracts is considered.

[9] The derivation of $\overline{z}$ is analogous to the derivation of $\widehat{z}$.