Financial Development and the Product Cycle

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Abstract

I develop a model to study how financial institution differences across countries affect the decision of Northern firms to offshore production and whether a product cycle arises when the only comparative advantage of Northern suppliers is their access to better financial institutions. A Northern final-good producer needs to buy an intermediate input from a supplier to complete production. She can find this supplier either in the low-wage but financially underdeveloped South or in the high-wage and financially developed North. I show that financial institution differences affect the optimal contract offered to the supplier and are enough to generate a product cycle. The final-good producer faces a trade-off between low wages and contracting distortions. When the good is new, she finds it optimal to keep production in the North at the cost of a higher wage but with the benefit of a less distorted contract. However, as the good becomes more standardized, the importance of the supplier increases and the cost of not shifting production to the South and take advantage of the lower wage offsets the contractual distortions that the underdeveloped Southern financial institutions create. The most salient empirical prediction is that the more R&D-intensive an industry is, the larger is the effect of financial development on offshoring. These results also hold when wages are endogenized. In the empirical section, the prediction is tested and confirmed using disaggregated trade data.

Keywords: Financial development, product cycle, offshoring

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1 Introduction

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

In practice, this product cycle could arise because of Southern imitation, technology transfer, foreign direct investment, and so on. In this paper I focus on offshoring of production. A product cycle takes place because Northern firms prefer to buy intermediate inputs from Southern suppliers to complete the production of their final good. Anecdotal evidence illustrates that this type of offshoring 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 the 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 the United States but the shoes and clothes are manufactured by the 75,000 workers employed in independent factories in Asia.

Financial development is a key determinant of firm behavior because it affects not only the size of the investment that financially constrained firms can undertake but also which type of contracts are written and how revenues and expenditures are shared ex-ante and ex-post. Even though there exists a widespread agreement about the importance of financial institutions and it is well known that financial development is heterogeneous across countries, the idea that financial institution differences could be a driving force of the product cycle has been largely ignored in the literature. In this paper I fill this gap by developing a simple model of offshoring in which the only comparative advantage of Northern suppliers is their access to better financial institutions.

I show that financial institution differences are enough to generate a product cycle akin to the one described by Vernon. The most salient empirical prediction of the model is that the more R&D-intensive an industry is, the larger is the effect of financial development on offshoring. In the empirical section I test this prediction using the number of goods that a country exports to the United States in each industry as a proxy of offshoring and domestic credit to private sector over GDP as a measure of financial development.

The model builds on Antràs (2005). A Northern final-good producer provides headquarter services and needs an input to complete production. She can acquire this input from a supplier located either in the high-wage and financially developed North or in the low-wage and financially underdeveloped South.

One of the main contributions of this paper is to endogenize the bargaining weights, which are crucial yet unexplained in Antràs (2005). I consider a complete contracting setting where revenues are contractible. The final-good producer, after contacting with a supplier, extends her a take-it-

\[\text{See, among others, Antràs et al. (2008), King and Levine (1993) and Rajan and Zingales (1998).}\]
or-leave-it offer consisting of an ex-ante transfer and an ex-post payment.

The supplier needs to pay a fixed cost (e.g., a relationship-specific plant) to enter into the relationship but she has no initial funds and has to cover this fixed cost with a loan from a local bank and the transfer from the final-good producer.\(^2\) Financial institution differences across countries affect the size of the loan that the bank offers to the supplier and the transfer that the final-good producer provides. In more financially developed countries, the supplier receives, \textit{ceteris paribus}, a larger loan from the bank and needs a lower transfer from the final-good producer. This is another departure from the related literature because it is usually assumed that both parties have deep pockets and the transfers are unconstrained.

Once this 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 and the final good is sold, revenues are divided according to the optimal ex-post payment chosen by the final-good producer.

In the appendix, I consider a more general model in which the ex-post payment includes a transfer and a share of revenues. Moreover, in this generalized model I assume that after the investments are made there exists a small probability of a bad shock that drives revenues to zero and because of this uncertainty, a limited commitment constraint is also added.

However, for expositional reasons and to gain a better intuition into the main result of the paper, my baseline model abstracts from uncertainty and the ex-post payment takes the form of a simple endogenous sharing rule. In this environment, the final-good producer would like to extract all the rents of the supplier by offering her a transfer as low as possible but when the supplier is located in the South, the final-good producer needs to leave her some rents. Otherwise the supplier would not have enough funds to cover the fixed cost. Therefore, the final-good producer chooses to tilt the ex-post sharing rule in her favor to extract more surplus from the Southern supplier ex-post. Changes in the sharing rule affect investment choices, thus, one result of the paper is that financial underdevelopment leads to distorted 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 the investment of one party is, the larger the share of revenues going to that party is.

Section 2 shows that these financial institution differences across countries are enough to generate a product cycle in which 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 because the services provided by headquarters become relatively less important). The intuition is that the final-good producer faces a trade-off between low wages and contracting distortions. When the good is new, the role of the supplier is small and the final-good producer finds it optimal to keep production in the North at the cost of a higher wage but with the benefit of a less distorted contract. However, as the good becomes more standardized, the importance of the supplier increases and the cost of not shifting production to the South and take advantage of the lower wage offsets the contractual distortions that

\(^2\)I assume, for easiness of exposition and without loss of generality, that the fixed cost is such that it is always the case that the transfer from the final-good producer to the supplier is positive.
the underdeveloped Southern financial institutions create. Moreover, I show that when Southern financial institutions improve, more production is located in the South and, more importantly, the effect of financial institutions is larger, the less standardized the good is. The intuition is that with poor financial institutions, the Southern supplier is already producing the more mature goods and when financial institutions improve and contractual distortions decrease, the final-good producer prefers to also buy from the South the relatively newer goods.

Section 3 shows, 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.

Section 4 describes and tests the most salient empirical prediction of the model. The model predicts that the effect of financial development on offshoring is larger, the more R&D-intensive the industry is. In order to test this prediction 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. My sample consists of all the trading partners of the United States and the 15 manufacturing industries for which data on R&D-expenditure (my proxy for R&D-intensity) are available. In all my regressions I control for country and industry fixed effects. The prediction of the model is confirmed in the data and it is robust to different specifications and definitions of financial development.

The literature that uses incomplete contracts to understand the organization of the firm and the patterns of trade heavily relies on the *exogenous* bargaining power of the parties. This is, when contracts are incomplete, revenues are shared according to an exogenous bargaining power and this sharing rule is crucial to determine the comparative statics. Section 2.4 shows that the implications of the model can be counterfactual when these sharing rules are exogenous. Moreover, it is difficult to assess the validity of the assumptions made to choose the bargaining power of both parties because they are unobservable. My framework features complete contracts and it does not suffer from these problems. On the one hand, the sharing rule is *endogenous*. This optimal sharing rule is uniquely determined and it gives comparative statics consistent with the product cycle hypothesis. On the other hand, differences in financial development are the source of the differences in the optimal contract that the final-good producer offers to the supplier. Therefore, the predictions of the model on the optimal contract could be taken to the data. As pointed out before, the model predicts a negative correlation between the financial development in the supplier country and the share of revenues that the final-good producer keeps for herself. Even though data on contracts are not available and the direct implications of the model cannot be tested, this prediction is consistent with the findings of Antràs et al. (2008) for US multinationals.

*Related literature.* 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) but I focus on a different, but potentially complementary, explanation of the
product cycle. In my framework the set of available contracts is the same in both countries but they differ in financial development. Antràs (2005) considers that the set of contracts is different across countries and ignores financial institution differences. Therefore, I consider differences in financial institutions across countries as the source of the product cycle, whereas he pushes the view that differences in the contractual framework are the relevant ones. My empirical results seem to suggest that both contracting and financial institutions are important. Bernanke and Gertler (1989) and Kiyotaki and Moore (1997) provide microfoundations to the collateral constraint which I interpret as an indicator of the stage of financial development. This paper also relates to the growing literature on the impact of financial development on trade. It includes, among others, Antràs and Caballero (2007), Beck (2002), Becker and Greenberg (2005), Kletzer and Bardhan (1987), Levchenko (2007), Manova (2007) and Matsuyama (2007). My model shares with them the idea that financial development can translate into comparative advantage. The main difference is that I focus on how financial institution differences affect the offshoring decision of the firm and the optimal contract that the final-good producer offers to the supplier. Moreover, I offer a new explanation of the product cycle, which was not the goal of any of those 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 exists a large number of identical profit-maximizing suppliers both in the North and the South with an outside option normalized to zero in both countries. I assume that all final-good producers are located in the North and there is free-entry in the production of the final good.

There is a unit measure of consumers with the following preferences

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

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 is endogenously determined in Section 3. The elasticity of substitution between varieties is \( 1/(1-\alpha) \) and it is one between industries.

The final-good producer needs headquarter services (\( h \)) and intermediate inputs (\( m \)) to produce each 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 and R&D-intensity of the good. The higher is $z_j$, the less important headquarter services (design, marketing,...) are and therefore the more standardized the good is.

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 needs to pay a fixed cost (e.g., patent) and then she contacts with a supplier located either in the North or the South. This supplier must also pay a fixed cost to enter into the relationship and she funds it with a loan 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 obtains 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 profits and she has to rely more on the ex-ante transfer of the final-good producer to cover the fixed cost.

Banks can be interpreted as a third-party that observes all the game but they recognize that enforcing the contract is very expensive when financial institutions are poorly developed. For example, although revenues are contractible, it can be more difficult and costly to assess the net worth of the supplier in less financially developed countries. Therefore, banks lend to the supplier only a fraction of their pledgeable income.\footnote{An interpretation similar to Bernanke and Gertler (1989) as I explain below.}

There is no uncertainty and the setting is one of complete contracting. I assume that investment choices 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 timeline of events is represented in figure 1 and summarized as follows.

- The final-good producer (F) of variety $i$ in industry $j$ chooses to locate production in country $c \in \{N, S\}$ and pays the fixed cost ($f_F$).

- After deciding where to buy the intermediate input, the final-good producer offers a contract to the supplier consisting of an ex-ante transfer ($T$) and an ex-post share of revenues ($\beta$).\footnote{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.} \footnote{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.}

- If the supplier (S) accepts the contract, she uses the ex-ante transfer ($T$) and the loan ($D$) from the bank to cover the fixed cost ($f_S$).
At $t=1$ both parties make their investment choices. The final-good producer invests in headquarter services ($h_{j(i)}$) and the supplier in intermediate inputs ($m_{j(i)}$). The final good ($x_{j(i)}$) is produced and revenues are shared according to the sharing rule chosen at $t=0$ (i.e., a fraction $\beta$ for the final-good producer and $1-\beta$ for the supplier).

2.2 Partial equilibrium

This section considers the choice of the 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 Definition

The subgame perfect equilibrium (SPE) can be described by a tuple $\{c^*, T^*, D^*, \beta^*, h_{j(i)}^*, m_{j(i)}^*, x_{j(i)}^*\}$ in which $c^*$ is the location of production, $\{T^*, \beta^*\}$ is the contract offered to the supplier, $D^*$ is the loan from the bank, $x_{j(i)}^*$ is the consumer demand by variety $i$ of industry $j$ and $\{h_{j(i)}^*, m_{j(i)}^*\}$ are the equilibrium investment choices.

The equilibrium can be solved backwards. The investments $\{h_{j(i)}^*, m_{j(i)}^*\}$ are the Nash equilibrium of the game in the stage in which both parties make their decisions non-cooperatively taking wages as given.

Given that $\{h_{j(i)}^*, m_{j(i)}^*\}$ are the equilibrium investments and demand, $x_{j(i)}^*$, is chosen by the consumers who maximize their utility given prices and income, the final-good producer chooses the terms of the contract $\{T^*, \beta^*\}$ and, indirectly, the loan, $D^*$, that the bank offers to the supplier in order to maximize her own profits when the supplier is located in country $c$.

Finally, the final-good producer compares profits in the different locations $c \in \{N, S\}$ and chooses to locate production where profits are larger.

2.2.2 Consumers

Each consumer chooses $x_{j(i)}$ subject to prices $p_{j(i)}$ and income to maximize the utility function defined above. It follows that the demand faced by the producer of variety $i$ in industry $j$ is given by

$$x_{j(i)} = \Delta p_{j(i)}^{-\frac{1}{\alpha}} \quad \text{where} \quad \Delta = \frac{1}{N} \frac{E}{\int_0^{p_{j(i)}} \frac{E}{p_{j(i)}^\alpha} \, d\alpha}$$

where $E$ is world income and each firm takes $\Delta$ as given.

Thus, revenues generated by variety $i$ in industry $j$ are $R = \Delta^{1-\alpha} x_{j(i)}^\alpha$.

2.2.3 Equilibrium

I solve backwards the SPE of the game between the final-good producer and the supplier described above. First, I consider the stage in which both parties make their investment decisions.
The supplier chooses intermediate inputs \((m)\) to maximize her profits which are her share of revenues minus the cost of producing these inputs. She takes into account consumer demand and acknowledges that revenues also depend on headquarter services \((h)\) which are chosen, simultaneously, by the final-good producer. Therefore, if the supplier is located in country \(c\), she solves the following problem

\[
\max_{\{m\}} (1 - \beta)R - w^C m \\
\text{s.t.} \quad R = \Delta^{1-\alpha} x^\alpha \\
\quad x = \left( \frac{h}{1 - z} \right)^{1-z} \left( \frac{m}{z} \right)^z 
\]

Similarly, the final-good producer makes her investment in headquarter services \((h)\) to maximize her own profits.

\[
\max_{\{h\}} \beta R - w^N h \\
\text{s.t.} \quad R = \Delta^{1-\alpha} \left( \frac{h}{1 - z} \right)^{\alpha(1-z)} \left( \frac{m}{z} \right)^{az} 
\]

It is straightforward to solve the equilibrium investment choices by combining the first-order conditions of both problems and check that revenues are given by

\[
R = \Delta \left[ \alpha \left( \frac{\beta}{w^N} \right)^{1-z} \left( \frac{1 - \beta}{w^C} \right)^z \right]^{\frac{1}{1-\alpha}}. 
\]

Now consider the stage in which the final-good producer has already decided to locate production in country \(c\) and extends a take-it-or-leave-it offer to that supplier. The final-good producer solves the following program where \(h\) and \(m\) are the equilibrium investments derived above \(^6\) \(^7\)

\[
\max_{\langle T,D \rangle} \pi^c = \beta R - w^N h - T - f_F \\
\text{s.t.} \quad T + D \geq f_S \quad (1) \\
\quad PS = T - f_S + (1 - \beta)R - w^c m \geq 0 \quad (2) \\
\quad D \leq \theta^c [(1 - \beta)R - w^c m] \quad (3) \\
\quad R = \Delta \left[ \alpha \left( \frac{\beta}{w^N} \right)^{1-z} \left( \frac{1 - \beta}{w^C} \right)^z \right]^{\frac{1}{1-\alpha}} \quad (4) 
\]

She chooses the terms of the contract \(\{\beta, T, D\}\) and, indirectly, the loan \((D)\) that the supplier

\(^6\)For simplicity, the gross interest rate is normalized to one.

\(^7\)The FOC of the supplier is \(w^C m = \alpha z (1 - \beta) R\) and the FOC of the final-good producer is \(w^N h = \alpha (1 - z) \beta R\).
receives in order to maximize her own profits which are given by her share of revenues ($\beta R$) minus the investment costs ($wNh$), the transfer provided to the supplier ($T$) and the fixed cost ($f_F$).

The first constraint is the budget constraint of the supplier. The supplier enters into the relationship only if she obtains enough funds to cover the fixed cost ($f_S$) which I assume, for simplicity, to be the same in both countries. The supplier obtains a loan from the bank ($D$) and the transfer from the final-good producer ($T$).

Equation (2) is the participation constraint of the supplier where the outside option is normalized to zero. The supplier prefers not to sign the contract with the final-good producer when her net profits are lower than her outside option. This happens when her share of revenues ($(1-\beta)R$) plus the ex-ante transfer ($T$) fall short of the fixed cost ($f_S$) and investment costs ($w^cN$).

Equation (4) is the equilibrium outcome in the final stage of the game that the final-good producer takes into account when choosing the terms of contract. She internalizes that changes in the ex-post sharing rule ($\beta$) affect the equilibrium investment choices and revenues in the next period.

Lastly, equation (3) is the collateral constraint and the main departure from the related literature. It says that the bank lends to the supplier, at most, a fraction $\theta^c$ of her future profits. The lower is $\theta^c$, the weaker financial institutions are. This constraint could be rationalized, along the lines of Bernanke and Gertler (1989), by saying that banks in less financially developed countries 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.

To solve this problem note that the final-good producer would like to extract all the profits of the supplier (i.e., make $PS = 0$) but she cannot do it when $\theta^c < 1$ because it would violate the budget constraint of the supplier (i.e., $T + D < f_S$ if $PS = 0$). It implies that, ceteris paribus, the final-good producer needs to leave more rents to the supplier when financial institutions are less developed (i.e., $\theta^c$ lower). It follows that the budget and the collateral constraint bind in equilibrium, $PS > 0$ and the problem simplifies to

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

Finally, after solving for the optimal sharing rule, the final-good producer chooses to locate production where profits are higher.

I next compute the profits of the final-good producer when she contracts with a Southern supplier, then with a Northern supplier and I compare them to see when offshoring takes place.

For simplicity and without loss of generality I set $\theta = \theta^S < \theta^N \equiv 1$. Northern financial institutions are perfect in the sense that the supplier can fully pledge her future profits and are imperfect in the South where the supplier can only a pledge a fraction of these profits.

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8Note that the final-good producer is able to extract all the rents of the supplier when $\theta^c = 1$. 
2.2.4 Southern supplier

If the supplier is located in the South, equation (5) becomes

\[
\max_{\{\beta\}} \pi^S = \Delta \beta \left[ 1 - \alpha (1 - z) \right] + \theta (1 - \beta) \left[ 1 - \alpha z \right] - f_F - f_S
\]

(6)

Lemma 1 \( \beta^S(\theta, z) \) is the unique solution to (6) and \( \beta^S(\theta, z) \) is weakly (strictly if \( z > 0 \)) decreasing in \( \theta \) and strictly decreasing in \( z \).

2.2.5 Northern supplier

If the final-good producer prefers to contact with a Northern supplier, equation (5) becomes

\[
\max_{\{\beta\}} \pi^N = \Delta \beta \left[ 1 - \alpha (1 - z) \right] + (1 - \beta) \left[ 1 - \alpha z \right] - f_F - f_S
\]

(7)

The optimal sharing rule is\(^{10} \) \( \beta^N(z) = \frac{(1 - \alpha z)(1 - z) - \sqrt{(1 - \alpha + \alpha z)(1 - \alpha z)(1 - z)}}{1 - 2z} \).

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 \( \beta \) is independent of wages and \( \frac{\partial \beta^S(\theta)}{\partial \theta} < 0 \) if \( z > 0 \).

Figure 2 represents the optimal sharing rules \( (\beta) \) for different levels of financial development \( (\theta) \). We can see that \( \beta \) is decreasing in \( z \). This is a well known result in the contract theory literature and it means that it is optimal to give more incentives to the party whose investment is relatively more important. As \( z \) increases, intermediate inputs become more important and the final-good producer gives a higher share of the ex-post revenues (low \( \beta \) ) to the supplier who produces these intermediate inputs.

A more interesting result is that \( \beta \) is decreasing in \( \theta \). It means that when financial institutions are underdeveloped, the ex-post share of revenues that the final-good producer keeps for herself is too high. The intuition is that when Southern financial institutions worsen (i.e., \( \theta \) 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 \( \beta \) ). 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. Note

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

\( ^{9} \beta^S(\theta) = \frac{(1 - \alpha z)(1 - \theta - \alpha (1 - z)(1 + \theta)) + \sqrt{(1 - \alpha z)(1 - \theta)(1 - 2\alpha z) + \alpha^2(1 - z)} - \theta}{2(1 - \theta - \alpha + (1 + \theta)\alpha z)} \]

\(^{10} \)This expression is the same as the one derived in Antràs and Helpman (2004) with the only difference that I define \( z \) as their \( 1 - \eta \).
that the negative correlation between Southern financial institutions and the optimal sharing rule is consistent with the findings of Antràs et al. (2008) for US multinationals.

2.3 Optimal location

The final-good producer compares equations (6) and (7) and chooses to locate production in the South if and only if

\[
\frac{w^N}{w^S} \geq A(\cdot, \theta, z),
\]

where

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

Note that as long as \( \theta < 1 \), \( A(\cdot, \theta, z) \) is decreasing in \( z \) if \( z < \hat{z} \), \( A(\cdot, \theta, z) \) is increasing in \( z \) if \( z > \hat{z} \), lim_{z \to 0} A(\cdot, \theta, z) = +\infty \) and lim_{z \to 1} A(\cdot, \theta, z) = \frac{1-(1-\alpha)\theta}{\alpha} > 1.11

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

I need to assume the relative Northern wage to solve the partial equilibrium and Proposition 1 shows that assumption A1 is sufficient for having a unique threshold which gives raise to a product cycle.

**Assumption A1**

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

This assumption implies that a larger wage differential is required, the worse Southern financial institutions are (i.e., the right-hand side decreases with \( \theta \)). It means that when Southern financial development declines, the Northern final-good producer demands a lower relative Southern wage to locate production in the South, otherwise she prefers not to offshore production and no product cycle takes place. Note that when Southern financial institutions converge to Northern ones (i.e., \( \theta \to 1 \)), assumption A1 approaches to the standard assumption \( \omega > 1 \).

In the next section where I close the model in general equilibrium I show that this assumption is part of the equilibrium outcome.

**Proposition 1**

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

ii) Effect of financial development: If A1 holds, \( z^* \) is decreasing in \( \theta \).

**Proof** See Appendix B.

\[\text{Proof: See Appendix B for the derivation of } \hat{z}.\]

11
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 intermediate inputs from a Northern supplier when $z \in (0, z^*)$ and from a Southern supplier when $z \in (z^*, 1)$. The intuition is that the final-good producer faces a trade-off between high wages and distorted contracts when choosing where to locate production. A product cycle emerges because the final-good producer prefers to keep production in the high-wage but financially developed 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 the contribution of intermediate inputs in the final good increases. To better understand this product cycle result and capture the time dimension, let me formalize my assumption that headquarter services become less important as the good matures and say that $z(t) = h(t)$ with $h'(t) > 0$, $h(0) > 0$ and $\lim_{t \to \infty} h(t) = 1$. Proposition 1 directly implies that production remains in the North when the good is new (i.e., $t < h^{-1}(z^*)$) and it is offshored to the South when becomes more standardized (i.e., $t > h^{-1}(z^*)$).

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 good is. This result can be seen in figure 3 which represents how the optimal location of production changes with Southern financial development. Graphically, when Southern financial institutions improve (i.e., $\theta$ increases), $A(\cdot, \theta, z)$ shifts down and, given relative wages, $z^*$ decreases. The intuition is that the Northern final-good producer requires a lower wage differential to offshore production because the improvement in 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 given, it implies that more production is located in the South. Moreover, the effect of financial development on offshoring is in the relatively less standardized (lower $z$) goods. The Southern supplier was already producing the more mature goods and as a result of the improvement in financial institutions she can also start producing more R&D-intensive goods. In the empirical part, section 5, I formalize this insight to take this prediction of the model to the data.

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 $\omega > 1 = A(\cdot, \theta = 1, z)$.

The next proposition shows that the time-series results in Proposition 1 go through if I consider a cross-section of countries which differ in their financial institutions.

**Proposition 2**  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 $z > z_{DC}$. Therefore, there is no reversal of comparative advantage.

---

12 This assumption is also made in Antràs (2005).
Proof  See Appendix C.

Proposition 2 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 in the empirical section.

2.4 Discussion of the model

A critical element of the model is how revenues are shared because it determines the investment choices that both parties make and the comparative advantage of the Northern supplier. The baseline model restricts the ex-post payment to a simple sharing rule. This restriction is not important and I show, in the appendix, that the results go through when the final-good producer is allowed to extract rents from the supplier ex-post through a non-distortionary transfer.

This subsection emphasizes the importance of considering a complete contracting setting and shows that very different results are obtained if contracts were incomplete (revenues were not contractible) and the sharing rule was exogenously given.

The model says that production is shifted to the South whenever

\[
\frac{w^N}{w^S} \geq A(\alpha, \theta, z),
\]

where

\[
A(\alpha, \theta, z) \equiv \frac{1 - \beta_N}{1 - \beta_S} \left( \frac{\beta_N}{\beta_S} \right)^{1-z} \left[ \frac{(1 - \beta_N)(1 - \alpha z) + \beta_N[1 - \alpha(1 - z)]}{\theta (1 - \beta_S)(1 - \alpha z) + \beta_S[1 - \alpha(1 - z)]} \right]^{\frac{1-\alpha}{\alpha z}}.
\]

This equation follows from comparing equations (6) and (7) and it is valid independently of how these sharing rules are chosen. Proposition 1 shows that a product cycle arises when these ex-post sharing rules are optimally chosen by the final-good producer.

Now, consider that contracts are incomplete (revenues are not contractible) and the final-good producer cannot choose the ex-post sharing rule but it is exogenously determined by the bargaining power of each party. In this case, \( \beta \) represents the bargaining power of the final-good producer. First, let us assume that the bargaining power of the final-good producer is the same when contracting with the Northern and Southern supplier (i.e., \( \beta_N = \beta_S = \beta \)).

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

The properties of \( A(\alpha, \theta, z) \) are qualitatively the same and all the results of the model would go through.

However, consider a more extreme case in which the bargaining power of the final-good producer is very high when contacting with a Southern supplier but very low when contacting with a Northern supplier (i.e., \( \beta_N = \epsilon, \beta_S = 1 - \epsilon \) where \( \epsilon > 0 \) and small). In this case,

\[
A(\alpha, \theta, z) \equiv \left( \frac{1-\epsilon}{\epsilon} \right)^{\frac{2z-1}{z}} \left[ \frac{(1-\epsilon)(1-\alpha z) + \epsilon[1-\alpha(1-z)]}{\theta (1-\epsilon)(1-\alpha z) + \epsilon[1-\alpha(1-z)]} \right]^{\frac{1-\alpha}{\alpha z}}.
\]

\( A(\alpha, \theta, z) \) is now increasing in \( z \) instead of being decreasing and if we assume that \( \omega < A(\alpha, \theta, z = 1) \), then there exists \( z^* \equiv A^{-1}(\omega) \) such that production is
kept in the North for the most standardized goods \( z > z^* \) and it is shifted to the South when they are new \( z < z^* \). This model counterfactually generates a reversed product cycle.

These examples illustrate the importance of considering a complete contracts setting. The cross-section and product cycle implications of the model could be dramatically different if the sharing rule was exogenously given. Therefore, it is important to derive the optimal contract to understand what determines these sharing rules.

3 General equilibrium effects

I show that the results derived in partial equilibrium go through and assumption A1 is confirmed in general equilibrium. The main difference is that the effect of financial development on offshoring 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. It follows from equations (6), (7), prices and the optimal location of production that

\[
\begin{align*}
    n_j &= \begin{cases} 
      \beta^N [1 - \alpha(1 - z)] + (1 - \beta^N)(1 - \alpha z) \frac{E}{N_{(J_S + J_F)}} & \text{when } z \in (0, z^*) \\
      \beta^S [1 - \alpha(1 - z)] + \theta(1 - \beta^S)(1 - \alpha z) \frac{E}{N_{(J_S + J_F)}} & \text{when } z \in (z^*, 1)
    \end{cases}
\end{align*}
\]

As discussed above, the final-good producer has to let rents to the Southern supplier because of the collateral constraint (i.e., \( PS > 0 \)). The rents of the Southern supplier of variety \( i \) in industry \( j \) can be expressed as \( PS_{j(i)} = (1 - \theta)(1 - \beta^S)(1 - \alpha z) \frac{E}{N_{n_j}} \).

If we denote \( F(z) \) as the fraction of industries with \( z < z^* \) and \( f(z) \) as its density function, then, using the expression for Southern rents derived above and recognizing that the Southern supplier produces only those intermediate inputs with \( z > z^* \), it follows that total Southern profits are

\[
\int_{z^*}^{1} (1 - \theta)(1 - \alpha z) [1 - \beta^S(\cdot, \theta, z)] Ef(z)dz.
\]

Noting that Northern suppliers obtain no rents \( (PS_{j(i)} = 0 \text{ if } \theta = 1) \) and the final-good producer has zero profits in equilibrium because of the free-entry condition, the goods market clearing condition becomes

\[
(1 - \theta)\varphi(z^*, 1)E + w^S L^S + w^N L^N = E
\]
where \( \varphi(a, b) \equiv \int_a^b (1 - \alpha z) [1 - \beta^S(, \theta, z)] f(z) dz \), \( L^c \) is the supply of workers in country \( c \) and \( E \) is world income.

After deriving the goods market clearing condition, I only need, by Walras’ law, to clear one of the two labor markets and I choose to focus on the Southern labor market. The labor demand of any Southern supplier of variety \( i \) in industry \( j \) is \( m^S_{j(i)} w^S = \alpha z(1 - \beta^S) \frac{E}{N^S_j} \), then, the Southern labor market condition is given by

\[
\int_{z^*}^1 \alpha z [1 - \beta^S(, \theta, z)] E f(z) dz = w^S L^S
\]

(9)

If we define \( \xi(a, b) \equiv \int_a^b [1 - \beta^S(, \theta, z)] z f(z) dz \), then, by plugging the labor market condition (9) into the goods market condition (8), 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 \( \frac{\partial B(, \theta, z^*)}{\partial \theta} < 0 \).

To close the model I need another equation that combines relative wages with the optimal threshold. In the partial equilibrium section I already obtained this equation \( (\omega = A(, \theta, z^*)) \) from the final-good producer optimal location problem which I use next to find the equilibrium outcomes.

### 3.2 Effect of financial development

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

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

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

Given reasonable parameter values and density function, \( f(z) \), assumption A1 holds in general equilibrium.\(^{13}\)

**Proposition 3** \( \frac{w^N}{w^S} \) and \( z^* \) are decreasing in \( \theta \).

\(^{13} \)However, it is theoretically possible to find a combination of relative labor supplies and density function, \( f(z) \), such that both curves cross at \( z^* > \tilde{z} \) and assumption A1 is violated. Even if A1 is violated, all results go through if \( z^* < \tilde{z} \) (i.e., \( \frac{\partial A(, \theta, z^*)}{\partial z^*} \bigg|_{z^* = \tilde{z}} < 0 \)). To ensure that it is indeed the case one could either restrict the values that \( z \) can take (i.e., \( z \in (0, \tilde{z}] \)) or assume that \( \frac{L^S}{E^S} \geq \frac{E^S}{L^S} \) where \( \frac{L^S}{E^S} \) is such that \( B(, \frac{L^S}{E^S}, \theta, 0) = A(, \theta, \tilde{z}) \).
This result can be seen in figure 4. Intuitively, an improvement in Southern financial institutions has two effects. First, it increases Southern labor demand (i.e., $B(., \theta, z)$ shifts down). Second, the comparative advantage of Northern supplier decreases because contractual distortions associated to the underdeveloped Southern financial institutions decline and the final-good producer requires a lower wage differential to offshore production (i.e., $A(., \theta, z)$ shifts down). The total effect is that relative Southern wage rises but it does not increase enough to offset the gain in contractual efficiency and more production is shifted to the South.

4 Empirical Evidence

4.1 Prediction of the model

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

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

To see that, remember that the model predicts that production takes place in the South whenever $z > z^*$. Let us define an indicator function, $M(z)$, that equals one if the good is offshored and zero otherwise. If goods in industry $i$ are represented by the distribution function $G_i(z)$, then $M_i = \int_0^1 M(z) dG_i(z)$ is a measure of offshoring in industry $i$.

Let us now assume that there are two industries (A and B) with industry A having more standardized (higher $z$) goods than industry B. To be more precise, $G_A(z)$ first-order stochastically dominates $G_B(z)$.

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

To provide a better intuition, let us take a look at figure 5. This figure represents two arbitrary distributions of goods in industries A and B with the assumption that industry B is a more R&D-intensive industry (i.e., $G_A(z)$ first-order stochastically dominates $G_B(z)$). Assume that the initial equilibrium is $z^*$. When Southern financial institutions improve (i.e., $\theta$ increases), the new equilibrium is, as predicted by the model, shifted to the left, let us say $z^{**}$. Therefore, this improvement in financial institutions affects the Southern production of those goods in the range ($z^{**}, z^*$) which were previously produced in the North and are now produced in the South. Given our distribution assumptions, the effect of financial development is larger in industry B which has more goods in this range. Graphically, the shaded region reflects how much larger the effect in industry B is (i.e., $\frac{\partial M_B}{\partial \theta} - \frac{\partial M_A}{\partial \theta}$).

14 Even though my model has also time-series predictions, I do not test these predictions because of the lack of time-variation in the measures of financial development for the period in which disaggregated trade data are available. Moreover, there exists a growing literature (e.g., Antràs et al. (2008) and Carluccio and Fally (2008)) on the effect of
4.2 Data

I use the number of goods per industry that a given country exports to the North as proxy for offshoring because the prediction of the model is more related to the extensive margin. My definition of a good is a 5-digit SITC and I assume that these goods are used as intermediate inputs. United States is treated as the North because of data availability and because it is sensible to assume that goods are created in the United States and then they are produced abroad. My sample includes all the trading partners of the United States (145 countries). These trade data come from NBER.

As robustness check I also use the intensive margin as proxy for offshoring. In this case I use the value of exports to US by industry instead of the number of goods. These trade data also come from NBER. Finally, US foreign direct investment is used as a potential proxy for offshoring and these data are obtained from BEA.

The proxy for standardization is R&D-expenditure at the industry level in the United States. 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). Vernon notes that when the good is new, it requires a high expenditure on product development (which is related to R&D-expenditure), but its importance decreases as the good becomes more standardized. The definition of an industry is a 3-digit NAICS and data from R&D-expenditure at industry level in the United States are obtained from NSF.

When doing robustness checks I add additional industry control variables. I use dependence on external finance, asset tangibility, capital intensity and industry share in total value added. Later on I argue why these variables can be useful. 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). Capital intensity which measures the use of capital in each industry is obtained from Manova (2007). Industry share is value added in industry $i$ in country $c$ over value added in country $c$. 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 ($D \text{ Credit}$) which I obtain from World Development Indicators (World Bank). Different definitions of financial development are used as robustness checks. $D \text{ Credit}$ (2) stands for private credit by deposit money banks and other financial institutions (% GDP), $\text{Stock Mkt}$ is stock market capitalization (% GDP), $\text{Repub}$ is risk of contract repudiation, $\text{Exprop}$ is risk of expropriation and $\text{Account}$ 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 those papers, I just want to remark that lower values in $\text{Repub}$ and $\text{Exprop}$ mean higher risks of contract repudiation and expropriation and higher values in $\text{Account}$ mean better accounting practices. Thus, for all definitions, higher values mean better financial institutions.

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15I also ran the same regressions when a good is defined as a 10-digit HS. I do not report these results because the coefficients are very similar due to the use of logs.
Appendix A reports average US R&D-expenditure at industry level for 1999-2001 and the measures of dependence on external finance, asset tangibility and capital intensity for the 15 industries for which R&D-expenditure is available. Unsurprisingly, the "computer and electronic products" industry is the most R&D-intensive and "wood products" and "beverage and tobacco products" are the least R&D-intensive ones and the different measures are correlated.

4.3 Empirical strategy

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

\[ G_{ic} = \beta_i + \gamma F_{Dc} R_{Di} + \epsilon_{ic}, \] (10)

\( G_{ic} \) is the number of goods in industry \( i \) that country \( c \) exports to the US, \( F_{Dc} \) is financial development of country \( c \), \( R_{Di} \) is US-R&D expenditure in industry \( i \) and \( \delta_i \) and \( \delta_c \) are a set of industry and country fixed effects, respectively. All variables are in logs and are the average for 1999-2001.\(^\text{16}\)

The variable of interest is the interaction between financial development and R&D-intensity and the model predicts a positive coefficient on this variable (i.e., \( \gamma > 0 \)).

As a first informal check of the model, figures 6 and 7 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. It implies that 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" industry.

4.4 Results

Table 1 reports the results of running equation (10) by using country-fixed effects with robust standard errors in parentheses.\(^\text{17}\) 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. It means that the effect of financial development on offshoring is larger, the more R&D-intensive the industry is. This effect is also economically significant, take for example the coefficient in the first column (0.098). Imagine that the financial development of one country goes from the 25th percentile of the distribution to the 75th percentile. That country would see that the number of goods in an industry in the 25th percentile of the R&D-intensity distribution that exports to the US increases by 0.91% whereas the number of goods in an industry in the 75th percentile of the distribution increases by 1.40%.\(^\text{18}\)

\(^\text{16}\)Except for risk of contract repudiation, risk of expropriation, accounting standards, dependence on external finance and asset tangibility which are not available for this period.

\(^\text{17}\)Similar results are obtained if equation (10) is estimated by using a Probit model.

\(^\text{18}\)To get these numbers note that the 25th and 75th percentiles of the R&D-expenditure distribution are 295 and 6347 and the percentiles in the domestic credit distribution are 11.83% and 60.69%, respectively. Given that the coefficient is 0.098, if domestic credit goes from 11.83% to 60.69%, the increase in the number of goods in the industry
In Table 2, I check whether my results are being driven by the most R&D-intensive industries. I eliminate from the sample the three most R&D-intensive industries.\textsuperscript{19} The top panel of Table 2 reports the coefficients for the whole sample (Table 1) and 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. For example, in column one the coefficient increases from 0.098 to 0.132.

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. Moreover, it could be that my measure of R&D-intensity is a proxy of capital intensity (see Romalis 2004). The top panel of Table 3 repeats the previous results and the bottom panel includes the interaction of financial development with these three 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 (for example, in the first column it slightly decreases to 0.083). Second, the interaction of financial development with these three 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 industry variables are included but it seems to be the relevant one.

Table 4 includes a new variable to try to disentangle offshoring from Hecksher-Ohlin effects. 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 \(c\). The top panel repeats again Table 1 and the bottom panel includes this industry share variable. The sample size falls a lot after including this new variable and for that reason the coefficients in 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 is almost unchanged (for example, it goes from 0.098 to 0.092 in column one) and it remains positive and significant. Therefore, even though industry share is statistically significant, the coefficient on the variable of interest remains large and significant.

Table 5 considers the effects of ignoring the zeros (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. To see whether ignoring these zeros affects my results, Table 5 runs two versions of equation (10) by using country-fixed effects in a Poisson

\[
\text{in the 25th percentile of the R&D distribution is } 0.098 \times \log(295) \times \left[ \log(60.69) - \log(11.83) \right] = 0.91 \text{ percentage points.}
\]

\textsuperscript{19} As can be seen in Appendix A, the industries with highest R&D-expenditure are computer and electronic products, transportation equipment and chemicals.
specification with bootstrap standard errors in parentheses. Private credit is used as measure of financial development. The first column reports the coefficients when I ignore the zeros and the second column reports 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 has almost no effect on the coefficients (the coefficient on the variable of interest changes from 0.117 when zeros are ignored to 0.115 when zeros are included). In the bottom panel the interaction term and the industry share are the explanatory variables. 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 the number of zeros in the sample is small.

4.5 Additional Robustness Checks

I perform additional robustness checks that confirm the empirical prediction of the model.

Table 6 investigates whether the effect of financial development on offshoring also applies to the intensive margin. The dependent variable is the value of exports to the United States for industry and country. The top panel only includes the interaction variable, the middle one adds the industry controls and the bottom one only considers the interaction variable and the industry share. All the coefficients on the variable of interest are positive and statistically significant. One interpretation of this result is that when financial development increases, not only the industries that are more R&D-intensive export more goods to the US but the share of these industries in the export sector also increases.

Table 7 studies the effect of financial development abroad when foreign direct investment (FDI) is used as proxy of offshoring. One would expect that when a country improves its financial institutions, it receives more direct investment from the North and it is biased towards the more R&D-intensive industries. To test this hypothesis, FDI data for all the available manufacturing industries are obtained from BEA. The dependent variable is US direct investment abroad measured as capital outflows. The top panel only includes the interaction variable, the middle one adds the industry variables and the bottom one uses the interaction variable and the industry share as explanatory variables. The first thing to note is that the sample is much smaller. The reason is that BEA only disaggregates data for seven manufacturing industries and the number of countries is also smaller. Having this in mind, we can see that the sign of the coefficient on the variable of interest goes always in the direction predicted by the model and it is also statistically significant in all the panels except in the bottom one where the sample size is very small.

Following the theoretical work of Antràs (2003) a growing empirical literature including Bernard et al. (2008) and Nunn (2007) has attempted to test the role of contracting institutions in intra-firm trade. Moreover, Acemoglu and Johnson (2005) emphasize that different institutions play a different role in the economic outcomes. Table 9 checks whether the effect of financial development

\[^{20}\text{From now on, when I add industry controls I omit the interaction with capital intensity because it is not statistically significant. My coefficient of interest does not change if the interaction is included.}\]
is still significant when other type of institutions are added. The top panel repeats Table 1, the middle panel adds constraint on the executive ($X_{Const}$) from Polity IV which measures, in scale from 1 to 7, how the rules constrain the state and the bottom panel includes rule of law ($RoL$) from Kaufmann et al. (2008). By using the terminology introduced by Acemoglu and Johnson, the middle panel studies the complementarity between financial and "property rights" institutions and the bottom one the complementarity between financial and "contracting" institutions. In the middle panel we see that the variable of interest remains positive, significant and the size of the coefficient is almost unchanged (for example, in the first column it decreases only from 0.098 to 0.086) and the interaction between constraint on the executive and R&D is positive and significant (except in the last three columns where the definition of financial development is very similar to constraint on the executive). The bottom panel shows that when the interaction between rule of law and R&D is included, the coefficient on rule of law is positive and significant and the coefficient on the variable of interest sharply falls. This reduction is specially large in the first column where the coefficient drops to 0.029. This result is not surprising given the high correlation (0.77) between domestic credit and rule of law. However, the coefficient still remains statistically significant. To conclude, these results suggest that property rights, contracting and financial institutions all matter and their effect on offshoring is larger, the more R&D-intensive the industry is. It would be interesting to see the different mechanisms at work but this exercise is outside the scope of the paper.

Finally, one could be concerned because I do not weigh the number of goods that a country exports to the United States by the importance of that industry in the country. I check this in Table 9. The dependent variable in the bottom panel is $G_{ic} V_{Aic}$ where $G_{ic}$ is the number of goods in industry $i$ that country $c$ exports to US and $V_{Aic}$ is the value added of industry $i$ in country $c$. By comparing the top (unweighted) and the bottom (weighted) panel, it can be seen that the coefficient on the variable of interest is positive, bigger and significant but with larger standard deviations (for example, in column one, the coefficient goes from 0.098 to 0.199 with standard deviation increasing from 0.009 to 0.037). Thus, the prediction of the model is also confirmed when the number of goods is weighted by the importance of the industry in the country.

Summing up, this empirical section has shown that the more R&D-intensive the industry is, the larger the effect of financial development on offshoring 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.

5 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 intermediate inputs from a supplier to complete production. This supplier can be found either in the high-wage but financially developed North or in the low-wage and financially underdeveloped South.
I show that these financial institution differences are enough to generate a product cycle in which the production of new goods is kept in the North and it is shifted to the South when the goods become more standardized. The intuition is that the final-good producer faces a trade-off between low wages and contractual distortions. When the good is new, intermediate inputs are not very important and the final-good producer finds it optimal to keep production in the North at the cost of a higher wage but with the benefit of a less distorted contract. However, when the good becomes more standardized and the importance of intermediate inputs increases, the low Southern wage compensates the contractual distortions that less developed financial institutions create and production is shifted to the South.

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

The model derived in the paper has abstracted from dynamic considerations. An interesting extension would be to consider a dynamic version of the model in which 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.
6 Tables

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

Dependent variable: Number of Goods Exported to US

<table>
<thead>
<tr>
<th></th>
<th>D Credit</th>
<th>D Credit(2)</th>
<th>Stock Mkt</th>
<th>Repud</th>
<th>Exprop</th>
<th>Account</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fin.Dev*R&amp;D</td>
<td>0.098</td>
<td>0.104</td>
<td>0.063</td>
<td>0.490</td>
<td>0.633</td>
<td>0.342</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.009)</td>
<td>(0.007)</td>
<td>(0.051)</td>
<td>(0.063)</td>
<td>(0.043)</td>
</tr>
<tr>
<td>No. Observations</td>
<td>1690</td>
<td>1580</td>
<td>1275</td>
<td>656</td>
<td>656</td>
<td>551</td>
</tr>
<tr>
<td>R^2</td>
<td>0.47</td>
<td>0.48</td>
<td>0.47</td>
<td>0.77</td>
<td>0.78</td>
<td>0.77</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is the average number of goods exported to the US for country and industry (1999-2001). 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

<table>
<thead>
<tr>
<th></th>
<th>D Credit</th>
<th>D Credit(2)</th>
<th>Stock Mkt</th>
<th>Repud</th>
<th>Exprop</th>
<th>Account</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole sample</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fin.Dev*R&amp;D</td>
<td>0.098</td>
<td>0.104</td>
<td>0.063</td>
<td>0.490</td>
<td>0.633</td>
<td>0.342</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.009)</td>
<td>(0.007)</td>
<td>(0.051)</td>
<td>(0.063)</td>
<td>(0.043)</td>
</tr>
<tr>
<td>No. Observations</td>
<td>1690</td>
<td>1580</td>
<td>1275</td>
<td>656</td>
<td>656</td>
<td>551</td>
</tr>
<tr>
<td>R²</td>
<td>0.47</td>
<td>0.48</td>
<td>0.47</td>
<td>0.77</td>
<td>0.78</td>
<td>0.77</td>
</tr>
<tr>
<td>Dropping NAICS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fin.Dev*R&amp;D</td>
<td>0.132</td>
<td>0.140</td>
<td>0.083</td>
<td>0.622</td>
<td>0.797</td>
<td>0.393</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.016)</td>
<td>(0.011)</td>
<td>(0.081)</td>
<td>(0.102)</td>
<td>(0.074)</td>
</tr>
<tr>
<td>No. Observations</td>
<td>1279</td>
<td>1200</td>
<td>981</td>
<td>512</td>
<td>512</td>
<td>413</td>
</tr>
<tr>
<td>R²</td>
<td>0.51</td>
<td>0.51</td>
<td>0.52</td>
<td>0.78</td>
<td>0.78</td>
<td>0.79</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is the average number of goods exported to the US for country and industry (1999-2001). 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

<table>
<thead>
<tr>
<th></th>
<th>D Credit</th>
<th>D Credit(2)</th>
<th>Stock Mkt</th>
<th>Repud</th>
<th>Exprop</th>
<th>Account</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fin.Dev*R&amp;D</td>
<td>0.098</td>
<td>0.104</td>
<td>0.063</td>
<td>0.490</td>
<td>0.633</td>
<td>0.342</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.009)</td>
<td>(0.007)</td>
<td>(0.051)</td>
<td>(0.063)</td>
<td>(0.043)</td>
</tr>
<tr>
<td>No. Observations</td>
<td>1690</td>
<td>1580</td>
<td>1275</td>
<td>656</td>
<td>656</td>
<td>551</td>
</tr>
<tr>
<td>R²</td>
<td>0.47</td>
<td>0.48</td>
<td>0.47</td>
<td>0.77</td>
<td>0.78</td>
<td>0.77</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>D Credit</th>
<th>D Credit(2)</th>
<th>Stock Mkt</th>
<th>Repud</th>
<th>Exprop</th>
<th>Account</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fin.Dev*R&amp;D</td>
<td>0.083</td>
<td>0.087</td>
<td>0.049</td>
<td>0.419</td>
<td>0.532</td>
<td>0.210</td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
<td>(0.019)</td>
<td>(0.011)</td>
<td>(0.066)</td>
<td>(0.066)</td>
<td>(0.039)</td>
</tr>
<tr>
<td>Fin. Dev*Ext. fin.</td>
<td>-0.034</td>
<td>-0.055</td>
<td>0.090</td>
<td>0.189</td>
<td>0.009</td>
<td>0.832</td>
</tr>
<tr>
<td></td>
<td>(0.076)</td>
<td>(0.084)</td>
<td>(0.619)</td>
<td>(0.535)</td>
<td>(0.639)</td>
<td>(0.362)</td>
</tr>
<tr>
<td>Fin. Dev*Tang.</td>
<td>-0.583</td>
<td>-0.724</td>
<td>-0.173</td>
<td>-1.45</td>
<td>-2.84</td>
<td>-2.103</td>
</tr>
<tr>
<td></td>
<td>(0.385)</td>
<td>(0.424)</td>
<td>(0.249)</td>
<td>(1.61 )</td>
<td>(1.97)</td>
<td>(0.771)</td>
</tr>
<tr>
<td>Fin. Dev*K_int</td>
<td>1.646</td>
<td>2.118</td>
<td>0.644</td>
<td>15.74</td>
<td>22.94</td>
<td>4.95</td>
</tr>
<tr>
<td></td>
<td>(1.805)</td>
<td>(1.996)</td>
<td>(0.912)</td>
<td>(8.43 )</td>
<td>(10.82)</td>
<td>(6.37)</td>
</tr>
<tr>
<td>No. Observations</td>
<td>1690</td>
<td>1580</td>
<td>1275</td>
<td>656</td>
<td>656</td>
<td>551</td>
</tr>
<tr>
<td>R²</td>
<td>0.42</td>
<td>0.43</td>
<td>0.46</td>
<td>0.77</td>
<td>0.78</td>
<td>0.77</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is the average number of goods exported to the US for country and industry (1999-2001). Ext. fin. is dependence on external finance, Tang is asset tangibility both from Braun (2003) and K_int is capital intensity from Manova (2007). 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 (1999-2001)

<table>
<thead>
<tr>
<th></th>
<th>D Credit</th>
<th>D Credit(2)</th>
<th>Stock Mkt</th>
<th>Repud</th>
<th>Exprop</th>
<th>Account</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fin.Dev*R&amp;D</td>
<td>0.098</td>
<td>0.104</td>
<td>0.063</td>
<td>0.490</td>
<td>0.633</td>
<td>0.342</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.009)</td>
<td>(0.007)</td>
<td>(0.051)</td>
<td>(0.063)</td>
<td>(0.043)</td>
</tr>
<tr>
<td>No. Observations</td>
<td>1690</td>
<td>1580</td>
<td>1275</td>
<td>656</td>
<td>656</td>
<td>551</td>
</tr>
<tr>
<td>R²</td>
<td>0.47</td>
<td>0.48</td>
<td>0.47</td>
<td>0.77</td>
<td>0.78</td>
<td>0.77</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Fin.Dev*R&amp;D</th>
<th>Industry share</th>
<th>Stock Mkt</th>
<th>Repud</th>
<th>Exprop</th>
<th>Account</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.092</td>
<td>0.177</td>
<td>0.069</td>
<td>0.256</td>
<td>0.352</td>
<td>0.161</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
<td>(0.026)</td>
<td>(0.013)</td>
<td>(0.067)</td>
<td>(0.088)</td>
<td>(0.080)</td>
</tr>
<tr>
<td>R²</td>
<td>0.53</td>
<td>0.52</td>
<td>0.55</td>
<td>0.80</td>
<td>0.81</td>
<td>0.87</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is the average number of goods exported to the US for country and industry (1999-2001). Industry share (Value added in industry i 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

<table>
<thead>
<tr>
<th></th>
<th>Without zeros</th>
<th>With zeros</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fin.Dev*R&amp;D</td>
<td>0.117</td>
<td>0.115</td>
</tr>
<tr>
<td></td>
<td>(0.028)</td>
<td>(0.023)</td>
</tr>
<tr>
<td>Fin.Dev*Ext. fin.</td>
<td>-0.004</td>
<td>-0.001</td>
</tr>
<tr>
<td></td>
<td>(0.129)</td>
<td>(0.112)</td>
</tr>
<tr>
<td>Fin. Dev*Tang</td>
<td>0.506</td>
<td>0.554</td>
</tr>
<tr>
<td></td>
<td>(0.310)</td>
<td>(0.283)</td>
</tr>
<tr>
<td>No. Observations</td>
<td>1690</td>
<td>2175</td>
</tr>
<tr>
<td>Fin. Dev*R&amp;D</td>
<td>0.032</td>
<td>0.032</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>Industry share</td>
<td>0.262</td>
<td>0.261</td>
</tr>
<tr>
<td></td>
<td>(0.033)</td>
<td>(0.028)</td>
</tr>
<tr>
<td>No. Observations</td>
<td>655</td>
<td>761</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is the average number of goods exported to the US for country and industry (1999-2001). 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 (50 replications) standard errors appear in parenthesis.
Table 6: Robustness check: The Intensive Margin


<table>
<thead>
<tr>
<th></th>
<th>D Credit</th>
<th>D Credit(2)</th>
<th>Stock Mkt</th>
<th>Repud</th>
<th>Exprop</th>
<th>Account</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fin.Dev*R&amp;D</td>
<td>0.203</td>
<td>0.227</td>
<td>0.138</td>
<td>1.20</td>
<td>1.55</td>
<td>0.945</td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td>(0.025)</td>
<td>(0.020)</td>
<td>(0.139)</td>
<td>(0.178)</td>
<td>(0.151)</td>
</tr>
<tr>
<td>No. Observations</td>
<td>1690</td>
<td>1580</td>
<td>1275</td>
<td>656</td>
<td>656</td>
<td>551</td>
</tr>
<tr>
<td>R²</td>
<td>0.36</td>
<td>0.36</td>
<td>.032</td>
<td>0.54</td>
<td>0.55</td>
<td>0.48</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fin.Dev*R&amp;D</td>
<td>0.187</td>
<td>0.217</td>
<td>0.122</td>
<td>1.16</td>
<td>1.52</td>
<td>0.532</td>
</tr>
<tr>
<td></td>
<td>(0.029)</td>
<td>(0.032)</td>
<td>(0.025)</td>
<td>(0.155)</td>
<td>(0.186)</td>
<td>(0.159)</td>
</tr>
<tr>
<td>Fin. Dev*Ext. fin.</td>
<td>0.128</td>
<td>0.044</td>
<td>0.278</td>
<td>3.13</td>
<td>4.14</td>
<td>4.65</td>
</tr>
<tr>
<td></td>
<td>(0.234)</td>
<td>(0.255)</td>
<td>(0.205)</td>
<td>(1.36)</td>
<td>(1.79)</td>
<td>(1.33)</td>
</tr>
<tr>
<td>Fin. Dev*Tang.</td>
<td>-0.183</td>
<td>-0.215</td>
<td>0.326</td>
<td>8.08</td>
<td>12.08</td>
<td>-0.628</td>
</tr>
<tr>
<td></td>
<td>(0.757)</td>
<td>(0.816)</td>
<td>(0.589)</td>
<td>(4.28)</td>
<td>(5.20)</td>
<td>(4.25)</td>
</tr>
<tr>
<td>No. Observations</td>
<td>1690</td>
<td>1580</td>
<td>1275</td>
<td>656</td>
<td>656</td>
<td>551</td>
</tr>
<tr>
<td>R²</td>
<td>0.35</td>
<td>0.36</td>
<td>0.32</td>
<td>0.50</td>
<td>0.51</td>
<td>0.52</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fin.Dev*R&amp;D</td>
<td>0.248</td>
<td>0.277</td>
<td>0.185</td>
<td>0.665</td>
<td>0.887</td>
<td>0.507</td>
</tr>
<tr>
<td></td>
<td>(0.041)</td>
<td>(0.042)</td>
<td>(0.034)</td>
<td>(0.177)</td>
<td>(0.232)</td>
<td>(0.223)</td>
</tr>
<tr>
<td>Industry share</td>
<td>0.449</td>
<td>0.488</td>
<td>0.485</td>
<td>0.718</td>
<td>0.721</td>
<td>0.828</td>
</tr>
<tr>
<td></td>
<td>(0.078)</td>
<td>(0.082)</td>
<td>(0.088)</td>
<td>(0.100)</td>
<td>(0.099)</td>
<td>(0.102)</td>
</tr>
<tr>
<td>No. Observations</td>
<td>656</td>
<td>633</td>
<td>606</td>
<td>382</td>
<td>382</td>
<td>308</td>
</tr>
<tr>
<td>R²</td>
<td>0.39</td>
<td>0.37</td>
<td>0.39</td>
<td>0.60</td>
<td>0.62</td>
<td>0.61</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is Value of Exports (1999-2001) for industry and country. Each specification is country-fixed effect regression with sector fixed effects. Heteroskedasticity consistent standard errors appear in parenthesis.
Table 7: Robustness check: US Direct Investment Abroad

Dependent variable: Capital Outflows (2001)

<table>
<thead>
<tr>
<th></th>
<th>D Credit</th>
<th>D Credit(2)</th>
<th>Stock Mkt</th>
<th>Repud</th>
<th>Exprop</th>
<th>Account</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fin.Dev*R&amp;D</td>
<td>43.22</td>
<td>45.08</td>
<td>33.11</td>
<td>147.45</td>
<td>199.06</td>
<td>150.16</td>
</tr>
<tr>
<td></td>
<td>(21.78)</td>
<td>(22.20)</td>
<td>(16.57)</td>
<td>(71.49)</td>
<td>(92.81)</td>
<td>(74.37)</td>
</tr>
<tr>
<td>No. Observations</td>
<td>283</td>
<td>276</td>
<td>280</td>
<td>234</td>
<td>234</td>
<td>219</td>
</tr>
<tr>
<td>R²</td>
<td>0.04</td>
<td>0.04</td>
<td>0.03</td>
<td>0.05</td>
<td>0.05</td>
<td>0.03</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Fin.Dev*R&amp;D</th>
<th>Stock Mkt</th>
<th>Repud</th>
<th>Exprop</th>
<th>Account</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>86.58</td>
<td>56.59</td>
<td>345.81</td>
<td>472.31</td>
<td>198.26</td>
</tr>
<tr>
<td></td>
<td>(34.96)</td>
<td>(19.74)</td>
<td>(142.33)</td>
<td>(179.93)</td>
<td>(82.30)</td>
</tr>
<tr>
<td>Fin. Dev*Ext. fin.</td>
<td>-10.59</td>
<td>-12.28</td>
<td>-24.15</td>
<td>17.65</td>
<td>4.16</td>
</tr>
<tr>
<td></td>
<td>(91.82)</td>
<td>(62.98)</td>
<td>(142.33)</td>
<td>(179.93)</td>
<td>(341.01)</td>
</tr>
<tr>
<td>Fin. Dev*Tang.</td>
<td>251.18</td>
<td>120.92</td>
<td>1072.60</td>
<td>1580.45</td>
<td>316.01</td>
</tr>
<tr>
<td></td>
<td>(209.02)</td>
<td>(150.15)</td>
<td>(783.02)</td>
<td>(967.43)</td>
<td>(769.64)</td>
</tr>
<tr>
<td>No. Observations</td>
<td>283</td>
<td>280</td>
<td>234</td>
<td>234</td>
<td>219</td>
</tr>
<tr>
<td>R²</td>
<td>0.05</td>
<td>0.03</td>
<td>0.05</td>
<td>0.06</td>
<td>0.03</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Fin.Dev*R&amp;D</th>
<th>Stock Mkt</th>
<th>Repud</th>
<th>Exprop</th>
<th>Account</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>28.51</td>
<td>17.60</td>
<td>78.92</td>
<td>132.85</td>
<td>209.85</td>
</tr>
<tr>
<td></td>
<td>(25.59)</td>
<td>(20.91)</td>
<td>(85.79)</td>
<td>(119.24)</td>
<td>(131.05)</td>
</tr>
<tr>
<td>Industry share</td>
<td>31.31</td>
<td>31.24</td>
<td>32.04</td>
<td>29.44</td>
<td>59.14</td>
</tr>
<tr>
<td></td>
<td>(32.39)</td>
<td>(31.54)</td>
<td>(39.21)</td>
<td>(37.85)</td>
<td>(55.19)</td>
</tr>
<tr>
<td>No. Observations</td>
<td>172</td>
<td>172</td>
<td>146</td>
<td>146</td>
<td>132</td>
</tr>
<tr>
<td>R²</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
<td>0.04</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is US Direct Investment Abroad (Capital Outflows) for industry and country. Each specification is country-fixed effect regression with sector fixed effects. Heteroskedasticity consistent standard errors appear in parenthesis.
Table 8: Robustness Check: Financial vs Other Institutions

Dependent variable: Number of goods exported to US by industry

<table>
<thead>
<tr>
<th></th>
<th>D Credit</th>
<th>D Credit(2)</th>
<th>Stock Mkt</th>
<th>Repud</th>
<th>Exprop</th>
<th>Account</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fin.Dev*R&amp;D</td>
<td>0.098</td>
<td>0.104</td>
<td>0.063</td>
<td>0.490</td>
<td>0.633</td>
<td>0.342</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.009)</td>
<td>(0.007)</td>
<td>(0.051)</td>
<td>(0.063)</td>
<td>(0.043)</td>
</tr>
<tr>
<td>No. Observations</td>
<td>1690</td>
<td>1580</td>
<td>1275</td>
<td>656</td>
<td>656</td>
<td>551</td>
</tr>
<tr>
<td>R²</td>
<td>0.47</td>
<td>0.48</td>
<td>0.47</td>
<td>0.77</td>
<td>0.78</td>
<td>0.77</td>
</tr>
</tbody>
</table>

|                        | 0.086    | 0.089       | 0.053     | 0.426 | 0.569  | 0.324   |
|                        | (0.010)  | (0.011)     | (0.008)   | (0.058)| (0.073)| (0.047) |
| XConst*R&D             | 0.025    | 0.032       | 0.026     | 0.019 | 0.015  | 0.016   |
|                        | (0.006)  | (0.006)     | (0.007)   | (0.011)| (0.011)| (0.013) |
| No. Observations       | 1517     | 1418        | 1188      | 643   | 643    | 538     |
| R²                     | 0.58     | 0.59        | 0.56      | 0.78  | 0.79   | 0.78    |

|                        | 0.029    | 0.032       | 0.020     | 0.237 | 0.441  | 0.238   |
|                        | (0.013)  | (0.014)     | (0.009)   | (0.098)| (0.133)| (0.052) |
| RoL*R&D                | 0.098    | 0.104       | 0.100     | 0.068 | 0.040  | 0.060   |
|                        | (0.013)  | (0.014)     | (0.014)   | (0.024)| (0.026)| (0.017) |
| No. Observations       | 1665     | 1542        | 1237      | 643   | 643    | 551     |
| R²                     | 0.46     | 0.47        | 0.47      | 0.75  | 0.77   | 0.79    |

Notes: The dependent variable is the number of goods exported to the US for country and industry. XConst is Constraint on the Executive from Polity IV Project (2006). RoL is rule of law from Kaufmann et al. (2008). Each specification is a country-fixed effect regression with industry fixed effects. Heteroskedasticity consistent standard errors appear in parenthesis.
### Table 9: Robustness Check: Weighting the number of goods

**Dependent variable: Number of goods exported to US by industry**

<table>
<thead>
<tr>
<th></th>
<th>D Credit</th>
<th>D Credit(2)</th>
<th>Stock Mkt</th>
<th>Repud</th>
<th>Exprop</th>
<th>Account</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unweighted</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fin.Dev* R&amp;D</td>
<td>0.098</td>
<td>0.104</td>
<td>0.063</td>
<td>0.490</td>
<td>0.633</td>
<td>0.342</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.009)</td>
<td>(0.007)</td>
<td>(0.051)</td>
<td>(0.063)</td>
<td>(0.043)</td>
</tr>
<tr>
<td>No. Observations</td>
<td>1690</td>
<td>1580</td>
<td>1275</td>
<td>656</td>
<td>656</td>
<td>551</td>
</tr>
<tr>
<td>R²</td>
<td>0.47</td>
<td>0.48</td>
<td>0.47</td>
<td>0.77</td>
<td>0.78</td>
<td>0.77</td>
</tr>
<tr>
<td><strong>Weighted</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fin.Dev* R&amp;D</td>
<td>0.199</td>
<td>0.200</td>
<td>0.199</td>
<td>0.964</td>
<td>1.23</td>
<td>0.764</td>
</tr>
<tr>
<td></td>
<td>(0.037)</td>
<td>(0.038)</td>
<td>(0.029)</td>
<td>(0.165)</td>
<td>(0.200)</td>
<td>(0.174)</td>
</tr>
<tr>
<td>No. Observations</td>
<td>656</td>
<td>633</td>
<td>606</td>
<td>382</td>
<td>382</td>
<td>308</td>
</tr>
<tr>
<td>R²</td>
<td>0.35</td>
<td>0.33</td>
<td>0.35</td>
<td>0.60</td>
<td>0.61</td>
<td>0.60</td>
</tr>
</tbody>
</table>

Notes: The dependent variable in the top panel is the average number of goods exported to the US for country and industry between 1999-2001 and in the bottom panel this average number of goods is weighted by the share of the industry in that country \( i.e. \ G_i \frac{V_{Ai}}{VA} \). 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.
7 References


8 Appendix

Appendix A: Data

List of Industries

<table>
<thead>
<tr>
<th>NAICS</th>
<th>Name</th>
<th>R&amp;D</th>
<th>Ext. fin.</th>
<th>Tang.</th>
<th>K_int</th>
</tr>
</thead>
<tbody>
<tr>
<td>311</td>
<td>Food</td>
<td>1475</td>
<td>0.136</td>
<td>0.377</td>
<td>0.062</td>
</tr>
<tr>
<td>312</td>
<td>Beverage and tobacco products</td>
<td>284</td>
<td>-0.187</td>
<td>0.250</td>
<td>0.040</td>
</tr>
<tr>
<td>313-316</td>
<td>Textile, apparel and leather</td>
<td>295</td>
<td>0.096</td>
<td>0.196</td>
<td>0.041</td>
</tr>
<tr>
<td>321</td>
<td>Wood products</td>
<td>119</td>
<td>0.284</td>
<td>0.379</td>
<td>0.065</td>
</tr>
<tr>
<td>324</td>
<td>Petroleum</td>
<td>837</td>
<td>0.188</td>
<td>0.487</td>
<td>0.135</td>
</tr>
<tr>
<td>325</td>
<td>Chemicals</td>
<td>9685</td>
<td>0.211</td>
<td>0.304</td>
<td>0.092</td>
</tr>
<tr>
<td>327</td>
<td>Nonmetallic mineral products</td>
<td>919</td>
<td>0.062</td>
<td>0.420</td>
<td>0.068</td>
</tr>
<tr>
<td>331</td>
<td>Primary metals</td>
<td>526</td>
<td>0.087</td>
<td>0.458</td>
<td>0.102</td>
</tr>
<tr>
<td>332</td>
<td>Fabricated metal products</td>
<td>1642</td>
<td>0.237</td>
<td>0.281</td>
<td>0.053</td>
</tr>
<tr>
<td>333</td>
<td>Machinery</td>
<td>6346</td>
<td>0.445</td>
<td>0.182</td>
<td>0.058</td>
</tr>
<tr>
<td>334</td>
<td>Computer and electronic products</td>
<td>42703</td>
<td>0.961</td>
<td>0.151</td>
<td>0.052</td>
</tr>
<tr>
<td>335</td>
<td>Electrical equipment, Appliances</td>
<td>4980</td>
<td>0.767</td>
<td>0.213</td>
<td>0.076</td>
</tr>
<tr>
<td>336</td>
<td>Transportation equipment</td>
<td>30005</td>
<td>0.306</td>
<td>0.254</td>
<td>0.071</td>
</tr>
<tr>
<td>337</td>
<td>Furniture and related products</td>
<td>278</td>
<td>0.235</td>
<td>0.263</td>
<td>0.039</td>
</tr>
<tr>
<td>339</td>
<td>Miscellaneous manufacturing</td>
<td>4887</td>
<td>0.470</td>
<td>0.188</td>
<td>0.039</td>
</tr>
</tbody>
</table>

Source: R&D data come 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) and K_int is capital intensity from Manova (2007).

List of Countries

The baseline specification consists of 145 countries. Albania, Algeria, Angola, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahamas, Bangladesh, Barbados, Belarus, Belize, Belgium, Benin, Bolivia, Bosnia, Brazil, Bulgaria, Burkina-Faso, Burundi, Cambodia, Cameroon, Canada, Chad, Chile, China, Colombia, Congo, Costa Rica, Croatia, Cyprus, Czech Republic, Djibouti, Dominican Republic, Ecuador, Egypt, Estonia, Ethiopia, Fiji, Finland, France, Gabon, Gambia, Georgia, Germany, Ghana, Greece, Guatemala, Guinea, Guyana, Guinea-Bissau, Haiti, Honduras, Hong Kong, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Ivory Coast, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Korea, Kuwait, Kyrgyzstan, Lao, Latvia, Lebanon, Liberia, Lithuania, Macao, Macedonia, Madagascar, Malawi, Malaysia, Mali, Malta, Mauritania, Mexico, Moldova, Morocco, Mozambique, Mauritius, Nepal, Netherlands, New Zealand, Nicaragua, Niger, Nigeria, Norway, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Qatar, Romania, Russia, Rwanda, Samoa, Saudi Arabia, Senegal, Seychelles, Sierra Leone, Singapore, Slovakia, Slovenia, South Africa, Spain, Sri Lanka, Saint Kits and Nevis, Sudan, Surinam, Sweden, Switzerland, Syria, Tajikistan, Thailand, Togo, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Uganda, United Kingdom, Ukraine, Uruguay, Venezuela, Vietnam, Yemen, Zambia and Zimbabwe.
Appendix B: Derivation of \( \hat{\xi} \) and proof of Proposition 1

In this appendix, I derive \( \hat{\xi} \) and show why assumption A1 is a sufficient condition to have uniqueness and \( z^* \) decreasing in \( \theta \).

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

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

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

Remember that \( \beta^N \) 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 \( \hat{\xi} \in (0,1) \) such that \( r(\hat{\xi},\theta,\alpha) = 0 \) and \( r(\hat{\xi},\theta,\alpha) > 0 \) if \( z < \hat{\xi} \) and \( r(\hat{\xi},\theta,\alpha) < 0 \) if \( z > \hat{\xi} \). Thus, \( \frac{\partial A(z,\theta)}{\partial z} < 0 \) if \( z < \hat{\xi} \). It can also be derived that \( \frac{\partial A(z,\theta)}{\partial \theta} < 0 \) and \( \frac{\partial A(z,\theta)}{\partial \alpha} > 0 \).

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

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

Appendix C: Proof of Proposition 2

It is proved by contradiction. Let us assume that S also produces the good when \( z = z_0 \in (z_N, z_{DC}) \). It follows that \( \pi^S(\theta^S, z_0) > \pi^{DC}(\theta^{DC}, z_0) \).

The above inequality implies that \( w_{\theta^{DC}}(\theta^S, z_0) > A(\theta^DC, \theta^S, z_0) \) where

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

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

For simplicity, I assume that \( \theta^{DC} \) and \( \theta^S \) are such that \( \tilde{r}(z,\theta^{DC}, \theta^S, \alpha) > 0 \) for all \( z \). Therefore, \( A(\theta^{DC}, \theta^S, z) \) is decreasing and 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 2.

Appendix D: Proof of Proposition 3

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 \( \frac{\partial F(\theta, z^*)}{\partial \theta} < 0 \) and \( \frac{\partial F(\theta, z^*)}{\partial z^*} < 0 \). Given that \( \frac{\partial A(\theta,z)}{\partial z^*} < 0 \) and \( \frac{\partial B(\theta,z)}{\partial z^*} > 0 \), \( \frac{\partial F(\theta, z^*)}{\partial \theta} < 0 \) and \( \frac{\partial F(\theta, z^*)}{\partial z^*} < 0 \) because \( \frac{\partial A(\theta,z)}{\partial \theta} > \frac{\partial B(\theta,z)}{\partial \theta} \).
Appendix E: A more general model

This appendix shows that the main results of the model go through in a more general environment. In particular, it shows that a modified version of Proposition 1 holds when a larger set of feasible contracts is allowed.

The first difference that I introduce is uncertainty after the investment choices are made. I assume that revenues are represented by the following equation where \( p \) is the (small) probability of a bad shock that drives revenues to zero.

\[
\begin{align*}
\tilde{R} = \begin{dcases}
R = \Delta^{1-\alpha} \left( \frac{h}{1-z} \right)^{\alpha(1-z)} \left( \frac{m}{z} \right)^{\alpha z} \text{ with prob. } 1-p \\
0 \quad \text{ with prob. } p
\end{dcases}
\end{align*}
\]

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

Finally, I also introduce limited liability and limited commitment.

The timeline of events is the same as described in the text. I next derive the optimal contract in this modified model. The problem of the Northern final-good producer when she chooses to locate production in country \( c \) can be represented as follows:

\[
\begin{align*}
\max_{\{h, m, G(\tilde{R}), T, D\}} \pi^c = E \left[ \tilde{R} - G(\tilde{R}) \right] - w^N h - T - f_F \\
st. T + D &\geq f_S \quad \text{(BC)} \\
D &\leq \theta^c \left[ E \left[ G(\tilde{R}) \right] - w^C m \right] \quad \text{(CC)} \\
PS &\equiv T + E \left[ G(\tilde{R}) \right] - w^C m - f_S \geq 0 \quad \text{(PC)} \\
PS &\geq V_{\text{default}} \quad \text{(LC)} \\
G(\tilde{R}) &\geq w^C m \forall \tilde{R} \quad \text{(LL)} \\
\hat{h} &\in \arg\max_h \left\{ E \left[ \tilde{R} - G(\tilde{R}) \right] - w^N \tilde{h} \right\} \quad \text{(ICC-F)} \\
\hat{m} &\in \arg\max_m \left\{ E \left[ G(\tilde{R}) \right] - w^C \tilde{m} \right\} \quad \text{(ICC-S)} \\
R &\quad \Delta^{1-\alpha} \left( \frac{h}{1-z} \right)^{\alpha(1-z)} \left( \frac{m}{z} \right)^{\alpha z}
\end{align*}
\]

The final-good producer chooses the terms of the contract, which are an ex-ante transfer \( (T) \) and an ex-post payment contingent on revenues \( G(\tilde{R}) \), and, indirectly, the loan \( (D) \) that supplier receives from the bank and the investment choices \( (h, m) \) in order to maximize her own (expected) profits. The profits of the final-good producer are given by total revenues minus what she gives to supplier ex-ante \( (T) \) and ex-post \( (G(\tilde{R})) \), the investment costs \( (w^N h) \) and the fixed cost \( (f_F) \).
The first constraint is the budget constraint which says that the supplier can enter into the relationship only if the funds she obtains, the ex-ante transfer \( T \) and the loan from the bank \( D \), are enough to cover the fixed cost \( f_S \).

The next two equations are the collateral constraint (CC) and the participation constraint (PC) that are the same as the ones derived in the main text with the only difference that revenues are now stochastic and both must hold in expectation.

Equation (LC) is the limited commitment constraint. It means that the supplier has now the option to default and not making any investment after receiving the ex-ante transfer. Note that she could do it because revenues are stochastic and when the final-good producer observes no revenues she cannot be certain whether it was a bad shock or the supplier did not make any investment. Therefore, the final-good producer must make sure that what the supplier obtains if she does the right investments \( PS \) is larger than what she obtains if she does not make them and keeps the ex-ante transfer (i.e., \( V_{\text{default}} = T + G(\bar{R} = 0) \)).

Equation (LL) is the limited liability constraint. It says that the supplier cannot have negative profits in any state of nature because if she were asked to make a payment that would drive her net income below zero she would refuse to do it. This constraint was not necessary in the main text because of the set of contracts that was considered. In this more general setup the final-good producer is constrained to give to the supplier enough revenues \( G(\bar{R}) \) to pay her investment costs \( wCm \). In other words, \( G(\bar{R}) < wCm \) cannot be an equilibrium for any given \( \bar{R} \) because the supplier would stop paying to the final-good producer when \( G(\bar{R}) = wCm \).

Equations (ICC-F) and (ICC-S) are the incentive compatibility constraints of the final-good producer and the supplier, respectively. They mean that the final-good producer is constrained to choose the investment choices that both parties make in the next period. The final-good producer knows that each party makes her investment choice in order to maximize its own profits.

Finally, the last equation is the revenues function that follows from the consumer demand and production function of the final-good.

To solve the model I assume that the contract that the final-good producer offers to the supplier to divide revenues ex-post is contingent on revenues and consists of a transfer and a share of revenues. To be more specific, it takes the following functional form

\[
G(\bar{R}) = \begin{cases} 
\mu_R + (1 - \beta)\bar{R} & \text{if } \bar{R} = \bar{R} \\
\mu_0 & \text{if } \bar{R} = 0
\end{cases}
\]

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

After noting that (ICC-F) and (ICC-S) reduce to \( wN h = \alpha(1 - z)(1 - p)\beta R \) and \( wCm = \alpha z(1 - \beta)(1 - p)R \), respectively, it is easy to see that the problem of the final-good producer becomes
\[
\max_{\{\mu_R, \mu_0, \beta, T\}} \bar{\pi} = (1 - p)(1 - \alpha(1 - z))\beta R - (1 - p)\mu_R - p\mu_0 - T - f_F
\]

\begin{align*}
st.0 & \leq T + \theta^c[(1 - p)\mu_R + p\mu_0 + (1 - \alpha z)(1 - \beta)R] - fs & (BC') \\
\mu_R & \geq -(1 - (1 - p)\alpha z)(1 - \beta)R & (LL-R) \\
\mu_0 & \geq \alpha z(1 - p)(1 - \beta)R & (LL-0) \\
\mu_R + (1 - \alpha z)(1 - \beta)R & \geq \mu_0 + \frac{fs}{1 - p} & (LC)
\end{align*}

The final-good producer chooses the ex-ante transfer \(T\), the ex-post transfer when revenues are \(R\) \((\mu_R)\), the ex-post transfer when revenues are zero \((\mu_0)\) and the ex-post sharing rule \((\beta)\) to maximize her own profits. In this equation the investment choices are already included and the probability of having a bad shock also taken into account.

\((BC')\) is the modified budget constraint when the investment choice of the supplier and the fact that the collar constraint binds in equilibrium are taken into account. Note that the participation constraint \((PC)\) is irrelevant because if \((BC')\) holds, \((PC)\) also holds given \(\theta^c \leq 1\).

\((LL-R)\) and \((LL-0)\) are the limited liability constraints when revenues are \(R\) and zero, respectively, when the equilibrium investment choice of the supplier is included.

Finally, \((LC)\) is the limited commitment constraint given the contract and investment choices.

It is straightforward to check that in equilibrium \((LL-0), (LC)\) and \((BC')\) bind and \((LL-R)\) holds with inequality.\(^{21}\) The intuition is that the final-good producer wants to offer an, as low as possible, ex-post transfer to the supplier and it translates into an ex-post transfer when revenues are zero \((\mu_0)\) determined by the limited liability constraint \((LL-0)\) and an ex-post transfer when revenues are \(R\) \((\mu_R)\) determined by the limited commitment constraint \((LC)\). In other words, the final-good producer must leave rents to the supplier when revenues are obtained to avoid default (i.e. \((LL-R)\) holds with inequality in equilibrium). \((BC')\) binds in equilibrium because the final-good supplier offers an ex-ante transfer \((T)\) as low as possible. Therefore, it follows that the ex-post fixed payments are

\[
\begin{align*}
\mu_0 &= \alpha z(1 - p)(1 - \beta)R \\
\mu_R &= \frac{fs}{1 - p} - (1 - (2 - p)\alpha z)(1 - \beta)R
\end{align*}
\]

and noting that \(R = \Delta(1 - p)^{1 - \alpha} \left[ \alpha \left( \frac{\beta}{w^c} \right)^{1 - z} \left( \frac{1 - \beta}{w^c} \right)^z \right]^{\frac{\alpha}{1 - \alpha}}\), the problem of the final-good producer reduces to

\(^{21}\) One could easily setup the Lagrangean of this program and verify that it is indeed the case.
\[
\max_{\beta} \pi^c(\theta^c) = \Delta(1-p)^{\frac{1}{1-\alpha}} \left[ (1-\alpha(1-z)) \beta + (1-(2-\theta^c)\alpha z) (1-\beta) \right]^{-\frac{1-\alpha}{1-\alpha}} - (2-\theta^c)f_s - f_F
\]

It can be shown that \(\beta^c(\theta^c, z)\) is the unique solution to this maximization problem and it is decreasing in \(\theta^c\) for all \(z\) and it is decreasing in \(z\) if \(z < \bar{z}(\theta^c, \alpha)\).

I set, as in the text, \(\pi^S(\theta)\) and \(\pi^N(\theta = 1)\) and chooses to locate production in the South if and only if \(\omega \geq \bar{A}(., z, \theta)\), where

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

where \(\kappa \equiv \frac{[1-\alpha(1-z)]\beta^N + [1-\alpha z](1-\beta^N) + (1-\theta)f_s \varphi \beta^N(1-z)(1-\beta^N)}{[1-\alpha(1-z)]\beta^S + (1-2\theta)\alpha z(1-\beta^S)}\) \(\frac{1}{\kappa^{\frac{1-\alpha}{1-\alpha}}}\) and \(\varphi \equiv \frac{w^N}{\alpha} \frac{1}{\Delta(1-p)^{\frac{1}{1-\alpha}}}\).

If \(f_s > 0\), \(\lim_{z \to 0} \bar{A}(., z, \theta) = +\infty\), \(\lim_{z \to 1} \bar{A}(., z, \theta) = (2-\theta) \left[ 1 + \frac{(1-\theta)f_s \varphi}{(1-\alpha)} \right]^{\frac{1-\alpha}{1-\alpha}} > 1\), \(\bar{A}(., z, \theta)\) is strictly decreasing in \(\theta\) for all \(z\) and it is strictly decreasing in \(z\) if \(z < \bar{z}\).\(^{22}\)

**Assumption A1’**

\[\omega > (2-\theta) \left[ 1 + \frac{(1-\theta)f_s \varphi}{(1-\alpha)} \right]^{\frac{1-\alpha}{1-\alpha}}\]

This assumption is the counterpart of assumption A1 in the text. Similarly, the required relative wage decreases with the development of Southern financial institutions (i.e., the right-hand side is decreasing in \(\theta\)) and A1’ approaches to the standard assumption \(\omega > 1\) when Southern financial institutions converge to Northern ones (i.e., \(\theta \to 1\)).

**Proposition 1’**

i) Existence of product cycle: If \(f_s > 0\) and A1’ holds, there exists a unique \(z^{**} \equiv \bar{A}^{-1}(\omega)\) such that \(\omega < \bar{A}(., \theta, z)\) when \(z < z^{**}\) and \(\omega > \bar{A}(., \theta, z)\) when \(z > z^{**}\).

ii) Effect of financial development: If \(f_s > 0\) and A1’ holds, \(z^{**}\) is decreasing in \(\theta\).

The proof of this proposition is analogous to the proof of Proposition 1.

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

\(^{22}\)The derivation of \(\bar{z}\) is similar to the derivation of \(\bar{z}\).
Figure 1: Timing of actions
Figure 2: Optimal sharing rules ($\beta$) for the North and different financial development in the South ($\theta = 0.3$ and $\theta = 0.6$).

Figure 3: Optimal location of production for different Southern financial institutions ($\theta = 0.3$ and $\theta = 0.6$). Partial equilibrium.
Figure 4: Optimal location of production for different Southern financial institutions ($\theta = 0.3$ and $\theta = 0.6$). General equilibrium.

Figure 5: Prediction of the model. The shaded region represents the increase in offshoring in Industry B (more R&D-intensive) respect to Industry A when Southern financial institutions improve.
Figure 6: Effect of financial development on offshoring in the "computer and electronic components" industry. Logpc is (log) number of goods each country exports to US. Logdc is (log) domestic credit to private sector over GDP.

Figure 7: Effect of financial development on offshoring in the "textile, apparel and leather" industry. Logpc is (log) number of goods each country exports to US. Logdc is (log) domestic credit to private sector over GDP.