Global Sourcing and Credit Constraints

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Abstract

This paper incorporates credit constraints into amodel of global sourcing and heterogeneous firms. Following Antras and Helpman(2004), heterogeneous firms decide whether to source inputs at arms length or within the boundary of the firm. Financing of fixed organizational costs requires borrowing with credit constraints and collateral based on tangible assets. The party that controls intermediate inputs is responsible for these financing costs. Sectors differ in their reliance on external finance and countries vary in their financial development. The model predicts that increased financial development increases the share of arms length transactions relative to integration in a country. The effect is most pronounced in sectors with a high reliance on external finance. Empirical examination of country-industry interaction effects confirms the predictions of the model.

Keywords: heterogeneous firms, financial development, heterogeneous firms, insourcing, outsourcing, vertical integration, related-party trade

JEL Classifications: F12, F13, F14, F36, G20, G28, G32.

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1. Introduction

A growing literature in international economics has emphasized the importance of financial development in facilitating trade. This literature has addressed questions including but not limited to how financial development promotes increased exports of finance intensive industries (e.g. Manova (2008) and Manova and Chor (2012)) and the importance of financial development in providing trade financing (e.g. Amiti and Weinstein (2009)). Within global supply chains, one of the implications of this literature is that international supply chain operations necessitate confidence in global suppliers to deliver their share of valued-added and to have the necessary financial means to produce and export it in a timely manner.[1] This paper examines in detail how differences in financial depth across countries and credit constraints across industries affect the organization of global supply chains.

To do so, this paper extends the work of Antras and Helpman (2004) to explain how the disruption in the ability of the financial sector to provide working capital leads to a shift in the global supply chain from arm's length transactions to vertical integration and contraction in trade. It also shows how the magnitude of this relationship depends crucially on credit constraints in an industry due to how well industry assets can serve as collateral. In addition, firms of varying productivity levels within an industry chose different organizational structures. Finally, the model generates predictions that can be easily verified in the data. First, it generates classic comparative advantage predictions regarding country-industry level patterns of specialization depending on country-level financial depth and industry-level credit constraints. Second, it incorporates firm heterogeneity and can therefore analyze how firms of varying productivity levels in an industry choose different organizational structures and how this sorting depends on financial depth and credit constraints. Third, it takes patterns of industrial specialization and can analyze what proportion of trade occurs within the boundary of the firm. While most prior studies focus on export volumes, I explore the patterns of multinational firm activity. This allows me to study how credit constraints explain not only export volumes but also how firms choose to produce intermediate inputs.

[1] To meet liquidity needs, firms often obtain trade finance from banks and other financial institutions. These financial arrangements are backed by collateral in the form of tangible assets. Therefore, there is a very active market that operates for the financing and insurance of international transactions, reportedly worth $10-12$ trillion – that is roughly 80% of 2008 trade flows valued at $15 trillion. Up to 90% of world trade has been estimated to rely on some form of finance (Auboin (2009)).

More precisely, I develop a multi-sector model of credit-constrained heterogeneous firms financing their fixed organizational costs, countries at different levels of financial development, and sectors of varying financial dependence. Production of a final good requires two inputs, headquarter services, and intermediate inputs. Headquarter services are only provided in the North. As in AH, a fixed organizational cost depends on whether the supplier of intermediate inputs resides in the North or the South and whether exchange occurs at arm's length or within the boundary of the firm. I assume that under vertical integration, the final good producer provides financing for these fixed costs. While under outsourcing, the intermediate supplier is responsible. Intuitively, in the case of establishing subsidiaries, parent firms often must incur the upfront fixed costs that cannot be financed out of retained earnings or internal cash flows from operations. With independent intermediate input suppliers, the burden lies on the independent intermediate input suppliers to finance such costs. Finally, the firm that is responsible for financing the costs faces the credit constraint of the country in which it is located and parties choose the organizational structure that maximizes ex-post surplus.

As shown in Rajan and Zingales (1998), financial dependence and credit constraints vary dramaticaly across both countries and industries. For example, sectors differ in their endowment of tangible assets that can serve as collateral (Braun (2003)). Final-good producers in some sectors find it easier to operate because they can more easily raise outside finance because they possess more tangible assets that can serve as collateral. Credit constraints vary across countries because financial contracts between firms and investors are more likely to be enforced at higher levels of financial development. If the financial contract is enforced, the financing firm makes a payment to the investor; otherwise the financing firm defaults and the investor claims the collateral. Financing firms then find it easier to raise external finance in countries with high levels of financial contractibility. The need to rely on external finance is common across firms. Firms often rely on external capital to finance upfront fixed costs, such as investment in fixed capital equipment, expenditures on R&D and product development, marketing research and advertising. When production requires the use of intermediate inputs, the final good producers can choose to open their own subsidiaries or find independent suppliers to produce them.

In the absence of credit constraints, all final-good producers above a certain cut-off level operate and sort to different type and location of organizational forms according to their productivity level.

With credit constraints in the South, more Northern firms choose to integrate with Southern firms relative to arm's length transactions. This is because the Northern firms can cover the fixed costs of production using the well developed Northern financial system more easily than if fixed costs were covered using the Southern financial system. For similar reasons, integration with other Northern input suppliers (using the Northern financial system) becomes more attractive relative to arm's length transactions with Southern input suppliers.

The empirical section of the paper examines two of the core predictions of the theoretical model. First, improvements in financial contractibility in the South increases the proportion of arm's length trade between the North and the South. Second, this effect is most pronounced in the sectors that depend more on external finance and have less tangible assets. I find strong support for the model's predictions in a sample of intra-firm U.S. imports from 90 exporting countries and 429 4-digit SIC manufacturing sectors in 1996-2005. I show how the interaction of country level financial development and industry level external dependence on finance and asset tangibility predict the choice of organizational forms. I use credit extended to the private sector as a share of GDP as my measure of financial development, and show consistent results with indices of accounting standards, risk appropriation, contract repudiation, and stock capitalization. I measure sector-level financial dependence in two ways. First, a sector relies more on external finance if it possesses a high share of investment not financed from internal cash flows. Second, asset tangibility for collateral purposes is constructed as the share of structures and equipment in total assets.

The rest of the paper is organized as follows. Section 2 describes the relation to the literature. Section 3 provides an overview of trade patterns in the data. Section 4 develops the model. Section 5 shows how firms with different productivity sort into different organizational forms and the role credit constraint plays on the firms' sourcing decisions. Section 6 provides the empirical specification to test. Section 7 discusses the data. Section 8 provides the regression results. Section 9 concludes.

2. Relation to the literature

Prior theoretical and empirical work has focused on the effect of financial development on industry-level outcomes and on factors that determine the boundary of the firm, but rarely the two together. A number of studies have proposed that financial development becomes a source of compara-

tive advantage and affects aggregate growth and volatility (Rajan and Zingales (1998), Braun (2003),Aghion et al. (2010)). There has been robust empirical evidence that financially developed countries export relatively more in financially dependent sectors.[2] In addition, there has also been evidence that host country financial development has implications for patterns of multinational firm activity and foreign direct investment flows (Antras, Desai, and Foley (2009)). Using Chinese transaction-level data, Manova, Wei, and Zhang (2011) show that foreign-owned affiliates and joint ventures have better export performance than private domestic firms, and that this advantage is systematically greater in sectors that require more external finance. Manova (2008) show that financial liberalizations increase exports disproportionately more in financially dependent sectors that require more outside finance or employ fewer assets that can be collateralized.

More generally, this paper contributes to a line of research that examines institutional frictions as a source of comparative advantage in international trade. For example, Nunn (2007) develops an incomplete-contracts model of relationship specific investments and finds that countries with better contract enforcement have a comparative advantage in industries intensive in such investments. Claessens and Laeven (2003) and Levchenko (2007) also show that property rights protection and the rule of law affect international trade. Antras and Foley (2011) show that transactions are more likely to occur on cash in advance or letter of credit terms when the importer is located in a country with weak contractual enforcement and in a country that is further from the exporter. Whereas these prior studies on institutions and trade focus on export volume, I explore the impact of financial institutions on the patterns of multinational firm activity.

3. First glance at the data

This section presents basic summary statistics and highlights simple correlations in the data that motivate the theoretical model and empirical analysis. The data set is assembled by the U.S. Census Bureau captures all U.S. international trade between 1996-2005. This dataset records the product classification, the value and quantity, the destination (or source) country, the transport mode, and whether the transaction takes place at arms length or between related parties. Related-party, or intra-firm, trade are shipments between U.S. companies and their foreign subsidiaries as well as

[2]Beck (2002), Beck (2003), Becker and Greenberg (2005), Hur, Raj, and Riyanto (2006), Svaleryd and Vlachos (2005), Manova (2006), Manova (2008), Chaney (2005).

trade between U.S. subsidiaries of foreign companies and their affiliates abroad.[3] Following Antras (2003), I take the share of intra-firm U.S. imports to be an indicator for prevalence of vertical integration.

Table 1 demonstrates substantial variation in the organizational behavior of 90 exporting countries in 429 4-digit SIC manufacturing sectors. In panel A, the average share of related-party trade across countries and sectors is 22% with standard deviation of .31%, and conditional on positive party-related trade, the mean rises to 36% and standard deviation is .32%. Across all industries, the U.S. imports from an average of 60 countries with a standard deviation of 30. With party-related trade, this number drops to 35 countries with a standard deviation of 19. The large number of countries the U.S. firms are trading with allows us to explore the cross country variation in their financial development on the organizational structures of multinational firms. Panel B shows the difference in capital-labor ratio and trade volumes for industries that have zero related-party trade and positive related-party trade. In Antras (2003) and Antras and Helpman (2004), those sectors with zero related-party trade are componenent intensive and those with positive related-party trade are headquarter intensive. Conditional on positive trade volume, 37% of the exporter-sector cells show no intra-firm trade.[4] The average and trade weighted capital-labor ratios for exporter-sector cells show no significant difference between industries with zero and strictly positive intra-firm trade. From panel C, the average trade volume is higher conditional on strictly positive intra-firm trade. This is consistent with Antras and Helpman (2004)'s model in which the firms with positive related-party trade tend to have higher revenues.

The first measure of financial development I use is the ratio of credit from banks and other financial intermediaries to the private sector as a share of GDP.[5] In the panel of 90 countries, private credit over GDP ratio varies significantly across countries and over time.Table 2 summarizes the cross sectional variation for private credit over GDP ratio. The countries listed are listed in descending order of the average private credit over GDP ratio over the years. Excluding the U.S., Switzerland, Hong Kong, and Great Britain are the top three countries that extend most private credit as a share of GDP. Vietnam and Denmark experienced greatest change in this measure of

[3]For imports, firms are related if they either own, control or hold voting power equivalent to 6 percent of the outstanding voting stock or shares of the other organization (see Section 402(e) of the Tariff Act of 1930).

[4]The capital-labor ratio for each sector is defined as log of the U.S. capital stock in over the number of production workers in 1994.

[5]I obtain this measure from Beck et al. (2000).

financial development over the years.

Sector-level measures of external dependence on finance and asset tangibility are constructed based on data for all publicly traded U.S. based companies from Compustat. A firm's external dependence on finance is defined as capital expenditures minus cash flow from operations divided by capital expenditures. A sector's level's measure of external dependence on finance is the median firm's external dependance on finance in a sector, as proposed by Rajan and Zingales (1998). Asset tangibility is similarly defined as the share of net property, plant and equipment in total book-value assets for the median firm in a given sector. Both measures are constructed as averages for the 1996-2005 period. For comparison reasons, after aggregating these measures to 3-digit SIC industry classification, they appear very similar to those constructed by Braun (2003). In Table 3 panel B, the mean and standard deviation of external dependence on finance across all sectors are -1.25 and 2.04, respectively. The mean and standard deviation of asset tangibility are .74 and .73.[6] [7]

In addition, sectors in greatest need for outside capital tend to have more affiliated trade with the U.S; and the opposite is true for sectors with greatest assets. Figure 1 shows shares of related-party (intra-firm) trade is computed by aggregating the data to 3-digit SIC classification. It is clear that industries that are more dependent on external finance are associated with a greater share of U.S. intra-firm trade. Figure 2 illustrates the opposite relationship for asset tangibility and share of U.S. intra-firm trade. This relationship persists for all years.

The Asian financial crisis of 1997-1999 provides additional motivation. During an episode of diminished financial depth, I expect an increase in the share of intra-firm trade and that this effect is more pronounced in sectors with the most binding credit constraints. Financial frictions rose during this period as international investors were reluctant to lend to developing countries. In Figure 3, for each country c and year t, I calculate the average external finance dependence and asset tangibility for the share of intra-firm trade as $\sum_i (FinDep_i * R_{ict}/T_{ict})$ and $\sum_i (Tang_i * R_{ict}/T_{ict})$

[6] The sectors in greatest need for outside capital tend to be intensive in up-front investments, such as professional and scientific equipment and electrical machinery. Apparel and beverages are the sectors that require the least amount of outside capital. Sectors with highest level of asset tangibility are petroleum refineries, paper and products, iron and steel, and industrial chemicals. Sectors with lowest level of asset tangibility are toys, electric machinery, and professional equipments.

[7] As in Rajan and Zingales (1998), using the U.S. as the reference country is convenient due to the limited data for many other countries. It's also reasonable to assume the U.S. measures reflect firms true demand for external finance and tangible assets because U.S. has the most sophisticated and advanced financial systems. Using U.S. measure also eliminates the potential bias for an industry's external dependence on finance to endogenously respond to a country's financial development.

respectively, where R_{ict}/T_{ict} is the share of intra-firm trade in sector i in country c in year t. I plot both measures for the 12 countries with the largest growth in the credit extended to private sector as a share of GDP between 1996 and 2004. I expect the average external finance dependence measure to be higher during financial crunches because the share of intra-firm trade will be higher, and this is especially true in the sectors that require greater outside finance. I expect the average asset tangbility measure to be lower during financial crunches because for sectors that have the greatest tangible assets for collateral, the share of intra-firm trade will be small. From Figure 3, I see that the average external finance dependence weighted by the share of intra-firm trade increased in 1997 for most countries. After year 1999, these values decreased. The opposite is true using the average asset tangibility weighted by the share of intra-firm trade, because the more tangible assets firms have, the less financially dependent they are. I also see another spike in 2001, this is likely due to the events of 9-11 and the bursting of the technology bubble, where credit tightened around the world and firms became more financially dependent. The 12 graphs are ordered by the standard deviation of the change in private credit to GDP ratio over this period as indicated in the graph headings.

The variation in the share of intra-firm trade in the data across countries, sectors and time are not random. I proceed with the following model to better understand the mechanisms behind these features.

4. The Model

Consider a world consisting of two countries: North (N) and South (S). There are $J + 1$ sectors consisting of J CES aggregates described below and a single homogenous goods sector. As described below, firms decide whether to produce, from where to source intermediate inputs, and the boundaries of the firm.

This section starts by describing consumer preferences and the production technology of firms. It then describes the incomplete contracting setting and credit constraints that are at the core of the model. I then derive the profit functions under arm's length and integrated sourcing with both Northern and Southern suppliers of intermediate inputs. Finally, I derive the equilibrium choice of firm boundaries and location of intermediate input suppliers as a function of credit constraints,

financial depth, and firm productivity.

4.1. Demand

The utility function of a representative consumer is given by:

$$U = x_0 + \frac{1}{\mu}\sum_{j=1}^{J} X_j^{\mu}, \qquad 0 < \mu < 1 \tag{1}$$

$$X_j = \left[\int x_j(i)^{\alpha} di\right]^{1/\alpha}, \qquad 0 < \alpha < 1 \tag{2}$$

where x_0 is the consumption of a homogeneous good, and X_j is the CES aggregate consumption index in sector j. Each firm produces an imperfectly substitutable variety $x_j(i)$ such that i indexes both firms and varieties. The constant elasticity of substitution in a sector is given by $\varepsilon = 1/(1-\alpha) > 1$. Assume $\alpha > \mu$, so that varieties within a sector are more substitutable within than across. Inverse demand for variety i in sector j is:

$$p_j(i) = X_j^{\mu-\alpha} x_j(i)^{\alpha-1} \tag{3}$$

and the revenue function for a given firm is

$$R_j(i) = X_j^{\mu-\alpha} x_j(i)^{\alpha}. \tag{4}$$

4.2. Production

The only factor of production is labor. Producers face a perfectly elastic supply of labor in each country. I assume that the wage rate is fixed in the North and the South and $w^N > w^S$.[8] As in Antras and Helpman (2004), only the North produces the final-good variety. The production of the final good requires two inputs, headquarter services $h_j(i)$, and intermediate inputs, $m_j(i)$ using a Cobb-Douglas production function,

$$x_j(i) = \theta \left[\frac{h_j(i)}{\eta_j}\right]^{\eta_j} \left[\frac{m_j(i)}{1-\eta_j}\right]^{1-\eta_j}, \qquad 0 < \eta_j < 1 \tag{5}$$

[8]The assumption of a higher wage in the North can be justified by assuming that labor supply is large enough in each country so that both countries produce x_0 and that x_0 is produced with constant returns to scale, but with higher productivity in the North.

where θ is the productivity of final good producer H of variety i in sector j. θ is drawn from a known distribution $G(\theta)$ after H pays a fixed cost of entry $w^N f_E$. η_j is sector specific, with higher η_j indicating greater intensity of headquarter services. Headquarter services must be produced in the North, whereas intermediate inputs can be produced in either the North or the South. H makes two decisions: whether to source intermediate inputs in the North or in the South, and whether to vertically integrate the supplier (V) or to outsource (O). The first is the location decision ($l \in \{N, S\}$) and the second is the organizational-structure decision ($k \in \{V, O\}$). Following Antras and Helpman (2004), the fixed organizational costs are assumed to be ranked in the following order:

$$f_V^S > f_O^S > f_V^N > f_O^N. \tag{6}$$

That is, in either location, the costs of vertical integration are higher than the costs of outsourcing and, for either ownership structure, costs are higher in the South than in the North.

4.3. Credit Constraints

Final good producers and intermediate suppliers face credit constraints in the financing of fixed costs associated with organizational choice depending on both reliance on external finance and the tangibility of assets that can serve as collateral. Following Manova (2006), I begin by assuming all firms can finance their variable costs internally, but they need to raise outside capital to finance for a fraction d_j of the fixed organizational costs.[9] Consequently, production requires that H or the M borrow $d_j w^N f_k^l$. Firms experience liquidity constraints because of up-front costs which they can cover after revenues are realized but not internally in advance. As argues by Rajan and Zingales (1998) I assume that the reliance on external finance d_j varies across industries.[10]

To obtain external finance, firms must use tangible assets as collateral.[11] If the firm fails to pay back its loan, the creditor receives ownership of the collateral. t_j corresponds to the measure of asset tangibility in my empirical analysis and is also innate to each industry, as in Braun (2003). A fraction t_j of the sunk costs must be provided as collateral to obtain external finance such that

[9] $0 < d_j < 1$.

[10] BRIEFLY SUMMARIZE THIS ARGUMENT.

[11] Examples of tangible assets include structures and equipment whereas an example of an intangible asset is human capital.

the total collateral that must be posted is $t_j w^N f_E$.[12]

The North and the South varies in their level of financial contractibility. Investors can be expected to be repaid with probability λ^l.[13] I assume that $\lambda^N > \lambda^S$. A final goods producer located in the North defaults with probability $(1 - \lambda^N)$, and intermediate supplier who is located in the North or South defaults with probability $(1 - \lambda^l)$, and the investors claim $t_j w^N f_E$. λ^l is exogenous in the model and corresponds to the strength of country l's financial institutions in my empirical analysis.

4.4. Incomplete Contracts

As in Antras (2003), final good producers and intermediate input suppliers cannot sign ex ante enforceable contracts specifying the purchase of specialized intermediate inputs for a certain price nor a contract contingent on the amount of labor hired or the volume of sales after the final good is sold.[14] Therefore, surplus is split between the final goods producer and intermediate supplier in generalized Nash bargaining such that the final good sproducer obtains a fraction $\beta \in (0, 1)$ of the ex post gains from the relationship.

Ex post bargaining takes place both under vertical integration and outsourcing. Under outsourcing, the outside option of both parties is assumed to be zero because the inputs are relationship specific and have no outside value. Under vertical integration, failure to reach an agreement on the distribution of surplus leaves M with no outside value; however, H can appropriate a fraction δ^l of the intermediate inputs produced because H cannot use the intermediate inputs as effectively in an outside relationship as it can with M.[15] I assume $\delta^N \geq \delta^S$, as in Antras and Helpman (2004), because a contractual breach is more costly to H when M is located in the South. This also reflects more corruption and lack legal protection in the South.

There is infinitely elastic supply of M in each country. Because of this M's profits from the relationship are equal to its outside option, which is assumed to be 0 here. Consequently, to ensure the relationship is at minimum costs to H, M pays a fee T for that makes its participation constraint

[12] $0 < t_j < 1$

[13] $0 < \lambda^l < 1$.

[14] This can be justified as in Hart and Moore (1999) where the precise nature of the intermediate input is revealed ex post only and is not verifiable by a third party.

[15] $0 < \delta^l < 1$ and $\delta^l \neq 1$ because if H were able to appropriate all intermediate inputs, H would always have an incentive to seize all inputs, and this would lead M to choose $m_j(i) = 0$ which leaves $x_j(i) = 0$.

binding.

4.5. Equilibrium

4.5.1. Ex-Post Revenue Shares

Looking at a particular sector j and dropping the industry subscript, if H and M agree in the bargaining, revenue from the sale of the final good is:

$$R(i) = X^{\mu-\alpha}\theta^{\alpha}\left[\frac{h(i)}{\eta}\right]^{\alpha\eta}\left[\frac{m(i)}{1-\eta}\right]^{\alpha(1-\eta)}. \tag{7}$$

If they fail to agree, the outside option for M is always zero. The outside option for H varies with ownership structure and the location of M.

When H outsources the intermediate inputs, its outside option is zero. Consequently, each party obtains a share of ex-post gains from trade $R(i)$ corresponding to their Nash bargaining weight. Therefore, H obtains $\beta R(i)$ and M receives $(1-\beta)R(i)$.

With vertical integration, if Nash bargaining breaks down, H can sell $\delta^l x(i)$ of output when M is in country l, which yields revenue $(\delta^l)^\alpha R(i)$. In the bargaining, H receives its outside option plus a fraction β of the ex post gains from the relationship. Consequently,H receives $\left[(\delta^l)^\alpha + \beta(1-(\delta^l)^\alpha)\right]R(i)$ and M receives $(1-\beta)\left(1-(\delta^l)^\alpha\right)R(i)$.

Using this information, I can order the shares of revenue that accrue to H under the four organizational forms. Let $\beta_k^l R(i)$ denotes the payoff of H under ownership structure k and the location of M in country l, then:

$$\beta_V^N = (\delta^N)^\alpha + \beta(1-(\delta^N)^\alpha) \geq \beta_V^S = (\delta^S)^\alpha + \beta(1-(\delta^S)^\alpha) > \beta_O^N = \beta_O^S = \beta \tag{8}$$

As in Grossman and Hart (1986), integration gives H the right to ex post use the inputs produced by M, which in turn enhances H's bargaining position ($\beta_V^l > \beta_O^l$).

4.5.2. Ex-Ante Investments and Financing

Since final good producers and intermediate input suppliers cannot sign ex ante enforceable contracts, the parties choose their quantities non-cooperatively. In absence of credit constraint, H

provides an amount of headquarter services that maximizes $\beta_k^l R(i) - w^N h(i)$ subject and M provides the intermediate input that maximizes $(1-\beta_k^l)R(i) - w^l m(i)$ each subject to (7). Combining the two first-order conditions, the total operating profit is

$$\pi_k^l(\theta, X, \eta) = X^{(\mu-a)/(1-\alpha)}\theta^{a/(1-\alpha)}\psi_k^l(\eta) - w^N f_k^l \tag{9}$$

where $\psi_k^l(\eta) = \frac{1-\alpha\left[\beta_k^l\eta+(1-\beta_k^l)(1-\eta)\right]}{\left\{(1/\alpha)\left(w^N/\beta_k^l\right)^\eta\left[w^l/\left(1-\beta_k^l\right)\right]^{1-\eta}\right\}^{\alpha/(1-\alpha)}}$.

Under credit constraints, two additional conditions must be satisfied.

4.5.3. Vertical Integration

If H chooses vertical integration, no matter where the supplier is located, H faces the financial friction in the North and chooses an amount of headquarter services that maximizes

$$\max_{h,F(a)} \quad \beta_V^l R(i) - w^N h(i) - (1-d)w^N f_V^l - \lambda^N F(i) - (1-\lambda^N)tw^N f_E + T \tag{10}$$

$$\begin{aligned}\text{subject to} \quad & (1)\ R(i) = X^{\mu-\alpha}\theta^\alpha\left[\tfrac{h(i)}{\eta}\right]^{\alpha\eta}\left[\tfrac{m(i)}{1-\eta}\right]^{\alpha(1-\eta)} \\ & (2)\ A(i) \equiv \beta_V^l R(i) - w^N h(i) - (1-d)w^N f_V^l + T \geq F(i) \\ & (3)\ B(i) \equiv -dw^N f_V^l + \lambda^N F(i) + (1-\lambda^N)tw^N f_E \geq 0.\end{aligned}$$

I describe each expression in turn. H maximizes its profits by financing all its variable costs and a fraction $(1-d)$ of its fixed costs internally. With probability λ^l the contract is enforced and the investor receives $F(i)$. With probability $1-\lambda^l$ there is default and the investor receives the collateral $tw^N f_E$. T is the ex-ante transfer payment M has to pay to H that makes M's participation constraint binding such that

$$T = (1-\beta_V^l)R(i) - w^l m(i). \tag{11}$$

Consider next the financial constraint (2). When financial contract is enforced, H can offer at most $A(i)$, its net revenue, to the investor. Thus the firm cannot borrow more than $A(i)$ such that $A(i) \geq F(i)$. Finally, consider the participation constraint (3). Investors only lend to H if they expect to at least break even. $B(i)$ represents the expected return to the investor taking into account the possibility default. With competitive credit markets, investors break even, H adjusts

$F(i)$ to bring investors' net return to 0, and $B(i) = 0$. Therefore, $F(i) = \frac{dw^N f_V^l - (1-\lambda^N) t w^N f_E}{\lambda^N}$.

Using equation (11) and the expression for $F(i)$, profits for H under vertical integration are

$$\max_m \pi_{HV}^l = R(i) - w^N h(i) - w^l m(i) - (1 - d + \frac{d}{\lambda^N}) w^N f_V^l + \frac{(1-\lambda^N)}{\lambda^N} t w^N f_E \tag{12}$$

$$\text{subject to } R(i) = X^{\mu-\alpha} \theta^\alpha \left[\frac{h(i)}{\eta}\right]^{\alpha\eta} \left[\frac{m(i)}{1-\eta}\right]^{\alpha(1-\eta)}.$$

The profit function for H then becomes

$$\pi_{HV}^l = X^{(\mu-a)/(1-\alpha)} \theta^{a/(1-\alpha)} \psi_V^l(\eta) - (1 - d + \frac{d}{\lambda^N}) w^N f_V^l + \frac{(1-\lambda^N)}{\lambda^N} t w^N f_E.$$

4.5.4. Outsourcing

If H chooses to outsource the intermediate inputs, M raises outside capital to finance fixed cost. Under outsourcing M chooses intermediate inputs that maximizes

$$\max_m (1 - \beta_O^l) R(i) - w^l m(i) - (1 - d + \frac{d}{\lambda^l}) w^N f_k^l + \frac{(1-\lambda^l)}{\lambda^l} t w^N f_E - T$$

$$\text{subject to } R(i) = X^{\mu-\alpha} \theta^\alpha \left[\frac{h(i)}{\eta}\right]^{\alpha\eta} \left[\frac{m(i)}{1-\eta}\right]^{\alpha(1-\eta)}.$$

Using the expression for T from equation (11), the resulting profit function for H is

$$\pi_{HO}^l = X^{(\mu-a)/(1-\alpha)} \theta^{a/(1-\alpha)} \psi_O^l(\eta) - (1 - d + \frac{d}{\lambda^l}) w^N f_O^l + \frac{(1-\lambda^l)}{\lambda^l} t w^N f_E.$$

4.5.5. Productivity Cutoffs

In absence of credit constraints, the total operating profit function defines a productivity cutoff $(\theta^*)^{\alpha/(1-\alpha)}$ above which H finds it profitable to operate.[16] Since profits are increasing in productivity θ, firms with productivity below this level do not operate. When final good producers face credit constraints, more productive firms can offer investors greater returns when financial contract is enforced and repayment occurs. Consequently, higher borrowing costs will cause the least productive firms to earn lower profits with credit constraints than they would in a world with frictionless credit

[16] This cutoff is given by the level of θ that solves $X^{(\mu-\alpha)/(1-\alpha)} (\theta^*)^{\alpha/(1-\alpha)} \psi_k^l(\eta) = w^N f_k^l$.

markets.

As a result, in the presence of credit constraint, a new and higher productivity cut-off for firms operating under vertical integration is $\left(\theta^*_{V,c}\right)^{\alpha/(1-\alpha)}$. This productivity cutoff is the level of productivity that solves the condition $A(\theta^*_{V,c}) = F(\theta^*_{V,c})$ such that

$$X^{(\mu-\alpha)/(1-\alpha)} \left(\theta^*_{V,c}\right)^{\alpha/(1-\alpha)} \psi^l_k(\eta) = (1 - d + \frac{d}{\lambda^N}) w^N f^l_V + \frac{(1-\lambda^N)}{\lambda^N} t w^N f_E. \tag{13}$$

The productivity cut-off for firms operating under outsourcing is

$$X^{(\mu-\alpha)/(1-\alpha)} \left(\theta^*_{O,c}\right)^{\alpha/(1-\alpha)} \psi^l_k(\eta) = (1 - d + \frac{d}{\lambda^l}) w^N f^l_O + \frac{(1-\lambda^l)}{\lambda^l} t w^N f_E. \tag{14}$$

Regardless of organizational structure, there is a higher productivity cut-off under credit constraint than without. This can be seen by noting that the right hand side of each of the expressions is increasing as λ falls. Consequently, with lower financial development, there are higher productivity cutoffs. Without financial frictions ($\lambda^l = 1$), the model reduces to original Antras and Helpman (2004) formulation. In addition, note that reliance on external funding (d_j) only has an impact when financial contracts are not perfectly enforced.

Also, note that the payment to investors $F(i)$ is decreasing in financial development. As financial development falls ($\lambda \downarrow$), intermediate suppliers in the South face a higher interest rates on loans. This then reduces the transfer payment T) they can make to H, and thus H that choose to outsource in the South in essence need to pay a higher repayment on loans.

Regardless of ownership, Final good producers cannot operate with productivity lower than $\min(\theta^*_{V,c}, \theta^*_{O,c})$ when they face credit constraints. $\min(\theta^*_{V,c}, \theta^*_{O,c}) > \theta^*$ whenever $df^l_k > t f_E$, which means credit constraints bind when firms need to borrow more than they can offer in collateral.[17]. Consequently, I make the following assumption on the magnitude of fixed costs to ensure that all four organizational forms *can* exist in equilibrium:

Assumption 1 *$df^S_O > t f_E$. Since df^S_O is the smallest, $df^l_k > t f_E$.*

I assume this condition holds for the rest of the analysis. In addition, notice that $\theta^*_{V,c} > \theta^*_{O,c}$ because $f^l_V > f^l_O$. Figure 4 illustrates the productivity cut-offs between credit constrained and

[17](Manova (2006), Greenaway et al. (2005), Becker and Greenberg (2005), Beck (2002), and Beck (2003)

unconstrained final good producers.

To summarize, after observing its productivity level θ, a final good producer H chooses the ownership structure and the location of M that maximizes π^l_{Hk}, or exits the industry and forfeits the fixed cost of entry $w^N f_E$. $\pi^l_{Hk}(\theta, X, \eta)$ is decreasing in w^l_k and f^l_k. Looking at variable costs, producing intermediate inputs in the South is preferred to producing intermediates in the North regardless of ownership structure because $w^S < w^N$. Looking at fixed costs, $f^S_V > f^S_O > f^N_V > f^N_O$, ranking of profits is the reverse order of the fixed costs.

As shown in Antras and Helpman (2004), if final good producer H could freely choose β, $\frac{\partial \beta^l_k}{\partial \eta} > 0$. This means the more intensive a sector is in headquarter services, the higher β^l_k H would prefer. Following Grossman and Hart (1986), β cannot be chosen freely, so the choice of β^l_k is constrained to the set $\{\beta^N_V, \beta^S_V, \beta^N_O, \beta^S_O\}$.

5. Organizational Forms

5.1. Headquarter Intensive Sector

First consider a sector with high headquarter intensity η, such that profits are increasing in β^l_k. In a headquarter intensive sector, the marginal product of headquarter services is high, making underinvestment in headquarter services more costly and integration more attractive. Because $\psi^l_V > \psi^l_O$, π^l_V is steeper than π^l_O such that the slope of the profit function for vertical integration is greater than the slope for outsourcing *within a country.* However, the slope of π^S_O can be steeper than the slope of π^N_V when the variable costs in the South are very low, or flatter than the slope of π^N_V because integration gives higher the final good producer a larger fraction of the revenue. Figure 5 reflects the benchmark case when slope of π^S_O is steeper than the slope of π^N_V. Unlike the case of the component intensive sector, all four forms of organization are now possible. The productivity cut-offs with credit constraints $(\theta^*_c, \theta^N_{V,c}, \theta^S_{O,c}, \theta^S_{V,c})$ and without credit constraints $(\theta^*, \theta^N_V, \theta^S_O, \theta^S_V)$ are provided in the Appendix.[18] Proposition 1 describes how changes in financial development affect productivity cut-offs under credit constraints.

Proposition 1 *For headquarter intensive sectors, firms tend to choose outsourcing in more fi-*

[18] Figure 5 plots the productivity cut-offs without credit constraints. With credit constraints, productivity cut-offs are increased.

nancially developed country ($\frac{\partial \theta^S_{V,c}}{\partial \lambda^S} > 0, \frac{\partial \theta^S_{O,c}}{\partial \lambda^S} < 0$ *and* $\frac{\partial \theta^S_{V,c}}{\partial \lambda^N} < 0, \frac{\partial \theta^S_{O,c}}{\partial \lambda^N} > 0$). *This effect is more pronounced in financially dependent sectors* ($\frac{\partial \theta^S_{V,c}}{\partial d \partial \lambda^S} > 0, \frac{\partial \theta^S_{O,c}}{\partial d \partial \lambda^S} < 0, \frac{\partial \theta^S_{V,c}}{\partial t \partial \lambda^S} < 0, \frac{\partial \theta^S_{O,c}}{\partial t \partial \lambda^S} > 0$ *and* $\frac{\partial \theta^S_{V,c}}{\partial d \partial \lambda^N} < 0, \frac{\partial \theta^S_{O,c}}{\partial d \partial \lambda^N} > 0, \frac{\partial \theta^S_{V,c}}{\partial t \partial \lambda^N} > 0, \frac{\partial \theta^S_{O,c}}{\partial t \partial \lambda^N} < 0$). *In sectors with higher headquarter intensity, integration is favored relative to outsourcing* ($\frac{\partial}{\partial \eta} \frac{\psi^l_V(\eta)}{\psi^l_O(\eta)} > 0$ *for* $l = N, S$).

For an improvement in the financial development in the South ($\lambda^S \uparrow$), the most productive firms that were vertically integrated in the North now outsource in the South. The least productive firms firms that integrated in the South now switch to arm's length transactions with suppliers in the South. Overall, the proportion of firms conducting sourcing with suppliers in the South relative to the North increases and revenue of firms that were both initially and currently sourcing from the South increase. In addition, the share of vertically integrated firms in the South relative to total firms firms sourcing from the south will decrease, as depicted in Figure 6. This effect is strongest in sectors that require more outside capital or possess fewer tangible assets.

For an increase in financial development in the North ($\lambda^N \uparrow$), the most productive firms that initially chose to exit now outsource in the North. The most productive firms that previously outsourced in the North will now vertically integrate and realize higher revenues. Firms that previously operated in the North continue to operate in the North and realize higher revenue. Increased financial development in the North lead to fewer firms conducting sourcing with suppliers in the South through two channels. First, the least productive firms that were outousrcing in the South now vertically integrate in the North. Second, the most productive firms that were outsourcing in the South now vertically integrate in the South to take advantage of the improved financial depth in the North. Overall, increase in financial development in the North leads to higher share of vertically integrated firms in the South relative to total firms sourcing from the South.

The share of firms and trade that occur via vertical integration relative to at arm's length (regardless of location), is increasing in the headquarters intensity of the industry (η_j). This result is also found in Antras (2003). Notice that any of the first three organizational forms (outsourcing in North, vertical integration in North, and outsourcing in South) may not exist in equilibrium but vertical integration with Southern suppliers always exists due to the absence of an upper bound on support of $G(\theta)$. See Figure 6 for illustration. Organizational forms that survive in equilibrium have firms sorted according to the order in Figure 6 depending on their productivities.

5.2. Component Intensive Sector

Next, consider a sector with sufficiently low headquarter intensity η that H prefers outsourcing to integration in every country l. This is because outsourcing has lower fixed costs and H prefers β_k^l to be as low as possible, or $\beta_k^l = \beta_O^l = \beta$. H trades off between lower variable cost in the South against the lower organizational costs in the North. If wage differential is small relative to the fixed cost differential, $w^N/w^S < (f_O^S/f_O^N)^{(1-\alpha)/\alpha(1-\eta)}$,

The top panel in Figure 7 depicts the choice of location of M depending on productivity level θ without credit constraints. As in Antras and Helpman (2004), the cutoffs θ^* and θ_O^S are given by:

$$\theta^* = X^{(\alpha-\kappa)/\alpha}\left[\frac{w^N f_O^N}{\psi_O^N(\eta)}\right]^{(1-\alpha)/\alpha},$$

$$\theta_O^S = X^{(\alpha-\kappa)/\alpha}\left[\frac{w^N(f_O^N - f_O^N)}{\psi_O^S(\eta) - \psi_O^N(\eta)}\right]^{(1-\alpha)/\alpha}.$$

As is clear from Figure 7, firms do not operate with productivity lower than θ^* and can only outsource in the South if their productivity level is above θ_O^S. The bottom panel in Figure 7 provides analogous cutoffs when there are credit constraints

$$\theta_c^* = X^{(\alpha-\kappa)/\alpha}\left[\frac{(1-d+d/\lambda^N)w^N f_O^N - \frac{1-\lambda^N}{\lambda^N} t w^N f_E}{\psi_O^N(\eta)}\right]^{(1-\alpha)/\alpha},$$

$$\theta_{O,c}^S = X^{(\alpha-\kappa)/\alpha}\left[\frac{(1-d+d/\lambda^S)w^N f_O^S - \frac{1-\lambda^S}{\lambda^S} t w^N f_E - \left[(1-d+d/\lambda^N)w^N f_O^N - \frac{1-\lambda^N}{\lambda^N} t w^N f_E\right]}{\psi_O^S(\eta) - \psi_O^N(\eta)}\right]^{(1-\alpha)/\alpha}.$$

H firms with productivity lower θ_c^* do operate. H outsources in the North when its productivity is between θ_c^* and $\theta_{O,c}^S$, and outsource in the South when its productivity is above $\theta_{O,c}^S$. Proposition 2 provides comparative statics on these cut-offs.

Proposition 2 *In component intensive sectors, firms do not integrate. An increase in financial development in the South leads to more outsourcing in the South* ($\frac{\partial \theta_{O,c}^S}{\partial \lambda^S} < 0$ *and* $\frac{\partial \theta_c^*}{\partial \lambda^S} = 0$). *An increase in financial development in the North leads to less outsourcing in the South* ($\frac{\partial \theta_{O,c}^S}{\partial \lambda^N} > 0$ *and* $\frac{\partial \theta_c^*}{\partial \lambda^N} < 0$). *This effect is stronger in the sectors that require more outside capital* ($\frac{\partial \theta_{O,c}^S}{\partial d \partial \lambda^S} < 0$ *and* $\frac{\partial \theta_c^*}{\partial d \partial \lambda^S} = 0$ *for the South,* $\frac{\partial \theta_{O,c}^S}{\partial d \partial \lambda^N} > 0$ *and* $\frac{\partial \theta_c^*}{\partial d \partial \lambda^N} < 0$ *for the North*) *and less tangible assets*

($\frac{\partial \theta^S_{O,c}}{\partial t \partial \lambda^S} > 0$ *and* $\frac{\partial \theta^*_c}{\partial d \partial \lambda^S} = 0$ *for the South,* $\frac{\partial \theta^S_{O,c}}{\partial t \partial \lambda^N} < 0$ *and* $\frac{\partial \theta^*_c}{\partial t \partial \lambda^N} > 0$ *for the North*).

An increase in financial development in the South ($\lambda^S \uparrow$) leads to a lower cut-off productivity $\theta^S_{O,c}$ for outsourcing firms in the South as depicted in figure 8. The most productive firms initially outsourcing in the North now switch to outsourcing in the South to take the advantage of better financial institutions in the South. The profits of the firms already outsourcing in the South also increase. This is because with less financial frictions, a smaller repayment is required when the financial contract is enforced. This effect is stronger for sectors that require more outside capital (d higher) or possess fewer tangible assets (t lower) as firms in those sectors find it cheaper to outsource from suppliers located in the South with a more developed financial system.

An increase in the financial development in the North ($\lambda^N \uparrow$) leads to a lower cut-off productivity θ^*_c for outsourcing firms in the North and a higher cut-off productivity $\theta^S_{O,c}$ for outsourcing firms in the South. The most productive firms that initially exited now find it profitable to outsource in the North. Firms that were initially outsourcing in the North now enjoy higher profits. The least productive firms that were outsourcing in the South now outsource in the North. By choosing to outsource in the North, the intermediate suppliers have smaller payments to investors ($F(I) \downarrow$) and possess higher profits than before. Overall, a higher proportion of operating firms choose to outsource in the North than the South relative to before the improvement in financial development. As with the case of increased financial development in the South, this effect is strongest in sectors that require more outside capital or possess fewer tangible assets.

Finally, regardless of headquarter intensity,

Proposition 3 *An increase in financial development in the South leads to higher firm revenues in the South regardless of whether sourcing is done through vertical integration or at arm's length. This effect is strongest in sectors that require more outside capital or possess fewer tangible assets.*

6. Empirical Analysis

The model presented above predicts that the share of intra-firm imports should be 0 for industries with headquarter intensity η below a certain threshold. After grouping the share of intra-firm U.S. imports into SIC 4 digit category, there is 37% of the sample that contains 0 share of intra-firm

trade. First, I consider the sectors with 0 intra-firm trade to be the component intensive sectors and the rest to be headquarter intensive sectors. I then test the three propositions outlined in the previous section. Later on, I will relax this assumption and consider different capital-labor ratio cut-offs to divide the data into component and headquarter intensive sectors.

6.1. Headquarter Intensive Sector

Under Proposition 1, in headquarter-intensive sector, with higher headquarter intensity η, outsourcing in the North is favored relative to outsourcing in the South, and integration is favored relative to outsourcing regardless of location. The more financially developed the South is, the more prevalent outsourcing is in the South, i.e. the less vertical integration there is in the South. This effect is strengthened in sectors that require more external capital and have less tangible assets.

Since the dependent variable share of U.S. intra-firm imports is a variable between 0 and 1, the effect of any particular explanatory variable cannot be constant throughout the range of the explanatory variables. This problem can be overcome by augmenting a linear model with non-linear functions of the explanatory variable.[19]

I report estimates from regression of the form:

$$\begin{aligned} \ln(S_j^l/(1-S_j^l)) &= \beta_1 + \beta_2 \ln(K/L_j) + \beta_3 FinDev^l * ExtFin_j + \beta_4 FinDev^l * Tang_j \\ &\quad + \beta_5 FinDev^l + \beta_6 X_j^l + \varepsilon_j^l \end{aligned} \tag{15}$$

where S_j^l is the industry j's share of U.S. intra-firm imports from country l, K/L_j is the capital-labor ratio in industry j. I test the first hypothesis that $\beta_2 > 0, \beta_3 < 0$, $\beta_4 > 0$, and $\beta_5 < 0$. Log-odds transformation is applied to the share of intra-firm imports instead of using a linear regression for two reasons. First, the predicted values can be greater than one and less than zero under linear regression and such values are theoretically inadmissible. Second, the significance testing of the coefficients rest upon the assumption that errors are normally distributed which is not the case when the dependent variable is between zero and one.

[19] This most common approach is to model the log-odds ratio of the dependent variable share of U.S. intra-firm imports as a linear function. This requires the dependent variable to be strictly between 0 and 1. Since in headquarter intensive sectors, integration from the South always exists in the absence of an upper bound on support of $G(\theta)$, the dependent variable is always bigger than 0. About 3% of the data is lost using this log-odds transformation approach from 100% of vertical integration in the South.

Next, under Proposition 3, there are more imports from the South the more financially developed the South is, and this effect is stronger in the financially dependent sectors. I run the regression of the following form:

$$\ln(M_j^l) = \zeta_1 + \zeta_2 \ln(K/L_j) + \zeta_3 FinDev^l * ExtFin_j + \zeta_4 FinDev^l * Tang_j + \zeta_5 FinDev^l + \zeta_6 X_j^l + \varepsilon_j^l \quad (16)$$

where M_j^l is the total imports from country l in sector j. The theory predicts that $\zeta_2 > 0$, $\zeta_3 > 0$, $\zeta_4 < 0$, and $\zeta_5 > 0$.The effect of financial development and its interaction with financial dependence on the total imports from the South should be stronger in the headquarter intensive sectors than in the component intensive sectors.

6.2. Component Intensive Sector

Under Proposition 2, there are more imports from the South the more financially developed the South is, and this effect is stronger in the financially dependent sectors. I report estimates from regression of the form:

$$\ln(M_j^l) = \delta_1 + \delta_2 FinDev^l * ExtFin_j + \delta_3 FinDev^l * Tang_j + \delta_4 FinDev^l + \delta_7 X_j^l + \varepsilon_j^l \quad (17)$$

where M_j^l is the total US. imports from country l and sector j, $j \in$component intensive sectors, or share of intra-firm trade is zero. I assume the terms in d, λ, and t can be expressed as the observed measures of country level financial development $FinDev$, sectoral indicators of external finance dependence $ExtFin$ and asset tangibility $Tang$. $FinDev^l * ExtFin_j$ is the interaction of financial development in country l and industry j's external dependence on finance, $FinDev^l * Tang_j$ is the interaction of financial development in country l and industry's asset tangibility, and X_j^l is a vector of controls. The theory predicts that $\delta_2 > 0$, $\delta_3 < 0$, $\delta_4 > 0$.

7. Data

In this section I use data on intra-firm and total U.S. imports from 90 countries and 429 sectors over the 1996-2005 period. I have also confirmed my results in a cross section for each year. I evaluate the impact of credit constraints on the choice of organizational form and location of

supplier by regressing intra-firm trade variables on the interaction of country level measure of financial development and industry level measure of dependence on external finance and asset tangibility.[20]

7.1. Intra-firm and total U.S. imports data

A sector is defined as a 4-digit SIC industry. The share of intra-firm U.S. imports $S_j^l = \frac{Related_j^l}{Total_j^l}$, where $Related_j^l$ is the U.S. reported import value from country l in sector j that is from a related party, and $Total_j^l$ is the total U.S. import from country l in sector j.

7.2. Financial development data

The first measure of financial development I use is the ratio of credit banks and other financial intermediaries to the private sector as a share of GDP, which I obtain from Beck et al. (2000). Domestic credit has been used extensively in the finance and growth literature (Rajan and Zingales, 1998; Braun 2003; Aghion et al. 2004). Stock market capitalization and stock traded are also used for robustness checks, which I obtain from the IMF.

In additional robustness checks, I use measures of the accounting standards, the risk of expropriation, and the repudiation of contracts from Porta et al. (1998). Even though these indices are not direct measures of the probability that financial contracts will be enforced, they are good measures for the contracting environment in a country, which allies to financial contracting as well. These indices are available for a subset of countries and do not vary over time. Table 3, panel A summaries the cross sectional variation in these measures.

7.3. External dependence on finance data

Industry-level measures of external dependence on finance and asset tangibility are constructed based on data for all publicly traded U.S. based companies from Compustat's annual industrial files based on usSIC 1987 classification. It is then converted to the SIC 4-digit industry classification system based on the concordance table provided by Jon Haveman. A firm's external dependence on finance is defined as capital expenditures minus cash flow from operations divided by capital

[20]Firm-level data are not available. As a result, I cannot estimate firm productivities and interact them with external finance dependence and financial development.

expenditures. An industry level's measure of external dependence on finance is the median firm's external dependance on finance in an industry, as proposed by Rajan and Zingales (1998). Asset tangibility is similarly defined as the share of net property, plant and equipment in total book-value assets for the median firm in a given industry. Both measures are constructed as averages for the 1996-2005 period, and appear very stable over time compared to indices for 1986-1995, 1980-1989, or 1966-1975 period.

8. Regression Results

8.1. Headquarter Intensive Sector

8.1.1. The Effect of Credit Constraints on the Multinationals' Sourcing Decisions

The capital to labor ratio is used to measure the headquarter intensity of a sector. Earlier papers on the role of capital labor ratios on the choice of organizational forms also have documented that the share of intra-firm imports is significantly higher, the higher the capital intensity of the exporting industry j in country i (Antras (2003)). Table 4 column 1 re-establishes this basic pattern between 90 countries and 375 sectors in the period 1996-2005. Since capital labor ratio, external dependence on finance, and asset tangibility do not have a time dimension, sector dummies are not included for all subsequent analysis. Industry dummies at 3-digit classification level are included. The results for the interaction terms are similar if sector dummies are used instead of the measures on external finance and asset tangibility.

Column 2 is the regression results of equation (15) using the ratio of private credit to GDP for each country as a measure of financial development. The interaction of financial development and external finance dependence enters negatively into the equation and the interaction of financial development and asset tangibility enters positively into the equation as predicted by the theory. This implies that North chooses more outsourcing than integration in financially developed countries when the sectors are in need of more external finance and have less tangible assets. Column 3-7 are the same regression results but using different measures of financial development for robustness checks. Those include the ratio of stock capitalization to GDP, ratio of stock traded to GDP, accounting standards, risk of expropriation, and contract repudiation. One might argue that degree

of a country's financial development is an endogenous outcome of a country's history, origin of law, or some other endowment factors. Column 8 provides the IV estimation result using the colonial origin of a country's legal system as reported in Porta et al. (1998) to instrument for the private credit to GDP ratio.

Table 9 Column 2 examines the economic significance of the effects of credit constraints on the share of intra-firm trade in the headquarter intensive sectors. Each cell reports on the odds-ratio of the share of intra-firm trade to the share of outsourcing for one standard deviation increase in the measure of financial development of the exporting country in the sector at the 75th percentile of the distribution by external finance dependence and asset tangibility, respectively, relative to the sector at the 25th percentile. The odds-ratio for the share of intra-firm trade to the share of outsourcing is 44% for one standard-deviation increase in the private credit to GDP ratio in the more financially dependent sectors (3rd quartile) than in the sectors are less financially dependent (1st quartile). With the odds-ratio less than 100%, this implies the share of intra-firm trade has decreased. More firms choose to outsource rather than vertically integrate when the foreign country is more financially developed in sectors that are more dependent on finance. The opposite is true for the interaction between financial development and asset tangibility. The odds-ratio is above 100% the interaction with asset tangibility. This indicates that more firms choose integration over outsourcing when the foreign country is more financially developed in sectors that have more tangible assets, and thus less dependent on finance. These results confirm the first part of Proposition 1: the North tends to choose more outsourcing instead of vertical integration when the South is more financially developed and the sector is more financially dependent.

Table 5 provides additional robustness checks by including additional measures of headquarter intensity and the interaction of headquarter intensity with financial development of a country to isolate the effect of financial development and its interaction with the financial dependence of a sector. Those include the U.S. industry research and development at 3 digit NAICS from NS R&D in industry in 2004, the Rauch Index[21], and Lall Index[22]. By including additional measures of

[21] Rauch (1999) classified products traded on an organized exchange as homogeneous goods. Products not sold on exchanges but whose benchmark prices exist were classified as reference priced; all other products were deemed differentiated.

[22] Lall (2000) classified products by technology at the 3-digit SITC level. Low technology products tend to have stable and slow-changing technologies. High technology products tend to have advanced and fast-changing technologies, normally associated with high R&D investments. Middle technology products lie somewhere in between.

headquarter intensity and their interaction with a country's financial development measure, the results provided are in Table 5 are not changed.

8.1.2. The Effect of Credit Constraints on Total U.S. Imports

Column 1 in Table 6 re-establishes the positive relationship between the capital labor ratio and total U.S. imports as shown in Antras(2003). Under Proposition 3, there are more imports from the South the more financially developed the South is, and this effect is stronger in the financially dependent sectors. I test Proposition 3 by looking at the OLS regression results of equation (16). Column 2-8 in Table 6 provide the results using different measures of financial development. Those measures include private credit to GDP ratio, ratio of stock capitalization to GDP, ratio of stock traded to GDP, accounting standards, risk of expropriation, and contract repudiation. The last three measures are time invariant and therefore are not included by themselves in the regression due to multicollinearity with country dummies in the regression. Table 9 Column 3 examines the economic significance of the effects of credit constraints on the total U.S. imports in the headquarter intensive sectors. Each cell reports on how much bigger the effect of one standard deviation increase in the measure of financial development of the exporting country on the total U.S. imports in the sector at the 75th percentile of the distribution by external finance dependence and asset tangibility, respectively, relative to the sector at the 25th percentile. All results confirm the statement in Proposition 3 that the North imports more from the South when the South becomes more financially developed, and especially so in the financially dependent sector.

8.2. Component Intensive Sector

Next, I consider the sectors with zero intra-firm trade to be the component intensive sectors. I test proposition 2 by estimating equation (17) for the effect of financial development and its interaction with financial dependence in the component intensive sectors using OLS specification. Later on, I will relax this assumption and consider different K/L cut-offs to divide the data into component and headquarter intensive sectors. Table 7 provides the regression results. The sample is limited to sector and country pairs that have no intra-firm trade. The dependent variable is log of the total U.S. imports from a country sector pair. According to Proposition 2, in the component intensive sectors, increased financial development in the South leads to more outsourcing in the South and

this effect is stronger in the financially dependent sector.

Table 7 presents empirical support for proposition 2. There is more U.S. imports from a country that is more financially developed when the sector is more dependent on outside finance and has less tangible assets. The effect of the financial development is not significant by itself; however, the sign works in the right direction. The second part of the Proposition 2 regarding the financial development of the North cannot be tested due to lack of domestic U.S. intra-firm trade data. Table 7 column 1 uses the ratio of the private credit to GDP as a measure of the financial development of a country. Subsequent columns use accounting standards, risk of expropriation, contract repudiation, and stock capitalization as different measures of the financial development as reported in Porta et al. (1998).[23] Last column includes the IV estimation using the colonial origin of a country's legal system instrument for financial development. This set of the results confirm the results presented in Manova (2006) and Manova (2008) regarding exporting and credit constraint[24]. In the last column I instrument for private credit with the country's legal origin, both the interaction of financial development with external dependence on finance and asset tangibility are strongly significant, whereas in the previous columns only the interaction with asset tangibility is strongly significant.

Table 9 Column (1) examines the economic significance of the effects of credit constraints on the share of intra-firm trade in the component intensive sectors. Each cell reports on the effect of one standard deviation increase in the measure of financial development of the exporting country on its exports in the sector at the 75th percentile of the distribution by external finance dependence and asset tangibility, respectively, relative to the sector at the 25th percentile. The U.S. will increase its imports by 10% to 18% more from countries that experience an one standard deviation increase in their financial development in the sectors that have little tangible assets for collateral (1st quartile) than in the sectors that have a lot of tangible assets (3rd quartile). The U.S. will increase its imports by 34% more from countries that have one standard deviation growth in their financial development in the sectors that are very dependent on external finance (3rd quartile) than in the sectors that are not too dependent on external finance (1st quartile).

[23]Financial development measured using accounting standards, risk of expropriation, contract repudiation, and stock capitalization do not have a time dimension.

[24]Manova (2006) and Manova (2008) uses bilateral export data to test the effect of financial development and its interaction with financial dependence of a sector using Heckman's selection to correct for the selection into exporting. Here the OLS and IV did not correct for selection into exporting and the data is limited to U.S. imports only.

Establishing causality has typically been difficult in the trade literature. Reverse causality could arise when an increase in demand for sectors that are heavily dependent on external funds to lead to both higher outsourcing and higher borrowing from the outsourcing country, as measured by the private credit to GDP ratio. This mechanism could generate the result that firms increase their outsourcing from financially developed countries in more external capital dependent sectors. However, the significant effect of the interaction between private credit and asset tangibility does suggest a causal effect of credit constraints on outsourcing patterns. If capital markets were frictionless, the availability of collaterals would not affect a sector's ability to raise outside capital. The increase in demand would not affect the private credit holding the financial dependence constant. The result that firms outsource less from the financially developed countries in sectors with more tangible assets is thus strong evidence of presence of credit constraints. Finally, using time-invariant measures of contract repudiation, accounting standards and the risk of expropriation further helps with establishing causality as these variables do not respond to variation in demand as the way private credit might.[25]

8.2.1. Difference in Difference Method

One of the biggest concerns of estimating the effect of financial development is determining causality. Countries that have higher export volumes have higher GDP levels, which in turn could affect the financial institutions in those countries. In addition to implementing the IV estimator using the colonial origin of a country's legal system, here I take the advantage of an exogenous event taking place that directly affects a country's financial development. In the year 1997, the Asian financial crisis was a period of financial crisis that gripped much of Asia and raised fears of a worldwide economic meltdown due to financial contagion, where small shocks which initially affect only a particular region of an economy, spread to the rest of financial sectors and other countries whose economies were previously healthy. The crisis started in Thailand with the financial collapse of the Thai baht caused by the decision of the Thai government to float the exchange rate for baht. Thailand became effectively bankrupt and as the crisis spread, most of Southeast Asia and Japan

[25] Prior researchers have instrumented for private credit with legal origin to establish causality. The interaction between external finance dependence and asset tangibility are strongly significant. However, it has been argued that legal origin may impact institution formation and the economy more broadly, which in turn are likely to affect trade through channels other than its effect on the financial development. For robustness checks, I use difference in difference methods around the Asian financial crisis as an exogenous source of variation in financial development.

saw a devalued stock market. International investors were reluctant to lend to developing countries, leading to economic slowdowns in developing countries in many parts of the world. By 1999, the economies of Asia were beginning to recover. I implement the difference in difference methods before and after the Asian financial crisis to avoid reverse causality. During the Asian financial crisis, the financial development measures for each country falls. Table 8 shows the estimates for the interaction between financial development and external finance dependence using the 3 years before the Asian financial crisis and the 3 years after (the dependent variable is $(S_{j1999} - S_{j1997}) - (S_{j1996} - S_{j1994})$). Here, I took the difference between share of intra-firm trade instead of the difference between the logs because it is easier to interpret the difference in shares instead of the difference in logs. Using the difference in difference method, financial contractibility in that country decreases the market share of vertically integrated firms in that country and this effect is again more pronounced in the financially dependent sectors.

The bottom panel in Table 9 shows the effect of countries' financial development and sectors' financial dependence on firms' sourcing decisions. During the Asian financial crisis, the share of intra-firm trade increased by 29% in sectors that are heavily dependent on external finance (3rd quartile) than in sectors that are less dependent on external finance (1st quartile).

8.2.2. Component vs. Headquarter Intensive Sectors

As an additional robustness check, I consider different K/L cut-offs to divide the data into component and headquarter intensive sectors. Column 1 in Table 10 provides the regression results for equation (17) under different K/L cut-offs. Column 2 and 3 provide the regression results for equation (15) and (16), respectively, under those K/L cut-offs. Table 10 confirms my previous results. In addition, the magnitude of the interaction effect between a country's financial development and the sector's financial dependence are increasing as I increase the K/L cut-offs for the headquarter intensive sectors. Proposition 1 states that integration is favored relative to outsourcing in sectors with higher headquarter intensity. If K/L ratio is an accurate measure of headquarter intensity, the reduction in the share of integration in the financially dependent sectors should be greater when the country improved its financial development, as Column 2 in Table 10 suggests.

9. Conclusion

In this paper I have extended the global sourcing model ofAntras and Helpman (2004) to incorporate the role of credit constraints. In the model, a continuum of firms with heterogeneous productivities decide whether to integrate or outsource the intermediate inputs and in which countries to source the inputs. By choosing an organizational structure, the firm (final good producer or intermediate supplier depending on the choice of organizational structure) faces a fixed cost, part of which cannot be financed internally and needs to raise outside capital to finance it. When the financial contract is enforced, the firms needs to make a payment to the investor; when the financial contract is not enforced, the investors claim the collaterals of the firms. By competing for investors' capital, some firms that could operate without credit constraint are now forced to exit the market with credit constraint because they cannot make enough repayment to the investors when the financial contract is enforced. The productivity cut-off level is raised for all forms of organization under credit constraint.

This model generates equilibria in which firms with different productivity levels choose different ownership structure and suppliers location. In the model, credit constraints affect firms in different countries and sectors differently. Final-good producers in some sectors find it easier to operate because they need to raise less outside finance and have more tangible assets. Credit constraints vary across countries because contracts between firms and investors are more likely to be enforced at higher levels of financial development.In particular, I study the effect of improvements in financial contractibility on relative prevalence of these organizational forms. I have shown that an improvement in financial contractibility in the South decreases the market share of vertically integrated final-good producers, this effect is more pronounced in the financially dependent sector, i.e. the interaction of financial development and external dependence on finance has a negative effect on the market share of vertically integrated firms, and the interaction of financial development and asset tangibility has a positive effect on the market share of vertically integrate firms.

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Figure 1. U.S. Intra-Firm Imports and External Financial Dependence

This graph shows the relationship betweeen the share of U.S. intra-firm imports in sector j and the sector's external dependence on finance. The share of U.S. intra-firm imports in sector j is defined as sum of all party-related U.S. imports in sector j divided by the sum of all U.S. imports in sector j. A firm's external dependence on finance is defined as capital expenditures minus cash flow from operations divided by capital expenditures. A sector's external dependence on finance is defined as the median firm's external dependence on finance in that sector. All data is for year 2000.

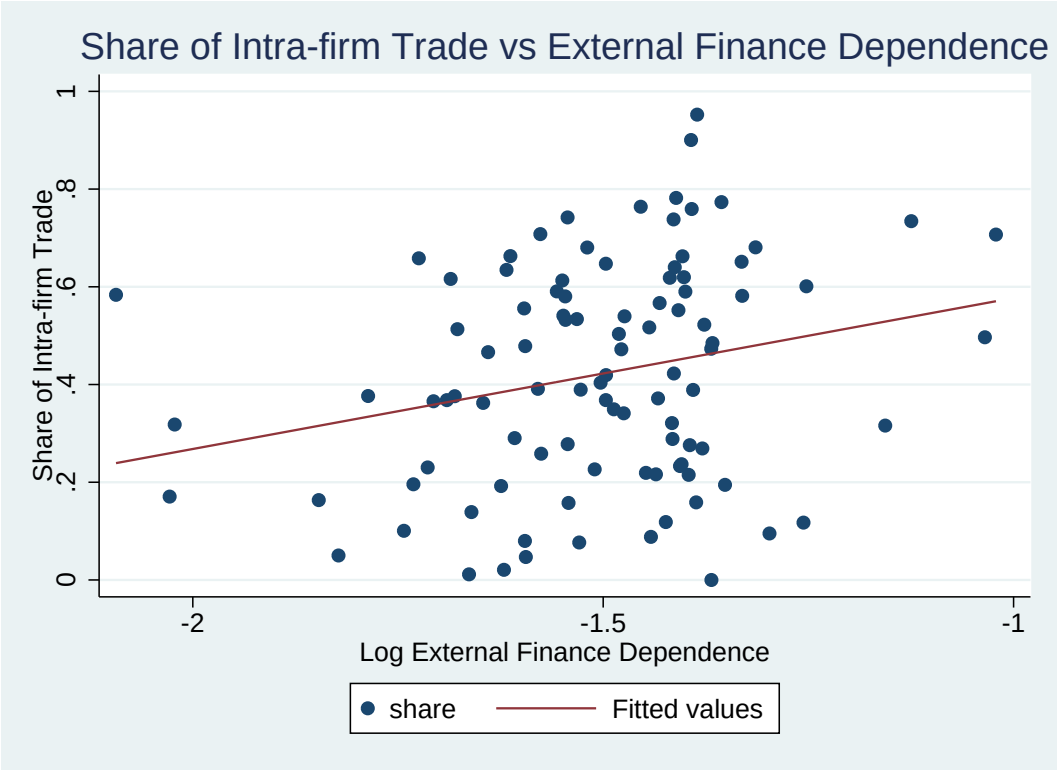

Figure 2. U.S. Intra-Firm Imports and Asset Tangibility

This graph shows the relationship betweeen the share of U.S. intra-firm imports in sector j and the sector's asset tangibility. The share of U.S. intra-firm imports in sector j is defined as sum of all party-related U.S. imports in sector j divided by the sum of all U.S. imports in sector j. A sector's asset tangibility is defined as the median firm's share of net property, plant and quipment in total book-value assets. All data is for year 2000.

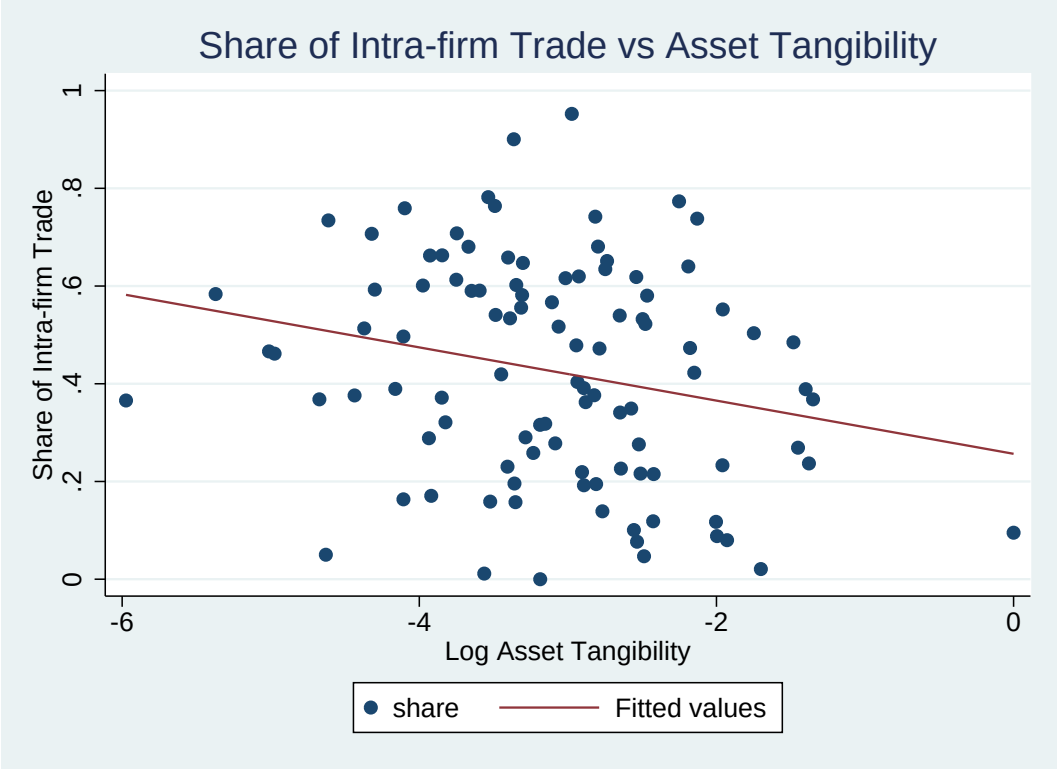

Figure 3. Average Financial Vulnerability of Intra-firm Trade

This figure shows the average financial vulnerability of share of intra-firm trade overtime for 12 countries that have improved their financial development by the measurement of private credit to GDP ratio by at least 20% of their 1996 level. For each year the average intensity of intra-firm trade with respect to external finance dependence (Avg Fin Dep of S) is calculated as $\sum_j FinDep_j * Intra^l_{j,t}$, where $Intra^l_{j,t}$ is the share of U.S. intra-firm imports in sector j from country l in time t. The average intensity of intra-firm trade with respect to asset tangibility (Avg Tang of S) is similarly constructed. Each country graph plots Avg Fin Dep of S (Avg Tang of S) on the left (right) vertical axis. Each graph's title indicates the difference between the log private credit in 1996 and 2004. The graphs are sorted by the degree of change in the financial development of a country.

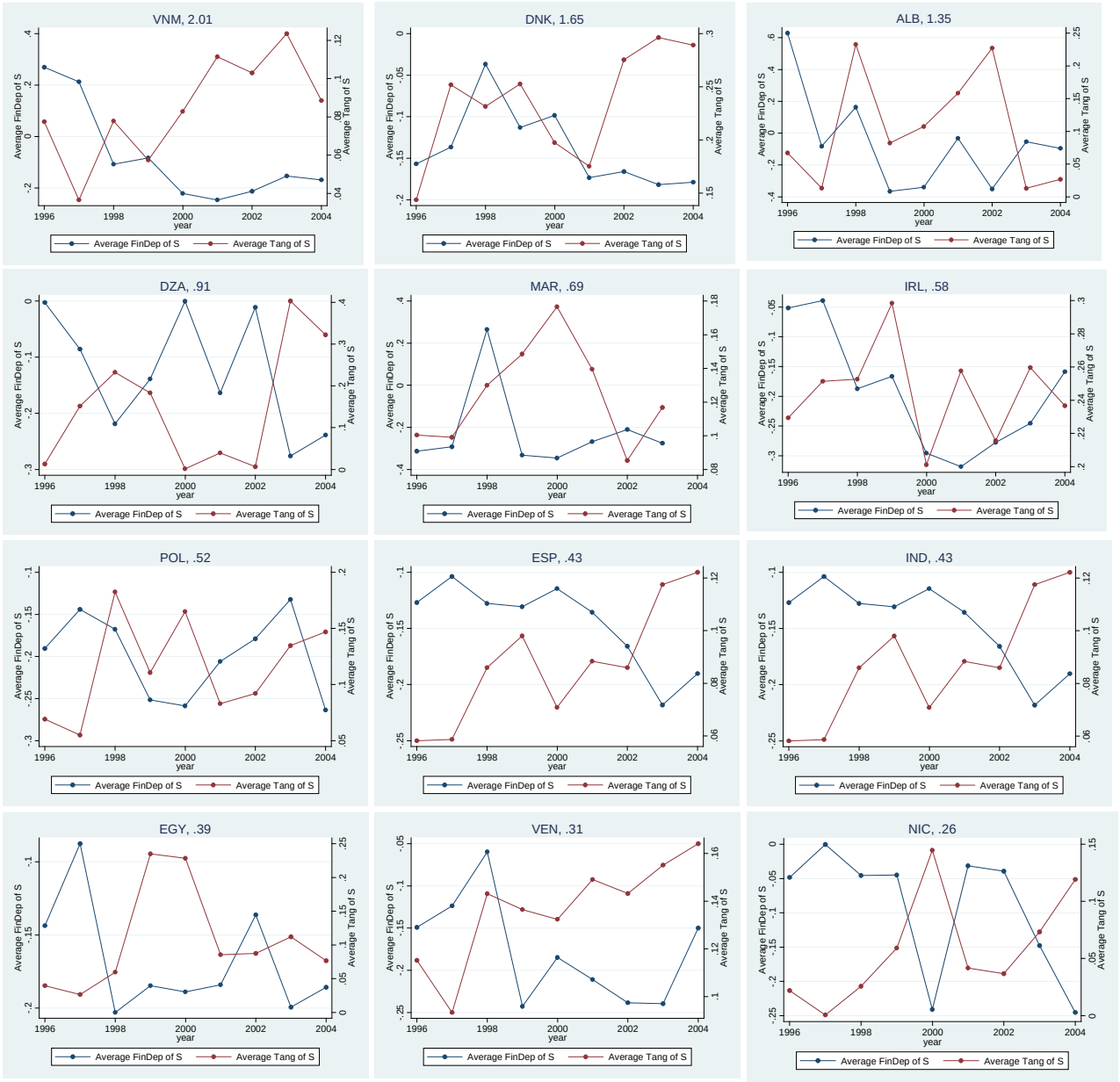

Figure 4. Productivity Cut-off with and without Credit Constraints

This graph plots the profit as a function of productivity and shows the wedge between the productivity cut-offs for operating with and without credit constraints in the financing of the fixed costs.

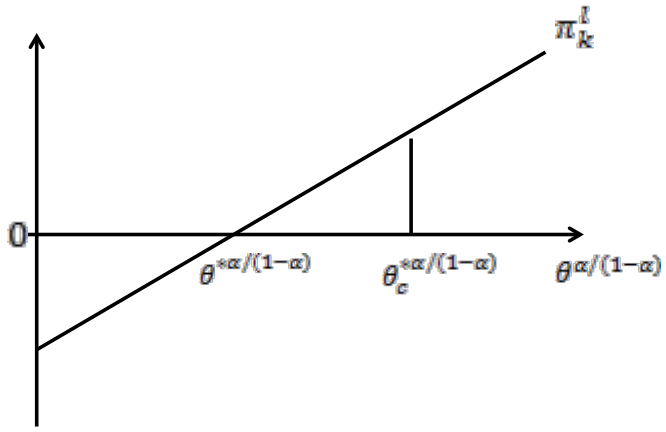

Figure 5. Productivity Cut-offs in Headquarter Intensive Sector without Credit Constraints

This graph plots the profit as a function of productivity in the Headquarter Intensive Sector and shows the productivity cut-offs for outsourcing in the North, vertical integration in the North, outsourcing in the South, and vertical integration in the South without credit constraints in the financing of the fixed costs.

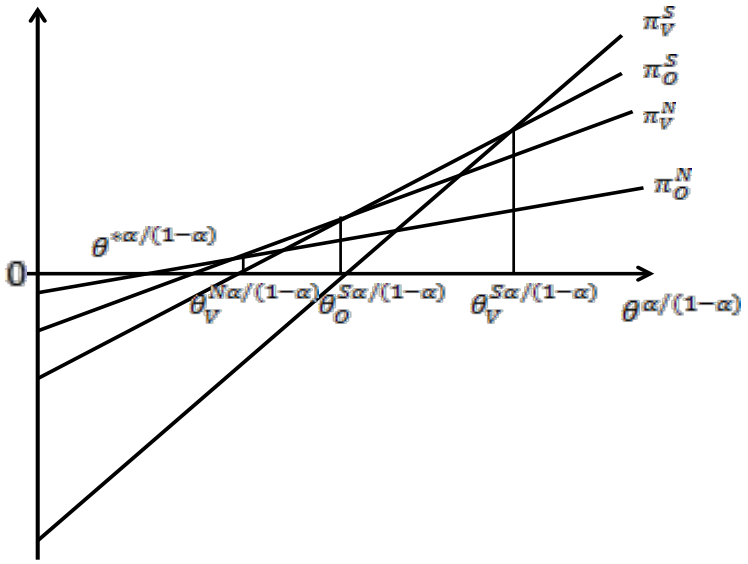

Figure 6. Existence of Multinational Firms and Financial Improvement in the South

This graph shows that different subsets of firm organizational firms may exist in the equilibrium; however, vertical integration in the South will always exist due to lack of the upper bound on the productivity. The arrows show how the productivity cut-offs will change for a financial improvement in the South.

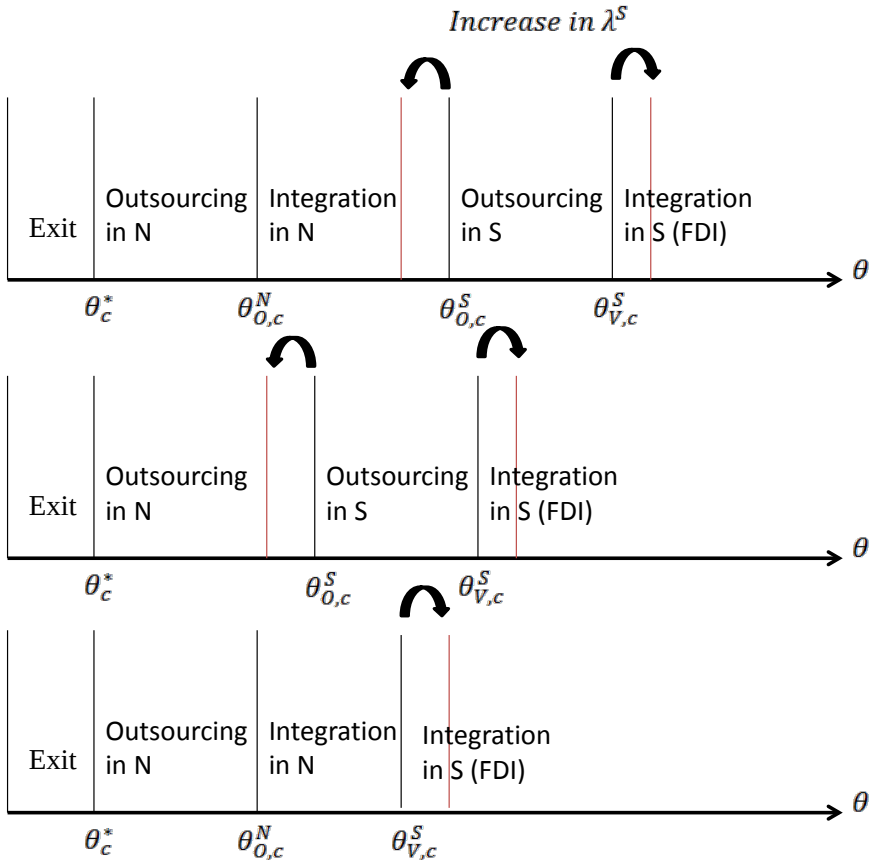

Figure 7. Productivity Cut-off with and without Credit Constraints in Component Intensive Sector

This graph plots the profit as a function of productivity in the Component Intensive Sector and shows the wedge between the productivity cut-offs for outsourcing in the North and South with and without credit constraints in the financing of the fixed costs.

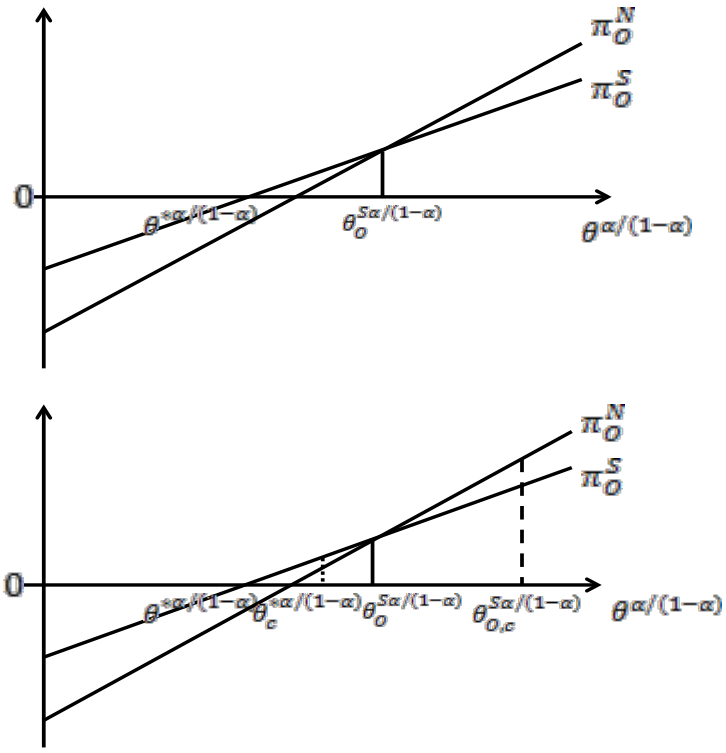

Figure 8. Financial Improvement in the South

This graph shows the change in the productivity cut-offs for outsourcing in the North and the South with credit constraints in the financing of the fixed costs when the South becomes more financially developed.

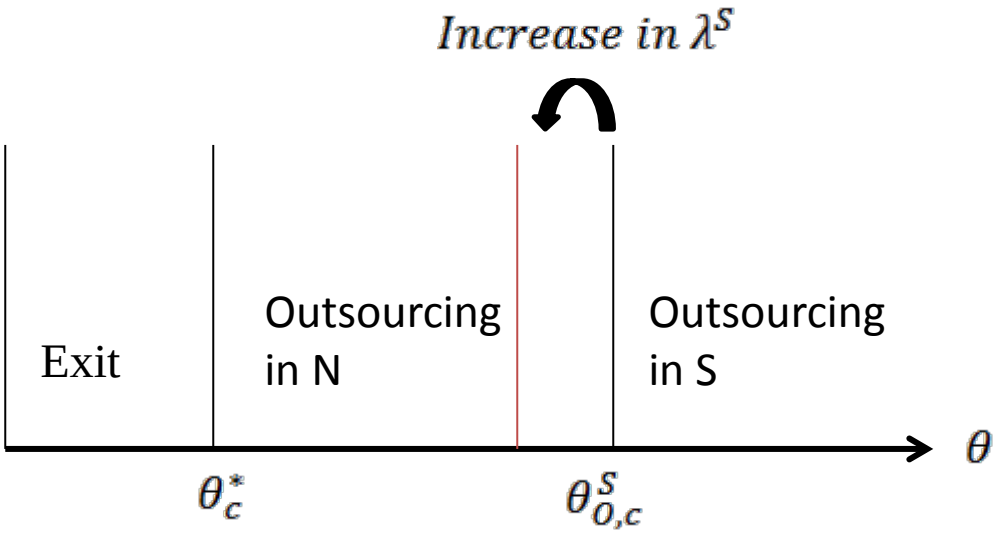

Table 1. Summary Statistics

This table summarizes the variation in the U.S. intra-firm imports from 90 countries and 429 4-digit SIC sectors in the period 1996-2005.

Panel A. Trading Partners

	N of Partners	Sample	Avg Share of Party-related Trade	Standard Deviation	Avg Number of Trade Partners	Standard Deviation
All	90	211826	0.22	0.31	60	30
Positive Party-related Trade	90	121800	0.36	0.32	35	19

Panel B. Vertical Integration v. Outsourcing

	Share of Positive Trade	KL	Standard Deviation	Weighted KL	Standard Deviation	Trade Volume (logs)	
						Mean	Standard Deviation
Positive Party-related Trade	0.63	4.40	0.94	4.73	1.08	14.55	3.04
Outsourcing Only	0.37	4.42	0.92	5.01	1.10	10.49	2.34

Table 2. Measurements of Financial Development

This table summarizes the variation a country's financial development variation over the timer period 1996–2005. The financial development is defined as the ratio of private credit to GDP.

ISO	Mean	St Dev	ISO	Mean	St Dev	ISO	Mean	St Dev
CHE	1.60	0.04	BOL	0.45	0.07	GTM	0.17	0.01
HKG	1.58	0.10	SVK	0.43	0.08	TUR	0.17	0.02
GBR	1.27	0.12	URY	0.42	0.13	TGO	0.15	0.01
PRT	1.17	0.30	HRV	0.40	0.08	MLI	0.15	0.03
DEU	1.13	0.05	SLV	0.40	0.02	HTI	0.14	0.01
JPN	1.11	0.05	PHL	0.38	0.07	PNG	0.14	0.02
NZL	1.07	0.07	IDN	0.31	0.17	MNG	0.13	0.08
SGP	1.04	0.08	HND	0.31	0.06	RUS	0.13	0.04
IRL	0.95	0.18	HUN	0.29	0.08	LTU	0.13	0.04
MYS	0.95	0.06	LKA	0.28	0.01	NGA	0.13	0.03
THA	0.93	0.18	BRA	0.28	0.01	MDA	0.13	0.04
CHN	0.92	0.03	VNM	0.27	0.16	KAZ	0.11	0.07
ESP	0.91	0.14	KEN	0.27	0.03	BFA	0.11	0.02
DNK	0.89	0.57	ECU	0.27	0.06	GHA	0.10	0.02
AUS	0.85	0.10	IND	0.27	0.04	VEN	0.09	0.02
PAN	0.82	0.11	SAU	0.25	0.03	MOZ	0.09	0.06
ISR	0.80	0.12	POL	0.24	0.04	MDG	0.09	0.01
KOR	0.72	0.15	PAK	0.23	0.02	ARM	0.07	0.01
ITA	0.70	0.12	PER	0.23	0.03	DZA	0.07	0.03
JOR	0.68	0.02	DOM	0.23	0.04	ZMB	0.07	0.01
ZAF	0.67	0.07	NIC	0.22	0.04	KHM	0.06	0.01
NOR	0.67	0.08	CRI	0.21	0.07	GEO	0.06	0.02
CAN	0.66	0.03	PRY	0.21	0.04	UGA	0.05	0.00
SWE	0.63	0.31	JAM	0.20	0.05	ALB	0.05	0.02
FIN	0.57	0.05	COL	0.19	0.02	CAF	0.05	0.01
CHL	0.56	0.04	ARG	0.19	0.05	KGZ	0.05	0.02
TUN	0.53	0.05	BGR	0.19	0.09	TZA	0.05	0.01
GRC	0.50	0.15	LVA	0.18	0.10	NER	0.05	0.01
CZE	0.49	0.15	MEX	0.18	0.03	AGO	0.03	0.01
EGY	0.46	0.07	SEN	0.17	0.02	SLE	0.02	0.01

Table 3. Measurements of Financial Development and Financial Vulnerability

Panel A provides the summary statistics for other financial development measures: risk of expropriation, risk of contract repudiation, accounting standard, and whether a country is of English origin. On a scale from 1 to 10, a higher score implies less risk of expropriation and contract repudiation. A higher score on accounting standard also implies better financial development. Panel B provides the summary statistics for a sector's external dependence on finance and asset tangibility.

Panel A. Measures of Financial Development

	Sample	Mean	Standard Deviation
Risk of Expropriation	41	7.83	1.53
Risk of Contract Repudiation	41	7.34	1.74
Accounting Standards	34	60	14
Eglish Origin	41	0.39	0.49

Panel B. Measures of Financial Vulnerabiltiy

	Sample	Mean	Standard Deviation
External Finance	172225	-1.25	2.04
Asset Tangibility	172225	0.74	0.73

Table 4. Financial Development and Sourcing Decisions

This table examines the effect of credit constraints on the choice of organizational forms. The dependent variable is log $[S^l_{jt}/(1\text{-}S^l_{jt})]$, where S^l_{jt} is the share of intra-firm U.S. imports in a 4-digit SIC sector j from country l in year t. There are 375 4-digit sectors, 122 3-digit industries, and the data spans from year 1996 to 2005. Financial development is measured by private credit. External finance dependence Ext fin dep and asset tangibility Tang are defined in the text. Log of capital to labor ratio is K/L in the table. IV estimation uses whether the exporting country is of English origin as the instrument. ***, ** and * indicate significance at 1%, 5% and 10% level.

Dependent Variable	Log R/(1-R)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		PC/GDP	Stock Cap	Stock Traded	Accounting	Contract	Expropriation	IV Estimation
Financial Development		-0.20	-0.06	-0.09	-0.97	-0.17	-0.18	-0.89
x External Finance		(0.07) ***	(0.06)	(0.04) ***	(0.59) *	(0.04) ***	(0.05) ***	(0.44) ***
Financial Development		0.05	0.10	0.03	1.32	0.13	0.15	2.00
x Asset Tangibility		(0.05)	(0.04) ***	(0.02)	(0.38) ***	(0.03) ***	(0.03) ***	(0.38) ***
Financial Development		-0.40	-0.02	-0.15				-0.13
		(0.15) ***	(0.12)	(0.07)				(0.93)
K/L	0.14	0.17	0.18	0.18	0.18	0.19	0.19	0.20
	(0.02) ***	(0.02) ***	(0.02) ***	(0.02) ***	(0.02) ***	(0.02) ***	(0.02) ***	(0.02) ***
External Finance		0.68	0.84	0.77	1.46	2.28	2.40	1.53
Dependence		(0.10) ***	(0.06) ***	(0.07) ***	(0.39) ***	(0.36) ***	(0.43) ***	(0.33) ***
Asset Tangibility		-0.71	-0.68	-0.71	-1.58	-1.84	-2.05	-2.15
		(0.07) ***	(0.07) ***	(0.05) ***	(0.25) ***	(0.24) ***	(0.29) ***	(0.27) ***
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	28,195	28,195	26,971	26,843	20,488	22,172	22,172	22,172
Adjusted R-squared	.10	.12	.12	.12	.11	.12	.12	.12

Table 5. Financial Development and Sourcing Decisions: Robustness Checks

This table examines the robustness of the effect of credit constraints on the choice of organizational forms. The dependent variable is log $[S^l_{jt}/(1\text{-}S^l_{jt})]$, where S_{jt} is the share of intra-firm U.S. imports in a 4-digit SIC sector j from country l in year t. There are 375 4-digit sectors, 122 3-digit industries, and the data spans from year 1996 to 2005. Financial development is measured by private credit. External finance dependence Ext fin dep and asset tangibility Tang are defined in the text. Log of capital to labor ratio is K/L in the table. R & D is log R&D from U.S.; Lall index is equal to one for high- and medium-tech products, zero for low-tech products (Lall, 2000); and Rauch Index is equal to one if it's traded on integrated market or referenced priced (Rauch, 1999), see detail discussion in text. ***, ** and * indicate significance at 1%, 5% and 10% level.

Dependent Variable	Log R/(1-R)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Private Credit	Stock Cap	Private Credit	Stock Cap	Private Credit	Stock Cap	Private Credit	Stock Cap
Financial Development	-0.18	-0.07	-0.11	-0.06	-0.21	0.05	-0.12	-0.01
x External Finance	(0.08) ***	(0.03) ***	(0.08)	(0.03) ***	(0.08) ***	(0.02) ***	(0.07) *	(0.06)
Financial Development	0.05	0.12	0.11	0.15	0.07	0.10	0.11	0.15
x Asset Tang	(0.05)	(0.04) ***	(0.05)	(0.04) ***	(0.05)	(0.04) **	(0.05) **	(0.05) ***
Financial Development	0.00	0.00					0.00	0.01
x R & D	(0.00)	(0.00)					(0.00)	(0.00) **
Financial Development			-0.01	0.00			-0.03	-0.03
x Lall Index			(0.04)	(0.03)			(0.04)	(0.03)
Financial Development					0.03	0.08	0.07	0.13
x Rauch Index					(0.06)	(0.05)	(0.06)	(0.05) ***
Financial Development	-0.36	-0.04	-0.21	-0.09	-0.42	-0.02	-0.20	-0.15
	(0.15) **	(0.13)	(0.15)	(0.12)	(0.15) ***	(0.12)	(0.15)	(0.13)
R & D	0.06	0.06					0.00	0.00
	(0.01) ***	(0.00) ***					(0.01)	(0.00)
Lall Index			0.92	0.92			0.86	0.86
			(0.05) ***	(0.04) ***			(0.06) ***	(0.04) ***
Rauch Index					-0.78	-0.74	-0.40	-0.38
					(0.09) ***	(0.06) ***	(0.09) ***	(0.06) ***
K/L	0.16	0.17	0.05	0.06	0.29	0.28	0.13	0.13
	(0.02) ***	(0.02) ***	(0.02) ***	(0.02) ***	(0.02) ***	(0.02) ***	(0.02) ***	(0.02) ***
External Finance	0.65	0.78	0.48	0.56	0.60	0.78	0.45	0.57
Depependce	(0.10) ***	(0.05) ***	(0.10) ***	(0.05) ***	(0.10) ***	(0.05) ***	(0.10) ***	(0.06) ***
Asset Tangiblity	-0.46	-0.41	-0.06	-0.06	-0.44	-0.43	0.04	0.03
	(0.08) ***	(0.05) ***	(0.08)	(0.06)	(0.08) ***	(0.06) ***	(0.09)	(0.06)
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	28,183	26,964	28,183	26,964	28,183	26,964	28,183	26,964
Adjusted R-squared	.13	.13	.15	.15	.13	.13	.15	.15

Table 6. Financial Development and Total U.S. Imports in Headquarter Intensive Sectors

This table examines the effect of credit constraints on the total U.S. imports. The dependent variable is log M_{jt}^{l}, where M_{jt}^{l} is the total U.S. imports in a 4-digit SIC sector j from country l in year t. There are 375 4-digit sectors, 122 3-digit industries, and the data spans from year 1996 to 2005. Financial development is measured by private credit. External finance dependence Ext fin dep and asset tangibility Tang are defined in the text. Log of capital to labor ratio is K/L in the table. IV estimation uses whether the exporting country is of English origin as the instrument. ***, ** and * indicate significance at 1%, 5% and 10% level.

Dependent Variable	Log Total U.S. Imports							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
		PC/GDP	Stock Cap	Stock Traded	Accounting	Contract	Expropriation	IV Estimation
Financial Development		0.31	0.14	0.12	3.52	0.32	0.30	0.73
x External Finance		(0.08) ***	(0.07) ***	(0.04) ***	(0.67) ***	(0.05) ***	(0.05) ***	(0.12) ***
Financial Development		-1.42	-0.82	-0.56	-7.26	-0.62	-0.61	-1.19
x Asset Tangibility		(0.05) ***	(0.05) ***	(0.02) ***	(0.44) ***	(0.03) ***	(0.04) ***	(0.09) ***
Financial Development		0.02	0.06	0.02				
		(0.16)	(0.14)	(0.08) ***				
K/L	0.34	0.28	0.28	0.29	0.31	0.31	0.31	0.32
	(0.02) ***	(0.02) ***	(0.02) ***	(0.02) ***	(0.02) ***	(0.02) ***	(0.02) ***	(0.02) ***
External Finance		0.85	0.58	0.62	-1.81	-2.19	-2.19	1.05
Dependence		(0.11) ***	(0.07) ***	(0.08) ***	(0.44) ***	(0.40) ***	(0.48) ***	(0.14) ***
Asset Tangibility		-1.62	-0.43	-0.71	4.75	5.16	5.37	-1.66
		(0.08) ***	(0.06) ***	(0.06) ***	(0.29) ***	(0.28) ***	(0.33) ***	(0.12) ***
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	29,612	29,612	27,942	29,612	27,812	20,949	22,788	22,785
Adjusted R-squared	.39	.40	.36	.39	037	.30	.32	.33

Table 7. Financial Development and Total U.S. Imports in Component Intensive Sectors

This table examines the effect of credit constraints on the total U.S. imports. The dependent variable is log M_{jt}^{l}, where M_{jt}^{l} is the total U.S. imports in a 4-digit SIC sector j from country l in year t. There are 54 4-digit sectors, 7 3-digit industries, and the data spans from year 1996 to 2005. Financial development is measured by private credit. External finance dependence Ext fin dep and asset tangibility Tang are defined in the text. Log of capital to labor ratio is K/L in the table. IV estimation uses whether the exporting country is of English origin as the instrument. ***, ** and * indicate significance at 1%, 5% and 10% level.

Dependent Variable	Log U.S. Imports					
	(1)	(2)	(3)	(4)	(5)	(6)
	Private Credit/GDP	Accounting Standards	Risk of Expropriation	Contract Repudiation	Stock Capitalization	IV Estimation
Financial Development x	0.06	-0.17	0.07	0.02	0.03	1.35
External Finance	(0.06)	(0.71)	(0.06)	(0.05)	(0.02)	(0.45) ***
Financial Development x	-0.27	-1.82	-0.20	-0.16	-0.11	-1.26
Asset Tangibility	(0.04) ***	(0.51) ***	(0.04) ***	(0.03) ***	(0.04) ***	(0.34) ***
Financial Development	0.12					1.13
	(0.13)					(2.30)
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Product Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Year Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Number of Observations	16,099	6,630	8,163	8,163	12,849	8,163
Adjusted R-squared	.28	.26	.26	.26	.27	.26

Table 8. Difference in Difference for Financial Development and Sourcing Decisions

This table examines the effect of credit constraints on the total U.S. imports using difference in difference method. The dependent variable is (S_{j1999} - S_{j1997}) - (S_{j1996}- S_{j1994}), where R_{jt} is the share of intra-firm U.S. imports in a 4-digit SIC sector j from country l in year t. There are 375 4-digit sectors, 122 3-digit industries. Because the data for the year 1995 are not available, the data used in all previous tables only begin from 1996. However, the data are available for 1994. Difference in difference method is applied here to look at the effec tof an exogenous event on multinational firms' export behaviors, namely the Asian financial crisis in the year 1997. Financial development is measured by private credit. External finance dependence Ext fin dep and asset tangibility Tang are defined in the text. Log of capital to labor ratio is K/L in the table. IV estimation uses whether the exporting country is of English origin as the instrument. ***, ** and * indicate significance at 1%, 5% and 10% level.

Dependent Variable	Difference in Difference of Share of Intra-firm Trade			
	(1)		(2)	
	PC/GDP		Stock Cap	
Financial Development x	-0.07	-0.07	-0.02	-0.02
External Finance	(0.03) ***	(0.03) **	(0.01) ***	(0.01) ***
Financial Development x	0.06	0.05	0.00	0.00
Asset Tangibility	(0.04)	(0.04)	(0.01)	(0.01) ***
Financial Development	-0.24		-0.05	
	(0.10) **		(0.03) *	
K/L	0.07	0.08	0.07	0.08
	(0.02) ***	0.02 ***	(0.02) ***	0.02 ***
External Finance	0.00)		0.01	
Dependence	(0.00)		(0.00) **	
Asset Tangibility	0.00		0.00	
	(0.00)		(0.00)	
Industry Dummies	No	Yes	No	Yes
Number of Observations	5,087	5,087	4,657	4,657
R-squared	.0053	.0792	.0063	.0708
Adjusted R-squared	.0041	.0338	.0050	.0324

Table 9. Economic Significance

This table examines the economic significance of the effects of credit constraints on the share of intra-firm trade in the component intensive sectors. Each column reports the effect of one standard deviation increase in the measure of financial development of the exporting country in the sector at the 75th percentile of the distribution by external finance dependence and asset tangibility, respectively, relative to the sector at the 25th percentile. Insignificant results are not reported.

Differential Effect between sectors at 75th percentile and 25th percentile				
		Component Intensive Sectors	Headquarter Intensive Sectors	
One Standard Deviation Increase in the Financial Development		Total U.S. Imports	Share of Intra-firm Trade (odds ratio)	Total U.S. Imports
		(1)	(2)	(3)
Private Credit	External Finance Dependence		44%	22%
	Asset Tangibility	-11%		-57%
Accounting Standards	External Finance Dependence		58%	33%
	Asset Tangibility	-10%	205%	-39%
Risk of Expropriation	External Finance Dependence		33%	32%
	Asset Tangibility	-12%	250%	-37%
Contract Repudiation	External Finance Dependence		30%	38%
	Asset Tangibility	-11%	247%	-43%
Stock Capitalization	External Finance Dependence			13%
	Asset Tangibility	-14%	170%	-44%
IV	External Finance Dependence	34%	27%	18%
	Asset Tangibility	-18%	360%	-17%
			Share of Intra-firm Trade	
Difference in Difference	External Finance Dependence	-	29%	-
	Asset Tangibility	-		-

Table 10. K/L Cut-offs for Component and Headqurater Intensive Sectors

This table provides the regressions results for equation (17) (15) and (16) using prive credit to GDP ratio as the financial development measure under different K/L cut-offs for Component and Headquarter Intensive Sectors. Column (1) reports the the results in Table 7 (1) using different K/L cut-offs. Column (2) reports Table 4 (2) using different K/L cut-offs. Column (3) reports Table 6 (2) using different K/L cut-offs.

	Component Intensive Sectors	Headquarter Intensive Sectors	
	(1)	(2)	(3)
	K/L bottom 10%	K/L top 90%	
Private Credit x	0.07	-0.05	0.20
External Finance	(0.04)	(0.02) ***	(0.01) ***
Private Credit x	-.07	0.20	-0.53
Asset Tangibility	(0.06)	(0.03) ***	(0.02) ***
Financial Development	.01	-0.19	0.07
	(0.24)	(0.08) ***	(0.07)
	K/L bottom 25%	K/L top 75%	
Private Credit x	0.12	-0.15	0.22
External Finance	(0.03) ***	(0.02) ***	(0.01) ***
Private Credit x	-0.20	0.20	-0.64
Asset Tangibility	(0.05) ***	(0.03) ***	(0.02) ***
Financial Development	0.03		0.08
	(0.15)		(.08)
	K/L bottom 50%	K/L top 50%	
Private Credit x	0.04	-0.20	0.34
External Finance	(0.02) ***	(.02) ***	(0.02) ***
Private Credit x	-0.20	0.25	-1.75
Asset Tangibility	(.02) ***	(.05) ***	(0.04) ***
Financial Development	0.19	-0.28	.46
	(0.10) **	(0.11) ***	(.10) ***

Appendix

Cut-off Productivies for Headquarter Intensive Sectors

As in Antras and Helpman (2004), the cutoffs without credit contraint are given by:

$$\theta^* = X^{(\alpha-\kappa)/\alpha}\left[\frac{w^N f_O^N}{\psi_O^N(\eta)}\right]^{(1-\alpha)/\alpha},$$

$$\theta_V^N = X^{(\alpha-\kappa)/\alpha}\left[\frac{w^N (f_V^N - f_O^N)}{\psi_V^N(\eta) - \psi_O^N(\eta)}\right]^{(1-\alpha)/\alpha},$$

$$\theta_O^S = X^{(\alpha-\kappa)/\alpha}\left[\frac{w^N (f_O^S - f_V^N)}{\psi_O^S(\eta) - \psi_V^N(\eta)}\right]^{(1-\alpha)/\alpha},$$

$$\theta_V^S = X^{(\alpha-\kappa)/\alpha}\left[\frac{w^N (f_V^S - f_O^S)}{\psi_V^S(\eta) - \psi_O^S(\eta)}\right]^{(1-\alpha)/\alpha},$$

With credit constraints, the new cutoffs are given by equation (3.13):

$$\theta_c^* = X^{(\alpha-\kappa)/\alpha}\left[\frac{(1-d+d/\lambda^N)w^N f_O^N - \frac{1-\lambda^N}{\lambda^N} t w^N f_E}{\psi_O^N(\eta)}\right]^{(1-\alpha)/\alpha}$$

$$\theta_{V,c}^N = X^{(\alpha-\kappa)/\alpha}\left[\frac{(1-d+d/\lambda^N)w^N (f_V^N - f_O^N)}{\psi_V^N(\eta) - \psi_O^N(\eta)}\right]^{(1-\alpha)/\alpha}$$

$$\theta_{O,c}^S = X^{(\alpha-\kappa)/\alpha}\left[\frac{(1-d+d/\lambda^S)w^N f_O^S - \frac{1-\lambda^S}{\lambda^S} t w^N f_E - \left[(1-d+d/\lambda^N)w^N f_V^N - \frac{1-\lambda^N}{\lambda^N} t w^N f_E\right]}{\psi_O^S(\eta) - \psi_V^N(\eta)}\right]^{(1-\alpha)/\alpha}$$

$$\theta_{V,c}^S = X^{(\alpha-\kappa)/\alpha}\left[\frac{(1-d+d/\lambda^N)w^N f_V^S - \frac{1-\lambda^N}{\lambda^N} t w^N f_E - \left[(1-d+d/\lambda^S)w^N f_O^S - \frac{1-\lambda^S}{\lambda^S} t w^N f_E\right]}{\psi_V^S(\eta) - \psi_O^S(\eta)}\right]^{(1-\alpha)/\alpha}$$

Proof of Proposition 1

In component intensive sectors, firms do not integrate. An increase in financial development in the South leads to more outsourcing in the South ($\frac{\partial \theta^S_{O,c}}{\partial \lambda^S} < 0$ and $\frac{\partial \theta^*_c}{\partial \lambda^S} = 0$). An increase in financial development in the North leads to less outsourcing in the South ($\frac{\partial \theta^S_{O,c}}{\partial \lambda^N} > 0$ and $\frac{\partial \theta^*_c}{\partial \lambda^N} < 0$). This effect is stronger in the sectors that require more outside capital ($\frac{\partial \theta^S_{O,c}}{\partial d \partial \lambda^S} < 0$ and $\frac{\partial \theta^*_c}{\partial d \partial \lambda^S} = 0$ for the South, $\frac{\partial \theta^S_{O,c}}{\partial d \partial \lambda^N} > 0$ and $\frac{\partial \theta^*_c}{\partial d \partial \lambda^N} < 0$ for the North) and less tangible assets ($\frac{\partial \theta^S_{O,c}}{\partial t \partial \lambda^S} > 0$ and $\frac{\partial \theta^*_c}{\partial d \partial \lambda^S} = 0$ for the South, $\frac{\partial \theta^S_{O,c}}{\partial t \partial \lambda^N} < 0$ and $\frac{\partial \theta^*_c}{\partial t \partial \lambda^N} > 0$ for the North).

Since X and $\psi^l_k(\eta)$ is not a function of λ, d, and t, the productivity cut-off increases if the partial derivative sign is positive, and decreases if it is negative:

$$\frac{\partial \theta^*_c}{\partial \lambda^N} \propto (\frac{t f_E - d f^N_O}{\lambda^{N2}}) w^N / \psi^N_O < 0, \frac{\partial \theta^*_c}{\partial \lambda^S} = 0$$

$$\frac{\partial \theta^S_{O,c}}{\partial \lambda^N} \propto -\frac{\partial \theta^*_c}{\partial \lambda^N} > 0, \frac{\partial \theta^S_{O,c}}{\partial \lambda^S} \propto (\frac{t f_E - d f^S_O}{\lambda^{S2}}) w^N / (\psi^S_O(\eta) - \psi^N_O(\eta)) < 0.$$

$$\frac{\partial \theta^*_c}{\partial d \partial \lambda^N} \propto -\frac{1}{\lambda^{N2}} w^N f^N_O / \psi^N_O < 0, \frac{\partial \theta^*_c}{\partial d \partial \lambda^S} = 0$$

$$\frac{\partial \theta^S_{O,c}}{\partial d \partial \lambda^N} > 0, \frac{\partial \theta^S_{O,c}}{\partial d \partial \lambda^S} \propto -\frac{1}{\lambda^{S2}} w^N f^S_O / \psi^S_O < 0,$$

and the opposite for tangible assets:

$$\frac{\partial \theta^*_c}{\partial t \partial \lambda^N} \propto \frac{1}{\lambda^{N2}} w^N f^N_O / \psi^N_O > 0, \frac{\partial \theta^*_c}{\partial d \partial \lambda^S} = 0$$

$$\frac{\partial \theta^S_{O,c}}{\partial t \partial \lambda^N} < 0, \frac{\partial \theta^S_{O,c}}{\partial t \partial \lambda^S} \propto \frac{1}{\lambda^{S2}} w^N f^S_O / \psi^S_O > 0.$$

Proof of Proposition 2

For headquarter intensive sectors, firms tend to choose outsourcing in more financially developed country ($\frac{\partial\theta^S_{V,c}}{\partial\lambda^S}>0$, $\frac{\partial\theta^S_{O,c}}{\partial\lambda^S}<0$ and $\frac{\partial\theta^S_{V,c}}{\partial\lambda^N}<0$, $\frac{\partial\theta^S_{O,c}}{\partial\lambda^N}>0$). This effect is more pronounced in financially vulnerable sectors ($\frac{\partial\theta^S_{V,c}}{\partial d\partial\lambda^S}>0$, $\frac{\partial\theta^S_{O,c}}{\partial d\partial\lambda^S}<0$, $\frac{\partial\theta^S_{V,c}}{\partial t\partial\lambda^S}<0$, $\frac{\partial\theta^S_{O,c}}{\partial t\partial\lambda^S}>0$ and $\frac{\partial\theta^S_{V,c}}{\partial d\partial\lambda^N}<0$, $\frac{\partial\theta^S_{O,c}}{\partial d\partial\lambda^N}>0$, $\frac{\partial\theta^S_{V,c}}{\partial t\partial\lambda^N}>0$, $\frac{\partial\theta^S_{O,c}}{\partial t\partial\lambda^N}<0$). In sectors with higher headquarter intensity, integration is favored relative to outsourcing ($\frac{\partial}{\partial\eta}\frac{\psi^l_V(\eta)}{\psi^l_O(\eta)}>0$ for $l=N,S$).

Productivity cut-offs without credit constraints in headquarter intensive sectors are the following:

$$\theta^*=X^{(\alpha-\kappa)/\alpha}\left[\frac{w^N f^N_O}{\psi^N_O(\eta)}\right]^{(1-\alpha)/\alpha},$$

$$\theta^N_V=X^{(\alpha-\kappa)/\alpha}\left[\frac{w^N(f^N_V-f^N_O)}{\psi^N_V(\eta)-\psi^N_O(\eta)}\right]^{(1-\alpha)/\alpha},$$

$$\theta^S_O=X^{(\alpha-\kappa)/\alpha}\left[\frac{w^N(f^S_O-f^N_V)}{\psi^S_O(\eta)-\psi^N_V(\eta)}\right]^{(1-\alpha)/\alpha},$$

$$\theta^S_V=X^{(\alpha-\kappa)/\alpha}\left[\frac{w^N(f^S_V-f^S_O)}{\psi^S_V(\eta)-\psi^S_O(\eta)}\right]^{(1-\alpha)/\alpha}.$$

With credit constraints, the new cutoffs are given by:

$$\theta^*_c=X^{(\alpha-\kappa)/\alpha}\left[\frac{(1-d+d/\lambda^N)w^N f^N_O-\frac{1-\lambda^N}{\lambda^N}tw^N f_E}{\psi^N_O(\eta)}\right]^{(1-\alpha)/\alpha}$$

$$\theta^N_{V,c}=X^{(\alpha-\kappa)/\alpha}\left[\frac{(1-d+d/\lambda^N)w^N(f^N_V-f^N_O)}{\psi^N_V(\eta)-\psi^N_O(\eta)}\right]^{(1-\alpha)/\alpha}$$

$$\theta^S_{O,c}=X^{(\alpha-\kappa)/\alpha}\left[\frac{(1-d+d/\lambda^S)w^N f^S_O-\frac{1-\lambda^S}{\lambda^S}tw^N f_E-\left[(1-d+d/\lambda^N)w^N f^N_V-\frac{1-\lambda^N}{\lambda^N}tw^N f_E\right]}{\psi^S_O(\eta)-\psi^N_V(\eta)}\right]^{(1-\alpha)/\alpha}$$

$$\theta^S_{V,c}=X^{(\alpha-\kappa)/\alpha}\left[\frac{(1-d+d/\lambda^N)w^N f^S_V-\frac{1-\lambda^N}{\lambda^N}tw^N f_E-\left[(1-d+d/\lambda^S)w^N f^S_O-\frac{1-\lambda^S}{\lambda^S}tw^N f_E\right]}{\psi^S_V(\eta)-\psi^S_O(\eta)}\right]^{(1-\alpha)/\alpha}$$

Comparative Statics:

$$\frac{\partial\theta^*_c}{\partial\lambda^N}\propto(\frac{tf_E-df^N_O}{\lambda^{N2}})w^N/\psi^N_O<0,\qquad\frac{\partial\theta^*_c}{\partial\lambda^S}=0$$

$$\frac{\partial\theta^N_{V,c}}{\partial\lambda^N}\propto\frac{-df^N_V}{\lambda^{N2}}w^N(f^N_V-f^N_O)/(\psi^N_V(\eta)-\psi^N_O(\eta))<0,\qquad\frac{\partial\theta^N_{V,c}}{\partial\lambda^S}=0$$

$$\frac{\partial \theta^S_{O,c}}{\partial \lambda^N} \propto -(\frac{tf_E - df^N_V}{\lambda^{N2}})w^N/(\psi^S_O(\eta) - \psi^N_V(\eta)) > 0,$$

$$\frac{\partial \theta^S_{O,c}}{\partial \lambda^S} \propto (\frac{tf_E - df^S_O}{\lambda^{S2}})w^N/(\psi^S_O(\eta) - \psi^N_V(\eta)) < 0$$

$$\frac{\partial \theta^S_{V,c}}{\partial \lambda^N} \propto (\frac{tf_E - df^S_V}{\lambda^{N2}})w^N/(\psi^S_V(\eta) - \psi^S_O(\eta)) < 0,$$

$$\frac{\partial \theta^S_{V,c}}{\partial \lambda^S} \propto -(\frac{tf_E - df^S_O}{\lambda^{S2}})w^N/(\psi^S_V(\eta) - \psi^S_O(\eta)) > 0$$