DISCUSSION PAPER SERIES

No. 5903

CONTRACTUAL INSTITUTIONS, FINANCIAL DEVELOPMENT AND VERTICAL INTEGRATION: THEORY AND EVIDENCE

Rocco Macchiavello

DEVELOPMENT ECONOMICS

Centre for Economic Policy Research

www.cepr.org

Available online at: **www.cepr.org/pubs/dps/DP5903.asp**

ISSN 0265-8003

CONTRACTUAL INSTITUTIONS, FINANCIAL DEVELOPMENT AND VERTICAL INTEGRATION: THEORY AND EVIDENCE

Rocco Macchiavello, Oxford University (Nuffield College), STICERD and CEPR

Discussion Paper No. 5903
October 2006

Centre for Economic Policy Research
90–98 Goswell Rd, London EC1V 7RR, UK
Tel: (44 20) 7878 2900, Fax: (44 20) 7878 2999
Email: cepr@cepr.org, Website: www.cepr.org

CEPR Discussion Paper No. 5903

October 2006

ABSTRACT

Contractual Institutions, Financial Development and Vertical Integration: Theory and Evidence*

This paper develops an industry equilibrium model of vertical integration under contractual imperfections with specific input suppliers and external investors. I assume that vertical integration economizes on the needs for contracts with specific input suppliers at the cost of higher financial requirements. I show that the two forms of contractual imperfections have different effects on the degree of vertical integration, and that contractual frictions with external investors affect vertical integration through two opposing channels: a direct negative, investment, effect and an indirect positive, entry, effect. Using cross-country-industry data, I present novel evidence on the institutional determinants of international differences in vertical integration which is consistent with the predictions of the theoretical model. In particular, I show that countries with more developed financial systems are relatively more vertically integrated in industries that are dominated by large firms.

JEL Classification: D23, L11, L22 and O14
Keywords: contract enforcement, credit constraints, developing countries, industry equilibrium and vertical integration

Rocco Macchiavello
LSE-STICERD
Houghton Street
London
WC2A 2AE
Email: r.macchiavello@lse.ac.uk

* I am especially indebted to Tim Besley and Maitreesh Ghatak for their support, and Abijhit Banerjee for encouraging me at the beginning of this project. I also thank Oriana Bandiera, Marianne Bertrand, Robin Burgess, Dave Donaldson, Leonardo Felli, Sharun Mukand, Steve Pisckhe, Xavier Ragot, Imran Rasul, Philipp Schmidt-Dengler, John Sutton, Fabian Waldinger, Fabrizio Zilibotti and participants at NEUDC 2005 conference, and seminars at Berkeley, Bocconi, Essex, HEC Paris, IFS, IIES, LSE, Maryland, Munich, Oxford, PennState, PSE-Jourdan and UvA for useful comments. All errors are mine.

Submitted 20 September 2006

Contractual Institutions, Financial Development and Vertical Integration: Theory and Evidence

Rocco Macchiavello*

First Version: April 2005

This Version: July 2006

Abstract

This paper develops an industry equilibrium model of vertical integration under contractual imperfections with specific input suppliers and external investors. I assume that vertical integration economizes on the needs for contracts with specific input suppliers at the cost of higher financial requirements. I show that the two forms of contractual imperfections have different effects on the degree of vertical integration, and that contractual frictions with external investors affect vertical integration through two opposing channels: a direct negative, investment, effect and an indirect positive, entry, effect. Using cross-country-industry data, I present novel evidence on the institutional determinants of international differences in vertical integration which is consistent with the predictions of the theoretical model. In particular, I show that countries with more developed financial systems are relatively more vertically integrated in industries that are dominated by large firms.

Keywords: Vertical Integration, Credit Constraints, Contract Enforcement, Developing Countries, Industry Equilibrium.

JEL Codes: D23, L11, L22, O14.

1 Introduction

This paper analyzes the different implications of contractual imperfections with suppliers of specific inputs and with external investors on the degree of vertical integration at the industry level. The

*Oxford University, Nuffield College, STICERD and CEPR. I am especially indebted to Tim Besley and Maitreesh Ghatak for their support, and Abijhit Banerjee for encouraging me at the beginning of this project. I also thank Oriana Bandiera, Marianne Bertrand, Robin Burgess, Dave Donaldson, Leonardo Felli, Sharun Mukand, Steve Pischke, Xavier Ragot, Imran Rasul, Philipp Schmidt-Dengler, John Sutton, Fabian Waldinger, Fabrizio Zilibotti and participants at NEUDC 2005 conference, and seminars at Berkeley, Bocconi, Essex, HEC Paris, IFS, IIES, LSE, Maryland, Munich, Oxford, PennState, PSE-Jourdan and UvA for useful comments. All errors are mine. E-Mail: R.Macchiavello@lse.ac.uk

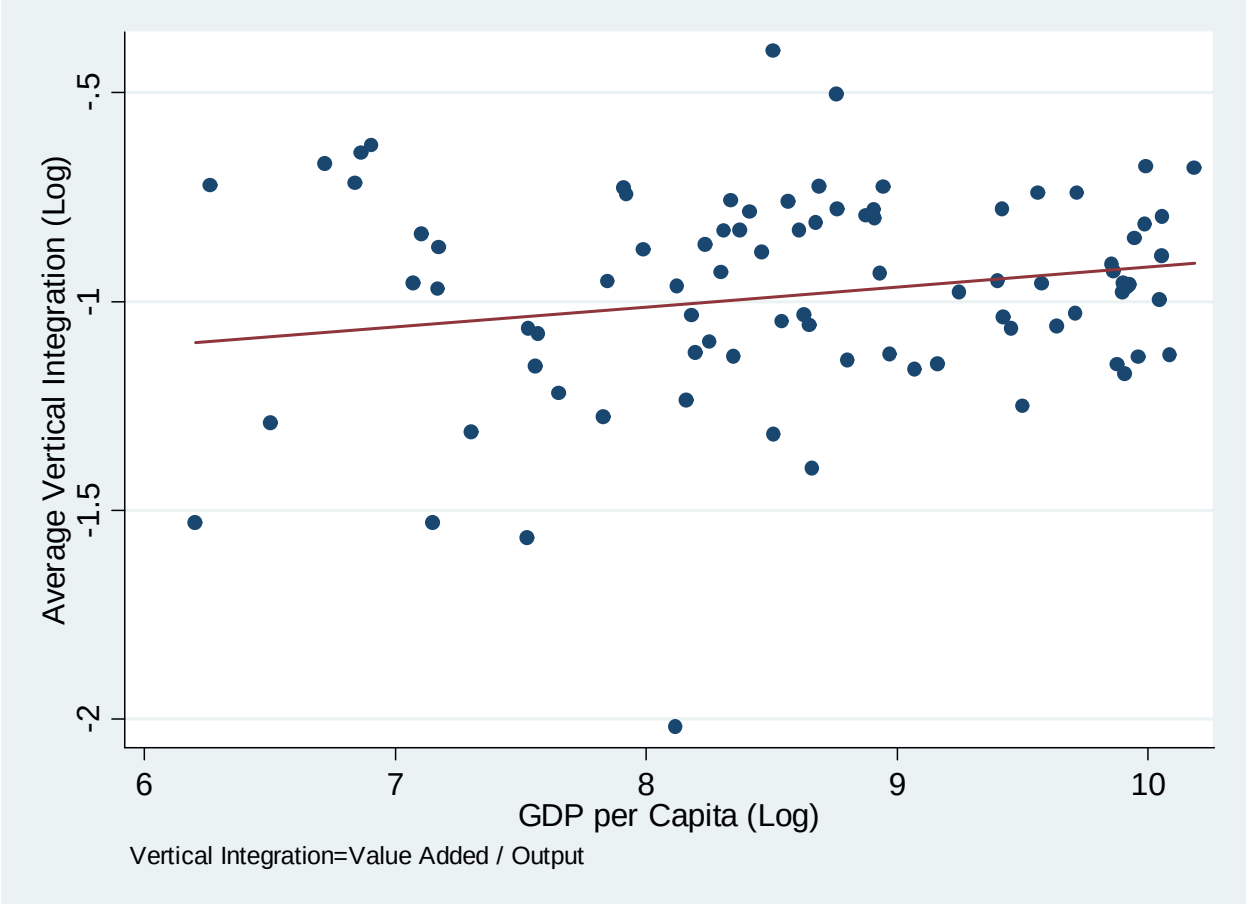
main results are that contractual imperfections with specific input suppliers and with external investors have different effects on vertical integration. In particular, financial market imperfections affect vertical integration through two opposing channels: a direct negative, investment, effect and an indirect positive, entry, effect. I develop an industry equilibrium model with heterogeneous firms that combines a simple theory of vertical integration with a convenient parametrization of contractual frictions in specific input and financial markets. The model provides guidance on how to disentangle the opposing effects empirically. Using cross-country-industry data, I find robust correlations which are consistent with the predictions of the theoretical model. In particular, I show that countries with more developed financial systems are relatively more vertically integrated in industries that are dominated by large firms. This work presents novel evidence on international differences in the organization of production and their institutional determinants, complements the existing literature on the determinants of vertical integration, and raises new theoretical questions on the long standing issue of what determines firm boundaries.

Anecdotal evidence, as well as theoretical considerations, suggests the possibility of important cross-country differences in the organization of production in general, and in the degree of vertical integration in particular. For instance, the transaction cost approach to vertical integration (see e.g. Williamson (1975, 1985)) argues that when it is difficult to write detailed contracts, trading at arm's length results in excessive transaction costs. Vertical integration, by replacing the bargaining process with authority, reduces transaction costs and becomes, *ceteris paribus*, more likely when contracts are hard to write and enforce. Since less developed countries are characterized by poor contractual enforcement, firms in those countries are often thought to be larger and more vertically integrated (see e.g. Khanna and Palepu (1997, 2000)).

In a recent paper, Acemoglu et al. (2005) provide evidence on the cross country determinants of vertical integration and cast some doubts on these views. They show that countries with worse contractual institutions have higher degrees of vertical integration but these findings are entirely driven by industrial composition. Within industries, there is no evidence that countries with worse contractual institutions have higher degrees of vertical integration. Figure 1 confirms Acemoglu et al. (2005) findings using an alternative measure of vertical integration. It plots (the log of) the unweighted average of the ratios of value added over output[1] across 25 industries in the manufac-

[1]Since Adelman (1955), a commonly used proxy of vertical integration in the industrial organization literature.

Figure 1: Vertical Integration and GDP Per Capita



turing sector against the (log of the) GDP per capita of each country. Figure 1 does not support the view that there is a higher propensity for firms to vertically integrate in poorer countries, and is instead consistent with anecdotal evidence suggesting that subcontracting arrangements are fairly extensive in the developing world and in late industrializing countries.[2]

Motivated by this evidence, this paper investigates whether contractual insitutions, and in particular financial markets imperfections, affect vertical integration differently across industries. Since contractual imperfections severely affect the efficiency of transactions in financial markets[3],

[2] See, for example, the experience of Italian industrial districts or the clusters in the early computer industry in Taiwan (Levy (1990)). Further examples from developing countries are given by the cotton industry in Tiruppur in southern India, the Guadalajara shoe cluster in Mexico (Woodruff (2002)), or the Sinos Valley in Brazil (Schmitz (1996)). Andrabi et al. (2004) provide an insightful analysis of the subcontracting arrangements of a large tractor producer in Pakistan.

[3] Cross-country studies show that measures of financial development are strongly correlated with legal origin and other aspects of the legal system (see e.g. LaPorta et al. (1998)).

contractual imperfections with specific input suppliers and with external investors may be highly correlated requiring an analysis that disentangles their different roles.

To provide such an analysis, I develop an industry equilibrium model of vertical integration with contractual imperfections in specific input and financial markets. I make one key assumption: vertical integration economizes on the needs for contracting with specific input suppliers at the cost of higher contractual needs with external investors. I embed this model of vertical integration in an industry equilibrium model in which firms are heterogeneous with respect to their productivity levels, as in Melitz (2003).

The model shows that contractual frictions in the intermediate input market and in the financial market have radically different implications for the extent of vertical integration in the industry. Since fewer contractual frictions in the intermediate input market mitigate the hold-up problem associated with arm's length transactions, the first part of the assumption implies that better contractual institutions reduce vertical integration in the industry.

The second part of the assumption nicely captures the fact that contractual frictions in financial markets affect vertical integration in the industry through two conceptually distinct and opposed channels and is consistent with acnedotal evidence from case studies from developing countries and American business history that suggest that external finance availability is an important determinant of vertical integration. For instance, Porter and Livesay (1971) document how only (entrepreneurs linked by various ties to) rich merchants where able to pursue a strategy of backward integration into the production stages.[4] Financial market imperfections thus have a *direct (investment)* impact on vertical integration: since vertical integration implies higher financial needs, less developed financial markets allow less firms to become vertically integrated. The industry equilibrium of the model naturally captures a second *indirect (entry)* effect of financial markets on vertical integration. Contractual frictions in financial markets deter entry, and thus increase the profit base that allows firms to vertically integrate. This second effect is also consistent with acnedotal evidence from the ninetheenth century texitle industry. For instance, Temin (1988) and Brown (1992) shows that firms in less competitive environments created by financial underdevelopment and / or trade barriers were significantly more vertically integrated. Haber (1991) convincingly demonstrate

[4] In a similar context, in a very detailed study of the Tiruppur cotton industry, Banerjee and Munshi (2004) analyze the effects of better access to local capital markets by different groups of entrepreneurs and conclude that entrepreneurs with better access to local finance are more vertically integrated and have greater control over the production process.

that financial market imperfections have been an important barrier to entry in ninetheenth century texitle industry.[5]

Since the "investment" and "entry" effects have opposite sign the net impact of financial market frictions on vertical integration is ambiguous. One of the key contributions of the model is to clarify in which industries the investment or the entry effect should be expected to be relatively stronger. The model implies that the "investment" effect is relatively more important, and hence better financial markets lead to higher vertical integration, in industries dominated by large firms, in which financial constraints are not a primary source of entry barriers. On the contrary, the "entry" effect is stronger, and hence better financial markets lead to lower vertical integration, in industries dominated by small firms, where financial market imperfections are more likely to be a powerful barrier to entry.

In section 3, I use cross-country-industry data to provide econometric evidence on the relationship between contractual imperfections and vertical integration. I find some evidence that better contract enforcement institutions affect vertical integration at the industry level consistently with the theoretical predictions. Most importantly, I show that countries with more developed financial markets are relatively more vertically integrated in industries that are dominated by large firms, as predicted by the theory.

This work is closely related to several strands in the literature. On the theoretical side there is a large literature on vertical integration and firm boundaries. The two dominant theories of firm boundaries are the transaction costs theory (TC) developed by Williamson (1971, 1975, 1985) and the property rights theory (PR), developed by Grossman and Hart (1986) and Hart and Moore (1990). The model in the theoretical section is most closely related to the former.[6]

While most of the theoretical work on firm boundaries presents partial equilibrium models, a new and rapidly growing literature analyzes models of firm boundaries and organization in industry equilibrium. The model in this paper is more closely related to this literature, and in particular to

[5] These evidence is conssistent with the historical experience of other industries. For instance, Helper (1996) and Langlois and Robertson (1989)) discuss the case of the early American car industry. The absence of a positive trend in vertical integration in American manufacturing industries during the nineteenth century (a period that also witnessed the gradual development of capital markets and contract laws) is also consistent with the mechanics of the model (see, e.g., references in Perry (1989)).

[6] While the two theories are conceptually different and have different empirical content (see e.g. Whinston (2003) and Gibbons (2004)), the adoption of a TC framework is not essential for our main results. In a PR tradition, Aghion and Tirole (1994), Legros and Newman (2004), and Acemoglu et al. (2006) consider settings in which ex-ante transfers are banned, an extreme form of financial markets imperfections.

Grossman and Helpman (2002). With respect to their framework, I introduce firm heterogeneity and credit market imperfections. The heterogeneity of firms is essential in generating the predictions on the differential effects of credit market imperfections on vertical integration across industries.[7] In his classical analysis of vertical integration and market imperfections, Williamson (1971) informally argued that in the presence of financial market imperfections, vertical integration may be used as a barrier to entry. The model in this paper takes a different angle on the relationship between credit constraints, entry barriers and vertical integration and leads to different conclusions.

On the empirical side, Acemoglu et al. (2005) is a parallel and independent study that is most closely related to this paper. In contrast to their work, the theoretical model in my paper allows to separate different opposing channels through which financial development affects the degree of vertical integration across industries and countries. To do so, I focus in the empirical part on relative differences across industries within countries, while they mostly focus on industrial composition and within industries propensities towards vertical integration. The two works are thus highly complementary.

Antras (2003), Acemoglu et al (2004) and Aghion et al. (2006) are recent examples of cross-industry studies of vertical integration. Antras (2003) links firm boundaries to trade flows while Acemoglu et al (2004) exploit a very rich dataset on British manufacturing establishments to investigate the links between technological intensity and vertical integration. In a similar context, Aghion et al. (2006) analyze the relationship between vertical integration and competition.[8]

The rest of the paper is organized as follows. Section 2 analyzes the theoretical model. Section 3 presents empirical evidence on the cross-country determinants of vertical integration using country-industry data. Section 4 provides some concluding remarks. Proofs and details about the main variables in the empirical analysis are in the Appendix.

[7] Antras (2003) and especially Antras and Helpman (2004) are also closely related. The latter in particular, analyzes an industry equilibrium model in which heterogeneous firms choose between FDI and outsourcing in a property rights framework. Other important recent contributions analyzing the internal organization of firms in industry equilibrum are Grossman and Helpman (2004, 2005) and Marin and Verdier (2002). Acemoglu et al. (2006) analyze an industry equilibrium model of the division of labor, while Acemoglu et al. (2003) analyze vertical integration in a Shumpeterian endogenous growth model.

[8] There is a large literature on the determinants of vertical integration in specific industries in the United States (see Whinston (2003)). A large part of this literature focussed on testing the TC theory of the firm. I am not aware of empirical papers that systematically examine the relationship between vertical integration, and credit markets. Fee et al (2005) analyze corporate equity ownership in vertical relationships in the United States.

2 Model

In this section I develop an industry equilibrium model of the relationship between vertical integration and contractual frictions with suppliers of specific inputs and external investors. The model shows that the two types of contractual frictions have different effects on vertical integration, that contractual frictions with external investors have an ambigous impact on vertical integration, and clarifies in which industries we should expect better financial markets to lead to more vertical integration.

This section is divided into three subsections. I first set up the model and introduce the contractual imperfections in input and financial markets as well as the distinction between vertical integration and non-integration, and discuss the main assumptions. I then derive the industry equilibrium. In the third part I derive the effect of contractual imperfections on the degree of vertical integration in the industry and discuss the main results.

2.1 Set Up

Environment

I consider an economy with population L that produces goods using only labor. There are $J+1$ sectors. One sector provides a single homogeneous good. This good is used as the numeraire, and its price is set equal to 1. It is produced under constant return to scale, with a technology employing 1 unit of labor to produce 1 unit of the homogeneous good. Provided that the economy produces the homogeneous good, the wage will be $w = 1$. In the remaining of the paper, I will assume that this is true. The other J sectors supply a continuum of differentiated goods. In each of these sectors there is a fixed set of potential entrepreneurs described later. Each firm is a monopolist over the variety it produces.

The workers are the only consumers, each endowed with 1 unit of labor. They all have the same CES preferences over the differentiated goods. A consumer that receives q_0 units of the homogeneous good, and $q(\theta)$ of each variety $\theta \in \Theta_j$ (to be determined in equilibrium) of the differentiated goods produced by industry $j \in \{1, ..j, ...J\}$, gets a utility U

$$U \equiv q_0^{1-J\varphi} \prod_{j=1}^{J} \left(\int_{\theta \in \Theta_j} q(\theta)^{\alpha_j} d\theta \right)^{\frac{\varphi}{\alpha_j}} \tag{1}$$

where $\varepsilon_j = \frac{1}{1-\alpha_j} > 1$ is the elasticity of substitution between two varieties of the differentiated goods in industry j.

If all varieties in the set Θ_j are available at a particular price $p(\theta)$ these preferences yield aggregate demand functions

$$q(\theta) = A_j p(\theta)^{-\varepsilon_j}$$

where $p(\theta)$ is the price of a particular variety θ and

$$A_j = \frac{\varphi L}{(\int_{\theta \in \Theta_j} p(\theta)^{-\alpha_j \varepsilon_j} d\theta)}$$

The monopolist of variety θ in industry j treats A_j as a constant, and so perceives a constant elasticity of demand ε_j. I denote $P_j = \left[\int_{\theta \in \Theta_j} p_j(\theta)^{-\alpha_j \varepsilon_j} d\theta\right]^{-\frac{1}{\alpha_j \varepsilon_j}}$ as the price index in industry j. The price index is inversely related to the "competitiveness" in the industry. Competitiveness is, *ceteris paribus*, increasing in the number of varieties produced in the industry, and decreasing in the (average) price charged by competitors.

Production and Firm Organization

I now turn to the description of firms' technology and modes of organization in the industry. Since the set of potential entrepreneurs in each industry is exogenously given, and production of the homogeneous good in the economy implies $w = 1$, industries can be treated independently. Therefore, I suppress the subscript j from industry variables. With a slight abuse of notation, I assume that each differentiated final product $y(\theta)$ is produced under a constant marginal cost technology according to

$$y(\theta) = \theta I \tag{2}$$

where I is a specialized component described below.[9] I also assume that the specialized component must be exact in its specifications, and that different final goods require distinct components. An input must also be of suitably high quality in order to be useful in the production of the final output. Furthermore, I assume that there are fixed costs associated with entering the market.

Final goods may be produced by vertically integrated firms, or by specialized producers that

[9] It is straightforward to extend the model to allow for labor as an additional factor in the production of y, by having a production function of the form $y = \theta(\frac{L}{1-\eta})^{1-\eta}(\frac{I}{\eta})^{\eta}$.

purchase their inputs at arm's length from external suppliers (outsourcing). In either case I assume that an intermediate input of low quality can be produced at no cost.

The intermediate specific input is produced undertaking specific investments in a unit measure of (symmetric) tasks, each entailing a constant marginal cost c. The (quality of) the intermediate input is then a Cobb-Douglas aggregate

$$I = \exp\left(\int_0^1 \ln x(i)di\right) \tag{3}$$

where $x(i)$ denotes the level of investment in task i.

I consider a setting with incomplete contracting where investments in some tasks i can be observed by suppliers and the customers, but cannot be verified by a court. Because of this lack of verifiability, contracts specifying a certain price for a given quantity cannot be enforced since the supplier would have strong incentives to reduce her investment in some task i. Because of the contract however, the buyer would be forced to buy the input at the stipulated price.[10]

Legal institutions vary greatly across countries. In order to capture the effects of different contractual institutions on vertical integration, I follow Acemoglu et al. (2006) in parametrizing the quality of the contract enforcement institutions in the following intuitive way. I assume that a measure μ of the tasks necessary to complete the intermediate input can be perfectly contracted upon, while a measure $(1-\mu)$ can not be contracted upon. While product and industry characteristics certainly affect the degree of contractual incompleteness in intermediate inputs transactions, contract enforcement institutions also affect the degree of incompleteness of contracts. In countries with better contracting institutions μ tends to be higher, i.e. it is relatively easy to enforce contracts that give appropriate incentives to undertake *ex-ante* investments.

There are two alternative ways of organizing the firm. Under vertical integration the entrepreneur retains control over all non contractible investments. Vertical integration entails centralized control, and thus the entrepreneur (efficiently) decides all the relevant investments $x(i)$.

Alternatively, the entrepreneur may decide to outsource to an independent supplier the production of the intermediate input. Under outsourcing the independent supplier retains control over

[10] The literature however discusses alternative solutions to contractual incompleteness (see e.g. Maskin and Tirole (1999) and Aghion et al. (1994)). I do not provide micro-foundations and take imperfect contracting as description of real commercial life.

the non-contractible investments. The absence of *ex-ante* enforceable contracts exposes parties to a hold-up problem. Once a supplier specializes its inputs to a particular final product, these inputs have higher value within the relationship than in any alternative uses. Assuming for simplicity that the value in alternative uses is zero, the downstream producer can then threaten to refuse the transaction with the upstream supplier, unless the price, negotiated once the investments are sunk, is low enough. This leaves the upstream supplier in a relatively weak position. Anticipating this situation, the upstream supplier has insufficient incentives to invest in the non-contractible tasks i.[11]

I assume that the marginal cost of investment $x(i)$ is equal to $c = 1$ in both vertically integrated firms and independent suppliers.[12]

The price for the intermediate input among two independent firms is negotiated *ex-post*. *Ex-post*, once the non contractible investments have been undertaken and the specific input produced, the two parties bargain over appropriable quasi rents which are given by the amount of profits that can be obtained using the specific input to produce the final good. To simplify, I assume that in the *ex-post* bargaining process the downstream firm retains a share $(1-\beta)$ of the revenues derived from the transaction, while the upstream firm retains the remaining share β. Treating industries in isolation, it is correct to interpret a higher μ as better contractual enforcement in the country, while a lower β parametrizes the extent to which the industry relies on contracts with suppliers. If β is high, the hold up problem is not particularly severe, while if β is low the hold up problem is very severe and significant underinvestment in the non-contractible tasks results as a consequence of contractual imperfections.

I assume that in each industry there is a fixed pool of potential entrepreneurs that are heterogenous with respect to their productivity θ. Each entrepreneur draws her productivity level θ from a distribution with associated continuous cumulative function $G(\theta)$ and observe her productivity

[11] As in the property rights theory of the firm (Grossman and Hart (1986) and Hart and Moore (1990)) I assume that (some) tasks $x(i)$ are not contractible. However, in contrast to the property rights framework, I assume that control over tasks is contractible and transferrable, as in Baker et al. (2004). This brings the theory of the firm in this model closer to Transaction Costs theories of the firm (see e.g. Williamson (1975, 1985) and Grossman and Helpman (2002)).

[12] When labor is an additional factor of production the results in the model can be obtained regardless of the contractibility of L. It would also be possible to allow differences in marginal costs of investment in task $x(i)$ across organizational form, and in particular $c < 1$ for specialized suppliers, without affecting the results. Specialized suppliers may be more efficient than vertically integrated firms due to diseconomies of scope, or the excessive bureaucratic costs associated with a more complex, vertically integrated firm.

before deciding whether to start production. To simplify, I also assume that the mass of potential entrepreneurs is equal to L in each industry. I take the distribution of the productivity parameter θ as exogenous.[13]

I assume that there is a large supply of homogenous external suppliers. This assumption implies that a firm deciding to "buy" the intermediate input always find a partner.[14]

Fixed costs and financial constraints

In order to start production, firms incur fixed costs, such as the costs of entering the market and setting up the organization and of designing the differentiated product, as well as those fixed costs associated with the equipment necessary to perform assembly operations. These costs have to be paid by all firms, regardless of the organizational form, and are denoted by f. In addition, firms that decide to become vertically integrated have to acquire control over the extra equipment needed to produce the intermediate inputs. I assume that the cost of this additional machinery is equal to k, and that both f and k are strictly positive. It is crucial that $k > 0$. This assumption introduces a trade-off between the two organizational forms which is central for the results. Vertical integration reduces the distortions associated with imperfect contracting in input markets, but comes at the cost of higher financial requirements for the firm. For our purposes, it is irrelevant whether a firm deciding to become vertically integrated incurs the extra cost k in order to acquire one of the existing suppliers, or instead builds at cost k the necessary equipment from scratch.[15]

I assume that fixed costs have to be paid up-front, i.e. before production takes place and that firms have no liquidity and need to borrow from external investors in order to finance the fixed cost investment. I assume for simplicity that the risk free interest rate in the economy is equal to zero, and that a large supply of risk neutral investors lend capital at this interest rate. I model credit constraints in a rather crude, but simple, way. I assume that the fixed costs f and k need to be

[13] However the marginal cost of producing one unit of the final good depends on the organizational form. Since firms with different θ choose different organizational forms, the distribution of measurable productivity is endogenous and is determined by the same forces shaping the organizational form choice.

[14] The assumption that suppliers are homogeneous implies that there are no matching / sorting issues between heterogeneous (in terms of θ) downstream and homogeneous upstream units, and is made for the sake of analytical tractability.

[15] The assumption that vertical integration entails higher fixed costs is common in the literature (see e.g. Williamson (1971), Grossman and Helpman (2002), Antras and Helpman (2004)). The assumption can be justified on different grounds such as, for example, "managerial" diseconomies of scales. Here I emphasize that in order to effectively acquire control over the production of the intermediate input a firm has to build its own plant, or must acquire an upstream supplier. In either case, these operations are assumed to be relatively more costly than dealing with an already established external supplier whose fixed costs are at least partially sunk.

financed in advance, and are in fact composed of a continuum of small investments. I assume that a fraction $1-\lambda$ of this investments is contractible: external investors can easily make sure that the capital is effectively invested in the project (for instance renting corporate buildings, acquiring specific machines, etc.). In contrast, the remaining fraction λ is not contractible, in the sense that the external provider of finance can not make sure that the capital is effectively invested in production (e.g. hiring the appropriate product designer, purchase of some specific services, etc.), and can be poketed by the entrepreneur.[16]

Denote with $\Pi_i(\theta)$ and F_i the variable profits and financial requirements of firms under organizational form $i \in \{v, o\}$.[17] In the Appendix I proove

Lemma 1

An entrepreneur with productivity θ obtains funding to set up a firm with organizational form $i \in \{v, o\}$ if and only if $\Pi_i(\theta) \geq (1+\lambda)F_i$.

Lemma 1 describes the effects of the contractual frictions in the financial market associated with the two different organizational forms. If λ is equal to zero, credit markets are perfect, and all projects that generate (variable) profits in excess of the fixed costs (i.e. with positive net present value), are financed. However, if λ is positive, some projects that would generate positive net present value cannot be financed because of the form of moral hazard introduced by contract incompleteness in the capital markets[18].

To summarize, the timing of events is as follows. Entrepreneurs with heterogenous productivity θ decide whether to enter the market, as a vertically integrated firm or as a specialized manufacturer of final goods. Those that choose vertical integration as the organizational form of their firm and find external investors willing to finance them, borrow from external investors and pay the corresponding fixed costs, f and k and undertake production decisions. Those that decide to enter as assemblers of final good and find external investors willing to finance them, are matched to

[16] The case of a specialized assembler is slightly more complicated, since the relationship between the external investors and the entrepreneur is also affected by the presence of the independent supplier. Since fixed costs f have to be financed before the specific match with the supplier is realized, I focus on bilateral contracts.

[17] $F_v = f + k$ and $F_o = f$ are the financial requirements of vertical integration and outsourcing respectively.

[18] The formulation relies on a form of *ex-ante* moral hazard. However one could imagine that, once firms realize revenues, the owner of the firm can hide (a share of) profits at some per unit cost $\lambda \leq 1$, avoiding to repay the external investors. This form of *ex-post* moral hazard would generate a form of credit constraints equivalent to the one introduced in the text.

a supplier. Suppliers can make *ex-ante* transfers to attract assemblers. The assembler and the supplier write an *ex-ante* contract specifying an initial transfer from the supplier to the assembler, and investments on the fraction μ of contractible tasks. After this contract is signed, the supplier undertakes non-contractible investments i. Finally, bargaining over the surplus takes place, the final goods are produced and sold, and external investors are repaid.

2.2 Industry Equilibrium

I now turn to the determination of the industry equilibrium. In order to solve the industry equilibrium, I first compute the profit functions for a vertically integrated and for a non-integrated firm respectively. I then analyze the organizational form and entry decision of entrepreneurs with productivity θ, and define the industry equilibrium. The derivation of profit functions and proofs of all the results are reported in the Appendix.

In the Appendix I show that the variable profits of a vertically integrated firm are given by

$$\Pi_v(\theta) = \alpha^{\alpha\varepsilon} A \theta^{\alpha\varepsilon}(1-\alpha) \tag{4}$$

while the profits of a non-integrated firm are equal to

$$\Pi_o(\theta) = \alpha^{\alpha\varepsilon} \Omega(\beta,\mu) A \theta^{\alpha\varepsilon}(1-\alpha) \tag{5}$$

where $\Omega(\beta,1) = 1$, $\Omega(\beta,0) = \left(\frac{1-\alpha\beta}{1-\alpha}\right)$ and $\frac{\partial\Omega(\beta,\mu)}{\partial\mu} \geq 0$. Under both organizational forms, profits are increasing in the productivity index θ, and increasing in the index A, i.e. decreasing in the number of firms active in the industry.

We have

Lemma 2

There exists a unique threshold $\widehat{\theta}_v$ such that a firm with productivity $\theta \geq \widehat{\theta}_v$ earns higher profits choosing vertical integration rather than non integration. The opposite is true for $\theta < \widehat{\theta}_v$.

In particular the unique threshold $\widehat{\theta}_v$ is determined by the equality

$$\Pi_v(\widehat{\theta}_v) - (f+k) = \Pi_o(\widehat{\theta}_v) - f \Longleftrightarrow \widehat{\theta}_v = \left(\frac{k}{A\alpha^{\alpha\varepsilon}(1-\alpha)} \frac{1}{(1-\Omega(\beta,\mu))} \right)^{\frac{1}{\varepsilon-1}} \tag{6}$$

Note that the threshold θ_v is decreasing in A. This implies that, ceteris paribus, in more competitive markets θ_v is higher, i.e. fewer firms find it profitable to integrate vertically. This is simply due to the fact that in order for vertical integration to be profitable, a firm must generate enough profits to repay the additional fixed costs. Vertical integration reduces inefficiencies caused by contract incompleteness, and is relatively more attractive for entrepreneurs with higher θ (lower marginal costs): as a result vertical integrated firms are larger and more productive.

Firms however, are not unconstrained in their choice of organizational form. When $\lambda > 0$ financial constraints prevent some firms from adopting the optimal organizational form. Substituting the profit function of a vertically integrated firm into the respective financial constraint, we obtain that a firm with productivity θ can enter the industry as a vertically integrated firm if and only if

$$\Pi_v(\theta) \geq (1+\lambda)(f+k) \Longleftrightarrow \theta \geq \theta_v = \left(\frac{(k+f)(1+\lambda)}{A\alpha^{\alpha\varepsilon}(1-\alpha)} \right)^{\frac{1}{\varepsilon-1}} \tag{7}$$

The relative position of the two thresholds θ_v and $\widehat{\theta}_v$ determines whether financial constraints affect the vertical integration decision of firms. If $\theta_v \leq \widehat{\theta}_v$, financial constraints are irrelevant when making a vertical integration. However, if $\theta_v > \widehat{\theta}_v$ instead some entrepreneurs who would like to enter the industry as vertically integrated firms are prevented from doing so by the existence of financial constraints. In the remaining part of this paper I will focus on the case in which $(1+\lambda)(1-\Omega(\beta,\mu)) > \frac{k}{(k+f)}$, and hence $\theta_v > \widehat{\theta}_v$, so that some entrepreneurs are constrained in their organizational form decision. A first implication of lower contractual frictions in the financial markets is that more entrepreneurs will be able to vertically integrate. Financial market imperfections thus impact vertical integration through a direct "investment" effect.

Finally, in order to solve for the industry equilibrium of the model I have to derive the thresholds determining whether an entrepreneur can enter the industry as a non-integrated firm. Combining the financial constraint inequality for a non-integrated firm with its respective profit function, it is obvious that an entrepreneur with productivity θ can enter the industry with a non-integrated

firm if and only if

$$\Pi_o(\theta) \geq (1+\lambda)f \Longleftrightarrow \theta \geq \theta_e = \left(\frac{f(1+\lambda)}{A\alpha^{\alpha\varepsilon}(1-\alpha)\Omega(\beta,\mu)}\right)^{\frac{1}{\varepsilon-1}} \tag{8}$$

The following proposition characterizes the equilibrium in the industry.

Proposition 3

If $\frac{f}{(k+f)} \leq \Omega(\beta,\mu)$ *there exists a unique equilibrium defined by two thresholds* θ_e *and* θ_v*, such that entrepreneurs with* $\theta < \theta_e$ *do not enter the industry, entrepreneurs with* $\theta \in [\theta_e, \theta_v)$ *enter the industry as specialized assemblers, and entrepreneurs with* $\theta \geq \theta_v$ *enter the industry as vertically integrated firms.*

If $\frac{f}{(k+f)} > \Omega(\beta,\mu)$ *there exists a unique equilibrium defined by the threshold* θ_v*, such that entrepreneurs with* $\theta < \theta_v$ *do not enter the industry, and entrepreneurs with* $\theta \geq \theta_v$ *enter the industry as vertically integrated firms.*

The model generates an endogenous sorting of firms with heterogeneous productivity into organizational forms: only relatively more productive firms generate enough variable profits to cover the extra financial requirements necessary to vertically integrate. When $\frac{f}{(k+f)} \leq \Omega(\beta,\mu)$, the distortions associated with outsourcing are relatively mild, and both organizational forms coexist in equilibrium. On the other hand, when $\frac{f}{(k+f)} > \Omega(\beta,\mu)$, the inefficiencies caused by incomplete contracting are so strong that the industry only displays vertically integrated firms. A firm trying to enter the industry as a non-integrated firm would not generate enough profits to credibly commit to repay external investors.

The endogenous sorting of firms into organizational forms implies a positive correlation between firm's size and vertical integration. Moreover, since the specialized component is useless outside the relationship, quasi-rents are entirely determined by the scale of operation of the firm. The model thus predicts a positive correlation between quasi-rents and vertical integration. These predictions are consistent with anecdotal as well as more formal evidence.[19]

[19] Acemoglu et al. (2005b) report positive correlation between size and vertical integration. The implication that vertically integrated firms are more productive, while not necessary for the results, is also consistent with empirical evidence (see e.g. Hortacsu and Syevrson (2005) on the cement industry in the U.S.). It is a common finding in empirical work in the transaction costs literature that higher quasi-rents are associated with higher vertical integration (see e.g. Whinston (2003) for a survey).

Large, and perhaps vertically integrated firms, are often believed to have easier access to financial markets, suggest the possibility that λ may vary with the organizational form of the firm, and in particular $\lambda_v < \lambda_o$. The main predictions of the model would be robust as far as $\frac{1+\lambda_o}{1+\lambda_v}\frac{f}{f+k} < \Omega(\beta,\mu)$. The model, however, suggests an alternative explanation for the presumption that vertically integrated firms, being larger, find easier access to finance. The underlying heterogeneity in productivity implies that vertically integrated firms are larger, and, while vertical integration requires more external finance, in a cross-section of firms vertically integrated firms are less likely to be financially constrained. This would also be true if instead of $k > 0$ we assumed that it is more difficult to monitor large and complex organizations, i.e. $\lambda_v > \lambda_o$ (as argued in Williamson (1971)).[20]

2.3 Main Predictions of the Model

I now turn to the analysis of the role that the institutional variables μ and λ play in determining the extent of vertical integration in the industry.

Following the seminal contribution in Adelman (1955), the empirical literature has often measured vertical integration as the ratio of valued added over sales. Intuitively, the ratio tells us the percentage of the value of production that is carried on within firm boundaries. In our model, the ratio of valued added over sales is equal to 1 for vertically integrated firms, and is instead equal to $(1-\beta)$ for non-integrated firms.

At the industry level, a convenient index of vertical integration is given by the average index of vertical integration of firms active in the industry. Denoting by N_v and N_o the number (measure) of vertically integrated and non-integrated firms respectively, the industry level index of vertical integration is given by

$$INT = \frac{N_o(1-\beta) + N_v \cdot 1}{N_o + N_v} = 1 - \beta\frac{N_o}{N_o + N_v} \tag{9}$$

I focus on the more interesting case $\frac{f}{(k+f)} \leq \Omega(\beta,\mu)$, in which both organizational forms coexist in the industry. When this is the case, in the industry equilibrium there is a mass of non-integrated

[20] While common in the literature, assuming $k > 0$ does not provide a satisfactory explanation of firm boundaries (see e.g. Gibbons (2004)) . On the other hand, assuming $\lambda_v > \lambda_o$ raises the interesting question of why vertical integration makes the monitoring by external investors more difficult. Macchiavello (2006) argues that vertical integration, by bringing the bargaining process inside the firm, reduces the amount of information that can be used by external investors to monitor the firm. Inderst and Mueller (2004), Faure-Grimaud and Inderst (2005) analyze models in which the organizational form of the firm affects the financial constraint of the firm. (see also the survey in Stein (2004)).

firms equal to $G(\theta_v) - G(\theta_e)$, and a mass of vertically integrated firms equal to $1 - G(\theta_v)$. The average index of vertical integration in the industry is then given by

$$INT = 1 - \beta \frac{G(\theta_v) - G(\theta_e)}{1 - G(\theta_e)} \tag{10}$$

As is clear from this expression, the industry level index of vertical integration critically depends on the shape of the underlying distribution of productivity, $G(\theta)$. I make the following assumption

Assumption

θ is distributed in the population according to a generalized Pareto distribution, i.e.

$$G(\theta) = 1 - (1 + \frac{\sigma}{(1-\sigma)} \frac{(\theta - 1)}{\overline{\theta} - 1})^{-\frac{1}{\sigma}} \tag{11}$$

with $\theta \geq 1$, $\overline{\theta} \geq 1$ and $\sigma \in (0, 1)$.[21]

The average productivity of the potential pool of entrepreneurs is parametrized by $\overline{\theta}$, while the shape of the distribution is conveniently parametrized by σ. For a given $\overline{\theta}$, the effect of different σ is depicted in 2.

When $\sigma = 1 - \frac{1}{\overline{\theta}}$, the distribution is a standard Pareto distribution. For $\sigma < 1 - \frac{1}{\overline{\theta}}$, the distribution has relatively lower density at low levels of θ, and higher density for large θ. The opposite is true for $\sigma > 1 - \frac{1}{\overline{\theta}}$. Proxying the size of the firm with revenues, equations 4 and 5 show that more productive firms (higher θ) are larger. Industries with low σ are dominated by (relatively) large firms, while industries with high σ are dominated by small firms.

Since this paper is mainly concerned with identifying the role of contractual institutions on vertical integration, Propositions 4 and 5 provides comparative statics results with respect to contractual imperfections with input suppliers (μ) and external investors (λ).[22]

[21] The density of a generalized Pareto is given by $g(\theta) = \frac{1}{\zeta}(1 + \sigma \frac{(\theta-1)}{\zeta})^{-1-\frac{1}{\sigma}}$. In order to perform comparative statics on ths shape parameter σ without simultaneously changing average productivity $\overline{\theta}$, I have fixed $\overline{\theta} = \int_1^\infty \theta dG(\theta) = \left(1 + \frac{\zeta}{1-\sigma}\right)$ substituting for the scaling parameter ζ to obtain the expression in the assumtpion.

[22] With respect to industry parameters, it can be shown that vertical integration is increasing in $\overline{\theta}$ and decreasing in β and σ.

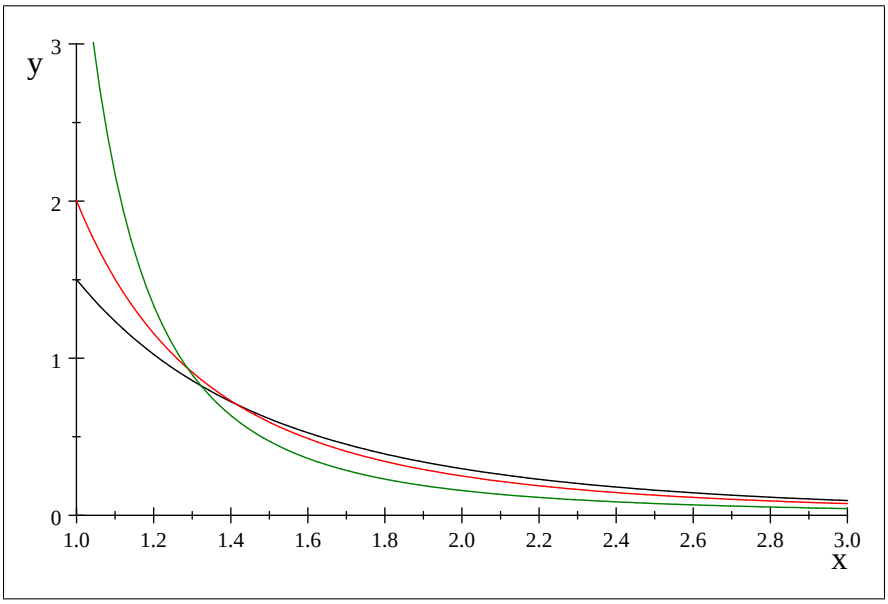


Figure 2: Generalized Pareto Distribution, for $\overline{\theta} = 2$, and $\sigma \in \{\frac{1}{3}, \frac{1}{2}, \frac{2}{3}\}$

Proposition 4

Assume $\frac{f}{(k+f)} < \Omega(\beta, \mu)$. *Better contractual institutions in input markets (higher* μ*) unambiguously reduces vertical integration in the industry.*

Proposition 4 considers the effects of changes in contractual institutions μ on the degree of vertical integration in the industry. There are two effects: a partial equilibrium effect and an industry equilibrium effect. The partial equilibrium effect is that the profits of a non-integrated firm increase, thus making non-integration relatively more profitable. This effect is illustrated in figure 3.[23] The figure reports the profits of firms with productivity θ under integration and non-integration. *Ceteris paribus*, better contract enforcement leads to a decrease in vertical integration in the industry, in the sense that fewer firms are vertically integrated. The industry equilibrium effect is due to the fact that, since non-integrated firms are relatively more efficient because of better contractual institutions, vertically integrated firms face higher competition. This implies that the profits of each firm with productivity $\theta \geq \widehat{\theta}_v$ decrease and this further shifts towards the right the threshold $\widehat{\theta}_v$. The industry equilibrium effect thus pushes further away from vertical integration.[24]

[23] Since the industry equilibrium effect goes in the same direction as the partial equilibrium effect, it is not illustrated in Figure 5 in order to keep the analysis simpler.

[24] This can be easily shown for the case in which θ follows a Pareto distribution in the industry. Under this

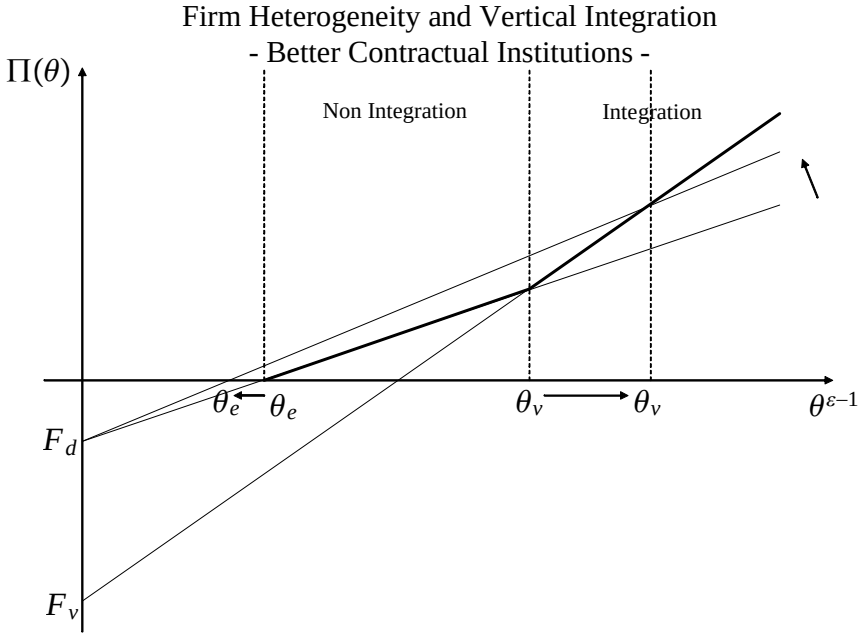


Figure 3: Comparative Statics and Industry Equilibrium (1)

Note that an implication of the model is that countries with better contract enforcement (higher μ) are *relatively more* vertically integrated in industries that heavily rely on contracts (low β). When β is very low the hold-up problem is so severe that non-integrated firms can not survive in the industry (remember that when β is too low, $\frac{f}{(k+f)} > \Omega(\beta, \mu)$). The vertical integration index is very high (in the model equal to one) regardless of contract enforcement μ. Industries with higher β instead will not be completely vertically integrated, and, as stated in proposition 4, will be more vertically integrated in countries with worse contract enforcement.

Proposition 5

Assume $\frac{f}{(k+f)} < \Omega(\beta, \mu)$. *Better contractual institutions in financial markets (lower* λ*) increase vertical integration if* $\sigma < 1 - \frac{1}{\theta}$ and *decrease vertical integration if* $\sigma > 1 - \frac{1}{\theta}$.

Proposition 5 considers the case of better capital markets (i.e. lower λ) and delivers the main prediction that I will test in the empirical section. As in the case of better contractual enforcement

circumstance the index of vertical integration only depends on the ratio $\widehat{\theta}_e/\widehat{\theta}_v$, it is easy to show that an increase in μ, raising $\Omega(\beta, \mu)$, reduces $\widehat{\theta}_e$ and thus implies lower vertical integration.

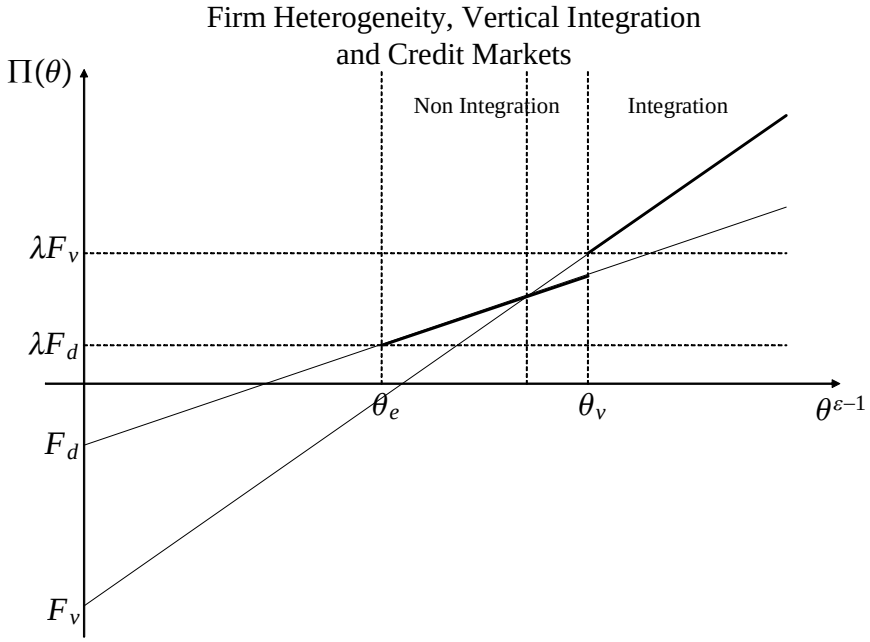


Figure 4: Comparative Statics and Industry Equilibrium (2)

there are two different effects: a partial equilibrium effect, and an industry equilibrium effect.

The effects of imperfect financial markets are illustrated in figure 4. First, whenever $\lambda > 0$ some firms are credit constrained and cannot integrate vertically. Because of the sorting effect, only firms with productivity above a certain threshold are vertically integrated. When capital markets improve, the threshold moves towards the left, as it becomes easier to raise external funds. Since lack of financial resources is the only constraint on vertical integration, better financial markets have a positive (partial equilibrium) "investment" effect on the degree of vertical integration. However, better financial markets also favor the entry of new competitors in the industry. First of all, the marginal entrant is a non-integrated firm, an effect that counterbalances the previous effect. More importantly, new competitors in the industry implies that each firm earns fewer profits. This effect implies that fewer firms can become vertically integrated.

Proposition 5 states that the effect of better financial markets on vertical integration, while *a priori* ambiguous, crucially depend on the shape of the underlying distribution of productivity in the industry and thus clarifies when we should expect the "investment" or the "entry" effect to

be stronger. Better financial markets increase vertical integration in industries that have relatively high densities at high θ, since the "investment" effect is relatively stronger in such industries. These industries are, for technological reasons, dominated by large firms, in the sense that a large share of output is produced in large firms. On the other hand, better financial markets reduce vertical integration in industries that have relatively high densities at low θ, since in those industries the "entry" effect is relatively stronger. These industries are instead dominated by relatively small firms, in the sense that a large share of output is produced by such firms.

This second effect differentiates the mechanics of the response of vertical integration to better contractual institutions in the capital markets compared with the effect of better contractual institutions in the specific input market. In the specific input market the industry equilibrium effect works in the same direction as the partial equilibrium effect, and the total effect is thus unambiguous. The model clarifies why contractual imperfections with suppliers of specific inputs, and with external investors impact vertical integration in radically different ways and provides a candidate explanation for why we do not find evidence that countries with better contractual institutions have lower degrees of vertical integration within industries (see Acemoglu et al. (2005)).

The fact that the relationship between credit constraints and vertical integration depends on other determinants of the firms size distribution in the industry is reminiscent of older informal arguments in the literature. In his pioneering paper on vertical integration and market failures, Williamson (1971) argues that, if borrowers are confronted by increasingly adverse rates as they increase their finance requirements, costs may not be independent of vertical structure. He goes on arguing that "established firms may use vertical integration strategically to increase finance requirements and thereby discourage entry if potential entrants feel compelled, as a condition of successful entry, to adopt the prevailing structure - as they may if the industry is highly concentrated" (Williamson (1971), pp. 119). The formal argument in the model reverses the perspective on vertical integration as a barrier to entry in the presence of financial markets imperfections and leads to different predictions. Since financial markets act as powerful barriers to entry, I show that poor functioning financial markets can lead to higher vertical integration if the industry is not highly concentrated.[25]

It is often argued that vertical integration may be a response to the difficulties of finding suitable

[25] In the model the size of a firm is determined by the productivity parameter θ. Qualitatively similar results would be reached if wealth, instead of productivity, was the source of heterogeneity in firms size.

and reliable suppliers. To the extent that institutional failures in developing countries hinder the development of upstream industries, it is expected that firms in the developing world are relatively more vertically integrated. The model developed so far assumed that a downstream firm always finds a potential supplier in the market. It is straightforward to relax this assumption in order to consider the effects of contractual imperfections in financial markets on the degree of vertical integration by examining the effect on the development of upstream industries. In the presence of credit market imperfections input markets become tighter, and it is more difficult to find a supplier for a non-integrated downstream assembler. This effect reduces the relative returns of non-integration in the industry, and is thus equivalent to a reduction in $\Omega(\beta, \mu)$ in the model in the previous subsection. We can state[26]

Proposition 6

Better contractual institutions in the financing of upstream industries reduce vertical integration in the downstream industry

In the next section I exploit cross-country variation in contractual institutions and cross-industry variation in contractual needs with specific input suppliers and with external investors to provide some evidence on the relationship between vertical integration and contractual imperfections. I mostly focus on the theoretical results in Proposition 5, which predicts that

1. Fewer contractual imperfections with external investors (lower λ) increase vertical integration in industries dominated by large firms, and decrease vertical integration in industries dominated by small firms.

   Since contractual imperfections with external investors (λ) and with input suppliers (μ) are likely to be highly correlated across countries, Proposition 4 suggest that we need to control for the additional effects of contractual imperfections with input suppliers. When we do so, we expect that

2. Countries with better contract enforcement are relatively more vertically integrated in industries with high contractual needs

[26] A variation of the model presenting this argument formally is available upon request.

Finally, proposition 6 suggests that we also need to control for the additional impact that financial market development has on vertical integration through the development of upstream industries. In other words, we also expect that

3. Better credit markets reduce vertical integration by allowing more firms to enter upstream industries.

3 Empirical Evidence

In this section I use data on cross-country-industry differences in vertical integration in the manufacturing sector to provide formal empirical evidence on the relationship between financial market development and vertical integration. This section is divided into three subsections. I first describe the data, and in particular the indexes of vertical integration. I than discuss the specification used to test the main prediction of the model. I finally presents the main results and robustness checks. An Appendix contains details on the construction of the industry level variables used in the regressions, as well as further robustness checks.

3.1 Data

The main measure of vertical integration in industry i in country c comes from the UNIDO database. Following the industrial organization literature (see e.g. Adelman (1955)), I measure vertical integration in industry i in country c as the ratio of value added over output, i.e.

$$INT_{ic} = \frac{VA_{ic}}{Y_{ic}} \tag{12}$$

At the firm level, the measure captures the proportion of the production process that is carried out within firm boundaries. A higher value of the index is therefore associated with a higher degree of vertical integration.[27]

The data used to compute the index of vertical integration are from the 2001 edition of the UNIDO Industrial Statistics Database. Data are available for the manufacturing sector, and are

[27] Because of data availability, I am constrained to use the index at the industry level. This aggregation may introduce measurement error. For example, the index is sensitive to the degree of intra-industry trade between vertically disintegrated firms within the industry.

aggregated at the three-digit level of the second revision of the ISIC Code classification system. This gives a total of 29 manufacturing industries. The data were supplied by national statistical offices and supplemented with estimates generated by UNIDO whenever necessary. The 2001 edition of the database covers 175 countries for the period 1963-1999. However, since period coverage as well as item coverage differ from country to country, I focus on a sample of 88 countries using the years from 1990 to 1998 inclusive. Since the analysis does not exploit time variation, I use only the average of the variable of interest for the period between 1990 and 1998. In the entire sample the index of vertical integration spans essentially all the unit interval. Table 1.a shows the average degree of vertical integration for each industry in the sample, and Table 1.b lists the countries used in the analysis.

In order to check for the robustness of the results, Table 6 reports results using a second measure of vertical integration in industry i and country c. This second measure is constructed from firm level information provided in Worldbase, a database maintained by Dun & Bradstreet, and follows the procedure in Acemoglu et al. (2005a). It exploits firm level information on primary 4-digit SIC code, and up to five other 4-digit SIC codes of secondary product lines for the firm, combined with input-output data from the United States. I describe in Appendix B the construction of this alternative measure in greater detail. I also restrict attention to the manufacturing sector and to the same sample of countries as for the UNIDO measure. The main advantages of the first measure are that it is a well known index of vertical integration and that data come from industrial statistics relying on Census information. While issues of comparability across countries and aggregation may introduce measurement error, the data are overall representative. The second measure instead has the advantage of being constructed from a very large firm level database, and exploit information on firms activities. Moreover, the industry classification allows me to consider two-digit input-output classification system, i.e. to break up the manufacturing sector in 52 industries. However, the construction of the firm level index hinges on the use of input-output information from the United States, and large countries tend to be over represented in the sample.

I use two main different types of right-hand-side variables.[28] A first set of variables are various industry characteristics in the United States. The main ones are external financial dependency

[28] Whenever possible, I control for other variables at the industry country level (such as average firm size, number of establishment, average mark-up). Results are never affected by the inclusion or exclusion of these additional controls. Henceforth, I omit to discuss them in the remaining of the text.

(Rajan and Zingales (1998) and author's calculations), importance of small firms, measured by the share of employees working in establishments with less than 100 or 500 employees (author's calculations from 1992 US census of industries), contractual needs, as proxied by the Herfhindal index of input shares (author's calculations) and external financial dependency of upstream industries (author's calculations). The Appendix describes the construction of these variables.

The second set of variables are country level measures of financial development and contractual institutions. The preferred measure of financial development is the average ratio of bank credit over GDP during the nineties, and it is taken from Levine (2005). Levine (2005) also provides alternative measures of financial development that I use in Table 5. Finally, I proxy contractual institutions with suppliers of specific inputs with (minus) the number of procedures mandated by law or court regulation demanding interactions between the parties or between them and the judge. I take this measure from the Doing Business database at World Bank available online, which follows the methodology in Djankov et al. (2003).

Table 1.c provides basic summary statistics for the industry level variables at the 3-digit ISIC level as well as for the country level variables in the sample.

3.2 Specification

I test the hypothesis that more developed financial markets increase vertical integration in industries dominated by large firms and decrease vertical integration in industries dominated by small firms. Since the model treats industries in isolation, the parameter for contractual imperfections in financial markets λ_{ic} can be thought as industry-country specific. Since I do not have data on exogenous variations in the supply of credit to industry i in country c, I follow Rajan and Zingales (1998) and proxy for λ_{ic} using an interaction between the degree of external financial dependency of industry i in the United States ED_i and a variable capturing the level of financial markets development FD_c in country c.

The model predicts that the effect of λ_{ic} should be allowed to depend on other technological determinants of firm's size distribution in the industry, and in particular on the relative importance of small and large firms. In the main specification, I proxy the degree to which industry i relies on small firms with the share of employees working in establishments with less than 500 employees in industry i in the United States, SF_i.

Denoting by INT_{ic} the degree of vertical integration in industry i and country c, the baseline specification is given by

$$INT_{ic} = \beta_0 + \beta_1 (ED_i \times FD_c) + \beta_2 (ED_i \times SF_i \times FD_c) + \beta_3 (SF_i \times FD_c) + \eta_i + \mu_c + \varepsilon_{ic} \quad (13)$$

which can be rewritten in compact notation as

$$INT_{ic} = \beta_0 + \widehat{\beta} X_{ic} + \eta_i + \mu_c + \varepsilon_{ic} \quad (14)$$

where η_i and μ_c are a set of industry and country dummies and $\widehat{\beta} X_{ic}$ is a compact notation for the interactions of interest. I also include as controls a measure of average size and the number of firms in the industry. Since the regression includes country fixed effects, the estimate of the vector of coefficient β identifies relative propensity towards vertical integration. The coefficient β_1, for instance, tells wether countries with more developed financial markets are relatively more or less vertically integrated in industries that depend on external finance. Whether industries in countries with better financial markets are on average more or less vertically integrated can not be identified in the regression, because of the inclusion of the country fixed effects μ_c. In other words, the specification tests the empirical validity of the main predictions of the model by exploring whether country level measures of contractual imperfections have a differential impact across industries.

The use of industry characteristics from the United States to differentiate industries along technological characteristics deserves some comment. The interaction term proxing for λ_{ic} captures the specific channels through which it is reasonable to expect financial market development to affect vertical integration in a given industry (external financial dependency). The results reported below on the baseline specification and on a number of robustness checks document robust correlations which are consistent with the predictions of the model, and that show that financial markets impact vertical integration differently across industries. The use of industry characteristics in the United States can be thought as a convenient device to describe correlation patterns in the data.

The use of industry characteristics in the United States, introduced in the influential work by Rajan and Zingales (1998), has been extensively used in the literature on industrial development and finance (see for a survey Levine (2005)), and in recent papers on the determinants of trade (e.g. Nunn (2005)). This literature claims that under two distinct sets of assumptions, the use of

industry characteristics from the U.S. allow for a causal interpretation of the coefficients estimated with equation 13. First, to the extent that markets in the United States are unregulated and well functioning, equilibrium variables in the U.S. can be taken as good proxies of technological characteristics inherent to the production process of a given industry. Second, if the ranking of industry characteristics in the United States is the same than in other countries, the technological characteristics of industry i in the U.S. are representative of technology in other countries. Under those two assumptions, the effect of financial development works through the specific channel of financial needs, thus increasing the likelihood of capturing a causal impact of financial markets development on vertical integration.[29] Since the validity of those two "identification assumptions" is hard to test empirically, I hope that the several robustness checks I include in the analysis will neverthless convince the reader that the correlation patterns I document in the data are robust to different specifications.[30]

In light of the theoretical predictions, I expect $\beta_1 > 0$ and $\beta_2 < 0$. When the technology of industry i is such that only a small fraction of employees work in small firms, the model predicts that better financial markets will lead to more vertical integration, and hence $\beta_1 + \beta_2 SF_i > 0$. When instead the technology of industry i is such that a big fraction of employees work in small firms, the model predicts that better financial markets will lead to less vertical integration, and hence $\beta_1 + \beta_2 SF_i < 0$.

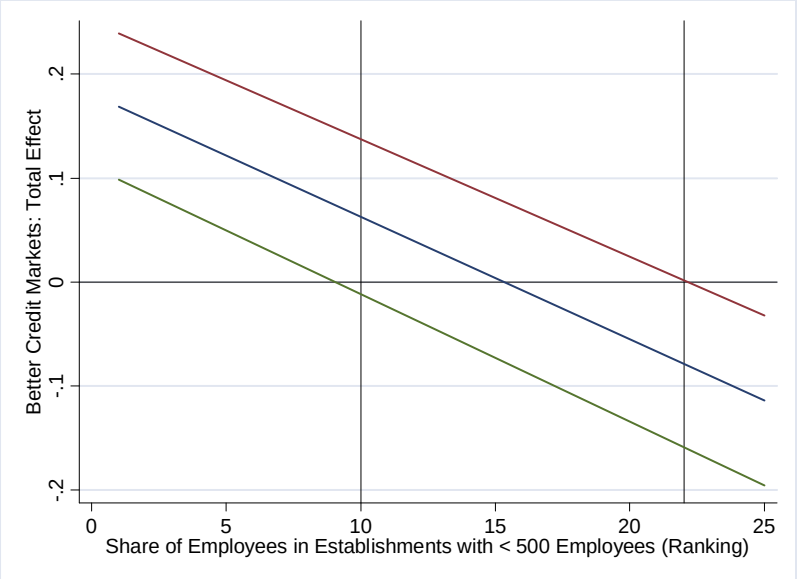
3.3 Results

Table 2 presents the main results. Column I reports the coefficient on the interaction of financial development and external financial dependency. As argued above, the model has ambiguous predictions on this coefficient, since better financial markets in industry i and country c can lead to higher or lower degrees of vertical integration depending on whether the industry is dominated by large or small firms. While the positive coefficient indicates that, on average, countries with better financial systems are relatively more vertically integrated in industries that heavily depends

[29] Note also that, even if measures of external financial dependency and firm's size distribution were available for industry i in country c, these measures should not be used in the analysis because these are likely to be endogenously determined and to be dependent on vertical integration.

[30] In line with the spirit of the main identification assumption, I run the regressions using the ranking of the industry level variables in the United States. Moreoever, I use the natural logarithm for the left-hand-side variables, and for all the country level variables used in the analyis.

Figure 5: Differential Effect of Better Credit Markets



on external finance, the relationship is not statistically different from zero.

As argued in the theoretical section, the effect of better financial markets on the degree of vertical integration should be allowed to depend on some proxy of other determinants of the size distribution of firms in the industry. Column II reports the results of estimating equation 13, in which I proxy the degree to which industry i relies on small firms with the share of employees working in establishments with less than 500 employees in the United States. In light of the theoretical predictions, I expect $\beta_1 > 0$ and $\beta_2 < 0$.[31] Consistently with the theoretical predictions, I find that in industries that rely on small firms, better financial markets have a negative impact on the degree of vertical integration ($\beta_1 + \beta_2 SF_i < 0$), while in industries that rely on large firms, better financial markets have a positive impact on the degree of vertical integration ($\beta_1 + \beta_2 SF_i > 0$). In other words, Columns II finds a positive, direct effect of financial development on vertical integration (the first coefficient increases with respect to Column I and becomes statistically significant). However, because the second coefficient is negative, larger, and statistically significant, the total effect is weaker (and for some industries negative), for industries that employ a large share of workers in relatively small establishments.

[31] Regressions in Columns II to VI in Tables 2 include the interaction between the variable SF_i and financial development to saturate the equation. I omit β_3 from the Table.

Figure 5 explains the differential impact of better credit markets on vertical integration. For any given industry, the total effect of the interaction between financial development and external financial dependency is given by the sum of the coefficient in the first line of Table 2, plus the coefficient in the second line multiplied by the ranking of the industry with respect to the share of employees working in establishments with less than 500 employees. The y-axis reports the appropriate linear combination of the estimated parameters, while the x-axis reports the corresponding ranking. The Figures also reports the appropriate interval of confidence on the estimated total effect of better financial markets. The total effect is positive and statistically different from zero for the ten industries with the highest share of employees working in establishments with more than 500 employees. These industries include, for example, tobacco, iron and steel, transportation equipment and glass. The effect is instead negative only for the 4 industries for which the share of employees working in establishments with less than 500 employes is highest (wood manufacturing, leather, metal and non-metal products).

Columns III to VI present a first sequence of robustness checks.

A first concern is that, as discussed at the end of the theoretical section, countries with better financial markets may have industries which are less vertically integrated, since financial market development fosters the development of input markets. Financial market frictions could thus induce more vertical integration through this separate channels. The inclusion of country fixed effects in the regressions controls for the possibility that better financial markets reduce vertical integration through the development of upstream industries only if these effects are the same across all the industries. However, industries largely differs in terms of their input requirements, and these differences may be correlated with the external financial dependency or the importance of small firms in the industry. Omitting to control for this additional channel would result in the coefficients of interest being biased.

In order to control for the possibility that financial market development impacts vertical integration through the development of upstream industries, I compute for each industry i a weighted average of the external financial dependency of the industries that sell inputs to industry i. I construct the weights using information from the input-output table of the United States. Denoting by ED_j the external finance dependency in industry j and by v_{ij} the share of use of input j in the production of i from the input-output table, the measure of external financial dependency of

upstream industries for industry i is given by

$$EDU_i = \Sigma_{j \neq i} v_{ij} \times ED_j$$

The intuition is that, ceteris paribus, better financial markets should affect vertical integration relatively more in those industries that purchase inputs from industries that are, on average, highly dependent on external finance.[32]

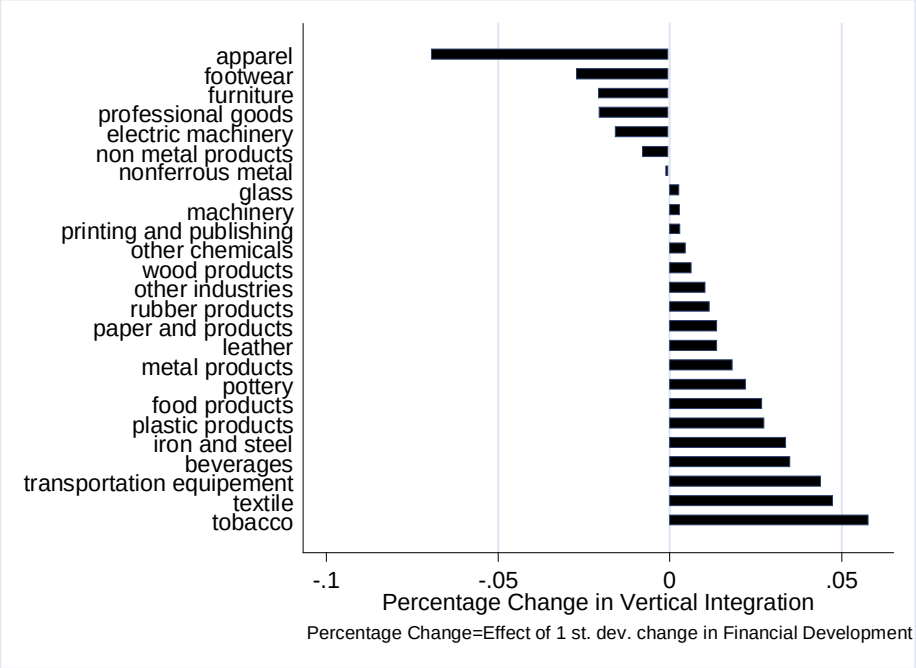
In column III I add to the specification in Column II the interaction between financial market development in country c and the external financial dependency of upstream industries. The inclusion of this further interaction reinforces the results in Column II, since the absolute values of the coefficients β_1 and β_2 go up. Moreover, the coefficient on the interaction between financial market development in country c and the external financial dependency of upstream industries (β_4) confirms the intuition informally discussed at the end of the theoretical section. I find that countries with more developed financial systems are relatively less vertically integrated in industries that use inputs from industries that are more externally financial dependent.

What is the magnitude of the effects we are identifying? Figure 6 provides an answer to this question. In Column III the country level measure of financial development affects vertical integration through four different, and opposing, channels (estimated by the vector of coefficients $\beta = [\widehat{\beta}\ \beta_4]$). Figure 6 reports, for each industry, the average percentage change induced in the index of vertical integration by an increase in the index of financial development of one standard deviation. In our sample, a difference of one standard deviation in the index of financial development is equivalent to the difference between the index of financial development in Algeria and South Korea. Figure 6 identifies that for some industries the net effect is positive (e.g. textile and transport equipment) while for other industries is negative (e.g. footwear), and is in the order of 3-5% points.[33]

[32] Similarly to the identification strategy discussed above, the use of U.S. Input-Output table is justified by concerns that, because of various sources of input markets imperfections correlated with financial markets imperfections, industries in country c may substitute inputs in ways which are correlated with other determinants of vertical integration. I further describe the construction of the average external financial dependency of upstream industries in the data Appendix.

[33] While the effect identified in Figure 6 is the net effect of four coefficients working in different directions, each single effect has a larger magnitude. The inclusion of country fixed effects prevents the identification of the average effect of financial development on vertical integration. The effect depicted in the figure imply a change in the ranking of industries in terms of vertical integration (for the average country) for 9 out of the 26 industries in the sample.

Figure 6: Quantitative Effect



An important concern with the regressions in Columns I to III is that, *within* industries, countries at different stages of the development process produce goods that differ in terms of factor intensities and value added. If those "within" industries product mixes differs systematically across industries with the level of financial development, the results in Columns I to III could be capturing those differences along with the effect of financial development on vertical integration.

Related to this concerns, since financial development is highly correlated with GDP per capita and with broader institutional quality it is possible that the coefficients in Columns I to III are also picking up the effects of other institutions on vertical integration that work differently across industries in a way which is correlated with the industry variables (external financial dependency and importance of small firms) included in the regression. While the relatively high level of aggregation makes it difficult to control for these within-industry compositional effects, Columns IV to VI try to address some of this concerns.

In Column IV I add the interaction between the degree of vertical integration in the United States in industry i and GDP per capita in country c. The idea of the interaction is to directly control for the possibility that richer countries produce goods that are relatively more similar to the

goods produced in the United States, and should tend to be relatively more vertically integrated in the industries that are integrated in the US. Column IV shows that the results on the effects of financial development on vertical integration are stable to the inclusion of this further control, and moreover confirm the intuition that richer countries are relatively more vertically integrated in industries that are more vertically integrated in the United States, consistently with the idea that product mixes within industries changes systematically with respect to their degree of vertical integration as countries achieve different development stages.

Column V is more directly concerned with the possibility that financial development is capturing the effect of broader institutional quality on vertical integration. I control for the possibility that financial development is simply picking up the effects of broader institutional quality by controlling for the interaction between GDP per capita, a proxy of institutional quality, and all the industry level interactions used in Column III. Results are once again very robust, suggesting that financial development is not picking up the effects of the higher quality of other institutions on vertical integration. Moreover, none of the (unreported) interactions between the industry level variables and GDP per capita is statistically significant from zero, suggesting that the industry variables proxy for the appropriate channels through which financial development impacts vertical integration.

Finally, Column VI adds interactions between industry dummies and GDP per capita. This is done to capture the fact that industries are engaged in different production across countries, and more broadly that there may be broader omitted institutional factors that have differential impact across industries working through specific channels which are different from, but correlated to, external financial dependency. I find that the results are robust to the inclusion of these additional twenty-six controls. Quite remarkably the magnitude as well as the statistical significance of the coefficients are virtually unchanged.

The theoretical model emphasizes the differential impact of better contractual institutions in specific input markets versus contractual imperfections in financial markets. Table 3 investigates empirically the relevance of this distinction. Beyond exploring the robustness of the evidence in favor of the credit market story to the inclusion of additional controls considering contractual institutions, Table 3 presents some results that are of separate and independent interest.

I proxy better contract enforcement in country c (the parameter μ in the model) with (minus)

the number of procedures mandated by law or court regulation demanding interactions between the parties or between them and the judge. I take this measure from the Doing Business database at World Bank, which construct the measure following the methodology in Djankov et al. (2003). I interact this measure of contractual enforcement with a measure of contractual intensity at the industry level in the U.S. I use as measure of contractual needs in industry i the (negative of the) Herfindahl index of input use. The rationale for using the Herfindahl index instead of the number of inputs used is that the number of inputs used would overestimate the importance of inputs that contribute only marginally to the production process. Instead I assume that industries that rely on a less concentrated set of suppliers are more exposed to hold-up problems (lower β in the model), and thus require more contractual provisions to mitigate hold-up problems.[34]

Column I shows that countries with better contractual enforcement are relatively more vertically integrated in industries that have higher contractual needs. The coefficient between contractual enforcement and contractual needs is positive, large and statistically significant. This result is in line with the theoretical prediction of the model. Industries that have very high contractual intensity (low β) are so severely exposed to the hold-up problem that non-integrated firms can not survive in the industry (remember that when β is too low, $\frac{f}{(k+f)} > \Omega(\beta, \mu)$). The vertical integration index is very high (in the model equal to one) regardless of contract enforcement μ. Industries with lower contractual intensity (higher β) instead will not be completely vertically integrated, and will be more vertically integrated in countries with worse contract enforcement. It follows that countries with better contract enforcement are *relatively more* vertically integrated in industries that heavily rely on contracts.

Before re-introducing financial markets interactions to control for the robustness of the insights gained with Table 2 and separate the role of contractual imperfections with input suppliers and external investors, Column II checks that the relationship in Column I does not depend on the size distribution of firms, as the model predicts. I add further interactions with the variable proxing for the importance of small firms and find no statistically significant effect.

Column III reintroduces the interactions linking financial development and vertical integration through the two opposite and distinct channels emphasized in the theoretical section.[35] Results

[34] I describe the details for the construction of this measure in the data Appendix. This measure of contractual dependency has been previously used in the literature (see e.g. Levchenko (2005) and Blanchard and Kremer (1997).

[35] I also include, but do not report, the interaction between financial market development in country c and the

are again highly robust, and the coefficients clearly identify the different role of contractual imperfections with input suppliers and external investors in shaping vertical integration.

Since financial development and contract enforcement are highly correlated, Column IV adds the cross-interactions between financial dependency and contractual enforcement, and financial development with contractual intensity in order to check that the two measures of contractual imperfections with suppliers and investors are indeed working (exclusively) through the appropriate channels.[36] Once again, Column IV shows that the results are highly robust both in terms of magnitudes and statistical significance. Moreover, the coefficients on the cross interactions are small and not statistically significant, suggesting that the main interactions of interest are indeed disentangling the role of contractual imperfections with input suppliers and external investors, instead of simply picking up the effects of broader contractual environment.

Finally, Columns V and VI add the same set of controls than the corresponding columns in Table 2. Column V adds interaction between the industry level variables and GDP per capita, while column VI adds interactions of industry dummies with GDP per Capita. Results are once again highly robust to those two alternative specifications.[37]

To summarize, the available data recommended the use of interactions of industry variables in the United States with country level variables proxing financial development to investigate the effects of contractual imperfections with external investors on vertical integration at the industry level, in a cross-country perspective. While this methodology requires strong identification assumptions to interpret the resulting evidence as causal, the results presented in this section and the further robustness checks reported in the Appendix, present very robust cross-country-industry correlations that are consistent with the main predictions of the model and shed some light on the ambiguous role of contractual institutions in general, and financial development in particular, in shaping international differences in vertical integration.

external financial dependency of upstream industries for industry i. The coefficient is always negative and statistically significant as in Table 2.

[36] I also include, but do not report, interaction between contract enforcement and importance of small firms, and the corresponding triple interaction with external financial dependency to saturate the equation. None of these interactions is statistically significant.

[37] Contractual enforcement may also be measured with the percentage costs needed to enforce a debt contract. When this is done, the statistical significance of the contract enforcement channel is significantly reduced, while credit market variables improve their statistical significance. I have also checked whether (minus) ethnic fragmentation and average level of trust in the society are substitutes for poorly functioning judicial systems by running the same set of regressions interacting the measures of contractual needs with social trust and ethnic fragmentation. The results have the expected sign, but are not strongly statistically significant and are available upon request.

4 Conclusion

This paper shows that contractual imperfections with suppliers of specific inputs and with external investors have radically different effects on the degree of vertical integration at the industry level. The main result is that financial market imperfections affect vertical integration through two opposing channels: a direct negative, investment, effect and an indirect positive, entry, effect. Using cross-country-industry data I find that countries with more developed financial systems are relatively more vertically integrated in industries that are dominated by large firms, consistently with the predictions of the theoretical model. This work thus presents novel evidence on international differences in the organization of production and their institutional determinants, complements the existing literature on the determinants of vertical integration, and raises new theoretical questions on the long standing issue of what determines firm boundaries.

Much work remains to be done, both on the theoretical and on the empirical side. With respect to the theory, an important avenue for future research is to explore the general equilibrium implications of the different mechanisms underlined in the model of this paper, and their implications for cross-country patterns of industrial structure.

On the empirical front more effort should be devoted to the exploration of interactions between the institutional characteristics considered in this paper and the role of other institutional variables such as, for example, trade openness, informal networks and human capital. While the current analysis may improve our understanding of institutional determinants of vertical integration across countries, it is eventually of crucial importance to understand how differences in organizational forms affect productivity.

References

[1] Acemoglu, D., P. Aghion and F. Zilibotti (2003) "Distance to Frontier and Vertical Integration", *Journal of the European Economic Association Papers and Proceedings*, vol 1, pp. 630-638.

[2] Acemoglu, D., P. Aghion, R. Griffith and F. Zilibotti (2004) Vertical Integration and Technology: Theory and Evidence, NBER working paper #10997

[3] Acemoglu, D., P. Antras and E. Helpman (2006) Contracts and Technology Adoption, mimeo MIT and Harvard

[4] Acemoglu, D., S. Jonshon and T. Mitton (2005) Determinants of Vertical Integration: Finance, Contracts and Regulation, mimeo MIT

[5] Adelman, M. (1955), "Concpet and Statistical Measurement of Vertical Integration," in Business Concentration and Price Policy Princeton University Press, Princeton NJ.

[6] Aghion, P. R. Griffith and P. Howitt (2006) "The U-Shaped Relationship Between Vertical Integration and Competition: Theory and Evidence", mimeo Harvard and IFS.

[7] Aghion, P. and J. Tirole (1994) "On the management of innovation", *Quarterly Journal of Economics* 109: 1185-1207.

[8] Aghion P., M. Dewatripont and P. Rey (1994) "Renegotiation Design With Unverifiable Information", *Econometrica* 62(2): 257-282.

[9] Andrabi, T., M. Ghatak and A. Khwaja (2004) "Subcontractors for Tractors: Theory and Evidence on Flexible Specialization, Supplier Selection, and Contracting", mimeo LSE

[10] Antras, P. (2003) "Firms, Contracts and Trade Structure", *Quarterly Journal of Economics* , 118, 1375-1418.

[11] Antras, P. and E. Helpman (2004) "Global Sourcing", *Journal of Political Economy* 112, 552-580

[12] Baker, G., R. Gibbons, and K. Murphy (2004) "Contracting for Control." mimeo, Harvard Business School

[13] Banerjee, A. (2004) "Notes Toward a Theory of Industrialization in the Developing World", mimeo MIT

[14] Banerjee, A., Esther Duflo, and Kaivan Munshi (2003) "The (mis)allocation of capital" *Journal of the European Economic Association* 1(23), 484-494

[15] Banerjee, A. and K. Munshi (2004) "How efficiently is capital allocated? Evidence from the knitted garment industry in Tirupur". *Review of Economic Studies* 71(1), 19-42

[16] Brown, J. (1992) "Market Organization, Protection, and Vertical Integration: German Cotton Textiles before 1914" *The Journal of Economic History*, Vol. 52, No. 2, pp. 339-351

[17] Burkart, M. and T. Ellingsen (2004) "In-Kind Finance: A Theory of Trade Credit", *American Economic Review*, 94 (3):569-590

[18] Carlton, D. (1979) "Vertical Integration in Competitive Markets Under Uncertainty", *Journal of Industrial Economics*, 27: 189-209.

[19] Djankov, S., R. La Porta, F. Lopez-de-Silanes and A. Shleifer (2002) "The Regulation of Entry", *Quarterly Journal of Economics* 117, 1-37

[20] Djankov, S., R. La Porta, F. Lopez-de-Silanes and A. Shleifer (2003) "Courts", *Quarterly Journal of Economics* 118, 453-517

[21] Faure-Grimaud, A. and R. Inderst (2005) "Conglomerate Entrenchment under Optimal Financial Contracting", forthcoming *American Economic Review*

[22] Fee, E., Hadlock, C. and S. Thomas (2005) "Corporate Equity Ownership and the Governance of Product Market Relationships", *Journal of Finance*, forthcoming

[23] Gibbons, R. (2004) "Four Fornal(izable) Theories of the Firm ?", mimeo MIT

[24] Grossman, S. and O.D. Hart (1986) "The costs and benefits of ownership: a theory of vertical and lateral integration", *Journal of Political Economy* 98: 1119-1158.

[25] Grossman, G. and E. Helpman (2002) "Integration vs. Outsourcing in Industry Equilibrium", *Quarterly Journal of Economics* 117, 85-120.

[26] Grossman G. and E.Helpman (2004), "Managerial incentives and the international organization of production", *Journal of International Economics* 63: 237-262.

[27] Grossman G. and E.Helpman (2005), "Outsourcing in a global economy", *Review of Economic Studies* 72: 135-159.

[28] Haber, S. (1991), "Industrial Concentration and the Capital Markets: A Comparative Study of Brazil, Mexico, and the United States, 1830-1930", *Journal of Economic History*, 51: 559-580.

[29] Hart, O.D. (1995) Firms, Contracts and Financial Structure (Oxford University Press, London).

[30] Hart, O. and J. Moore (1990) "Property rights and the nature of the firm", *Journal of Political Economy* 98: 1119-1158.

[31] Helper, S. and D. Hochfelder (1996) "Joint Product Development in the Early American Auto Industry", *Business and Economic History*, Winter 1996.

[32] Hortačsu, A. and C. Syverson (2005) "Cementing Relationships: Vertical Integration, Foreclosure, Productivity and Prices", mimeo Chicago University.

[33] Inderst, R. and H.Müller (2003) "Internal vs. External Financing: An Optimal Contracting Approach", *Journal of Finance*, Volume 58: Issue 3, 1033 - 1062.

[34] Khanna, T., and K. G. Palepu (1997), "Why Focused Strategies May Be Wrong for Emerging Markets", *Harvard Business Review* 75:4, 41-51.

[35] Khanna, T. and K. Palepu (2000), "Is Group Affiliation Profitable in Emerging Markets? An Analysis of Diversified Indian Business Groups", *Journal of Finance* 55, 867-891.

[36] Kumar, K. B., R. G. Rajan and L. Zingales (2001), "What Determines Firm Size", University of Chicago, mimeo.

[37] La Porta, R. , F. Lopez-de-Silanes, A. Shleifer and R. W. Vishny (1998), "Law and Finance", *Journal of Political Economy*, 106: 1113-1155.

[38] Langlois, R. and P. Robertson (1989) "Explaining Vertical Integration: Lessons from the American Automobile Industry" *The Journal of Economic History*, Vol. 49, No. 2, pp. 361-375

[39] Legros, P. and A. Newman (2004) "Competing for ownership" ULB and UCL, mimeo.

[40] Levine, R. (2005) "Finance and Growth: Theory and Evidence." forthcoming in P. Aghion and S. Durlauf, eds. Handbook of Economic Growth. The Netherlands: Elsevier Science.

[41] Levy, B. (1990) "Transactions costs, the size of firms and industrial policy : Lessons from a comparative case study of the footwear industry in Korea and Taiwan" *Jounral of Development Economics*, vol. 34, issue 1-2, pages 151-178.

[42] Livesay, H. and P. Porter (1969) "Vertical Integration in American Manufacturing, 1899-1948" *The Journal of Economic History*, Vol.29, No.3, September, pp.494-500.

[43] Macchiavello, R. (2006) "Pleadgeable Income and the Costs and Benefits of Vertical Integration", mimeo LSE.

[44] Marin, D. and T. Verdier (2002) "Power Inside the Firm and the Market: a General Equilibrium Approach", mimeo DELTA.

[45] Maskin, E. and J. Tirole (1999) "Unforeseen Contingencies and Incomplete Contracts" *Review of Economic Studies*, 66:1, pp. 83-114.

[46] Melitz, M. (2003) The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity, *Econometrica* 71, 1695-1725

[47] Nunn, N. (2005) Rekationship Specificity, Incomplete Contracts and the Pattern of Trade, mimeo UBC.

[48] Perry, M. (1989) "Vertical Integration: Determinants and Effects" in Handbook of Industrial Organization, North-Holland, 1989.

[49] Porter, R. and J. Livesay (1971) "Merchants and Manufacturers: studies in the changing structure of nineteenth-century marketing" Baltimore, Md. Johns Hopkins Press.

[50] Rajan, R. and L. Zingales (1998) Financial Dependence and Growth, *American Economic Review* 88, 559-586.

[51] Rauch, J. (1999) "Networks Versus Markets in International Trade," *Journal of International Economics* 48 June: 7-35.

[52] Schmitz, H. (1995) " Small shoemakers and fordist giants: Tale of a supercluster", *World Development* Pages 9-28.

[53] Stein, J. (2004) "Agency, Information and Corporate Investment", forthcoming in eds. G. Constantinides, M. Harris and R. Stulz. Handbook of the Economics of Finance, Amsterdam: North Holland.

[54] Temin, P. (1988) "Product Quality and Vertical Integration in the Early Cotton Textile Industry", *The Journal of Economic History*, Vol. 48, No. 4, pp. 891-907

[55] Williamson, O (1971) "The Vertical Integration of Production: Market Failures Considerations", *American Economic Review*, Vol. 61.

[56] Williamson, O. (1975) "Markets and Hierarchies: Analysis and Antitrust Implications", Free Press, New York.

[57] Williamson, O. (1985) "The Economic Institutions of Capitalism", Free Press, New York.

[58] Whinston, M. (2003) "On the transaction costs determinants of vertical integration", *Journal of Law, Economics and Organizations*, 19: 1-23.

[59] Woodruff, C. (2002) "Non-contractible Investments and Vertical Integration in the Mexican Footwear Industry", *International Journal of Industrial Organization* 20, 1197-1224.

5 Appendix A

5.1 Proof of Lemma 1

Let us first consider the case of an entrepreneur borrowing K units of capital and signing a contract in which she commits to repay B out of her (variable) profits $\Pi(\theta)$. Of the K units of capital, a fraction $1-\lambda$ has to be invested in the project, since the investors can perfectly monitor such investments. The remaining amount λK can either be invested, or it can be diverted by the entrepreneur. If the entrepreneur invests, she generates revenues $\Pi(\theta)$, and she repays B. If instead she diverts cash, she obtains λK. She abstains from diversion if and only if $\lambda K \leq \Pi(\theta) - B$. When this inequality is satisfied, the entrepreneur repays the external investors with probability equal to one, since there is no uncertainty in production. Since external investors are risk neutral and on the long side of the market, $B = K$. The former inequality can be rewritten as

$$(1+\lambda)K \leq \Pi(\theta)$$

In this environment, an entrepreneur does not have the incentive to borrow more than what is required to finance the fixed costs to start production, and hence without loss of generality one can consider $K = f + k$ for a vertically integrated firm and $K = f$ for a firm entering the market as assembler. This proves the result for a vertically integrated firm. I now turn to the case of a non-integrated firm.

The sequence of events is as follows. First the final assembler finances the fixed costs f borrowing from the external investors, issuing an amount of debt equal to $B = f$. Then she is matched with an upstream supplier. Since suppliers are on the long side of the market, they compete in order to attract customers. Since they have deep pockets, they offer an *ex-ante* transfers $T(\theta)$ to an assembler with productivity θ. *Ex-ante* competition among suppliers, implies that the *ex-ante* transfers drive their profits to zero. *Ex-post*, the match realizes revenues $R(\theta)$, and the supplier retains a fraction β of these revenues. Denoting by $C(I)$ the costs of producing the intermediate input, *ex-ante* competition among suppliers implies that $T(\theta) + C(I) = \beta R(\theta)$. External investors hold claims on the assembler's *ex-post* profits $(1-\beta)R(\theta)$ and on the *ex-ante* transfer $T(\theta)$, i.e. on $(1-\beta)R(\theta) + T(\theta) = R(\theta) - C(I) = \Pi_o(\theta)$. Applying the same reasoning as for the case of a vertically integrated firm completes the proof of the Lemma.

5.2 Derivation of Profit Functions and Proof of Lemma 2

Under vertical integration, the firm chooses investments I to maximize profits

$$\Pi_v(\theta) = A^{1-\alpha}\theta^{\alpha}I^{\alpha} - C(I) \tag{15}$$

Since all elementary investments $x(i)$ are symmetric, and profits are a concave function of $x(i)$, the firm optimally sets $x(i) = \overline{x}$, for all $i \in [0,1]$. The intermediate input becomes $I = \exp\left(\int_0^1 \ln \overline{x} di\right) = \overline{x}$, and hence profits can be rewritten as

$$\Pi_v(\theta) = A^{1-\alpha}\theta^{\alpha}\overline{x}^{\alpha} - \overline{x}$$

The first order condition with respect to $\overline{x}$ yields

$$\overline{x}(\theta) = \alpha^{\varepsilon} A\theta^{\alpha\varepsilon}$$

Substituting into the profit function yields $\Pi_v(\theta) = \alpha^{\alpha\varepsilon} A\theta^{\alpha\varepsilon}(1-\alpha)$, which is the expression in the text.

I now turn to the profits of a non-integrated firm. Denoting x_c the contractible investment, and x_n the non contractible investments, profits can be written as

$$\Pi_o(\theta) = A^{1-\alpha}\theta^{\alpha}x_c^{\alpha\mu}x_n^{\alpha(1-\mu)} - \mu x_c - (1-\mu)x_n \tag{16}$$

The sequence of events is as follows. First, firms contract on contractible tasks. Second, the upstream firm take the non contractible investements decision as given, and, anticipating *ex-post* bargaining, maximizes with respect to x_n her share of profits. I solve for the subgame perfect equilibrium.

The first order condition for the upstream firm gives

$$x_n = (\alpha\beta)^{\frac{1}{1-\alpha(1-\mu)}} A^{\frac{1-\alpha}{1-\alpha(1-\mu)}} \theta^{\frac{\alpha}{1-\alpha(1-\mu)}} x_c^{\frac{\alpha\mu}{1-\alpha(1-\mu)}}$$

Substituting this expression back into the profit function yields

$$\Pi_o(\theta) = A^{\frac{1-\alpha}{1-\alpha(1-\mu)}} \theta^{\frac{\alpha}{1-\alpha(1-\mu)}} x_c^{\frac{\alpha\mu}{1-\alpha(1-\mu)}} (\alpha\beta)^{\frac{\alpha(1-\mu)}{1-\alpha(1-\mu)}} (1-(1-\mu)(\alpha\beta)) - \mu x_c \tag{17}$$

The contract, anticipating the choice of x_n picks up the optimal x_c. The first order condition is gives

$$x_c = \left(\frac{\alpha}{1-\alpha(1-\mu)}\right)^{\varepsilon(1-\alpha(1-\mu))} A\theta^{\alpha\varepsilon} (\alpha\beta)^{\alpha(1-\mu)\varepsilon} (1-(1-\mu)(\alpha\beta))^{\varepsilon(1-\alpha(1-\mu))} \tag{18}$$

and by further substitution in the profits function, I obtain

$$\Pi_o(\theta) = A\theta^{\alpha\varepsilon}\alpha^{\alpha\varepsilon}(1-\alpha)\beta^{\varepsilon}\left(\frac{1}{\beta}\frac{1-\alpha\beta(1-\mu)}{1-\alpha(1-\mu)}\right)^{\varepsilon\alpha\mu+1} = A\theta^{\alpha\varepsilon}\alpha^{\alpha\varepsilon}(1-\alpha)\Omega(\beta,\mu) \tag{19}$$

When $\mu \to 0$ we obtain

$$\lim_{\mu\to 0} \Pi_o(\theta) = A\theta^{\alpha\varepsilon}(1-\alpha\beta)(\alpha\beta)^{\alpha\varepsilon}$$

while when $\mu \to 1$ we obtain

$$\lim_{\mu\to 1} \Pi_o(\theta) = A\theta^{\alpha\varepsilon}\alpha^{\alpha\varepsilon}(1-\alpha)$$

which are the profits of a vertically integrated firm.

I finally prove that profits are monotonically increasing in μ. Taking the logarithm of the profit function, I obtain

$$sign\left|\frac{\partial \log \Pi_o(\theta)}{\partial \mu}\right| = sign\left|\frac{\partial \log\left(\frac{1-(1-\mu)\alpha\beta}{1-\alpha(1-\mu)}\right)^{\varepsilon\alpha\mu+1}}{\partial \mu}\right|$$

Denoting $\Lambda(\beta,\mu) = \left(\frac{1-(1-\mu)\alpha\beta}{1-\alpha(1-\mu)}\right)^{\varepsilon\alpha\mu+1}$, and taking the derivative with respect to μ, gives

$$sign\left|\frac{d\left(\log\Lambda(\beta,\mu)\right)}{d\mu}\right| = sign\left|\left(\ln\frac{1-\alpha\beta(1-\mu)}{1-\alpha(1-\mu)}\right) - \frac{(1-\beta)}{1-\alpha\beta(1-\mu)}\right| \geq 0$$

where the inequality follows from the fact that

$$sign\left|\frac{\partial^2 \log\Lambda(\beta,\mu)}{\partial\mu\partial\beta}\right| = sign\left|1 - \frac{1}{1-\alpha\beta(1-\mu)}\right| < 0$$

Note in fact that $\frac{\partial^2 \log\Lambda(\beta,\mu)}{\partial\mu\partial\beta} < 0$ implies that $\frac{d\log\Lambda(\beta,\mu)}{d\mu}$ reaches a minimum in $\beta = 1$, i.e. when

$\frac{d(\log\Lambda(\beta,\mu))}{d\mu} = 0$, and thus is positive everywhere else. I have proved that $\frac{\partial\Pi_o(\theta)}{\partial\mu} \geq 0$. Combining this observation with the fact that $\lim_{\mu\to 1}\Pi_o(\theta) = A\theta^{\alpha\varepsilon}\alpha^{\alpha\varepsilon}(1-\alpha)$ proves Lemma 2 in the text.

5.3 Proof of Proposition 3

The condition $\frac{f}{(k+f)} \leq \Omega(\beta,\mu)$ ensures that $\theta_v > \theta_e$, and hence that the equilibrium is interior. Since A is in equilibrium a function of θ_v and θ_e, the two thresholds θ_v and θ_e defines a system of two equations in two unknown. Unicity of the equilibrium follows from the fact that the ratio $\frac{\theta_v}{\theta_e} = \frac{k}{f}\frac{(1-\alpha\beta)\beta^{\alpha\varepsilon}}{(1-\alpha)-(1-\alpha\beta)\beta^{\alpha\varepsilon}} > 1$ is constant, and that, by totally differentiating the expression for θ_e, we obtain

$$\begin{aligned} \theta_e &= \left[\frac{f}{A(\theta_e,\theta_v)\,(\alpha\beta)^{\alpha\varepsilon}\,(1-\alpha\beta)}\right]^{\alpha\varepsilon} \Longleftrightarrow \\ d\theta_e &= -\alpha\varepsilon\left(\frac{f}{(\alpha\beta)^{\alpha\varepsilon}\,(1-\alpha\beta)}\right)^{\alpha\varepsilon} A(\theta_e,\theta_v)^{-\varepsilon}\left[\frac{\partial A(\theta_e,\theta_v)}{\partial\theta_v}d\theta_v + \frac{\partial A(\theta_e,\theta_v)}{\partial\theta_e}d\theta_e\right] \end{aligned} \tag{20}$$

which can be rewritten as

$$\frac{d\theta_e}{d\theta_v} = -\frac{KA(\theta_e,\theta_v)^{-\varepsilon}\frac{\partial A(\theta_e,\theta_v)}{\partial\theta_v}}{(1+KA(\theta_e,\theta_v)^{-\varepsilon}\frac{\partial A(\theta_e,\theta_v)}{\partial\theta_e}} < 0 \tag{21}$$

since $\frac{\partial A(\theta_e,\theta_v)}{\partial\theta_v} > 0$ and $\frac{\partial A(\theta_e,\theta_v)}{\partial\theta_e} > 0$, if $\frac{dG(\theta)}{d\theta} > 0$.

When $\frac{f}{(k+f)} > \Omega(\beta,\mu)$ instead $\theta_v < \theta_e$, and only vertically integrated firms enter the industry. The unicity of the equilibrium follows from the fact that θ_v is decreasing in A, and that A is instead an increasing function of θ_v.

5.4 Proof of Proposition 4

Consider the (unweighted) average level of vertical integration in the industry given by the index

$$INT = 1 - \beta\left(1 - \frac{1-G(\theta_v)}{1-G(\theta_e)}\right) \tag{22}$$

Note that by taking the derivative w.r.t. μ we obtain

$$sign\left|\frac{\partial INT}{\partial \mu}\right| = -sign\left|\frac{g(\theta_v)\frac{\partial \theta_v}{\partial \mu}}{[1-G(\theta_e)]} - \frac{g(\theta_e)\frac{\partial \theta_e}{\partial \mu}}{[1-G(\theta_e)]}\frac{[1-G(\theta_v)]}{[1-G(\theta_e)]}\right| < 0$$

since $\frac{\partial \theta_v}{\partial \mu} > 0$ and $\frac{\partial \theta_e}{\partial \mu} < 0$.

5.5 Proof of Proposition 5

Taking the derivative of INT w.r.t. λ we obtain

$$\frac{\partial \widehat{INT}}{\partial \lambda} \geq 0 \Longleftrightarrow \frac{\frac{d\theta_e}{d\lambda}}{\frac{d\theta_v}{d\lambda}}\frac{g(\theta_e)}{g(\theta_v)} \leq \frac{1-G(\theta_e)}{1-G(\theta_v)} \tag{23}$$

since $\frac{d\theta_v}{d\lambda}$ (to see this, note that in equilibrium the ratio $\frac{\theta_e}{\theta_v}$ is constant and does not depend on λ). First we note that $\frac{d\theta_e}{d\lambda} = \frac{\partial \theta_e}{\partial \lambda} + \frac{\partial \theta_e}{\partial A}\frac{\partial A}{\partial \lambda}$ implies $\frac{d\theta_e}{d\lambda} = \left(\frac{1}{\alpha}-1\right)\theta_e\left(\frac{1}{1+\lambda} - \frac{1}{A}\frac{\partial A}{\partial \lambda}\right)$ and similarly $\frac{d\theta_v}{d\lambda} = \frac{\partial \theta_v}{\partial \lambda} + \frac{\partial \theta_v}{\partial A}\frac{\partial A}{\partial \lambda}$ implies $\frac{d\theta_v}{d\lambda} = \left(\frac{1}{\alpha}-1\right)\theta_v\left(\frac{1}{1+\lambda} - \frac{1}{A}\frac{\partial A}{\partial \lambda}\right)$, hence

$$\frac{\frac{d\theta_e}{d\lambda}}{\frac{d\theta_v}{d\lambda}} = \frac{\theta_e}{\theta_v}$$

Moreover, imposing that $G(\theta)$ is distributed according to a generalized Pareto distribution with mean $\overline{\theta}$ and shape parameter κ, i.e. $G(\theta) = 1-(1+\frac{\sigma}{(1-\sigma)}\frac{(\theta-1)}{\overline{\theta}-1})^{-\frac{1}{\sigma}}$, we obtain

$$\frac{\partial INT}{\partial \lambda} \geq 0 \Longleftrightarrow \theta_e(1 - \frac{\sigma}{(1-\sigma)}\frac{1}{\overline{\theta}-1}) \leq (1 - \frac{\sigma}{(1-\sigma)}\frac{1}{\overline{\theta}-1})\theta_v \tag{24}$$

Since $\theta_v > \theta_e$, the inequality is satisfied if and only if $1 - \frac{\sigma}{(1-\sigma)}\frac{1}{\overline{\theta}-1} > 0$, i.e. if $\left(1-\frac{1}{\overline{\theta}}\right) > \sigma$.

6 Appendix B

6.1 Data Description

Vertical Integration from Dun&Bradstreet

The Wordbase dataset reports for each firm the primary 4-digit SIC code, and up to five other codes of secondary product lines for the firm. I only have access to information at the industry

level, constructed in the following way. For each firm f in industry i in country c let V_{fic} the index of vertical integration,

$$V_{fic} = \frac{1}{2}\frac{1}{|I_{fic}|}\Sigma_i\Sigma_j v_{ij}$$

where v_{ij} is the input-output coefficient between industry i and industry j in the U.S., and $|I_{fic}|$ is the cardinality of the set of industries in which firm f is active, I_{fic}. Vertical integration at the industry level is given by the unweighted average of the indexes of vertical integration of firms in industry i and country c, i.e.

$$INT_{ic} = \frac{1}{N_{ic}}\Sigma_f V_{fic}$$

where N_{ic} is the number of firms in industry i and country c.

External Financial Dependency

I rely on the data provided in Rajan and Zingales (1998) for the regresssions using UNIDO database. For results in Table 6, I have computed the external financial dependency of 52 two-digit Input-Output industries. Starting from Compustat data, I have followed the methodology in Rajan and Zingales (1998) to compute the external financial dependency of 4-digit SIC industries. I have matched 4-digits codes with IO 2-digits codes and taken median values.

Small Firms

The variable "Small firms" is the share of employees working in establishments with less than 500 (or 100, in Table 4) employees in the United States. Data are from the 1992 Census of Industries. I have matched 4-digit SIC codes with 3-digit ISIC codes in order to provide aggregate figures at the 3-digit ISIC level in Tables 1 to 5. For Table 6 I have matched 4-digits codes with IO 2-digits codes.

External Financial Dependency of Upstream Industries

From the 1992 input-output table for the US, I construct an average measure of External Financial Dependency of upstream industries as follows. I construct input-output shares at the 3-digit ISIC level, using only flows within the manufactring sector. Denoting by ED_j the external financial dependency in 3-digit ISIC industry j and by v_{ij} the share of inputs purchased by (3-digit

ISIC code) industry i from other (3-digit ISIC code) industries j, the measure is given by

$$EFDU_i = \Sigma_{j \neq i} v_{ij} \times ED_j$$

I use the same procedure in Table 6, at the 2-digit IO level.

Contractual Needs

Starting from the 1992 input-output table in the United States, I construct for each 6-digit IO industry the Herfindahl index of input use. Letting s_{ij} be the share of input use of industry i from industry j, the index is given by $HI_i = \Sigma_j s_{ij}^2$. I then match the 6-digit IO industry codes with 3-digit ISIC codes, and take the median value within industry groups to generate the measure of contractual needs in Table 3. For Table 6, I perform the same excercise at the IO 2-digit level.

6.2 Further Robustness Checks

In this subsection I check the robustness of the results to alternative measures of the main variables used in Table 2.

Table 4 presents results when I use different measures to proxy for the importance of small firms in the industry. Columns I, II and III present results from the same specifications of Columns III, V and VI from Table 2 when the importance of small firms is proxied by the share of employees working in establishments with less than 100, instead of 500, employees. Results are broadly robust, even if the statistical significance is somewhat reduced.

Columns IV, V and VI of Table 4 repeat the exercise when the importance of small firms in the industry is proxied by the share of employees working in establishment with less than 500 employees in the United Kingdom, and thus checks that the main results do not depend on the use of industry variables in the United States, and that the importance of small firms is really capturing technological features of the industry. Results for these specifications are very robust, and the magnitude of the coefficients of interest is somewhat increased.

Other concerns may arise with respect to the use of the ratio of bank credit over GDP as a measure of financial development. Table 5 presents results for the baseline specification using alternative measures of financial development. Column I uses the ratio of bank assets over GDP

per capita. Results are robust to the use of this alternative measure of financial development. Column II proxies financial development with (the inverse of) bank concentration, as measured by the share of deposits of the three largest banks. Unfortunately this measure is available only for a smaller set of countries, significantly reducing the number of observations. On the other hand, this variable is closer in spirit to the anecdotal evidence on the relationship between financial markets and vertical integration in XIX century New England discussed in the introduction, since it proxies for the structure of the financial system. I find once again the main results to be robust to this specification. Finally column III reports results when financial development is measured by an index of legal rights of investors (from Doing Business database at World Bank). The advantage of this type of measure over measures of bank credit is that they are less directly an outcome variable related to the availability of credit. On the other hand, it is plausible that the index captures availability of credit with higher measurement error. I do not take the logarithm of the index to run the regression, and hence the coefficients are not directly comparable to the coefficients in Columns I and II. The main message of the analysis is consistent, even if statistical significance is reduced, possibly due to higher measurement error in the measure of credit availability.

The last two Columns of Table 5 instead present results for the baseline specification when I break the sample between OECD and non OECD countries. The results are once again robust, and I find evidence consistent with the theoretical predictions in both sets of countries, although the magnitude and statistical significance of the coefficients for the within non OECD countries are reduced. This can be due to the fact that vertical integration is measured with greater measurement error in poorer countries, and that there is less variation in financial development among those countries. Results are improved when I pool the sample, and impose the same industry fixed effects for OECD and non-OECD countries (results are available upon request).

In order to check for the robustness of the results, Table 6 reports results using a second measure of vertical integration in industry i and country c. This second measure is constructed from firm level information provided in Worldbase, a database maintained by Dun & Bradstreet, and follows the procedure in Acemoglu et al. (2005a). As noted above, the main advantages of the UNIDO measure are that it is a well known index of vertical integration and that data come from industrial statistics relying on Census information and are thus overall representative. The Worldbase measure has the advantage of being constructed from a large firm level database

exploiting information on firms activities. The industry classification allows me to consider two-digit input-output classification system, i.e. to break up the manufacturing sector in 52 industries. On the other hand, the construction of the firm level index hinges on the use of input-output information from the United States, and large countries tend to be over represented in the sample.

Table 6 performs the same exercise of Table 2 with the second measure of vertical integration. Column I presents results from the baseline specification which are highly consistent with the theoretical predictions. Column II includes the interaction with external dependency of upstream industries, and Column III further introduces the interaction between contractual intensity and contractual enforcement. The magnitude and statistical significance of the coefficients β_1 and β_2 is virtually unchanged, but in contrast to the results in Table 2 and Table 3, the two further interactions in the third and fourth lines have the appropriate sign, but are not statistically significant.

Finally, Columns IV to VI repeat the exercise of the corresponding Columns in Table 2, by adding the interaction of vertical integration in the United States with GDP per capita (Column IV), the interaction of industry variables with GDP per capita (Column V) and interactions of fifty two industry dummies with GDP per capita (Column VI). While the statistical significance of the results is somewhat reduced, the magnitude and interpretation of the coefficients are once again unchanged.

TABLE 1A

Average Vertical Integration by Industry in the Sample

industry	Code ISIC	Vertical Integration	Industry	Code ISIC	Vertical Integration
food products	311	0.29	rubber prductus	355	0.39
beverages	313	0.48	plastic products	356	0.36
tobacco	314	0.56	pottery	361	0.52
textile	321	0.38	glass	362	0.45
apparel	322	0.41	non metal products	369	0.42
leather	323	0.33	iron and steel	371	0.31
footwear	324	0.39	nonferrous metal	372	0.28
wood products	331	0.38	metal products	381	0.38
furniture	332	0.40	machinery	382	0.41
paper and products	341	0.35	electric machinery	383	0.38
printing / publishing	342	0.47	transportation equip.	384	0.36
other chemicals	352	0.38	professional goods	385	0.44
petroleum raffineries	353	0.29	other industrries	390	0.41

TABLE 1B

List of Countries in the Sample

Algeria	Costa Rica	Indonesia	Namibia	Singapore
Argentina	Cote d'Ivoire	Iran	Nepal	Slovakia
Australia	Croatia	Ireland	Netherlands	Slovenia
Austria	Czech	Israel	New Zeland	South Africa
Bangladesh	Denmark	Italy	Nigeria	Spain
Belgium	Ecuador	Jamaica	Norway	Sri Lanka
Bolivia	Egypt	Japan	Oman	Sweden
Bosnia	El Salvador	Jordan	Pakistan	Syria
Botswana	Ethiopia	Kenya	Panama	Tanzania
Brazil	Fiji	South Korea	Paraguay	Thailand
Bulgaria	Finland	Kuwait	Peru	Tunisia
Burundi	France	Latvia	Philippines	Turkey
Cameroon	Ghana	Macedonia	Poland	Unit. Kingdom
Canada	Greece	Malawi	Portugal	Venezuela
Centr. African Rep.	Honduras	Malaysia	Romania	Zambia
Chile	Hong Kong	Mexico	Russian	Zimbabwe
China	Hungary	Mongolia	Senegal	
Colombia	India	Morocco	Sierra Leone	

TABLE 1C
Descriptive Statistics

	Observations	Mean	St. Dev	Min	Max
Main Industry Variables					
Vertical Integration	28	0.50	0.12	0.17	0.75
External Financial Dependency	28	0.24	0.33	-0.45	1.14
Share of Small Firms	28	0.38	0.16	0.06	0.64
External Financial Dependency of Upstream Industries	28	0.33	0.10	0.11	0.55
Contractual Needs	28	0.17	0.04	0.12	0.33
Main Country Level Variables					
GDP per Capita (Log)	89	8.61	1.04	6.2	10.18
Bank Credit / GDP	89	0.37	0.29	0.03	1.45
Number of Procedures	89	29.29	11.32	11	58

TABLE 2: FINANCIAL MARKETS AND VERTICAL INTEGRATION

Vertical Integration: UNIDO Measure	I	II	III	IV	V	VI
External Financial Dependency × Financial Development	0.040	0.178***	0.191***	0.173***	0.173**	0.168**
	[0.030]	[0.063]	[0.064]	[0.066]	[0.089]	[0.087]
External Financial Dependency × Financial Development × Empl. in Small Firms		-0.264***	-0.285***	-0.256***	-0.245**	-0.240**
		[0.091]	[0.094]	[0.097]	[0.113]	[0.109]
External Financial Dependency of Upstream Industries × Financial Development			-0.049**	-0.041*	-0.061*	-0.059*
			[0.021]	[0.022]	[0.034]	[0.034]
Vertical Integration in U.S. × GDP per Capita				0.086*	0.088*	0.067
				[0.045]	[0.046]	[0.086]
Industry Dummies	yes	yes	yes	yes	yes	yes
Country Dummies	yes	yes	yes	yes	yes	yes
Vertical Integration U.S. × GDP Per Capita				yes	yes	
Industry Characteristics × GDP Per Capita					yes	
Industry Dummies × GDP Per Capita						yes
Observations	1734	1734	1734	1734	1734	1734
R-squared	0.52	0.52	0.52	0.53	0.53	0.54

***, ** and * mean statistically significant at 1%, 5% and 10% respectively. Robust standard errors clustered at the country level are reported in parenthesis. Vertical Integration is the (log of the) ratio of Value Added over Output at the Industry level (source: UNIDO 2001 database). Financial Development is the (log of the) ratio of Bank Credit over GDP (source: Levine (2003)). External Financial Dependency (source: Rajan and Zingales (1998)). Employment in small firms is the share of employees in establishment with less than 500 employees (source: author's calculations). External Financial Dependency of Upstream Industries (source: author's calculations). I use the ranking of the industry level variables.

TABLE 3: DISENTANGLING CONTRACTS WITH INVESTORS AND INPUT SUPPLIERS

Vertical Integration: UNIDO Measure	I	II	III	IV	V	VI
Contractual Needs × Quality of Contract Enforcement	0.210***	0.393**	0.220***	0.273***	0.249***	0.272***
	[0.056]	[0.181]	[0.060]	[0.111]	[0.070]	[0.082]
Contractual Needs × Qual. of Contr. Enforc. × Empl. in Small Firms		-0.415				
		[0.333]				
External Financial Dependency × Financial Development			0.170***	0.163**	0.149*	0.156*
			[0.064]	[0.071]	[0.085]	[0.085]
External Financial Depend. × Financ. Developm. × Empl. in Small			-0.274***	-0.261**	-0.225**	-0.236**
			[0.094]	[0.109]	[0.110]	[0.109]
Contractual Needs × Financial Development				0.025		
				[0.033]		
External Financial Dependency × Quality of Contract Enforcement				-0.09		
				[0.118]		
Industry Dummies	yes	yes	yes	yes	yes	yes
Country Dummies	yes	yes	yes	yes	yes	yes
Industry Characteristics × GDP Per Capita					yes	
Industry Dummies × GDP Per Capita						yes
Observations	1734	1734	1734	1734	1734	1734
R-squared	0.52	0.52	0.53	0.53	0.53	0.55

***, ** and * mean statistically significant at 1%, 5% and 10% respectively. Robust standard errors clustered at the country level are reported in parenthesis. Vertical Integration is the (log of the) ratio of Value Added over Output at the Industry level (source: UNIDO 2001 database). Financial Development is the (log of the) ratio of Bank Credit over GDP (source: Levine (2003)). Quality of Contract Enforcement is (minus the log of) the number of procedures to enforce a contract (source: Doing Business Database at World Bank). External Financial Dependency (source: Rajan and Zingales (1998)). Employment in small firms is the share of employees in establishment with less than 500 employees (source: author's calculations). External Financial Dependency of Upstream Industries (source: author's calculations). Contractual Needs is the Herfindahl index of input use (source: author's calculations). I use the ranking of the industry level variables.

TABLE 4: ALTERNATIVE MEASURES FOR SMALL FIRMS

Vertical Integration: UNIDO Measure	I	II	III	IV	V	VI
External Financial Dependency × Financial Development	0.198***	0.135	0.141*	0.230***	0.205***	0.205***
	[0.064]	[0.088]	[0.085]	[0.072]	[0.082]	[0.084]
External Financial Dependency × Financial Development × Empl. in Small Firms	-0.303***	-0.182	-0.190*	-0.342***	-0.298***	-0.299***
	[0.098]	[0.117]	[0.114]	[0.104]	[0.115]	[0.117]
External Financial Dependency of Upstream Industries × Financial Development	-0.060***	-0.065*	-0.061*	-0.044*	-0.059	-0.055
	[0.022]	[0.034]	[0.034]	[0.024]	[0.037]	[0.038]
Industry Dummies	yes	yes	yes	yes	yes	yes
Country Dummies	yes	yes	yes	yes	yes	yes
Industry Characteristics × GDP Per Capita		yes			yes	
Industry Dummies × GDP Per Capita			yes			yes
Observations	1734	1734	1734	1734	1734	1734
R-squared	0.52	0.53	0.54	0.52	0.53	0.55

***, ** and * mean statistically significant at 1%, 5% and 10% respectively. Robust standard errors clustered at the country level are reported in parenthesis. Vertical Integration is the (log of the) ratio of Value Added over Output at the Industry level (source: UNIDO 2001 database). Financial Development is the (log of the) ratio of Bank Credit over GDP (source: Levine (2003)). External Financial Dependency (source: Rajan and Zingales (1998)). Employment in small firms is the share of employees in establishment with less than 100 employees in the US in Columns I, II, III, and share of employees in establishment with less than 100 employees in the UK in Columns IV, V, VI. (source: author's calculations). External Financial Dependency of Upstream Industries (source: author's calculations). I use the ranking of the industry level variables.

TABLE 5: ALTERNATIVE SAMPLES AND MEASURES OF FINANCIAL DEVELOPMENT

Vertical Integration: UNIDO Measure	I	II	III	IV	V
External Financial Dependency × Financial Development	0.194***	0.420*	0.044*	0.253***	0.085
	[0.073]	[0.222]	[0.026]	[0.096]	0.065
External Financial Dependency × Financial Development × Empl. in Small Firms	-0.294***	-0.670**	-0.053	-0.322**	-0.185*
	[0.104]	[0.305]	[0.034]	[0.161]	[0.107]
External Financial Dependency of Upstream Industries × Financial Development	-0.042*	0.048	-0.008	-0.059	-0.038
	[0.024]	[0.131]	[0.009]	[0.056]	[0.036]
Industry Dummies	yes	yes	yes	yes	yes
Country Dummies	yes	yes	yes	yes	yes
Observations	1734	1059	1734	561	1147
R-squared	0.52	0.55	0.54	0.65	0.5

***, ** and * mean statistically significant at 1%, 5% and 10% respectively. Robust standard errors clustered at the country level are reported in parenthesis. Vertical Integration is the (log of the) ratio of Value Added over Output at the Industry level (source: UNIDO 2001 database). Financial Development is the (log of the) ratio of Bank Assets over GDP in Column I, the (log of the) share of the deposit of the three largest banks in Column II (source: Levine (2003)) and the index of investor's rights in Column III (source: Doing Business Database at World Bank). External Financial Dependency (source: Rajan and Zingales (1998)). Employment in small firms is the share of employees in establishment with less than 500 employees (source: author's calculations). External Financial Dependency of Upstream Industries (source: author's calculations). I use the ranking of the industry level variables. Columns IV and V present results from separate regressions for OECD and Non OECD countries respectively.

TABLE 6: ALTERNATIVE MEASURE OF VERTICAL INTEGRATION

Vertical Integration: Dun & Bradstreet Measure	I	II	III	IV	V	VI
External Financial Dependency × Financial Development	0.710***	0.706***	0.696***	0.559**	0.623**	0.646*
	[0.234]	[0.238]	[0.238]	[0.241]	[0.324]	[0.347]
External Financial Dependency × Financial Development × Empl. in Small Firms	-1.545***	-1.537***	-1.515***	-1.196**	-1.029	-1.128
	[0.581]	[0.593]	[0.593]	[0.599]	[0.792]	[0.855]
External Financial Dependency of Upstream Industries × Financial Development		-0.037	-0.038	-0.004	-0.118	-0.11
		[0.169]	[0.170]	[0.169]	[0.192]	[0.209]
Contractual Needs × Quality of Contract Enforcement			0.554			
			[2.256]			
Industry Dummies	yes	yes	yes	yes	yes	yes
Country Dummies	yes	yes	yes	yes	yes	yes
Vertical Integration U.S. × GDP Per Capita				yes	yes	
Industry Characteristics × GDP Per Capita					yes	
Industry Dummies × GDP Per Capita						yes
Observations	2417	2417	2417	2417	2417	2417
R-squared	0.55	0.55	0.55	0.55	0.55	0.58

***, ** and * mean statistically significant at 1%, 5% and 10% respectively. Robust standard errors clustered at the country level are reported in parenthesis. Vertical Integration is the (log of the) ratio of the index of vertical integration from the Dun & Bradstreet Worldbase (source: author's calculations). Financial Development is the (log of the) ratio of Bank Credit over GDP (source: Levine (2003)). Quality of Contract Enforcement is (minus the log of) the number of procedures to enforce a contract (source: Doing Business Database at World Bank). External Financial Dependency (source: Rajan and Zingales (1998)). Employment in small firms is the share of employees in establishment with less than 500 employees (source: author's calculations). External Financial Dependency of Upstream Industries (source: author's calculations). Contractual Needs is the Herfindahl index of input use (source: author's calculations). I use the ranking of the industry level variables. Industries are classified as in Table 6.a.

TABLE 6A

List of Industries: IO Code

13	Ordnance and accessories
14	Food and kindred products
15	Tobacco products
16	Broad and narrow fabrics, yarn and mills
17	Miscellaneous textile goods
18	Apparel
19	Miscellaneous fabricated textile products
20+21	Lumber and wood products
22+23	Furniture and fixtures
24	Paper and allied products
25	Paperboard containers and boxes
26A	Newspapers and periodicals
26B	Other printing and publishing
27A	Industrial and other chemicals
27B	Agricultural fertilizers and chemicals
28	Plastics and synthetic materials
29A	Drugs
29B	Cleaning and toilet preparation
30	Paints and allied products
31	Petroleum refining and related products
32	Rubber and miscellaneus plastics products
33+34	Footwear, leather, and leather products
35	Glass and glass products
36	Stone and clay products
37	Primary iron and steel manufacturing
38	Primary nonferrous metals manufacturing
39	Metal containers
40	Heating, plumbing and fabric. Struct. Mat.
41	Screw machine products and stampings
42	Other fabricated metal products
43	Engines and turbines
44+45	Farm, construction and mining machinery
46	Materials handling machinery and equip.
47	Metalworking machinery and equipment
48	Special industry machinery and equipment
49	General industrial machinery and equipment
50	Miscellaneous machinery and equipment
51	Computer and office equipment
52	Service industry machinery
53	Electrical industrial equip. and apparatus
54	Household appliances
55	Electric lighting and wiring equipment
56	Audio, video and communication equipment
57	Electronic components and accessories
58	Misc. electrical machinery and supplies
59A	Motor vehicles passangers cars and trucks
59B	Motor vehicles parts
60	Aircraft and parts
61	Other transportation equipment
62	Scientific and controlling instruments
63	Ophthalmic and photographic equipment
64	Miscellaneous