

Institutional Quality and Contract Complexity: The Effect On The Intensive and Extensive Margins of Trade

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Abstract

This contribution aims at analyzing the role of domestic institutions in export decisions along their extensive and intensive margins, supported by an empirical analysis based on customer agency data. A modified version of Melitz (2003) model is developed by admitting cross country differences in the quality of institutions and cross sector differences related to contract complexity. In the presence of high-quality domestic institutions selection conditions are very strict; selling in export market is difficult, but when firms enter export markets their high efficiency allows them to get high revenues. The exporting probability is higher in more complex sectors provided that institutions are able to overcome the inefficiency induced by contract incompleteness.

Keywords: institutional quality, trade margins, developing and developed countries

JEL codes: E02, F12, F14

1. Introduction

Empirical evidence suggests that institutions affect the general efficiency of economic activities and large discrepancies appear when comparing developed economies with developing ones (Acemoglu et al. 2002). Institutions are defined as all mechanisms able to enforce contracts at lower transaction costs. In international trade, export decisions may be widely influenced by the quality of institutions. In this view, the focus of this contribution is the theoretical analysis of institutional determinants of export decisions along their extensive and intensive margins, supported by an empirical analysis based on customer agency data.

The proposed framework is Melitz (2003) model, which considers the self-selection process of firms in export markets on the basis of their (heterogeneous) productivity levels. It is extended to account for cross-country institutional differences along two dimensions. First, given that institutions positively affect domestic firms' performance, the ex-ante probability of a high productive firm is assumed to be higher in a country with better institutions. Second, I admit the existence of several industries, which differ from each other for the complexity of the production process due to sector-specific characteristics (Nunn, 2007). The presence of incomplete contracts and holdup problems in acquiring inputs may create inefficiencies negatively affecting firms' performance. Thus, we assume that the ex-ante probability of a high productive firm is higher in less complex sectors. Moreover, factor markets are segmented because of the presence of incomplete information and factor rewards differ across sectors (Levchenko, 2007). These industries are also characterized by a heterogeneous elasticity of substitution. More complex goods show lower elastic demand conditions (Krishna and Levchenko 2013; Maggioni et al. 2014). High institutional quality may lower inefficiencies and cross-sector wage differences as stated by Levchenko (2007) and Nunn (2007). The costs to produce complex goods are lower and this cost advantage translates into a comparative advantage in international markets.

Main results related to the intensive and extensive margins of trade are formally shown by using comparative statics. The former margin is measured by average revenues in export markets and the latter one is expressed in terms of export probability.

The predictions of the theoretical model are then tested for a panel of developed and developing countries. Specifically, we empirically evaluate whether and how domestic institutions affect export flows along their intensive and extensive margins in 1997-2007 years, using country data disaggregated by sectors (World Bank Exporter Dynamics Database). Institutional quality indexes (rule of law, control of corruption, and regulatory quality) are drawn from World Bank WGI dataset. To take account of the different importance of relationship-specific inputs across sectors, we use the contract intensity measure

constructed by Nunn (2007). Given the presence of zeroes in number of exporters and average per exporter export values series and to account for heteroskedasticity appropriate econometric techniques are used.

This paper is strictly related to other contributions exploring how domestic institutional quality impacts comparative advantage. Anderson and Marcoullier (2002), Francois and Manchin (2013) and many others show that bilateral trade volumes are positively affected by institutions. Furthermore, sector specific characteristics are crucial. Cross sector differences are related to factor markets segmentation due to incomplete information (Levchenko, 2007), to complexity of upstream intermediate inputs (Nunn, 2007) and to heterogeneous elasticity of substitution of final goods (Ranjan and Lee, 2007).

The paper is organized as follows. The extended Melitz model is presented in section 2, by admitting cross country differences in institutions (section 2.2) and cross sector differences related to input contract complexity and demand conditions (section 2.3). Data description, econometric model and results are reported in section 3. Section 4 concludes.

2. The model

For the purpose of the paper, we present a modified version of Melitz (2003) model, by admitting cross country differences in the quality of institutions and cross sector differences related to input contract complexity and demand conditions.

2.1 Basic framework

We first outline the Melitz (2003) model as a benchmark for subsequent analysis. The preferences of a representative consumer are given by a CES utility function over a continuum of goods indexed by ω , $\omega \in \Omega$, where the measure of the set Ω represents the mass of available goods. These goods are imperfect substitutes with an elasticity of substitution between any two goods of $\varepsilon > 1$. It is easy to show that the optimal expenditure for individual varieties is

$$[1] \quad r(\omega) = R \left[\frac{p(\omega)}{P} \right]^{1-\varepsilon}$$

where $R = \int_{\omega \in \Omega} r(\omega) d\omega$ denotes aggregate expenditure and $P = \left[\int_{\omega \in \Omega} p(\omega)^{1-\varepsilon} d\omega \right]^{\frac{1}{1-\varepsilon}}$ is the aggregate price.

As for production, there is a continuum of firms, each choosing to produce a variety ω . There is only one factor, labor, which is inelastically supplied at the aggregate level L and is an index of the domestic economy's size. The cost function exhibits a constant marginal cost $1/\varphi$ with a fixed overhead cost f . All firms share the same fixed cost $f > 0$ but have different

productivity levels indexed by $\varphi > 0$. Each firm chooses the same profit maximizing mark-up

$\left(\frac{\varepsilon}{1-\varepsilon} = \frac{1}{\rho}\right)$, which yields the following pricing rule:

$$[2] \quad p_d(\varphi) = \frac{w}{\rho\varphi}$$

where w is the wage rate, which is normalized to one. Firm profit in the domestic market is then

$$[3] \quad \pi_d(\varphi) = \frac{r_d(\varphi)}{\varepsilon} - f$$

Melitz (2003) also considers firm entry and exit. Prior to entry firms are identical. To enter the domestic market, firms must make an initial investment, modeled as a fixed sunk entry cost $f_e > 0$ and measured in terms of labor units. Firms then draw their initial productivity parameter φ from a common distribution $g(\varphi)$; $g(\varphi)$ is defined over a positive support and has a continuous cumulative distribution $G(\varphi)$. If the firm produces, it faces an exit probability δ in every period due to a bad shock.

Equilibrium in the closed economy is characterized by a mass M of firms (and hence M goods) and a distribution $\mu(\varphi)$ of productivity levels. There exists the lowest productivity level φ^* such that $\pi(\varphi^*) = 0$. For given φ^* the shape of the distribution $\mu(\varphi)$ and the ex ante survival probability η_d are exogenously determined by $g(\varphi)$ and δ :

$$[4] \quad \mu(\varphi) = \begin{cases} \frac{g(\varphi)}{1-G(\varphi^*)} & \text{if } \varphi \geq \varphi^* \\ 0 & \text{otherwise} \end{cases}$$

$$[5] \quad \eta_d \equiv 1 - G(\varphi^*)$$

The average productivity level is endogenously determined as

$$[6] \quad \tilde{\varphi}(\varphi^*) = \left[\frac{1}{1-G(\varphi^*)} \int_{\varphi^*}^{\infty} \varphi^{\varepsilon-1} g(\varphi) d\varphi \right]^{\frac{1}{\varepsilon-1}}$$

as well as the average revenue level

$$[7] \quad r_d(\tilde{\varphi}) = (1 + k(\varphi^*)) r_d(\varphi^*)$$

where $k(\varphi^*) \equiv \left[\frac{\tilde{\varphi}(\varphi^*)}{\varphi^*} \right]^{\varepsilon-1} - 1$. The average profit level is

$$[8] \quad \pi_d(\tilde{\varphi}) = (1 + k(\varphi^*)) \frac{r_d(\varphi^*)}{\varepsilon} - f$$

The zero cutoff profit condition $\pi_d(\varphi^*) = 0$ implies that $r_d(\varphi^*) = \varepsilon f$ and

$$[9] \quad r_d(\tilde{\varphi}) = (1 + k(\varphi^*)) \varepsilon f$$

$$[10] \quad \pi_d(\tilde{\varphi}) = f k(\varphi^*)$$

And the zero free entry value condition $v_s = [1 - G(\varphi^*)] \frac{\pi_d(\tilde{\varphi})}{\delta} - f_s = 0$ implies that

$$[11] \quad \pi_d(\tilde{\varphi}) = \frac{\delta f_s}{1-G(\varphi^*)}$$

There exists an equilibrium $(\varphi^*, \pi_d(\tilde{\varphi}))$ that simultaneously satisfies the zero cutoff profit and zero free entry value conditions, [10] and [11]; φ^* is obtained solving the following equation

$$[12] \quad k(\varphi^*)[1 - G(\varphi^*)] = \frac{\delta f \varepsilon}{f}$$

and the average profit level $\pi_d(\tilde{\varphi})$ is then recovered by either [10] or [11] by substituting back the value of φ^* given by [12]. The average firm revenue is then obtained as

$$[13] \quad r_d(\tilde{\varphi}) = \varepsilon[\pi_d(\tilde{\varphi}) + f]$$

The mass of producing firms in any period can be determined from the average revenue level [13] and the aggregate revenue R, which is fixed by the size of labor force L, as follows:

$$[14] \quad M = \frac{R}{r_d(\tilde{\varphi})} = \frac{L}{\varepsilon[\pi_d(\tilde{\varphi}) + f]}$$

When firms can also sell in foreign markets, they face additional per-unit costs, such as transport costs and tariffs, and some fixed costs modeled as independent of the firm's export volume. For the latter one, the standard iceberg formulation is assumed, with $t > 1$ units of a good to be shipped in order for 1 unit to arrive at destination. Entry into each export market requires a fixed sunk cost $f_x > 0$ measured in labor units.

Firms who export set a price $p_d(\varphi) = \frac{1}{\rho\varphi}$ in the domestic market and a higher price in the foreign market $p_x(\varphi) = \tau p_d(\varphi)$. Melitz (2003) shows that the zero cutoff profit condition $\pi_x(\varphi_x^*) = 0$ implies that

$$[15] \quad \pi_x(\tilde{\varphi}_x) = f_x k(\varphi_x^*)$$

where $k(\varphi_x^*) = \left[\frac{\tilde{\varphi}(\varphi_x^*)}{\varphi_x^*} \right]^{\varepsilon-1} - 1$ and $\varphi_x^* = \varphi^* \tau \left(\frac{f_x}{f} \right)^{\frac{1}{\varepsilon-1}}$. The new zero cutoff profit condition for the open economy is

$$[16] \quad \bar{\pi} = f k(\varphi^*) + \eta_x n f_x k(\varphi_x^*)$$

where $\eta_x \equiv [1 - G(\varphi_x^*)]/[1 - G(\varphi^*)]$ is the ex ante probability that a successful firm will export and n is the number of countries. The zero free entry value condition remains unchanged and implies that

$$[17] \quad \bar{\pi} = \frac{\delta f \varepsilon}{1 - G(\varphi^*)}$$

There exists an equilibrium $(\varphi^*, \bar{\pi})$ that simultaneously satisfies the zero cutoff profit and zero free entry value conditions, [16] and [17]; φ^* is obtained solving the following equation

$$[18] \quad \left[k(\varphi^*) + \eta_x \frac{n f_x}{f} k(\varphi_x^*) \right] [1 - G(\varphi^*)] = \frac{\delta f \varepsilon}{f}$$

where $\varphi_x^* = \varphi^* \tau \left(\frac{f_x}{f} \right)^{\frac{1}{\varepsilon-1}}$. The solution φ^* can be substituted back into condition [17] to obtain $\bar{\pi}$. The average firm revenue is

$$[19] \quad \bar{r} = \varepsilon(\bar{\pi} + f + \eta_x \eta f_x)$$

Again, the mass of producing firms in any period can be determined from the average revenue level and the aggregate revenue R as follows:

$$[20] \quad M = \frac{R}{\bar{r}} = \frac{L}{\varepsilon(\bar{\pi} + f + \eta_x \eta f_x)}$$

and the mass of exporting firms is $M_x = \eta_x M$.

In summary, all firms sort into three alternatives $s = \{e, d, x\}$ and it is shown that only firms with $\varphi > \varphi^*$ enter the domestic market and, among active firms, only a subset of firms with $\varphi > \varphi_x^*$ can export. From [11] and [15] it is easy to show that $\pi_x(\tilde{\varphi}_x) > \pi_d(\tilde{\varphi}) > \pi_e = -f_e$.

Therefore we can say that $\pi(\varphi, \sigma)$ is supermodular in (φ, σ) : high- φ firms have relative higher profits in high- s markets. Given that the s set includes three alternatives only, for any $\varphi_2 \geq \varphi_1$ the following conditions are satisfied

$$\pi_x(\varphi_2) - \pi_d(\varphi_2) \geq \pi_x(\varphi_1) - \pi_d(\varphi_1)$$

$$\pi_x(\varphi_2) - \pi_e(\varphi_2) \geq \pi_x(\varphi_1) - \pi_e(\varphi_1)$$

$$\pi_d(\varphi_2) - \pi_e(\varphi_2) \geq \pi_d(\varphi_1) - \pi_e(\varphi_1)$$

Let us now consider cross country differences related to the quality of institutions. We can imagine that the quality of institutions affects productivity by influencing the level of transaction costs in a world of imperfect contract enforcement where relationship-specific investments are required for production (Nunn, 2007). In next section, we consider the possibility of differences in productivity distribution functions due to institutional quality differences. In section 2.3, we introduce cross-sector differences in contract complexity and demand conditions. Then, in section 2.4 we consider the interplay of sector complexity due to the incompleteness of information and better institutions.

2.2 Productivity and institutional quality

We extend the basic framework presented in section 2.1 by considering the individual firm's choice among exit (e), selling in the domestic market (d), and selling in the domestic and export markets (x) in an economy where firm's productivity probability distribution is affected by the quality of domestic institutions.

In this case, firms draw their initial productivity parameter φ from a common distribution $g(\varphi, \gamma)$; $g(\varphi, \gamma)$ is defined over a positive support and has a continuous cumulative distribution $G(\varphi, \gamma)$. We assume that γ is related to country's characteristics expressed in terms of institutional quality and $G(\varphi, \gamma_A)$ dominates the productivity distribution $G(\varphi, \gamma_B)$ in terms of the hazard rate order that is

$$\frac{g(\varphi, \gamma_A)}{1 - G(\varphi, \gamma_A)} < \frac{g(\varphi, \gamma_B)}{1 - G(\varphi, \gamma_B)}$$

This hypothesis allows to state that the expectation of an increasing function of productivity above some cut off level i , $E[y(\varphi)|\varphi > i]$, is increasing in institutional quality γ (Demidova, 2008). This hypothesis implies that $G(\varphi, \gamma)$ is decreasing in γ - that is high- γ countries are relatively more abundant in high- φ firms. Given any two countries A and B, with $\gamma_A > \gamma_B$, then $G(\varphi, \gamma_A) \leq G(\varphi, \gamma_B)$ for all φ with a strict inequality over some interval¹.

Moreover, we assume that $G(\varphi, -\gamma)$ is supermodular in $(\varphi, -\gamma)$, that is

$$[21] \quad G(\varphi_1, -\gamma_0) - G(\varphi_0, -\gamma_0) \geq G(\varphi_1, -\gamma_1) - G(\varphi_0, -\gamma_1)$$

when $\varphi_1 \geq \varphi_0$ and $\gamma_1 \geq \gamma_0$. Intuitively, supermodularity of $G(\varphi, -\gamma)$ in $(\varphi, -\gamma)$ means a higher positive change of the share of lower productive firms with a lower institutional quality level.

We next study the effects of institutional quality on extensive and intensive margins of trade. The former margin is expressed in terms of export probability and the latter one is measured by average revenue in export markets.

As a first step, we show that selection conditions are affected by institutions, so that the cut off productivity levels φ^* and φ_x^* increase when institutional quality γ increases. We start from condition [18], which we re-write as follows

$$B(\varphi^*, \gamma) = 0$$

where

$$B(\varphi^*, \gamma) \equiv f j(\varphi^*, \gamma) + n f_x j(\varphi_x^*, \gamma) - \delta f_B$$

$$\varphi_x^* = \varphi^* \tau \left(\frac{f_x}{f} \right)^{\frac{1}{\varepsilon-1}}$$

$$j(i, \gamma) \equiv k(i, \gamma) [1 - G(i, \gamma)], \quad i = \varphi^*, \varphi_x^*$$

$$k(i, \gamma) \equiv \left[\frac{\tilde{\varphi}(i, \gamma)}{i} \right]^{\varepsilon-1} - 1$$

$$\tilde{\varphi}(i, \gamma) = \left[\frac{1}{1-G(i, \gamma)} \int_i^\infty \varphi^{\varepsilon-1} g(\varphi, \gamma) d\varphi \right]^{\frac{1}{\varepsilon-1}}.$$

It can be shown that the smallest productivity levels selecting firms into domestic and foreign markets, φ^* and φ_x^* , are higher the better is institutional quality. Specifically, for the domestic cut-off we have

$$\frac{d\varphi^*}{d\gamma} = - \frac{\partial B(\varphi^*, \gamma) / \partial \gamma}{\partial B(\varphi^*, \gamma) / \partial \varphi^*} > 0$$

where

$$\frac{\partial B(\varphi^*, \gamma)}{\partial \gamma} = f \frac{\partial j(\varphi^*, \gamma)}{\partial \gamma} + n f_x \frac{\partial j(\varphi_x^*, \gamma)}{\partial \gamma}$$

which is positive given that $\partial j(i, \gamma) / \partial \gamma > 0$ for all $i = \varphi^*, \varphi_x^*$.² In addition, the derivative

¹ This assumption corresponds to the definition of first order stochastic dominance.

² It is easy to show that the derivative $\frac{\partial j(i, \gamma)}{\partial \gamma} = - \frac{\partial G(i, \gamma)}{\partial \gamma} k(i, \gamma) + \frac{\partial k(i, \gamma)}{\partial \gamma} [1 - G(i, \gamma)]$, $i = \varphi^*, \varphi_x^*$ is positive since $\partial G(i, \gamma) / \partial \gamma$ is negative and $\partial k(i, \gamma) / \partial \gamma$ is positive. The dominance in terms of the hazard rate of

$$\frac{\partial B(\varphi^*, \gamma)}{\partial \varphi^*} = f \frac{\partial j(\varphi^*, \gamma)}{\partial \varphi^*} + n f_x \tau \left(\frac{f_x}{f} \right)^{\frac{1}{s-1}} \frac{\partial j(\varphi_x^*, \gamma)}{\partial \varphi_x^*}$$

is negative since $\partial j(i, \gamma) / \partial i < 0$ for all $i = \varphi^*, \varphi_x^*$.

It is also shown that institutional quality changes positively affect the export productivity cut-off

$$\frac{d\varphi_x^*}{d\gamma} = \tau \left(\frac{f_x}{f} \right)^{\frac{1}{s-1}} \frac{d\varphi^*}{d\gamma} > 0.$$

Firm-selection left-truncates a share of the productivity distribution. This share increases the lower is institutional quality. When the domestic institutional setting gets better, the domestic cut-off increases: there is a reallocation of market shares and revenues toward highly productive firms.

As a second step, we study the impact of changes in domestic institutional quality γ on the probability of exporting, for a given productivity level φ .

Proposition 1: *The ex ante probability of exporting η_x is an increasing function of institutional quality γ for a given level of productivity φ , when $G(\varphi, -\gamma)$ is supermodular in $(\varphi, -\gamma)$.*

PROOF: Proposition 1 can be shown by considering the partial derivative of η_x with respect to γ :

$$\frac{\partial \eta_x}{\partial \gamma} = \frac{\eta_x \frac{\partial G(\varphi^*, \gamma)}{\partial \gamma} - \frac{\partial G(\varphi_x^*, \gamma)}{\partial \gamma}}{1 - G(\varphi^*, \gamma)} > 0$$

When $G(\varphi, -\gamma)$ is supermodular in $(\varphi, -\gamma)$, there are decreasing changes of $G(\cdot)$ when productivity φ increases. Since $\partial G(\varphi, \gamma) / \partial \gamma < 0$ this means that the ratio $\frac{\partial G(\varphi_x^*, \gamma) / \partial \gamma}{\partial G(\varphi^*, \gamma) / \partial \gamma}$ is greater than 1 and the numerator of the partial derivative is positive. Therefore the effect of institutional quality improvements on export probability is positive. QED.

This leads to the distribution of productivity being dilated when institutions improve.

As a third step, we study what is the effect of a change of the domestic productivity cut-off on export probability, for a given level of institutional quality γ . There is a negative change which is stated in next proposition.

the productivity distribution for better institutions is a sufficient condition to guarantee that the latter derivative is positive. Indeed, the dominance hypothesis implies that the expectation of an increasing function of productivity above some cut off level i , $E[\varphi^{s-1} | \varphi \geq i]$ is increasing in institutional quality γ (Demidova, 2008).

Proposition 2: *The ex ante probability of exporting η_x is negatively affected by the domestic productivity cut-off φ^* for a given level of institutional quality γ , when*

$$\frac{h(\varphi^*, \gamma)}{h(\varphi_x^*, \gamma)} < \tau \left(\frac{f_x}{f} \right)^{\frac{1}{s-1}}, \text{ with } h(\varphi, \gamma) \equiv \frac{g(\varphi, \gamma)}{1-G(\varphi, \gamma)}.$$

PROOF: Proposition 2 can be shown by considering the partial derivative of η_x with respect to φ^* .

$$\frac{\partial \eta_x}{\partial \varphi^*} = \frac{\eta_x g(\varphi^*, \gamma) - \tau \left(\frac{f_x}{f} \right)^{\frac{1}{s-1}} g(\varphi_x^*, \gamma)}{1 - G(\varphi^*, \gamma)} < 0$$

where $g(\varphi, \gamma) = \partial G(\varphi, \gamma) / \partial \varphi$. Let us consider the expression:

$$\frac{\eta_x g(\varphi^*, \gamma)}{g(\varphi_x^*, \gamma)} = \frac{h(\varphi^*, \gamma)}{h(\varphi_x^*, \gamma)} > 1$$

It indicates the ratio of two values of the hazard function calculated for φ^* and φ_x^* , respectively. Since its value is greater than 1, the hazard ratio decreases with positive productivity changes. If this decrease is moderate, that is when $1 < \frac{h(\varphi^*, \gamma)}{h(\varphi_x^*, \gamma)} < \tau \left(\frac{f_x}{f} \right)^{\frac{1}{s-1}}$, the numerator of the partial derivative is negative, and therefore the effect of productivity cut off variation on export probability is negative.

QED.

Finally, we study the overall effect of institutional changes on the exporting probability η_x . We have already stated that a better institutional quality implies a greater probability of exporting for given selection conditions in Proposition 1. Then we have also shown that good institutions positively affect both domestic and export cut-off levels (Proposition 2). However, when cut off productivity levels increase export probability decreases (Proposition 3). Therefore, there are two contrasting effects induced by better institutional quality: a direct positive effect and an indirect negative one through the variation of the cut off productivity levels φ^* and φ_x^* .

We are now interested in studying the effects of institutional changes on the intensive margin of trade, measured in terms of revenue in exporting markets, $r_x(\varphi)$. Following Melitz (2003) we find that $r_x(\varphi) = \varepsilon f_x [1 + k(\varphi, \gamma)]$, $\forall \varphi > \varphi_x^*$. It is easy to show that an increase in institutional quality positively affects export revenues. Specifically:

$$\frac{dr_x(\varphi)}{d\gamma} = \varepsilon f_x \frac{\partial k(\varphi, \gamma)}{\partial \gamma} > 0$$

Given that $r_x(\varphi)$ is higher for any $\varphi > \varphi_x^*$ and the average productivity $\bar{\varphi}(\varphi_x^*)$ is higher when institutions improve, then export revenue of the average exporter $r_x(\bar{\varphi})$ is higher.

2.3 Sector complexity

We now admit the existence of several industries, which differ from each other for the complexity of the production process due to sector-specific technological and demand characteristics. For the moment, there are no institutional differences across countries.

First, the degree of complexity may be due to the existence of differences related to the complexity of upstream intermediate inputs as outlined by Nunn (2007).

The existence of relationship-specific investments to obtain inputs and imperfectly enforceable contracts imply that there is under-investment ex ante (Grossman and Hart, 1986; Hart and Moore, 1990) and this is a potential source of comparative advantage. On one hand, we can assume that there are cross sector differences of productivity φ probability distribution. On the other hand, we can admit differences related to labor markets. With a sector specific productivity probability distribution, in any sector s firms draw their initial productivity parameter φ from a common distribution $g(\varphi, s)$; $g(\varphi, s)$ is defined over a positive support and has a continuous cumulative distribution $G(\varphi, s)$. We assume that $G(\varphi, s)$ is increasing in s - that is high- s sectors are relatively less abundant in high- φ firms. This hypothesis implies that given any two sectors H and L , with $s_H > s_L$, then $G(\varphi, s_L) \leq G(\varphi, s_H)$ for all φ with a strict inequality over some interval³. This means that it is more likely that the holdup problem is much more severe and inefficiencies related to factor market distortions are higher (therefore productivity is low) in more complex sectors. We also assume that $G(\varphi, s_L)$ dominates the productivity distribution $G(\varphi, s_H)$ in terms of the hazard rate order, that is

$$\frac{g(\varphi, s_L)}{1 - G(\varphi, s_L)} < \frac{g(\varphi, s_H)}{1 - G(\varphi, s_H)}$$

This hypothesis allows stating that the expectation of an increasing function of productivity above some cut off level i , $E[y(\varphi) | \varphi > i]$, is decreasing with complexity (Demidova, 2008).

Moreover, we assume that $G(\varphi, s)$ is supermodular in (φ, s) , that is

$$[22] \quad G(\varphi_1, s_H) - G(\varphi_0, s_H) \geq G(\varphi_1, s_L) - G(\varphi_0, s_L)$$

when $\varphi_1 \geq \varphi_0$ and $s_H > s_L$. $\frac{\partial^2 G(\varphi, s)}{\partial \varphi \partial s} > 0$

The degree of complexity may be also modeled in terms of a fraction of labor specific to the production of sector s' good. In this context, Levchenko (2007) shows that wages differ

³ This assumption corresponds to the definition of first order stochastic dominance.

across sectors due to the presence of incomplete information and imperfect institutions. The reward to a unit of labor increases in more complex sectors. This is due to the fact the ratio of specificity is higher and, therefore, labor markets are more segmented in more complex sectors. If we define $w(s, \gamma)$ as sector s ' wage rate, it is verified that $w(s, \gamma)$ is higher in more complex sectors, with the lowest complex sector (sector 0) wage taken as the numeraire: $w(0, \gamma) = 1$. Fixed sunk costs in domestic and exporting markets are higher in more complex sectors as well. In any sector s , all firms pay a fixed entry cost $w(s, \gamma)f_s$, share the same cost function that exhibits a constant marginal cost $w(s, \gamma)/\varphi$ with a fixed sunk cost $w(s, \gamma)f$ (all costs are expressed in units of sector 0 wage). Firms have different productivity levels indexed by $\varphi > 0$ and choose the following profit optimizing pricing rule:

$$[23] \quad p_d(\varphi, s, \gamma) = \frac{w(s, \gamma)}{\rho\varphi}$$

The firm must pay a fixed sunk cost $w(s, \gamma)f_x$ to enter a foreign market and a variable iceberg-type cost t . The corresponding pricing rule for exports is $p_x(\varphi, s, \gamma) = \tau p_d(\varphi, s, \gamma)$. Second, the degree of complexity may be influenced by cross sector differences in demand characteristics with complexity related to downstream final goods. Specifically, we assume that the elasticity of substitution $\varepsilon = 1/(1 - \rho)$ is lower in more complex sectors, $\varepsilon_h < \varepsilon_l$, for a given productivity level φ and institutional quality γ . In less complex sectors, firms will charge lower prices in domestic and foreign markets than firms producing in more complex sectors. This is in line with Krishna and Levchenko (2013), who argue that there is some indirect evidence to justify that more complex goods command higher prices. Indeed, it is documented that more developed countries export goods with higher unit values and the same countries export more complex goods. The fact that more complex goods present a lower elasticity of substitution is empirically found in Maggioni et al. (2014). In addition, Borda and Weinstein (2006) give evidence that goods with high elasticity of substitution correspond to less differentiated goods, even with reference to Rauch (1999) classification of goods in terms of commodities, reference priced goods and differentiated goods.

As in section 2.2 we can show that there exist cross sector differences in cut off productivity levels φ_s^+ and φ_{xs}^+ when relationship-specific investments and final goods' substitution are different across sectors.

Again, we start from condition [18] by allowing cross sector differences

$$B(\varphi^+, s, \gamma) = 0$$

where

$$B(\varphi^+, s, \gamma) \equiv w(s, \gamma)[fj(\varphi_s^+, \gamma) + n_{fx}j(\varphi_{xs}^+, \gamma) - \delta f_s]$$

$$\varphi_{xs}^+ = \varphi_s^+ \tau \left(\frac{f_x}{f} \right)^{\frac{1}{\varepsilon-1}}$$

$$j(i, s, \gamma) \equiv k(i, s, \gamma)[1 - G(i, s, \gamma)], \quad i = \varphi_s^+, \varphi_{xs}^+$$

$$k(i, s, \gamma) \equiv \left[\frac{\tilde{\varphi}(i, s, \gamma)}{i} \right]^{\varepsilon-1} - 1$$

$$\tilde{\varphi}(i, s, \gamma) = \left[\frac{1}{1-G(i, s, \gamma)} \int_i^{\infty} \varphi^{\varepsilon-1} g(\varphi, s, \gamma) d\varphi \right]^{\frac{1}{\varepsilon-1}}.$$

It can be shown that the smallest productivity levels selecting firms into domestic and foreign markets, φ_s^* and φ_{xs}^* , decrease when s increases⁴. Specifically, for the domestic cut-off we have

$$\frac{d\varphi^*}{ds} = - \frac{\partial B(\varphi^*, s, \gamma) / \partial i}{\partial B(\varphi^*, s, \gamma) / \partial \varphi^*}$$

where

$$\frac{\partial B(\varphi_s^*, s, \gamma)}{\partial s} = f \frac{\partial j(\varphi_s^*, s, \gamma)}{\partial s} + n f_x \frac{\partial j(\varphi_{xs}^*, s, \gamma)}{\partial s}$$

which is negative given that $\partial j(i, s, \gamma) / \partial s < 0$ for all $i = \varphi^*, \varphi_x^*$ ⁵. In addition, the derivative

$$\frac{\partial B(\varphi_s^*, s, \gamma)}{\partial \varphi_s^*} = f \frac{\partial j(\varphi_s^*, s, \gamma)}{\partial \varphi_s^*} + n f_x \tau \left(\frac{f_x}{f} \right)^{\frac{1}{\varepsilon-1}} \frac{\partial j(\varphi_{xs}^*, s, \gamma)}{\partial \varphi_{xs}^*}$$

is negative since $\partial j(i, s, \gamma) / \partial i < 0$ for all $i = \varphi_s^*, \varphi_{xs}^*$. In conclusion, we have $\frac{d\varphi^*}{ds} < 0$. For

more complex sectors characterized by more specific inputs (higher s), the domestic cut-off

is lower in more complex sectors than in less complex ones. Given that $\varphi_{xs}^* = \varphi_s^* \tau \left(\frac{f_x}{f} \right)^{\frac{1}{\varepsilon-1}}$, it is

also shown that the export productivity cut-off is lower for higher s -sectors

$$\frac{d\varphi_{xs}^*}{ds} = \tau \left(\frac{f_x}{f} \right)^{\frac{1}{\varepsilon-1}} \frac{d\varphi_s^*}{ds} < 0.$$

This means that export conditions in more complex sectors are less selective than in less complex ones. As a second step, we study the impact of changes in s on the probability of exporting, for a given productivity level φ .

Proposition 3: *The ex ante probability of exporting η_x is a decreasing function of input sector complexity s for a given level of productivity φ , when $G(\varphi, s, \gamma)$ is supermodular in (φ, s) .*

⁴ It is important to note that the wage rate $w(s, \gamma)$ cancels out when imposing the equality between the zero cut off profit and zero free entry value conditions.

⁵ It is easy to show that the derivative $\frac{\partial j(i, s, \gamma)}{\partial s} = - \frac{\partial G(i, s, \gamma)}{\partial s} k(i, s, \gamma) + \frac{\partial k(i, s, \gamma)}{\partial s} [1 - G(i, s, \gamma)]$, $i = \varphi^*, \varphi_x^*$ is negative since $\partial G(i, s, \gamma) / \partial s$ is positive and $\partial k(i, s, \gamma) / \partial s$ is negative. The dominance in terms of the hazard rate of the productivity distribution for less complex sectors is a sufficient condition to guarantee that the latter derivative is negative. Indeed, the dominance hypothesis implies that the expectation of an increasing function of productivity above some cut off level i , $E[\varphi^{\varepsilon-1} | \varphi \geq i]$ is decreasing in sector complexity (Demidova, 2008).

PROOF: Proposition 3 can be shown by considering the partial derivative of η_x with respect to s :

$$\frac{\partial \eta_x}{\partial s} = \frac{\eta_x \frac{\partial G(\varphi_{xs}^*, \gamma)}{\partial s} - \frac{\partial G(\varphi_{xs}^*, \gamma)}{\partial s}}{1 - G(\varphi_s^*, s, \gamma)} < 0$$

When $G(\varphi, s, \gamma)$ is supermodular in (φ, s) , there are increasing changes of $G(\cdot)$ when productivity φ increases. Since $\partial G(\varphi, s, \gamma) / \partial s > 0$ this means that the ratio $\frac{\partial G(\varphi_{xs}^*, \gamma)}{\partial s} / \frac{\partial G(\varphi_{xs}^*, \gamma)}{\partial s}$ is greater than 1 and the numerator of the partial derivative is negative. Therefore the export probability is lower in more complex sectors. QED.

We now study what is the effect of changes in selection conditions on export probability, for a given sector s . There is a negative change which is shown in proposition 4.

Proposition 4: *The ex ante probability of exporting η_x is negatively affected by the domestic*

productivity cut-off φ^ in any sector s , when $\frac{h(\varphi_{xs}^*, \gamma)}{h(\varphi_{xs}^*, \gamma)} < \tau \left(\frac{f_x}{f}\right)^{\frac{1}{s-1}}$, with*

$$h(\varphi, s, \gamma) \equiv \frac{g(\varphi, s, \gamma)}{1 - G(\varphi, s, \gamma)}.$$

PROOF: Proposition 4 can be shown by considering the partial derivative of η_{xs} with respect to φ_s^* .

$$\frac{\partial \eta_{xs}}{\partial \varphi_s^*} = \frac{\eta_{xs} g(\varphi_s^*, s, \gamma) - \tau \left(\frac{f_x}{f}\right)^{\frac{1}{s-1}} g(\varphi_{xs}^*, s, \gamma)}{1 - G(\varphi_s^*, s, \gamma)} < 0$$

where $g(\varphi, s, \gamma) = \partial G(\varphi, s, \gamma) / \partial \varphi$. Let us consider the expression:

$$\frac{\eta_{xs} g(\varphi_s^*, s, \gamma)}{g(\varphi_{xs}^*, s, \gamma)} = \frac{h(\varphi_s^*, s, \gamma)}{h(\varphi_{xs}^*, s, \gamma)} > 1$$

It indicates the ratio of two values of the hazard function calculated for φ_s^* and φ_{xs}^* , respectively. Since its value is greater than 1, the hazard ratio decreases with positive productivity changes. If this decrease is moderate, that is when

$1 < \frac{h(\varphi_{xs}^*, \gamma)}{h(\varphi_{xs}^*, \gamma)} < \tau \left(\frac{f_x}{f}\right)^{\frac{1}{s-1}}$, the numerator of the partial derivative is negative, and

therefore the effect of productivity cut off variation on export probability is negative. QED.

We can study the overall effect of an increase of s on the exporting probability η_x . We have already stated that the probability of exporting is lower in more complex sectors s for given

selection conditions in Proposition 3. We know that domestic and export cut offs are lower and that a decrease of the domestic cut off increases the exporting probability. Therefore, there are two contrasting effects of contract complexity: a direct negative effect related to the properties of the productivity distribution function and an indirect positive one through the negative variation of the domestic cut off productivity level φ^* . As for ε , the elasticity of substitution affects the exporting probability through selection conditions only. It can be shown that for any complex sector characterized by a lower elasticity of substitution (lower ε), domestic and export cut-offs are lower and the exporting probability is higher than in less complex ones (see the Appendix for detailed proof).

We are now interested in studying the effects on the intensive margin of trade, measured in terms of revenue in an exporting market, $r_{xs}(\varphi)$. Following Melitz (2003) we find that $r_{xs}(\varphi) = \varepsilon f_x w(s, \gamma) [1 + k(\varphi, s, \gamma)]$, $\forall \varphi > \varphi_{xs}^*$. It is easy to show that an increase in input contract complexity negatively affects export revenues. Specifically:

$$\frac{dr_{xs}(\varphi)}{ds} = \varepsilon f_x w(s, \gamma) \frac{\partial k(\varphi, s, \gamma)}{\partial s} < 0$$

Given that $r_{xs}(\varphi)$ is lower for any $\varphi > \varphi_{xs}^*$ and the average productivity $\bar{\varphi}(\varphi_{xs}^*)$ is lower with more input complexity, then export revenue of the average exporter $r_{xs}(\bar{\varphi})$ is lower. Differently, more segmented labor markets imply higher export revenues. When the elasticity of substitution is lower, there are contrasting forces and therefore it is not clear how this affects the average export revenue (see the Appendix for proof).

2.4 Institutional quality and contract complexity

In section 2.2, we have shown that better institutions imply tougher selection conditions and a greater fraction of high productive firms by influencing the properties of the productivity distribution function $G(\varphi, \gamma)$. The exporting probability can increase or decrease while export revenues of active exporters are higher the better are institutions. These results are obtained by assuming cross sector homogeneous characteristics. In section 2.3, we have introduced differences related to contract complexity across sectors. The probability of exporting is shown to be higher or lower in more complex sectors for a given level of institutional quality. Export revenues of active exporters are lower in more complex sectors.

Now, we evaluate the effect of institutional quality on the extensive and intensive margins of trade across heterogeneous sectors. Quality levels of contract enforcement and property rights affect productivity and relative wage levels: better institutions imply less inefficiency and less segmented sector-specific labor markets in more complex sectors.

Let us consider a very simple case where we have two countries, labeled A and B. Country A has better institutions than B, $\gamma_A > \gamma_B$. For simplicity, we assume that in country A there is

complete information. No productivity and wage differences emerge across sectors: that is $G(\varphi, s, \gamma) = G(\varphi, \gamma)$ and $w(s) = 1$ for all s . In this case, all sectors are homogeneous except for demand elasticity.

We start with a comparison between country A and B with reference to the least complex sector ($s = 0$). It can be easily shown that in sector 0, all results found in section 2.2 hold. Export probability in country A can be lower than country B, $\eta_{x0}^A < \eta_{x0}^B$, if the negative effect of selection conditions more than compensate the positive one given by the presence of a larger fraction of high-productive firms. Country A's average export revenues are higher than country B: $r_{x0}^A(\bar{\varphi}) > r_{x0}^B(\bar{\varphi})$.

When comparing sectors within a country we refer to the predictions of section 2.3. In the extreme case where institutions are able to guarantee complete information (country A), wages are equal in all sectors independently of their complexity and productivity distribution is homogeneous across sectors. Sectors differ for elasticity of substitution differences only. In that case we know that export probability is heterogeneous across sectors because of heterogeneous selection conditions. In a high (low) complex sector with a low (high) elasticity of substitution firms face a low (high) probability of exporting: $\eta_{xh}^A > \eta_{xl}^A$. In country B, export probability can be higher in a more complex sector, $\eta_{x0}^B < \eta_{xh}^B$, if the positive effect of selection conditions (and lower elasticity) more than compensate the negative one given by the presence of a smaller fraction of high-productive firms (because of the presence of inefficient contracts). Thus, we have $\eta_{xh}^A < \eta_{xh}^B$. Export propensity is smaller in countries with better institutions across all sectors. This negative effect can be (partially or more than) compensated by a positive effect related to sector complexity. The analysis of the effect of institutions and contract complexity on the intensive margin of trade is reversed. The theory predicts a positive effect of good institutions and a negative one of contractual complexity.

3. Data description, econometric model and results

The predictions of the theoretical model are tested for a panel of developed and developing countries. We empirically evaluate whether and how domestic institutions affect export flows along their intensive and extensive margins in 1997-2007 years, using country data disaggregated by sectors. The model predicts that better institutions have a direct positive effect on export probability and a negative indirect one connected to selection conditions. Average revenues are positively affected. As for contract complexity, we expect a negative direct effect on export probability and a positive one connected to selection conditions. The effect on average revenues is mixed. Finally, there are interaction effects between

institutions and sector complexity. The model predicts a complementary relationship for export probability.

We consider the number of exporters and the average value of exports based on exporter-level customs data. They are collected from national customs agencies by World Bank in the Exporter Dynamics database. Detailed information can be found in Cebeci et al. (2012). The dataset covers 38 developing and 7 developed countries and ranges from 1997 to 2007 and is organized at several levels of disaggregation. We consider the version which comprises 'country of origin-year-product' units with no information about destination markets. Products are disaggregated at 6-digit level and recorded with reference to HS classification. The number of exporters refers to the following definition: at time t , an *exporter* is any firm that exports in year t .

Institutional quality is measured with the *Rule of Law* index from World Bank Worldwide Governance Indicators (WGI) database (Kaufmann et al. 2009). The index measures individuals' perceptions of the effectiveness and predictability of the judiciary and the enforcement of contracts. Higher values correspond to better governance outcomes. This measure is widely used and classifies a large number of countries for several years. As institutions change only very slowly over time, almost all the variation is cross-sectional.

To take account of the different importance of relationship-specific inputs across sectors, we use the contract intensity measure constructed by Nunn (2007) with reference to ISIC 3 digit classification. A correspondence table for HS and ISIC indices has been used to match data. Factor endowments at country level and factor intensities come from the UNCTAD Revealed Factor Intensity (RFI) Database, for products classified at the HS 6 digit level. The RFI database contains yearly data about three indices of revealed factor Intensity (Shiritori et al. 2010): revealed physical capital intensity index, revealed human capital intensity index and revealed natural resource intensity index. The database also includes country endowment yearly data: capital stocks per worker, average years of schooling and arable land per worker.

By merging all datasets we obtain observations for 32 countries⁶.

From Levchenko (2007) and Nunn (2007) we know that countries with better institutions have a comparative advantage in more complex goods. We now test the impact of institutions and contract complexity on trade along the extensive and intensive margins. As for the extensive margin, the number of exporters in sector s and country c to the rest of the world at time t is

⁶ Albania, Belgium, Bangladesh, Bulgaria, Botswana, Chile, Cameroon, Colombia, Costa Rica, Ecuador, Estonia, Guatemala, Iran, Jordan, Kenya, Cambodia, Lao PDR, Morocco, Mexico, Mali, Mauritius, Malawi, Nicaragua, Norway, Pakistan, Peru, Portugal, Senegal, El Salvador, Tanzania, Uganda, South Africa

defined as M_{sct} . As for the intensive margin, the average per firm export revenue is defined R_{sct} . Let us indicate with Y_{sct} either M_{sct} or R_{sct} .

Given the presence of zeroes in the number of exporter series and to account for heteroskedasticity, appropriate econometric techniques are used to verify previous findings. The empirical literature on zeroes in trade data includes Santos Silva and Tenreyro (2006), and Helpman et al. (2008), among others. Santos Silva and Tenreyro (2006) propose a Poisson pseudo-maximum likelihood (PPML) estimator. The specification proposed by Santos-Silva and Tenreyro (2006, 2015) requires minimal distributional assumptions at the estimation stage and presents consistency in the presence of heteroskedasticity. Furthermore, in PPML technique $Pr[Y_{sct} = I_{sct} | X_{sct}]$ is Poisson distributed and the variance is proportional to the mean, $E(Y) \propto V(Y)$. When this hypothesis is not satisfied, PPML estimates are consistent but inefficient (Santos-Silva and Tenreyro, 2006). The conditional mean of Y_{sct} can be written as a function of the vector of covariates:

$$[24] \quad E(Y_{sct} | X_{sct}) = \mu_{sct} = \exp(X'_{sct}\beta).$$

Conditional on X_{sct} , the dependent variable Y_{sct} is Poisson distributed with probability

$$[25] \quad P(Y_{sct} = I_{sct} | X_{sct}) = \frac{e^{-\mu_{sct}} \mu_{sct}^{I_{sct}}}{I_{sct}!}$$

$$\text{with } X'_{sct}\beta = b_r + b_t + b_0 \gamma_{ct} + b_1 z_{isic} + a_1 h_{st} H_{ct} + a_2 k_{st} K_{ct} + a_3 l_{st} L_{ct} + \xi_{sct}$$

where γ_{ct} is a (log) measure of the quality of institutions in country c at time t ; z_{isic} is a (log) measure of the importance of relationship-specific investments which differs across sectors along the ISIC 3 digit classification. Since contract intensive sectors tend to be skill intensive, we control for cross country differences in factor endowments. H_{ct} , K_{ct} and L_{ct} denote country c 's endowments of skilled labor, per worker capital, and per worker land; h_{st} , k_{st} and l_{st} are human capital, physical capital and natural resources intensities in sector s (interaction variables are then log transformed); time and region fixed effects dummies are denoted by b_r, b_t , respectively. Regions refers to African, American, Asian, and European countries. Results are reported in table 4 for the impact of institutions and contract complexity on total trade flows and on the extensive and intensive margins.

As a second step, interaction effects of institutional quality and contract complexity on the pattern of trade are then studied with reference to different regressors. Specifically, the vector of covariates is the following:

$$[26] \quad X'_{sct}\beta = b_c + b_t + b \gamma_c z_{isic} + a_1 h_{st} H_{ct} + a_2 k_{st} K_{ct} + a_3 l_{st} L_{ct} + \xi_{sct}$$

where time and country fixed effects dummies are denoted by b_c, b_t , respectively. Results are presented in table 5.

PPML-estimated coefficients are quite similar using the whole sample and using the positive-trade subsample for both specifications. However, most coefficients differ—often

significantly—from those obtained using OLS. This suggests that in this case, heteroskedasticity (rather than truncation) is responsible for the differences between PPML results and those of OLS using only the observations with positive exports. PPML estimates using the positive trade subsample and OLS ones are available upon request.

PPML estimates with robust standard errors show that institutions negatively influence the extensive margin of trade and positively affect the intensive margin. Sector complexity affects the two margins of trade with opposite sign. Countries with better institutions tend to select firms more narrowly to enter foreign markets, but when exporting are able to sell more. If a firm is able to face the incompleteness of contracts and produce with positive profits in a complex sector then exporting is more likely because of more favorable demand conditions. However, it is less easy to increase trade revenues.

With reference to the second model specification, the institutions-complexity interaction variable is positive indicating that the difficulty to export complex goods can be limited with good institutions, in line with Nunn (2007). This effect is obtained thanks to the positive influence of the interaction variable on the extensive margin of trade, which overcomes the negative impact on the intensive margin.

4. Concluding remarks

Domestic institutions affect trade through the effect on firms' productivity and selection conditions, along the extensive and the intensive margins. Huge differences across sectors emerge because firms face different conditions with reference to input complexity and demand. Theoretical predictions are confirmed by the empirical evidence. For a sample of developed and developing countries, we find that institutions have different effects on producers within the same industry: good domestic institutions are strict in selecting firms for exporting and favor the most efficient ones only. When selected firms do export their high efficiency allows them to have high revenues.

Selection conditions are less severe in more complex sectors, but when firms do export their revenues are negatively affected by input complexity. The empirical study confirms that countries with better institutions export relatively more in more complex sectors and shows that the positive effect of institution-complexity interaction relates to the extensive margin of trade.

Further investigation will be devoted to the dynamics of export decisions by studying how institutions influence entry and exit flows in export markets. In the empirical analysis, nonlinearities can be investigated by using semi-parametric estimation methods.

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Tables

Table 1: Descriptive statistics

| Variable description | N. obs | Mean | St.deviation | Min | Max |
|------------------------------------|---------|-------|--------------|-------|-------|
| Number of exporters | 744541* | 18.75 | 63.81 | 0 | 5894 |
| Average export revenue (log) | 519170 | 9.81 | 2.45 | 0.18 | 20.86 |
| Institutional quality (log) | 560462 | 1.11 | 0.29 | 0.43 | 1.61 |
| Contract intensity (log) | 472465 | -0.78 | 0.46 | -2.85 | -0.15 |
| Physical capital interaction (log) | 482380 | 21.74 | 1.47 | 13.93 | 24.89 |
| Human capital interaction (log) | 482380 | 4.07 | 0.43 | 0.91 | 5.04 |
| Land interaction (log) | 482380 | -1.55 | 0.78 | -5.33 | 1.47 |

*The number of zero observations is 69303 and the number of exporters is equal to 1 in 156068 cases (missing value for average revenue)

Table 2: List of countries

| N. | CODE | Country name | N. | CODE | Country name |
|----|------|--------------|----|------|--------------|
| 1 | ALB | Albania | 17 | LAO | Lao PDR |
| 2 | BEL | Belgium | 18 | MAR | Morocco |
| 3 | BGD | Bangladesh | 19 | MEX | Mexico |
| 4 | BGR | Bulgaria | 20 | MLI | Mali |
| 5 | BWA | Botswana | 21 | MUS | Mauritius |
| 6 | CHL | Chile | 22 | MWI | Malawi |
| 7 | CMR | Cameroon | 23 | NIC | Nicaragua |
| 8 | COL | Colombia | 24 | NOR | Norway |
| 9 | CRI | Costa Rica | 25 | PAK | Pakistan |
| 10 | ECU | Ecuador | 26 | PER | Peru |

| | | | | | |
|----|-----|-----------------------|----|-----|-----------------|
| 11 | EST | Estonia | 27 | PRT | Portugal |
| 12 | GTM | Guatemala | 28 | SEN | Senegal |
| 13 | IRN | Iran, Islamic Rep. | 29 | SLV | El Salvador |
| 14 | JOR | Jordan | 30 | TZA | Tanzania |
| 15 | KEN | Kenya | 31 | UGA | Uganda |
| 16 | KHM | Cambodia | 32 | ZAF | South Africa |

Table 3: Sector description

| Manufacturing - ISIC Rev. 2 | Sector description |
|--|--|
| 31 - Manufacture of Food, Beverages and Tobacco | 312 - Food manufacturing |
| | 313 - Beverage industries |
| | 314 - Tobacco manufactures |
| 32 - Textile, Wearing Apparel and Leather Industries | 321 - Manufacture of textiles |
| | 322 - Manufacture of wearing apparel, except footwear |
| | 323 - Manufacture of leather and products of leather, leather substitutes and fur, except footwear and wearing apparel |
| | 324 - Manufacture of footwear, except vulcanized or moulded rubber or plastic footwear |
| 33 - Manufacture of Wood and Wood Products, Including Furniture | 331 - Manufacture of wood and wood and cork products, except furniture |
| | 332 - Manufacture of furniture and fixtures, except primarily of metal |
| 34 - Manufacture of Paper and Paper Products, Printing and Publishing | 341 - Manufacture of paper and paper products |
| | 342 - Printing, publishing and allied industries |
| 35 - Manufacture of Chemicals and Chemical, Petroleum, Coal, Rubber and Plastic Products | 351 - Manufacture of industrial chemicals |
| | 352 - Manufacture of other chemical products |
| | 353 - Petroleum refineries |
| | 354 - Manufacture of miscellaneous products of petroleum and coal |
| | 355 - Manufacture of rubber products |
| | 356 - Manufacture of plastic products not elsewhere classified |
| 36 - Manufacture of Non-Metallic Mineral Products, except Products of Petroleum and Coal | 361 - Manufacture of pottery, china and earthenware |
| | 362 - Manufacture of glass and glass products |
| | 369 - Manufacture of other non-metallic mineral products |
| 37 - Basic Metal Industries | 371 - Iron and steel basic industries |
| | 372 - Non-ferrous metal basic industries |
| 38 - Manufacture of Fabricated Metal Products, Machinery and Equipment | 381 - Manufacture of fabricated metal products, except machinery and equipment |
| | 382 - Manufacture of machinery except electrical |

| | |
|-------------------------------------|---|
| | 383 - Manufacture of electrical machinery apparatus, appliances and supplies |
| | 384 - Manufacture of transport equipment |
| | 385 - Manufacture of professional and scientific, and measuring and controlling equipment not elsewhere classified, and of photographic and optical goods |
| 39 - Other Manufacturing Industries | 390 - Other Manufacturing Industries |

Table 4: The effect of institutions and contract complexity, PPML estimates

| | Total exports Y_{sct} | Extensive margin M_{sct} | Intensive margin R_{sct} |
|--------------------------------|-------------------------------|----------------------------------|----------------------------------|
| Institutional quality | -0.235 | -0.080*** | 2.203*** |
| | 0.258 | 0.021 | 0.215 |
| Contract intensity | 0.218*** | 0.669*** | -1.048*** |
| | 0.071 | 0.010 | 0.074 |
| Physical capital interaction | 0.610*** | 0.363*** | 0.027 |
| | 0.044 | 0.006 | 0.047 |
| Human capital interaction | -0.169*** | -0.223*** | 0.286*** |
| | 0.055 | 0.013 | 0.096 |
| Land interaction | 0.297*** | 0.345*** | 0.666*** |
| | 0.039 | 0.007 | 0.050 |
| Region fixed effects | yes | yes | yes |
| Year fixed effects | yes | yes | yes |
| High-income countries dummy | yes | yes | yes |
| N. of observations | 418608 | 418608 | 418608 |

Robust standard errors; *** 1%, ** 5%, significant coefficient

Table 5: The effect of institution-complexity interaction, PPML estimates

| | Total exports Y_{sct} | Extensive margin M_{sct} | Intensive margin R_{sct} |
|----------------------------------|----------------------------|-------------------------------|-------------------------------|
| Institution-contract interaction | 0.228*** 0.061 | 0.644*** 0.008 | -0.818*** 0.058 |
| Physical capital interaction | -0.217*** 0.054 | -0.166*** 0.010 | -0.803*** 0.055 |
| Human capital interaction | 0.787*** 0.113 | 0.069*** 0.028 | 1.460*** 0.149 |
| Land interaction | 0.686*** 0.050 | 0.111*** 0.010 | 0.682*** 0.059 |
| Country fixed effects | yes | yes | yes |
| Year fixed effects | yes | yes | yes |
| N. of observations | 418608 | 418608 | 418608 |

Robust standard errors; *** 1%, ** 5%, significant coefficient

Appendix:

Following the analysis of sections 2.2-2.3, we study how cross-sector differences in final goods' elasticity of substitution affect cut off productivity levels φ_s^* and φ_{xs}^* .

We start from condition [18] by allowing cross sector differences

$$B(\varphi^*, s, \gamma) = 0$$

where

$$B(\varphi^*, s, \gamma) \equiv w(s, \gamma) [fj(\varphi_s^*, \gamma) + nf_x j(\varphi_{xs}^*, \gamma) - \delta f_s]$$

$$\varphi_{xs}^* = \varphi_s^* \tau \left(\frac{f_x}{f} \right)^{\frac{1}{\varepsilon-1}}$$

$$j(i, s, \gamma) \equiv k(i, s, \gamma) [1 - G(i, s, \gamma)], \quad i = \varphi_s^*, \varphi_{xs}^*$$

$$k(i, s, \gamma) \equiv \left[\frac{\tilde{\varphi}(i, s, \gamma)}{i} \right]^{\varepsilon-1} - 1$$

$$\tilde{\varphi}(i, s, \gamma) = \left[\frac{1}{1-G(i, s, \gamma)} \int_i^\infty \varphi^{\varepsilon-1} g(\varphi, s, \gamma) d\varphi \right]^{\frac{1}{\varepsilon-1}}.$$

It can be shown that the domestic cut off φ_s^* is higher the higher is the elasticity of substitution, while the export cut off φ_{xs}^* may increase or decrease. Specifically, for the domestic cut-off we have

$$\frac{d\varphi^*}{d\varepsilon} = - \frac{\partial B(\varphi^*, s, \gamma) / \partial \varepsilon}{\partial B(\varphi^*, s, \gamma) / \partial \varphi^*}$$

where

$$\frac{\partial B(\varphi_s^*, s, \gamma)}{\partial \varepsilon} = -nf_x \frac{\ln(f_x/f)}{(\varepsilon-1)^2} \frac{\partial j(\varphi_{xs}^*, s, \gamma)}{\partial \varphi_{xs}^*}$$

which is positive given that $\partial j(\varphi_{xs}^*, s, \gamma) / \partial \varphi_{xs}^* < 0$ and when $f_x/f > 1$.

In addition, the derivative

$$\frac{\partial B(\varphi_s^*, s, \gamma)}{\partial \varphi_s^*} = f \frac{\partial j(\varphi_s^*, s, \gamma)}{\partial \varphi_s^*} + nf_x \tau \left(\frac{f_x}{f} \right)^{\frac{1}{\varepsilon-1}} \frac{\partial j(\varphi_{xs}^*, s, \gamma)}{\partial \varphi_{xs}^*}$$

is negative since $\partial j(i, s, \gamma) / \partial i < 0$ for all $i = \varphi_s^*, \varphi_{xs}^*$. In conclusion, we have $\frac{d\varphi^*}{d\varepsilon} > 0$. For

more complex sectors characterized by lower elasticity of substitution (lower ε), the domestic cut-off is lower in more complex sectors than in less complex ones. Given that

$\varphi_{xs}^* = \varphi_s^* \tau \left(\frac{f_x}{f} \right)^{\frac{1}{\varepsilon-1}}$, the export productivity cut-off may be higher or lower. When the elasticity

of substitution increases we have two contrasting effects⁷:

$$\frac{d\varphi_{xs}^*}{d\varepsilon} = \tau \left(\frac{f_x}{f} \right)^{\frac{1}{\varepsilon-1}} \frac{d\varphi_s^*}{d\varepsilon} - \varphi_s^* \tau \left(\frac{f_x}{f} \right)^{\frac{1}{\varepsilon-1}} \frac{\ln(f_x/f)}{(\varepsilon-1)^2}.$$

⁷ It can be shown that the export cut off decreases when average profits are equal across sectors.

The first term is positive while the second one is negative and implies a shorter distance from the domestic cut off. Thus, in the presence of differences in the elasticity of substitution the effect is ambiguous.

As a second step, we study the impact of changes in ε on the probability of exporting, for a given productivity level φ .

Proposition A1: *The ex ante probability of exporting $\eta_{x\varphi}$ is not affected by the elasticity of substitution ε for a given level of productivity φ .*

PROOF: Proposition 4 can be easily shown by considering the fact that the elasticity of substitution influences the exporting probability only indirectly through its effect on domestic and export cut offs. QED.

Then we can study the overall effect of an increase of ε on the exporting probability $\eta_{x\varphi}$. The elasticity of substitution affects the exporting probability through selection conditions only. The higher is ε , the higher is the domestic productivity cut-off. Since we already know that the probability of exporting $\eta_{x\varphi}$ is negatively affected by the domestic productivity cut-off φ^* (proposition 4), the higher is ε , the lower is the exporting probability $\eta_{x\varphi}$.

We are now interested in studying the effects on the intensive margin of trade, measured in terms of revenue in an exporting market, $r_{x\varphi}(\varphi)$, given by [24]. We can show that the effect of the elasticity of substitution on export revenues is mixed.

Proposition A2: *The exporting revenue $r_{x\varphi}(\varphi)$ is lower (higher) the higher is the elasticity of substitution ε , for firms with a productivity level φ less (greater) than*

$$\left(\frac{\varepsilon_h w(h, \gamma) (\varphi_l^*)^{\varepsilon_l - 1}}{\varepsilon_l w(l, \gamma) (\varphi_h^*)^{\varepsilon_h - 1}} \right)^{\frac{1}{\varepsilon_l - \varepsilon_h}} \tau, \text{ with } \varepsilon_h < \varepsilon_l; h \text{ and } l \text{ are high-complex and low-complex sectors, respectively.}$$

PROOF: This is shown by considering the ratio of export revenues in (h, l) sectors with $\varepsilon_h < \varepsilon_l$.

$$\frac{r_{xh}(\varphi)}{r_{xl}(\varphi)} = \frac{\varepsilon_h w(h, \gamma)}{\varepsilon_l w(l, \gamma)} \left(\frac{\varphi}{\tau} \right)^{\varepsilon_h - \varepsilon_l} \frac{(\varphi_l^*)^{\varepsilon_l - 1}}{(\varphi_h^*)^{\varepsilon_h - 1}}$$

The ratio is less than 1 when $\varphi > \left(\frac{\varepsilon_h w(h, \gamma) (\varphi_l^*)^{\varepsilon_l - 1}}{\varepsilon_l w(l, \gamma) (\varphi_h^*)^{\varepsilon_h - 1}} \right)^{\frac{1}{\varepsilon_l - \varepsilon_h}} \tau$; it is greater than 1

when $\varphi < \left(\frac{\varepsilon_h w(h, \gamma) (\varphi_l^*)^{\varepsilon_l - 1}}{\varepsilon_l w(l, \gamma) (\varphi_h^*)^{\varepsilon_h - 1}} \right)^{\frac{1}{\varepsilon_l - \varepsilon_h}} \tau$. QED.

In more complex sectors the elasticity of substitution is lower. This implies that the export revenue $r_{x,s}(\varphi)$ is higher (lower) for low (high) levels of φ than less complex sector revenue. In summary, it is not clear if the export revenue of the average exporter $r_{x,s}(\bar{\varphi})$ is higher or lower given that the average productivity $\bar{\varphi}$ may either increase or decrease.