Globalization and Productivity in The Developing World

Reto Foellmi / Manuel Oechslin

We explore the impact of international trade in a monopolistically competitive economy that encompasses technology choice and an endogenous distribution of mark-ups due to credit frictions. We show that in such an environment a gradual opening of trade may but not necessarily must have a negative impact on productivity and overall output. The reason is that the pro-competitive effects of trade reduce mark-ups and hence make access to credit more difficult for smaller firms (an implication we substantiate using firm-level data from Latin America). As a result, smaller firms – while not driven out of the market – may be forced to switch to less productive technologies. Our framework matches several salient patterns in the empirical literature on the impact of trade in developing countries.

Die Nationalen Forschungsschwerpunkte (NFS) sind ein Förderinstrument des Schweizerischen Nationalfonds.
Les Pôles de recherche nationaux (PRN) sont un instrument d'encouragement du Fonds national suisse.
The National Centres of Competence in Research (NCCR) are a research instrument of the Swiss National Science Fondation.

1 Introduction

How and through what channels does international trade affect productivity and overall output in an economy? The recent literature emphasizes several beneficial pro-competitive effects of trade: Stiffer competition is predicted to boost economic performance by reallocating production factors from less to more productive firms (e.g., Bernard et al., 2003; Melitz, 2003; Melitz and Ottaviano, 2008) or by improving within-firm efficiency as companies are forced to trim their fat (Pavcnik, 2002) or to upgrade technology (e.g., Lileeva and Trefler, 2010; Bustos, 2011). This paper, in contrast, identifies channels through which intensified foreign competition may have a negative effect on productivity and output. These channels only emerge in presence of asset inequality and significant credit market frictions, i.e., under circumstances we encounter throughout the developing world. Our analysis thus provides new insights into why the empirical literature does not find unambiguously positive effects of international trade on economic performance in less advanced economies.

We explore the impact of trade in a monopolistically competitive model (à la Dixit and Stiglitz, 1977) that features an *endogenous distribution of mark-ups* due to credit market frictions. It is assumed that loan repayment is imperfectly enforceable so that an entrepreneur's borrowing capacity depends on her private wealth. As a result, less affluent entrepreneurs are forced to run small firms – and thus charge high prices and mark-ups. Greater exposure to trade, however, is bound to reduce these mark-ups: Competition from abroad reduces the maximum prices smaller firms can charge; moreover, there is a rise in the cost of borrowing since larger firms increase capital demand to take advantage of new export opportunities. Lower mark-ups, in turn, reduce the borrowing capacity of less affluent firm owners – which means that they may no longer be able to make the investments required to operate the high-productivity (i.e., state-of-the-art) technology.

The magnitude and consequences of this reduction in the access to credit depend on the degree to which a country integrates into the world economy. A steep fall in trade barriers unambiguously boosts economic performance as the availability of scarce goods improves and low-productivity firms are driven out of the market. A smaller reduction, however, may actually hurt the economy through two different channels, both of which closely related to the credit market friction. First, there is a *polarization effect*. An intermediate reduction of trade barriers reduces the maximum amount smaller firms can borrow and invest. As a result, some of these smaller firms are forced to switch to less productive (i.e., "traditional") technologies. But because trade is not yet frictionless, even these firms are not forced to leave the market –

which means that average productivity may fall. So a partial opening up reinforces the polar structure of the economy, i.e., the coexistence of small low-productivity firms and efficient large-scale companies. Second, we identify a *replacement effect.* The integration-induced fall in the borrowing capacity – and hence the output – of the smaller firms requires the economy to import larger quantities and hence to spend more resources on trade-related costs (e.g., transportation costs). Put differently, an intermediate fall in trade barriers leads to a "costly" partial replacement of domestically-produced supplies with imports. This replacement effect is particularly strong in the neighborhood of the autarky equilibrium, i.e., if a fall in trade barriers pushes the economy from an equilibrium without trade to one with some trade. In this case, the replacement effect necessarily dominates the positive effects of trade (stemming from a better availability of goods) and the aggregate output must fall.

The result that the aggregate output might – and in some cases must – fall in response to a gradual decline in trade barriers is an illustration of the theorem of the second best (discussed by, e.g., Bhagwati, 1971). From this literature we know that lower trade barriers may lead to losses if the result is an even sharper deviation of the actual output distribution from the undistorted one. So, looking from this perspective, one contribution of the present paper is to show that credit market frictions exactly imply such harmful adjustments. Lower trade barriers tighten the borrowing constraints faced by smaller firms and force them to invest less, thereby increasing the extent of under-production. On the other hand, absorbing capital no longer employed by the constrained small firms, large companies increase their output – which means even more over-production by these firms.

So far, there has been little empirical research on how a fall in trade barriers affects the ability of small firms in developing economies to obtain external financing. The present paper offers some suggestive evidence in this regard, relying on a firm-level dataset that has recently been put together by Foellmi, Legge, and Tiemann (2013). The dataset, which has a two-period panel structure, covers seven Latin American countries and contains 544 manufacturing firms, surveyed in 2006 and 2010. The empirical findings are supportive of the key mechanism we describe in our framework: A reduction in tariff protection makes small and medium-sized businesses much more likely to respond "access to finance" when asked which element of the current business environment represents the biggest obstacle; among large firms, on the other hand, such an effect of tariff reductions cannot be identified.

Our model further offers a coherent perspective on a growing body of empirical evidence on the effects of trade in developing countries. At the most aggregate level, the predicted ambiguity regarding the impact on overall output is consistent with a voluminous cross-country literature

on trade policy and economic performance. This literature fails to identify a robust link between policies related to openness and economic growth, particularly among developing countries (see, e.g., Kehoe and Ruhl, 2010).[1] Moreover, the model features a genuine mechanism which makes the richest segment of society benefit disproportionally – and hence may explain why liberalizing trade went hand in hand with surging top income shares in several developing countries (e.g., in India in the early 1990s). At a more disaggregate level, the model accounts for recent observations regarding misallocation and firm productivity. Among them are findings from India which suggest that allocative efficiency deteriorated sharply (Hsieh and Klenow, 2009) and that the pro-competitive effects of trade did not promote average firm productivity in a broad sample of formal sector firms (Nataraj, 2011).

In modeling the credit market imperfection, we follow an approach taken in some of our existing work, in particular Foellmi and Oechslin (2010). While this earlier contribution explores the impact of trade liberalization on the income distribution, the present paper focuses on the effects on productivity and aggregate output. It is thus closely related to the literature on international trade and heterogeneous firms. Yet, by emphasizing the role of credit market frictions and inequality, our theory deviates from the standard classes of models (i.e., Bernard et al., 2003; Melitz, 2003; Melitz and Ottaviano, 2008; Bustos, 2011) and, as a result, suggests an ambiguous relationship between trade and economic performance.

We further add to a growing literature on international trade and finance. Papers in this literature (e.g., Amiti and Weinstein, 2011; Feenstra et al., 2011; Manova, 2013) explore how financial frictions constrain export-oriented firms and distort aggregate export flows. Relying on a general equilibrium framework, our paper is more interested in how international trade affects mark-ups and borrowing conditions of smaller (and not necessarily export-oriented) firms.[2] By focusing on how trade affects the distribution of mark-ups, our analysis also connects with recent work Epifani and Gancia (2011) who show that the pro-competitive effects of trade can reduce welfare when they increase the mark-up dispersion. This paper, in contrast, shows that – when there are credit market imperfections – international trade may reduce welfare even if it leads to a more even distribution of mark-ups.

More broadly, our analysis is connected to yet another strand of literature that explores

---

[1] This empirical pattern is also consistent with anecdotal evidence from East Asia. As pointed out by, e.g., Stiglitz and Charlton (2005) or Rodrik (2010), many of the East Asian miracle countries did not follow free-trade policies but used to protect selected industries from import competition.

[2] Early papers which rely on general-equilibrium models include Banerjee and Newman (2004) and Matsuyama (2005). These papers elaborate variants of the Ricardo-Viner model and do not address how the pro-competitive effects of trade affect mark-ups and thus access to credit and technology choices.

how distortions (e.g., Hsieh and Klenow, 2009) or factor market imperfections lead to resource misallocation and hence compromise total factor productivity in low-income countries. Papers by, for instance, Banerjee and Newman (1993), Matsuyama (2000), Banerjee and Duflo (2005), or Song et al. (2011) also examine the role of credit market imperfections, partly in connection with wealth or income inequality. Yet, these papers do not address whether greater exposure to international trade affects the resource allocation in a positive or a negative way – which is the prime focus here. We share this prime focus with other recent work by Kambourov (2009), Coşar et al. (2010), Helpman et al. (2010), or McMillan and Rodrik (2011) which, however, explore the role of labor market frictions or labor flows.

The rest of this paper is organized as follows. The next section develops and solves the closed-economy model. In Section 3, we explore the effects of opening up to international trade. We proceed in two steps. First, focusing on an intermediate-openness case, we describe the different channels through which trade affects economic performance. Second, we provide a systematic overview of the adjustments associated with a continuous decrease in trade barriers from prohibitive levels to zero. Section 4 presents new evidence on trade openness and access to finance. The section further discusses how or theoretical results relate to existing empirical findings. Section 5, finally, summarizes the main results and concludes.

2 The Closed Economy

2.1 Endowments, Technologies, and Preferences

Assumptions. We consider a static economy that is populated by a continuum of (potential) entrepreneurs. The population size is normalized to 1. The entrepreneurs are heterogeneous with respect to their initial capital endowment $\omega_i, i \in [0, 1]$, and their production possibilities. The capital endowments are distributed according to the distribution function $G(\omega)$ which gives the measure of the population with an endowment below ω. We further assume that $g(\omega)$, which refers to the density function, is positive over the entire positive range. The aggregate capital endowment, $\int_0^\infty \omega dG(\omega)$, will be denoted by K.

Each entrepreneur owns a specific skill (or technological know-how) that makes him a monopoly supplier of a single differentiated good. All goods are produced with a simple technology that requires physical capital as the only input into production. Following much of the literature on the role of credit market imperfections (e.g., Galor and Zeira, 1993; Matsuyama, 2000; Banerjee and Moll, 2010), this technology is characterized by a non-convexity. In particular, its productivity is relatively low if the level of investment falls short of a critical threshold.

In formal terms, we impose

$$y_i = \begin{cases} bk_i & : & k_i < \kappa \\ ak_i & : & k_i \geq \kappa \end{cases}, \ b < a, \tag{1}$$

where y_i and k_i denote, respectively, output and capital and κ refers to the critical scale of investment. In what follows, we say that an entrepreneur operates the "low-productivity technology" if she invests less than the κ-threshold; similarly, we say that an entrepreneur operates the "high-productivity technology" if the investment exceeds this threshold.

The assumptions of market power and non-convexities play an important role in our model. They will allow us to mirror the idea that opening up exposes firms to more vigorous competition and hence may affect technology choices (especially, as is discussed below, in the presence of credit market imperfections). Of course, the idea that exposure to international trade enhances competition is not restricted to poor economies. Yet, firms in low-income countries might be particularly prone to losing market power because they tend to produce less innovative goods (see, e.g., Acemoglu and Zilibotti, 2001) and since the market structure in these places is often monopolistic (see, e.g., UNCTAD, 2006).

The entrepreneurs' utility function is assumed to be of the familiar CES-form,

$$U = \left(\int_0^1 c_j^{(\sigma-1)/\sigma} dj \right)^{\frac{\sigma}{\sigma-1}}, \tag{2}$$

where c_j denotes consumption of good j and $\sigma > 1$ represents the elasticity of substitution between any two goods. Each entrepreneur i maximizes objective function (2) subject to

$$\int_0^1 p_j c_j dj = m(\omega_i), \tag{3}$$

where p_j is the price of good j and $m(\omega_i)$ refers to entrepreneur i's nominal income (which, in turn, will depend on the initial capital endowment, as is discussed further below).

Finally, for tractability purposes, we impose a parameter restriction which puts an upper bound on the critical scale of investment:

$$\kappa < K(b/a)^{\sigma-1}. \tag{R1}$$

Implications. Under these conditions, entrepreneur i's demand for good j is given by

$$c_j(y(\omega_i)) = \left(\frac{p_j}{P} \right)^{-\sigma} \frac{m(\omega_i)}{P}, \tag{4}$$

where $P \equiv (\int_0^1 p_j^{1-\sigma} dj)^{1/(1-\sigma)}$ denotes the CES price index. In a goods market equilibrium, aggregate demand for good j must be equal to the supply of good j, y_j. Taking this into account, we can express the real price of good j as a function of y_j and Y/P,

$$\frac{p_j}{P} = \frac{p(y_j)}{P} \equiv \left(\frac{Y}{P}\right)^{\frac{1}{\sigma}} y_j^{-1/\sigma}, \tag{5}$$

where $Y \equiv \int_0^1 p(y_j) y_j dj$ denotes the economy-wide nominal output and the ratio Y/P refers to the real output. Notice further that, in a goods market equilibrium, the real price of a good is strictly decreasing in the quantity produced. The reason is simple: Since the marginal utility from consuming any given good falls in the quantity consumed, the only way to make domestic consumers buy larger quantities is to lower the price.

Later on, it will be helpful to have an expression for the aggregate real output (or, equivalently, for the aggregate real income) that depends only on the distribution of firm outputs. Using (5) in the definition of Y, we obtain

$$\frac{Y}{P} = \left(\int_0^1 y_j^{(\sigma-1)/\sigma} dj\right)^{\frac{\sigma}{\sigma-1}} = \frac{M}{P}, \tag{6}$$

where $M \equiv \int_0^1 m(\omega_i) di$ denotes the aggregate nominal income.

2.2 The Credit Market

Assumptions. Entrepreneurs may borrow and lend in an economy-wide credit market. Unlike the goods market, the credit market is competitive in the sense that both lenders and borrowers take the equilibrium borrowing rate as given. However, the credit market is imperfect in the sense that borrowing at the equilibrium rate may be limited. As in Foellmi and Oechslin (2010), such credit-rationing may arise from imperfect enforcement of credit contracts. More specifically, we assume that borrower i can avoid repayment altogether by incurring a cost which is taken to be a fraction $\lambda \in (0, 1]$ of the current firm revenue, $p(y_i) y_i$.

The parameter λ mirrors how well the credit market works. A value close to one represents a near-perfect credit market while a value near zero means that the credit market functions poorly. Intuitively, in the latter case, lenders are not well protected since the borrowers can "cheaply" default on their payment obligations – which invites ex post moral hazard. As a result, lenders are reluctant to provide external finance. Poor creditor protection and the associated problem of moral hazard are in fact important phenomena in many developing economies. It is, for example, well documented that – throughout the developing world –

insufficient collateral laws or unreliable judiciaries often make it extremely hard to enforce credit contracts in a court (see, e.g., Banerjee and Duflo, 2005; 2010).

Implications. Taking the possibility of ex post moral hazard into account, a lender will give credit only up to the point where the borrower just has the incentive to pay back. In formal terms, this means that the amount of credit cannot exceed $\lambda p(y_i) y_i / \rho_i$, where ρ_i denotes the interest rate borrower i faces. Note further that – since borrowers always repay and because there are no individual-specific risks associated with entrepreneurship – the borrowing rate must be the same for all agents ($\rho_i = \rho$). Using this information, and accounting for (1), we find that borrower i does not default on the the credit contract ex post if

$$\lambda p(y_i) y_i / \rho \geq \begin{cases} y_i/b - \omega_i & : & y_i < a\kappa \\ y_i/a - \omega_i & : & y_i \geq a\kappa \end{cases}, \tag{7}$$

where the right-hand side of (7) gives the size of the credit.

We now derive how the maximum amount of borrowing, and hence the maximum output, depends on the initial wealth endowment, ω.[3] To do so, suppose that there is a wealth level $\omega_\kappa < \kappa$ which permits borrowing exactly the amount required to meet the critical investment size κ. Taking (5) and (7) into account, this threshold level is defined by

$$\omega_\kappa + \lambda x \left(a\kappa\right)^{(\sigma-1)/\sigma} = \kappa, \tag{8}$$

where

$$x \equiv P^{(\sigma-1)/\sigma} Y^{1/\sigma} / \rho = (Y/P)^{1/\sigma} / (\rho/P).$$

With these definitions (and expressions 5 and 7) in mind, it is immediately clear that the maximum firm output is implicitly determined by

$$\overline{y} = \begin{cases} b \left(\omega + \lambda x \overline{y}^{(\sigma-1)/\sigma}\right) & : & \omega < \omega_\kappa \\ a \left(\omega + \lambda x \overline{y}^{(\sigma-1)/\sigma}\right) & : & \omega \geq \omega_\kappa \end{cases} \tag{9}$$

and hence depends on the initial wealth endowment. It is the purpose of the following lemma to clarify the relationship between $\overline{y}$ and ω.

Lemma 1 *A firm's maximum output, $\overline{y}(\omega)$, is a strictly increasing function of the initial capital endowment, ω.*

---

[3]Since the initial wealth is the only individual-specific factor that determines maximum borrowing, the index for individuals will be dropped in the rest of this section.

Proof. See Appendix I. ∎

The maximum firm output increases in ω for two different reasons. First, and most directly, an increase in ω means that the entrepreneur commands more own resources which can be invested. Second, there is an indirect effect operating through the credit market: An increase in ω allows for higher borrowing since the entrepreneur has more "skin in the game" (Banerjee and Duflo, 2010). Figure 1 shows a graphical illustration of $\overline{y}(\omega)$.

Figure 1 here

Besides the positive slope, the figure highlights two additional properties of the $\overline{y}(\omega)$-function. First, the function is locally concave. This mirrors the fact that the marginal return on investment falls in the level of investment; thus, the positive impact of an additional endowment unit on the borrowing capacity must decrease. Second, there is a discontinuity at ω_κ since, at that point, an entrepreneur is able to switch to the more productive technology.

2.3 Output Levels

We now discuss how individual firm outputs depend on capital endowments, holding constant the aggregate variables Y/P and ρ/P (and hence x). Our discussion presumes

$$x \geq \frac{1}{a}\frac{\sigma}{\sigma - 1}(a\kappa)^{1/\sigma}, \tag{10}$$

which will actually turn out to be true in equilibrium (see Proposition 1).

$\omega \geq \omega_\kappa$. We start by looking at entrepreneurs who are able to use the more productive technology. Resources permitting, these entrepreneurs increase output up to the point where the marginal revenue, $((\sigma-1)/\sigma)P^{(\sigma-1)/\sigma}Y^{1/\sigma}y^{-1/\sigma}$, equals the marginal cost, ρ/a. We denote this profit-maximizing output level by $\widetilde{y}$ and we use $\widetilde{\omega}$ to denote the wealth level which puts an agent exactly in a position to produce $\widetilde{y}$. Using these definitions, we have

$$\widetilde{y} = \left(ax\frac{\sigma - 1}{\sigma}\right)^\sigma \quad \text{and} \quad \widetilde{\omega} = \left(1 - \lambda\frac{\sigma}{\sigma - 1}\right)\frac{\widetilde{y}}{a}, \tag{11}$$

where $\widetilde{y}/a \geq \kappa$ due to (10).

Two points should be noted here. First, because of Lemma 1 and $\widetilde{y} \geq a\kappa$, we have $\widetilde{\omega} \geq \omega_\kappa$. Second, as can be seen from the second expression in (11), $\lambda < (\sigma-1)/\sigma$ is sufficient for having a group of credit-constrained entrepreneurs, i.e., entrepreneurs who have too little access to credit to produce at the profit-maximizing output level. On the other hand, if $\lambda \geq (\sigma - 1)/\sigma$, even entrepreneurs with a zero wealth endowment can operate at the profit-maximizing scale.

9

Why? The smaller the elasticity of substitution, the higher is the constant mark-up $\sigma/(\sigma - 1)$ over marginal costs. So, if σ is small, even poor agents are able to generate revenues which are large relative to the payment obligation. This means that only a very low λ may induce a borrower to default ex post. Put differently, the credit market imperfection is binding for some entrepreneurs only if it is "more substantial" than the imperfection in the product market.

The following lemma is an immediate corollary of the above discussion:

Lemma 2 *Suppose $\lambda < (\sigma - 1)/\sigma$. Then, entrepreneurs (i) with $\omega \in [\omega_\kappa, \widetilde{\omega})$ produce $\overline{y}(\omega) < \widetilde{y}$; (ii) with $\omega \in [\widetilde{\omega}, \infty)$ produce $\widetilde{y}$. Otherwise, if $\lambda \geq (\sigma - 1)/\sigma$, all entrepreneurs produce $\widetilde{y}$.*

Proof. See Appendix I. ■

$\omega < \omega_\kappa$.   We now focus on the investment behavior of less affluent entrepreneurs, i.e., agents with a capital endowment below ω_κ (which does not allow for the use of the high-productivity technology). As established above, such entrepreneurs can only exist if $\lambda < (\sigma - 1)/\sigma$.

Lemma 3 *Suppose $\lambda < (\sigma - 1)/\sigma$. Then, entrepreneurs with a wealth endowment below ω_κ produce $\overline{y}(\omega)$.*

Proof. See Appendix I. ■

Putting things together.   An immediate implication of Lemmas 2 and 3 is that the equilibrium individual firm outputs are given by

$$y(\omega) = \begin{cases} \overline{y}(\omega) & : & \omega < \widetilde{\omega} \\ \widetilde{y} & : & \omega \geq \widetilde{\omega} \end{cases}, \tag{12}$$

where $\overline{y}(\omega)$ is implicitly determined by (9) and $\widetilde{y}$ is given in (11). Note that the case $\omega < \widetilde{\omega}$ is only relevant if the parameter restriction $\lambda < (\sigma - 1)/\sigma$ holds (and hence $\widetilde{\omega} > 0$). Assuming that the restriction does hold, Figure 2 gives a graphical illustration of (12). The figure shows two possible situations. In panel $a.$, we have $\omega_\kappa > 0$ so that a positive mass of entrepreneurs are forced to use the less productive technology. Panel $b.$ shows a situation where $\omega_\kappa \leq 0$ so that all entrepreneurs have access to the more productive technology.

Figure 2 here

The distribution of firm outputs is mirrored in the distribution of output prices. Since each firm faces a downward-sloping demand curve (equation 5), smaller firms charge higher prices – despite the fact that each good enters the utility function symmetrically. Only if there is no credit rationing do output levels across firms fully equalize so that all prices are the same.

2.4 The Equilibrium under Autarky

When characterizing the use of technology and individual firm outputs, we kept constant aggregate real output and the real interest rate (and hence the ratio $x = (Y/P)^{1/\sigma}/(\rho/P)$). We now establish that, in fact, both Y/P and ρ/P are uniquely determined in the macroeconomic equilibrium. To do so, note that we can write aggregate gross capital demand (i.e., the sum of all physical capital investments by firms) as a function of x,

$$K^D(x) = \int\limits_0^{\omega_\kappa} \frac{\overline{y}(\omega;x)}{b}dG(\omega) + \int\limits_{\omega_\kappa}^{\widetilde{\omega}} \frac{\overline{y}(\omega;x)}{a}dG(\omega) + \int\limits_{\widetilde{\omega}}^\infty \frac{\widetilde{y}(x)}{a}dG(\omega), \tag{13}$$

where aggregate capital supply, $K = \int_0^\infty \omega dG(\omega)$, is exogenous and inelastic.

Proposition 1 *There exists a unique macroeconomic equilibrium (i.e., real output, Y/P, and the real interest rate, ρ/P, are uniquely pinned down). If $\lambda < (\sigma-1)/\sigma$, a positive mass of entrepreneurs are credit-constrained (and the poorest among them may be forced to use the low-productivity technology). Otherwise, if $\lambda \geq (\sigma-1)/\sigma$, no one is credit-constrained.*

Proof. See Appendix I. ■

Figure 3 here

Figure 3 shows K^D as a function of x (for the case $\lambda < (\sigma-1)/\sigma$). The figure also highlights that condition (10), on which both Lemma 2 and 3 rely, is indeed satisfied.[4]

Finally, note that – if the credit market friction is sufficiently severe – the properties of this equilibrium are consistent with a large body of firm-level evidence from developing countries. In particular, we have a coexistence of (i) more and less advanced technologies; (ii) high and low marginal (revenue) products of capital (see Banerjee and Duflo, 2005, for empirical evidence). Moreover, there is substantial variation in the revenue productivities (TFPR) across firms, as is the case in China and India (see Hsieh and Klenow, 2009, for empirical evidence).

3 Integrating into the World Economy

We now explore the consequences of opening up to trade. After introducing the assumptions (Section 3.1), we focus first on an equilibrium that arises if trade costs are in an intermediate range (Section 3.2). We do so because this equilibrium is very suitable for illustrating the

---

[4]If $\lambda \geq (\sigma-1)/\sigma$, we have $K^D(x) = (x(\sigma-1)/\sigma)^\sigma a^{\sigma-1}$, and it can be easily checked that $K^D(x) = K$ defines a unique x (with $Y/P = aK$ and $\rho/P = a(\sigma-1)/\sigma$).

channels through which trade affects the economy. We then move on to a full characterization of how the economy responds as trade costs fall from prohibitive levels to zero (Section 3.3).

3.1 Assumptions

The home economy – which is taken to represent a developing country – will be called the "South". The rest of the world (i.e., the South's trading partner) is referred to as the "North" and represents an advanced economy. So far, the trade barriers have been assumed to be sufficiently high to prevent trade between South and North. This section focuses on a situation in which trade between the two regions may occur. Yet, North and South are less than perfectly integrated due to the existence of per-unit trade costs (which may be composed of tariffs and transport costs). We rely on the usual "iceberg" formulation and assume that $\tau \geq 1$ units of a good have to be shipped in order for one unit to arrive at the destination.

The North differs from the South in that its markets function perfectly. In particular, the northern credit market is frictionless so that there are no credit constraints. Moreover, in the North, each variety is produced by a large number of firms so that the northern goods market is perfectly competitive. Regarding access to technology and preferences, there are no differences between the two regions (i.e., technology and preferences are also represented by equations 1 and 2, respectively). Moreover, for the sake of simplicity, the North produces the same spectrum of goods as the South does.[5] Thus, following Banerjee and Newman (2004) and Foellmi and Oechslin (2010), poor and rich countries are not distinguished in terms of technology or endowments but according to how well markets work.

Given our assumptions regarding markets and technologies, it is immediately clear that all northern firms operate the high-productivity technology and charge a uniform price – which, in turn, is equal to the marginal cost. In what follows, it is convenient to normalize the northern price level to one. This normalization implies that all goods prices in the North (as well as the northern marginal cost) are also equal to one.

3.2 An Equilibrium with Intermediate Trade Costs

Under the assumptions made above, it is clear that τ gives the (marginal) cost of producing one unit of a good in the North and selling it in the South. As a result, since the northern firms operate under perfect competition, the price of any good produced in the North and exported

---

[5]It may be more natural to assume that the North produces a larger number of varieties than the South. Doing so would increase the gains from trade but not change the qualitative implications otherwise.

to the South is given by τ. This, in turn, implies that all southern producers face a northern competitive fringe and cannot set a price above τ (in terms of the numéraire).

3.2.1 Characterizing the Equilibrium

In what follows, we focus on an "intermediate" τ which makes a positive fraction of entrepreneurs – but not all of them – unable to set the price that would make domestic demand equal to the output produced by the firm. More specifically, we discuss an equilibrium where τ is such that (i) the price that would imply a domestic demand of $a\kappa$ units exceeds the upper bound τ; (ii) the profit-maximizing price charged by unconstrained entrepreneurs lies below the upper bound. In formal terms, we focus on

$$p(a\kappa) > \tau > p(\widetilde{y}), \tag{14}$$

where $p(y)$ and $\widetilde{y}$ are defined in (5) and (11), respectively.

Allowing for international trade leads to two formal adjustments. First, the fact that there is a binding upper bound on prices changes the relationship between the endowment and the maximum firm output. For price-constrained firms, the relationship is now given by

$$\overline{y}^I = \begin{cases} b\left(\omega + \lambda\tau\rho^{-1}\overline{y}^I\right) & : & 0 \leq \omega < \omega_\kappa^I \\ a\left(\omega + \lambda\tau\rho^{-1}\overline{y}^I\right) & : & \omega_\kappa^I \leq \omega < \omega_\tau^I \end{cases}, \tag{9'}$$

where ω_κ^I denotes the level which permits borrowing of exactly the amount required to meet the critical investment size κ; ω_τ^I refers to the threshold which allows an entrepreneur to produce a quantity of output that goes exactly together with an equilibrium price of τ.[6] A straightforward derivation of the two thresholds in (9') gives

$$\omega_\kappa^I = \left(1 - \frac{\lambda a\tau}{\rho}\right)\kappa \quad \text{and} \quad \omega_\tau^I = \left(1 - \frac{\lambda a\tau}{\rho}\right)(Y/P)(\tau/P)^{-\sigma}/a. \tag{15}$$

The second formal change concerns the determination of the borrowing rate. Since we are looking at an equilibrium in which a positive mass of entrepreneurs is price-constrained, the economy imports goods from abroad. This, in turn, implies that there must be positive aggregate exports (because trade needs to be balanced in our static framework). The fact that the equilibrium involves exports allows us to explicitly pin down the borrowing rate. Since exporting one unit of an arbitrary good (which requires $1/a$ units of capital) generates an income of $1/\tau$, the domestic borrowing rate must be a/τ. If the equilibrium borrowing

---

[6] For capital endowments equal to or bigger than ω_τ^I, the maximum output a firm can produce continues to be implicitly determined by $\overline{y}^I = a(\omega + \lambda x\left(\overline{y}^I\right)^{(\sigma-1)/\sigma})$.

rate were higher, nobody would export since lending would generate a higher return; if the borrowing rate were lower, demand for capital would exceed supply since even the richest agents in the economy would seek credit in order to export as much as possible.

We now work towards a description of the parameter constellations under which this equilibrium arises. The first step is to note that using $\rho = a/\tau$ in (15) yields

$$\omega_\kappa^I = \left(1 - \lambda\tau^2\right)\kappa \quad \text{and} \quad \omega_\tau^I = \left(1 - \lambda\tau^2\right)(Y/P)(\tau/P)^{-\sigma}/a.$$

Thus, for a positive mass of price-constrained entrepreneurs to exist, we need $\tau^2 < 1/\lambda$. Secondly, observe that condition (14) implies a lower bound on τ. Using both $\rho = a/\tau$ and the definition of $\widetilde{y}$ in expression (5) gives $p(\widetilde{y}) = (1/\tau)(\sigma/(\sigma - 1))$. As a result, $\tau > p(\widetilde{y})$ is equivalent to $\tau^2 > (\sigma/(\sigma - 1))$. In sum, we must therefore have

$$\frac{\sigma}{\sigma - 1} < \tau^2 < \frac{1}{\lambda}. \tag{R2}$$

Finally, we want to make sure that entrepreneurs with $\omega < \omega_\kappa^I$ do indeed run a firm (instead of becoming lenders). To get the required condition, note that each capital unit invested in a low-productivity firm generates a return of τb while lending is associated with a return of a/τ. We assume that the former exceeds the latter:

$$a/b < \tau^2. \tag{R3}$$

3.2.2 Establishing the Equilibrium

We now establish the existence of the equilibrium described above, assuming that the two additional parameter restrictions hold. We proceed in two steps. First, we derive an expression for aggregate imports. Second, we establish that the real output is uniquely pinned down.

Aggregate exports. Total consumption expenditures on an arbitrary good supplied by an entrepreneur with $\omega < \omega_\tau^I$ are $\tau c(\tau) = YP^{\sigma-1}\tau^{1-\sigma}$. To get the value of imports, we have to deduct the value of the domestic production. Moreover, with balanced trade, the total value of all imports must be equal to the value of all exports, EXP. As a result, we have

$$
\begin{aligned}
EXP \;=\;& YP^{\sigma-1}\tau^{1-\sigma}G(\omega_\tau^I) \\
& -\tau\int_0^{\omega_\kappa^I} \frac{b}{1-\lambda\tau^2 b/a}\omega\,dG(\omega) - \tau\int_{\omega_\kappa^I}^{\omega_\tau^I} \frac{a}{1-\lambda\tau^2}\omega\,dG(\omega),
\end{aligned}
$$

where the expression on the right-hand side of the first line gives total expenditures on all goods that are imported (i.e., goods produced by entrepreneurs with $\omega < \omega_\tau^I$); the first expression of

14

the second line is the total value of the goods produced by domestic entrepreneurs with $\omega < \omega_\kappa^I$ (i.e., by low-productivity firms); the second expression of the second line gives the total value of the goods produced by domestic entrepreneurs with $\omega_\kappa^I \leq \omega < \omega_\tau^I$ (i.e., by high-productivity firms with an output that is too small to meet the demand at price τ).

Resource constraint. To find an expression for (gross-)capital demand, note first that from (11) and $\rho = a/\tau$ we have $\widetilde{y} = (Y/P)P^\sigma \tau^\sigma ((\sigma - 1)/\sigma)^\sigma$ and $\widetilde{\omega} = (1 - \lambda(\sigma/(\sigma - 1))(\widetilde{y}/a)$. With these expressions in mind, the credit market equilibrium condition reads

$$
K = \int_0^{\omega_\kappa^I} \frac{1}{1 - \lambda\tau^2 b/a}\omega dG(\omega) + \int_{\omega_\kappa^I}^{\omega_\tau^I} \frac{1}{1 - \lambda\tau^2}\omega dG(\omega) + \int_{\omega_\tau^I}^{\widetilde{\omega}} \frac{\overline{y}^I(\omega)}{a} dG(\omega)
$$
$$
+ \int_{\widetilde{\omega}}^\infty \frac{\widetilde{y}}{a} dG(\omega) + \tau \frac{EXP}{a},
$$

where $\overline{y}^I(\omega)$ is implicitly determined by (9'). Using the expression for total exports, EXP, derived above, the equilibrium condition can be rewritten as

$$
K = \int_0^{\omega_\kappa^I} \frac{1 - \tau^2 b/a}{1 - \lambda\tau^2 b/a}\omega dG(\omega) + \int_{\omega_\kappa^I}^{\omega_\tau^I} \frac{1 - \tau^2}{1 - \lambda\tau^2}\omega dG(\omega) + \int_{\omega_\tau^I}^{\widetilde{\omega}} \frac{\overline{y}^I(\omega)}{a} dG(\omega)
$$
$$
+ \frac{1}{a}YP^{\sigma-1}\tau^\sigma \left(\frac{\sigma - 1}{\sigma}\right)^\sigma [1 - G(\widetilde{\omega})] + \frac{1}{a}YP^{\sigma-1}\tau^{2-\sigma}G(\omega_\tau^I).
$$

The following proposition shows that this condition pins down a unique equilibrium.

Proposition 2 *Suppose that conditions (R2) and (R3) hold and that κ is sufficiently low (in a sense made clear in the proof). Then, there exists a unique macroeconomic equilibrium (i.e., an equilibrium with the values of Y/P and ρ/P uniquely pinned down) where (i) the poorest entrepreneurs use the low-productivity technology; (ii) all poorer entrepreneurs are price-constrained and face import competition; (iii) all richer entrepreneurs set the profit-maximizing price; (iv) the richest entrepreneurs export parts of their output.*

Proof. See Appendix I. ∎

The properties of this equilibrium are – in addition to the evidence discussed after Proposition 1 – consistent with stylized facts about the relative performance of exporting firms (see, e.g., Bernard et al., 2003). In particular, the firms that export parts of their production tend to be the biggest ones and they are also more productive than the average firm in the economy (since some import-competing small firms use the low-productivity technology). Moreover,

to the extent that the set of richest entrepreneurs is relatively small, exporting firms are a minority. The mechanism behind these implications, however, is entirely different from the one in the standard models of trade and heterogeneous firms (i.e., Bernard et al., 2003; Melitz, 2003). Here, in an environment characterized by credit market frictions and inequality, it is the wealth endowment that determines whether an entrepreneur can access the resources required to operate the high-productivity technology and to enter export markets.

3.2.3 The Impact of Lower Trade Costs

Trade barriers and real output. In this equilibrium, a fall in trade barriers affects aggregate real output through three different channels, two adverse and one beneficial, which we now describe. Their relative strength is explored in Section 3.3.

The first adverse channel is associated with the impact of trade barriers on the minimum wealth level required to operate the high-productivity technology, ω_κ^I. Because $\omega_\kappa^I = \left(1 - \lambda\tau^2\right)\kappa$ is negatively related to τ, a fall in trade barriers increases the number of firms using the low-productivity technology, $G(\omega_\kappa^I)$. This result is a consequence of the credit-market imperfection. As τ shrinks, the maximum price that can be demanded by the price-constrained firms decreases while the cost of borrowing ($\rho = a/\tau$) increases. As a result, profit margins shrink – which means that these firms face a reduction in the collateral they can put up. Less collateral, in turn, implies a lower borrowing capacity so that some additional firms become unable to meet the κ-threshold. In what follows, we call this effect *polarization effect* as it reinforces the (preexisting) polar structure of the economy, i.e., the coexistence of small low-productivity firms and efficient large-scale companies.

While the polarization effect leads to a fall in unweighted average firm productivity, it does not necessarily imply a reduction in capital-weighted average productivity: Because preexisting low-productivity firms experience a decline in their ability to borrow as well, they are forced to invest less. The share of capital invested in low-productivity firms is given by

$$\frac{1}{1 - \lambda\tau^2 b/a} \int\limits_0^{(1-\lambda\tau^2)\kappa} \omega dG(\omega)/K.$$

The impact of lower trade barriers on the above expression depends on the parameters of the model and on the mass of entrepreneurs at ω_κ^I. If the latter is sufficiently large, a gradual reduction in trade barriers implies that a larger fraction of the capital stock is used in low-productivity firms. Put differently, in this case, the pro-competitive effects of trade impair, rather than improve, capital-weighted average firm productivity.

The second adverse channel, which we call *replacement effect*, is related to the fact that all preexisting price-constrained firms, high- and low-productivity alike, are forced to produce less as borrowing constraints become tighter. As a result, part of the output that used to be produced by these firms is replaced with imports from abroad;[7] at the same time, absorbing capital no longer employed by the price-constrained firms, large companies increase their output and send more goods abroad, thereby keeping trade balanced. These adjustments are a source of inefficiency as they may force the economy to spend more, rather than less, resources on transportation costs in response to a fall in trade barriers.

The beneficial channel, finally, is related to the fact that lowering trade barriers reduces the dispersion of prices and mark-ups in the domestic economy. Put differently, lower trade barriers reduce the relative prices of goods that are scarce due to the credit-market imperfection, thereby allowing individuals to consume a more balanced basket of goods. Other things equal, this improvement in the *availability of consumption goods* raises the welfare of the average individual in the economy (which is identical to the aggregate real output).

Trade barriers and the distribution. A fall in trade barriers does not only affect the level of the aggregate income but also the income distribution, which becomes more polarized. To see this, note that the nominal rate of return in unconstrained firms is a/τ, whereas the rate in price-constrained firms is given by $(1-\lambda)\tau b/(1-\lambda\tau^2(b/a))$ if the the low-productivity technology is used; and by $(1-\lambda)\tau a/(1-\lambda\tau^2)$ if the high-productivity technology is used. Thus, lowering trade barriers increases incomes in the higher parts of the distribution and diminishes those at the bottom. As a result, higher incomes gain disproportionally, confirming a similar finding in the more parsimonious setting presented in Foellmi and Oechslin (2010).

3.3 From Autarky to Full Integration

We now broaden our focus and explore how aggregate real output is affected by the three different channels as trade costs fall from prohibitive levels to zero. We focus first on the economy's behavior at the line separating the autarky equilibrium from the neighboring "trade equilibrium" using the general version of the model. For tractability reasons, the rest of the analysis will then be based on the assumption of a two-point distribution.

---

[7]This replacement effect is reminiscent of a mechanism discussed in a paper by Brander and Krugman (1983). They show that the rivalry of oligopolistic firms can lead to "reciprocal dumping" (i.e., two-way trade in the same product) and hence to "wasteful" spending on transportation.

3.3.1 From Autarky to Partial Integration

Whether or not the two regions exchange goods in equilibrium is determined by the trade costs, other things equal. If τ is so high that even firms with a zero wealth endowment ($\omega = 0$) are able to set their constrained-optimal price, there is no trade between North and South. However, as soon as τ turns into a binding maximum price, trade emerges.

The critical threshold in this regard can be calculated explicitly. Consider an autarky equilibrium in which the poorest entrepreneurs (i.e., those with $\omega = 0$) are forced to use the low-productivity technology. The highest price charged in such an equilibrium is $p(\bar{y}(0))$, where $p(\cdot)$ is given by (5) and $\bar{y}(0)$ can be calculated using (9). Observing these functional forms, we obtain $p(\bar{y}(0)) = \rho/(b\lambda)$. We further know that the borrowing rate in a trade equilibrium equals a/τ. Thus, at the border between autarky and the neighboring trade equilibrium, we must have $p(\bar{y}(0)) = a/(b\lambda\tau)$. As a result, the critical τ-threshold is given by

$$\tau^{AT} \equiv (a/(b\lambda))^{1/2}.$$

The following proposition establishes how trade costs affect real output at this threshold.

Proposition 3 *Consider an equilibrium where the poorest entrepreneurs use the low-productivity technology. Suppose further that $\tau = \tau^{AT}$. Then, a (marginal) reduction in trade costs, τ, leads to a fall in aggregate real output, Y/P:*

$$\left. \frac{d(Y/P)}{d\tau} \right|_{\tau=\tau^{AT}} > 0.$$

Proof. See Appendix I. ∎

Note that the output declines as τ falls below τ^{AT} although some smaller firms rely on the low-productivity technology (and the supply of goods is particularly uneven). This result continues to hold in the alternative case where all firms have access to the high-productivity technology under autarky (as can be shown using an approach similar to the one in the proof of Proposition 3).[8] The negative impact of trade in the neighborhood of τ^{AT} is due to the fact the reduction in mark-ups forces the smallest firms to downsize substantially. Put differently, the adverse replacement effect has first-order consequences, while the improvement in consumption possibilities is only a second-order effect.

---

[8]Note further that Proposition 3 does not depend on the assumption that the lowest wealth level is zero (rather than positive) nor on the fact that we impose a continuous wealth distribution (rather than a discrete one). Detailed derivations are available from the authors on request.

3.3.2 From Partial to Full Integration

Two-point distribution. We are now interested in how aggregate output changes as τ falls further below τ^{AT} and eventually approaches unity. To do so, we impose a two-point endowment distribution as this allows us to obtain closed-form solutions. Moreover, a two-point distribution (in combination with the credit market friction) implies a bimodal size-distribution of firms, a feature that is typical for developing countries (see, e.g., Tybout, 2000). In what follows, we assume that a fraction β of entrepreneurs are "poor" (P), owning $\omega_P = \theta K$ capital units, where $\theta < 1$. The remaining entrepreneurs, which we call "the rich" (R), are endowed with $\omega_R = (1 - \beta\theta)K/(1 - \beta)$ capital units (so that the aggregate endowment is K).

The full analytical characterization of the two-group example is given in Appendix II, while a numerical example is discussed below. Note that there are 2×2 possible equilibrium constellations under which international trade occurs: (i) either only the poor (τP) or all entrepreneurs (τE) are price-constrained; (ii) either only the rich (aR) or all entrepreneurs (aE) use the high-productivity technology. If the poor entrepreneurs are not price-constrained, there is no international trade (i.e., the autarky equilibrium prevails).

Numerical example. Figure 4 shows aggregate real output as a function of trade costs, relying on a parametrization (specified in the notes to the figure) which implies that all entrepreneurs have access to the high-productivity technology under autarky. Before exploring the different effects of trade on output, note that for all τ greater than 1.48 neither of the two groups of entrepreneurs is price-constrained (see condition 20 derived in Appendix II). Thus, as long as $\tau > 1.48$, the economy is in an autarky equilibrium so that a reduction in trade costs is without any effect. This is no longer true, however, as soon as τ reaches 1.48. From this point on, a further continuous fall in costs pushes the economy successively through the three equilibrium constellations $(\tau P, aE)$, $(\tau P, aR)$, and $(\tau E, aR)$.

Figure 4 here

Figure 4 illustrates that the relationship between τ and Y/P is non-monotonic, suggesting that the relative strength of the replacement effect is decreasing as trade costs fall from 1.48 to unity: In the neighborhood of the autarky equilibrium, as predicted by Proposition 3, a fall in trade costs causes a decline in Y/P; however, at lower levels of τ, a further reduction in trade costs has a positive impact on aggregate output, implying that the beneficial effect on consumption possibilities dominates the replacement effect. Finally, with fully integrated markets, all distortions vanish and the first-best output level is achieved.

19

The negative polarization effect becomes visible in the discontinuous decline at $\tau = 1.29$. As soon as τ falls below $((1 - \theta K/\kappa)/\lambda)^{1/2} \simeq 1.29$, the capital endowment of the poor agents, θK, falls short of ω_κ^I so that the high-productivity technology is no longer available to them. Yet, at this point, switching to the low-productivity technology is still more profitable than lending, and so the poor agents prefer to remain entrepreneurs.[9] However, as soon as competition gets sufficiently tough, the poor give up their businesses become lenders instead. This happens when τ reaches $(a/b)^{1/2} \simeq 1.12$ (and is reflected by the kink in the graph).

Figure 5 here

Figure 5 illustrates the relationship between τ and Y/P under the assumption of a more severe credit market imperfection (i.e., with a lower value of λ). In this case, in contrast to the situation shown in Figure 4, the poor entrepreneurs do not have access to the high-productivity technology under autarky. This difference is mirrored in a lower level of autarky output and in the fact that there is no discontinuous fall in output as trade costs decline. The non-monotonic pattern, however, is preserved. More generally, the numerical analysis suggests that the U-shaped relationship between τ and Y/P is a robust implication and does not depend on specific parameter values chosen here.

4 Evidence

4.1 Evidence on Trade and Access to Finance

While there is substantial evidence on the relationship between firm size and credit constraints, we know only little about the effect of trade openness on access to finance by smaller firms. It is the purpose of this subsection to present some new findings in this regard.

Data. We rely on a firm-level dataset that has recently been put together by Foellmi, Legge, and Tiemann (2013). The dataset combines two data sources, the World Bank's Enterprise Surveys (WBES) and the World Integrated Trade Solution (WITS) database. WBES provides firm-level survey data, including information on access to finance, firm size, and industry classification. WITS contains information on tariff rates at the four-digit ISIC classification level, allowing us to infer the degree of tariff protection enjoyed by each firm surveyed by WBES. To ensure comparability across countries, the dataset focuses on Latin America where firms

---

[9]Note that the jump is an artefact of the discrete two-group distribution, with a continuous distribution there would be a gradual increase in entrepreneurs relying on the inefficient technology as τ shrinks.

were interviewed with standardized questionnaires. It covers all Latin American countries in which firms were interviewed twice (in 2006 and 2010) and for which tariff rates were available: Argentina, Bolivia, Chile, Colombia, Paraguay, Peru, and Uruguay. The dataset includes only manufacturing firms, of which 880 were interviewed in both years. Among these 880 firms, 320 changed their industry classification between 2006 and 2010, implying that any difference in tariff protection between 2006 and 2010 is affected by the firm's own decision to switch industries. Excluding these firms leaves us with a small but clean two-period panel data set that contains 560 manufacturing firms from seven Latin American countries. Tariff information is lacking in 16 cases, however, so that our regression sample consists of 544 firms.

The main variable our empirical analysis focuses on is called *FIN_CONS*. This is a dummy variable that takes on the value 1 if a firm responds "access to finance" when asked which element of the business environment represents the biggest obstacle ("access to finance" is one answer in a list of 15 possible answers). We are interested in two related questions. First, did the share of firms responding "access to finance" increase by more in the subset of firms which were in industries that experienced a substantial tariff reduction? Second, is the negative effect (if any) of such tariff reductions on access to finance stronger among smaller firms? Throughout, we consider tariff cuts of 0.5 percentage points or more to be substantial. On average, tariffs fell by 4 percentage points in industries with substantial reductions.[10]

Results. Table 1 presents the empirical pattern separately for smaller firms (columns 1 and 2) and larger firms (columns 3 and 4). Regarding firm size, we consider two different definitions. In Panel A of Table 1, our sample of smaller firms includes firms with less than 20 employees (i.e., firms classified as small by WBES); in Panel B, the sample of smaller firms consists of firms with less than 100 employees (i.e., firms WBES classifies as either small or medium-sized). Relevant for the classification is the reported firm size in 2006.

Table 1 here

Focusing first on smaller firms as defined in Panel A, we observe that the share of firms identifying access to finance as their major problem rose significantly in the subset of firms that experienced a substantial decrease in tariffs (column 1); on the other hand, this share fell in the subset of the remaining smaller firms, but only mildly and insignificantly (column 2).[11] The coefficient in the fourth row is the difference-in-difference estimate (with country

---

[10] The average tariff protection is about 10 percent. Note that the results presented in Table 1 are robust: Setting the threshold at either −0.25 or −0.75 percentage points leads to similar results.

[11] In spite of the global financial crisis that started to affect Latin America in 2008, credit markets expanded on

fixed effects included) of the impact of a substantial reduction in tariffs. According to this estimate, such a tariff cut leads to a 11-percentage-point increase in the probability that a smaller firm identifies access to finance as the biggest obstacle (significant at the 15% level). Interestingly, the difference-in-difference estimator identifies an effect of similar size among larger firms (again as defined in Panel A), although the simple difference estimates (columns 3 and 4) suggests a smaller magnitude. Moving on to Panel B, we observe that tariff cuts have again a negative impact on access to finance among the set of smaller firms (which now includes small and medium-sized firms). The difference-in-difference estimate suggests that a substantial tariff cut leads to a 13-percentage-point increase in the probability that a smaller firm identifies access to finance as the biggest obstacle (significant at the 1% level). However, unlike in Panel A, a similar effect cannot be observed among larger firms.

Overall, the evidence presented in Table 1 lends support to the key mechanism underlying the paper's main theoretical results: While a reduction in tariff protection makes it harder for small and medium-sized firms to obtain credit, we do not find evidence of such a negative effect of tariff cuts on "access to finance" in a sample of large enterprises.

4.2 Existing Evidence

Our model offers further a coherent perspective on the existing empirical evidence – both within and across countries – on the effects of international trade in developing countries.

Within-country evidence. A substantial part of the within-country evidence comes from India in the early 1990s, i.e., from a period during which the country liberalized trade rapidly in return for IMF assistance. Overall, this literature does not suggest that the pro-competitive effects of trade strongly improved allocative efficiency or firm productivity. Evidence on allocative efficiency in India can be found in Hsieh and Klenow (2009) who relate the actual output to the (hypothetical) efficient output, i.e., the level of output that would be achieved if the production factors were efficiently allocated across firms. This "efficiency ratio" is available for three years. The numbers are 0.50 in 1987, 0.49 in 1991, and 0.44 in 1994 (Hsieh and Klenow, 2009, Table IV), implying that liberalizing trade went hand in hand with a strong deterioration in allocative efficiency. While such a paradoxical pattern is hard to obtain in standard heterogeneous-firms models relying on perfect factor markets, it arises naturally in the present

---

average between 2006 and 2010 in the seven Latin American countries considered. According to data provided by the World Development Indicators (WDI) database, the cross-country average of the measure "Domestic Credit to Private Sector (% of GDP)" rose from 31.4% in 2006 to 35.8% in 2010.

setup. In particular, in the two-group version discussed above, a reduction in τ that forces small firms to switch to the low-productivity technology (i.e., that pushes the economy from constellation $(\tau P, aE)$ to $(\tau P, aR)$) implies a fall in the "efficiency ratio" because part of the capital stock is allocated to less productive firms in the new equilibrium.[12]

Beyond explaining a fall in allocative efficiency, our model is also able to account for some more subtle developments discussed in Hsieh and Klenow (2009). On the one hand, their Table I documents an increase in the dispersion of physical productivities (TFPQ) across firms in the early 1990s – which is exactly what happens in the example illustrated by Figure 4. On the other hand, Table II shows a mild decline in the dispersion of revenue productivities (TFPR). We observe a similar pattern as those firms with an initially high TFPR see their prices and TFPQ fall while firms with an initially low TFPR experience a price increase.

The evidence regarding the impact of international trade on firm productivity in India is less surprising. Overall, however, it does not seem that the pro-competitive effects of trade lead to a substantial improvement in this dimension. For instance, focusing on big formal-sector firms, Topalova and Khandelwal (2011) do find a positive effect on average firm productivity. Yet, this effect is quite small: A 10-percentage-point decline in output tariffs leads to a 0.32% improvement in productivity (which implies that the enormous decline of 54 percentage points in the first half of the 1990s lifted productivity by a modest 1.7% on average).[13] Moreover, results by Nataraj (2011) suggest that this positive effect is limited to big companies: No such effect can be detected in a representative sample of formal-sector firms, suggesting – consistent with our theoretical framework – that there is a non-positive impact of a fall in output tariffs on the productivity of smaller firms.

Cross-country evidence. Emphasizing adverse effects of international trade on allocative efficiency, our model does not provide any reason to expect a clear-cut positive impact of trade on aggregate economic performance in developing countries. On the other hand, assuming that the owners of the biggest companies belong to the top income earners, the model does predict that an opening of trade increases the share of the GDP that goes to those at the very top of the

---

[12]In the context of your simple one-sector/one-factor economy, TFPQ and TFPR are given by z and pz, respectively, where $z \in \{a, b\}$. The equivalent of Hsieh and Klenow's (2009) measure of the efficient output, $Y_{efficient}$, is $\left(\beta(z_P)^{\sigma-1} + (1-\beta)(z_R)^{\sigma-1}\right)^{1/(\sigma-1)}$, and so on. The numerical example we discuss here considers a fall in τ from 1.4 to 1.25, relying on the parameter values given in Figure 4.

[13]While the evidence does not suggest a significant role of the pro-competitive channel, it clearly supports the relevance of the input channel: Both papers find that a fall in input tariffs boosts average firm productivity (as firms gain access to cheaper and more input factors). A similar pattern is documented for Indonesia, a country which liberalized trade in the second half of the 1990s (see Amiti and Konings, 2007).

distribution. These predictions match the broad patterns observed in cross-country data. As is well known, the empirical literature on trade barriers and economic performance in developing countries does not find any robust results. There are a number of studies (Dorwick and Golley; 2004; DeJong and Ripoll, 2006) that identify a positive impact of openness on growth in more advanced economies but no effect whatsoever in developing countries. Other papers find that – in developing countries – more openness is actually harmful for growth (Yanikkaya, 2003); others again suggest exactly the opposite effect (e.g., Warner, 2003).

Income-distribution data are scarcer but the available evidence suggests that more openness goes hand in hand with an increase in the fraction of the GDP that goes to the top income earners. For instance, in the aftermath of significant liberalization steps in the early 1990s, the top-1% income shares in Argentina and India surged (Atkinson et al., 2011, Figure 11; Banerjee and Piketty, 2005, Figure 4). Similarly, there is evidence of surging top-income shares in Mexico (Foellmi and Oechslin, 2010) after the country liberalized trade in the mid-1980s and in Indonesia (Leigh and van der Eng, 2007) after the country joined the WTO in 1995.

5 Summary and Conclusions

We study the macroeconomic implications of trade liberalization in a monopolistically competitive economy that features technology choice and credit market frictions. In contrast to much of the recent literature which emphasizes beneficial pro-competitive effects of trade, we find that a partial integration into world markets may actually worsen the allocation of production factors and reduce overall output. The reason is that a partial integration lowers mark-ups and hence the borrowing capacity of the less affluent entrepreneurs. So, for small or medium-sized firms, lower trade barriers mean less access to external financing, a prediction we substantiate using a firm-level dataset covering seven Latin American countries.

In our model, a deterioration in the access to credit affects economic performance through two different channels. First, while not driven out of the market, some smaller firms are forced to switch to less productive technologies (polarization effect). Second, the loss in output generated by the smaller firms must be compensated through higher imports – which requires the economy to spend more on trade-related costs (replacement effect). It is further clear that these changes in the use of technologies and firm sizes are reflected in the income distribution: While the owners of smaller firms lose, the most affluent entrepreneurs win substantially – which implies a further polarization of the distribution of incomes.

While we show that globalization may have negative consequences in developing economies,

our analysis does not suggest that these countries should stay away from trade liberalization. Such a conclusion would be inappropriate for two reasons. First, we find that an opening of trade may have detrimental effects on aggregate output only if it is incomplete. A reform that brings trade costs close to zero will always be beneficial. Second, even a modest reduction in trade barriers could be helpful if it were implemented together with complementary reforms.[14] Since the negative effect of a partial liberalization comes from tighter credit constraints, the complementary measures should concentrate on the credit market. One option would be to improve credit contract enforcement. If the improvement were sufficiently strong, the borrowing constraints faced by small firms would ease even though mark-ups shrink.

A significant improvement in the quality of credit contract enforcement may be difficult to achieve, though. It would require substantial institutional reform (such as the introduction of India-style Debt Recovery Tribunals) and hence be very time-consuming or infeasible. There is, however, a less ambitious alternative. Since a firm's borrowing capacity is negatively related to the borrowing rate, introducing a subsidized-credit scheme for constrained firms would have a very similar effect. The subsidy could be financed through an income tax which has upon introduction welfare costs of second order only (in the present framework it would not lead to any further distortions at all). It is finally worthwhile to note that our analysis, relying on a general equilibrium framework with technology choice, suggests that smaller firms should be the target of subsidized-credit schemes. The trade and finance literature, emphasizing fixed costs of entering foreign markets, would rather suggest that such programs should be directed towards big export-oriented companies.

---

[14] A sizeable reduction might be infeasible because the remoteness of the place implies high trade costs even if tariffs are negligible; or the lack of a tax bureaucracy means that the state is forced to rely on trade taxes.

References

[1] Acemoglu, Daron and Fabrizio Zilibotti (2001); "Productivity Differences," *Quarterly Journal of Economics*, 116(2), 563-606.

[2] Amiti, Mary and Jozef Konings (2007); "Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia", *American Economic Review*, 97(5), 1611-1638.

[3] Amiti, Mary and David Weinstein (2011); "Exports and Financial Shocks", *Quarterly Journal of Economics*, 126(4), 1841-1877.

[4] Atkinson, Anthony, Thomas Piketty, and Emmanuel Saez (2011); "Top Incomes in the Long Run of History", *Journal of Economic Literature*, 49(1), 3-71.

[5] Banerjee, Abhijit and Esther Duflo (2005); "Growth Theory Through the Lens of Development Economics," in: Aghion, P. and S. Durlauf, eds., *Handbook of Economic Growth*, Vol. 1A. Amsterdam: Elsevier.

[6] Banerjee, Abhijit and Esther Duflo (2010); "Giving Credit Where It is Due", *Journal of Economic Perspectives*, 24(3), 61-80.

[7] Banerjee, Abhijit and Benjamin Moll (2010); "Why Does Misallocation Persist?", *American Economic Journal: Macroeconomics*, 2(1), 189-206.

[8] Banerjee, Abhijit and Andrew Newman (1993); "Occupational Choice and the Process of Development," *Journal of Political Economy*, 101(2), 274-298.

[9] Banerjee, Abhijit and Andrew Newman (2004); "Notes for Credit, Growth, and Trade Policy", unpublished manuscript, MIT.

[10] Banerjee, Abhijit and Thomas Piketty (2005); "Top Indian Incomes, 1922-2000," *World Bank Economic Review* 19(1), 1-20.

[11] Bernard, Andrew, Jonathan Eaton, J. Bradford Jensen, and Samuel Kortum (2003); "Plants and Productivity in International Trade", *American Economic Review*, 93(4), 1268-1290.

[12] Bhagwati, Jagdish (1971); "The Generalized Theory of Distortions and Welfare", in Bhagwati, J. et al., eds., *Trade, Balance of Payments and Growth*. Amsterdam and London: North-Holland.

[13] Brander, James and Paul Krugman (1983); "A 'Reciprocal Dumping' Model of International Trade", *Journal of International Economics*, 15(3-4), 313-321.

[14] Bustos, Paula (2011); "Trade Liberalization, Exports, and Technology Upgrading: Evidence on the Impact of MERCOSUR on Argentinian Firms", *American Economic Review*, 101(1), 304-340.

[15] Coşar, Kerem, Nezih Guner, and James Tybout (2010); "Firm Dynamics, Job Turnover, and Wage Distributions in an Open Economy", NBER Working Paper 16326.

[16] DeJong, David and Marla Ripoll (2006); "Tariffs and Growth: An Empirical Exploration of Contingent Relationships", *Review of Economics and Statistics*, 88(4), 625-640.

[17] Dixit, Avinash and Joseph Stiglitz (1977); "Monopolistic Competition and Optimum Product Diversity", *American Economic Review*, 67(3), 297-308.

[18] Dowrick, Steve and Jane Golley (2004); "Trade Openness and Growth: Who Benefits?", *Oxford Review of Economic Policy*, 20(1), 38-56.

[19] Epifani, Paolo and Gino Gancia (2011); "Trade, Markup Heterogeneity and Misallocations", *Journal of International Economics*, 83(1), 1-13.

[20] Feenstra, Robert, Zhiyuan Li, and Miaojie Yu (2011); "Exports and Credit Constraints under Incomplete Information: Theory and Evidence from China", NBER Working Paper 16940.

[21] Foellmi, Reto and Manuel Oechslin (2010); "Market Imperfections, Wealth Inequality, and the Distribution of Trade Gains", *Journal of International Economics*, 81(1), 15-25.

[22] Foellmi, Reto, Stefan Legge, and Alexa Tiemann (2013); "Responses to Trade Liberalization: Evidence at the Firm-Level", unpublished manuscript, University of St. Gallen.

[23] Galor, Oded and Joseph Zeira (1993); "Income Distribution and Macroeconomics," *Review of Economic Studies*, 60(1), 35-52.

[24] Helpman, Elhanan, Oleg Itskhoki, and Stephen Redding (2010); "Inequality and Unemployment in a Global Economy", *Econometrica*, 78(4), 1239-1283.

[25] Hsieh, Chang-Tai and Peter Klenow (2009); "Misallocation and Manufacturing TFP in China and India", *Quarterly Journal of Economics*, 124(4), 1403-1448.

[26] Kambourov, Gueorgui (2009); "Labour Market Regulations and the Sectoral Reallocation of Workers: The Case of Trade Reforms", *Review of Economic Studies*, 76(4), 1321-1358.

[27] Kehoe, Timothy and Kim Ruhl (2010); "Why Have Economic Reforms in Mexico Not Generated Growth?", *Journal of Economic Literature*, 48(4), 1005-10273.

[28] Leigh, Andrew and Pierre van der Eng (2007); "Top Incomes in Indonesia, 1920-2004", Australian National University, Centre for Economic Policy Research Discussion Paper No. 549.

[29] Lileeva, Alla, and Daniel Trefler (2010); "Improved Access to Foreign Markets Raises Plantlevel Productivity . . . For Some Plants", *Quarterly Journal of Economics*, 125(3), 1051-1099.

[30] Manova, Kalina (2013); "Credit Constraints, Heterogeneous Firms, and International Trade", *Review of Economic Studies*, 80(2), 711-744.

[31] Matsuyama, Kiminori (2000); "Endogenous Inequality," *Review of Economic Studies,* 67(4), 743-59.

[32] Matsuyama, Kiminori (2005); "Credit Market Imperfections and Patterns of International Trade and Capital Flows", *Journal of the European Economic Association*, 3(2-3), 714-723.

[33] McMillan, Margaret and Dani Rodrik (2011); "Globalization, Structural Change, and Productivity Growth", NBER Working Paper 17143.

[34] Melitz, Marc (2003); "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity", *Econometrica*, 71(6), 1695–1725.

[35] Melitz, Marc and Giancarlo Ottaviano (2008); "Market Size, Trade, and Productivity", *Review of Economic Studies*, 75(1), 295-316.

[36] Nataraj, Shanthi (2011); "The impact of Trade Liberalization on Productivity: Evidence from India's Formal and Informal Manufacturing Sectors", *Journal of International Economics*, 85(2), 292-301.

[37] Pavcnik, Nina (2002); "Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants", *Review of Economic Studies*, 69(1), 245-276.

[38] Rodrik, Dani (2010); "Diagnostics before Prescription", *Journal of Economic Perspectives*, 24(3), 33-44.

[39] Song, Zheng, Kjetil Storesletten, and Fabrizio Zilibotti (2011); "Growing Like China", *American Economic Review*, 101(1), 202-241.

[40] Stiglitz, Joseph and Andrew Charlton (2005); *Fair Trade For All. How Trade Can Promote Development*. New York: Oxford University Press.

[41] Topalova, Petia and Amit Khandelwal (2011); "Trade Liberalization and Firm Productivity: The Case of India", *Review of Economics and Statistics*, 93(3), 995-1009.

[42] Tybout, James (2000); "Manufacturing Firms in Developing Countries: How Well Do They Do,and Why?", *Journal of Economic Literature*, 38(1), 11-44.

[43] UNCTAD (2006); *The Least Developed Countries Report 2006. Developing Productive Capacities*. New York and Geneva: United Nations Publication.

[44] Warner, Andrew (2003); "Once More Into the Breach: Economic Growth and Global Integration", Center for Global Development Working Paper Number 34.

[45] Yanikkaya, Halit (2003); "Trade Openness and Economic Growth: A Cross-Country Empirical Investigation", *Journal of Development Economics*, 72(1), 57-89.

APPENDIX I: PROOFS

Proof of Proposition 1. (i) We focus first on the case $\lambda < (\sigma - 1)/\sigma$ (credit rationing). In order to establish that there is a unique macroeconomic equilibrium, we proceed in two steps. We first show the existence of a unique equilibrium value of x. In a second step, we prove then that Y/P and ρ/P are uniquely pinned down.

To achieve the first step, observe that the equilibrium value of x must solve $K^D(x) = K$, where $K^D(x)$ is given by (13). Suppose now that x is exactly equal to the threshold given in (10). Then, $\widetilde{y}(x)/a$ is equal to κ whereas both $\overline{y}(\omega; x)/a$ (with $\omega \in [\omega_\kappa, \widetilde{\omega})$) and $\overline{y}(\omega; x)/b$ (with $\omega < \omega_\kappa$) are strictly smaller than κ. As a result, K^D must also be strictly smaller than κ. Moreover, since $\kappa < K$ due to (R1), we have $K^D < K$. Assume now that $x \to \infty$. Obviously, under these circumstances, we have $K^D \to \infty > K$. Finally, to show that there is a unique value that solves the equilibrium condition $K^D(x) = K$, we now establish that K^D increases monotonically as x rises from the threshold in (10) to infinity. Expressions (9) and (11) imply that both $\overline{y}(\omega; x)$ and $\widetilde{y}(x)$ are monotonically increasing in x. Moreover, the threshold ω_κ falls in x which reinforces the increase in capital demand since

$$\left[\frac{\overline{y}(\omega_\kappa^-)}{b} - \frac{\overline{y}(\omega_\kappa^+)}{a} \right] g(\omega_\kappa) \frac{d\omega_\kappa}{dx} \geq 0.$$

Thus, we have $K^D(x)/dx > 0$, and the proof of the first step is complete.

To show also that ρ/P (and hence Y/P) is uniquely pinned down, we make use of the CES price index. The first step is to find an expression for the price associated with an output level $\widetilde{y}$. To do so, we apply the expressions for x and $\widetilde{y}$ in (5) and get $p(\widetilde{y}) = (\rho/a)(\sigma/(\sigma-1))$. With this expression in mind, the definition of the CES price index implies

$$P^{1-\sigma} = \int_0^{\widetilde{\omega}} [p(\overline{y}(\omega))]^{1-\sigma} \, dG(\omega) + \left[\frac{\sigma}{\sigma-1} \frac{\rho}{a} \right]^{1-\sigma} [1 - G(\widetilde{\omega})]. \qquad (16)$$

Then, relying again on (5) to substitute for $p(\overline{y}(\omega))$, we eventually obtain

$$\left(\frac{\rho}{P} \right)^{\sigma-1} = \int_0^{\widetilde{\omega}(x)} x^{1-\sigma} [\overline{y}(\omega; x)]^{(\sigma-1)/\sigma} \, dG(\omega) + \left[\frac{\sigma}{\sigma-1} \frac{1}{a} \right]^{1-\sigma} [1 - G(\widetilde{\omega}(x))],$$

which pins down the real interest rate ρ/P as a function of x (note that we can choose P as the numéraire and normalize to 1).

(ii) Assume now that $\lambda \geq (\sigma-1)/\sigma$ (no credit rationing). In this situation, all firms produce $\widetilde{y}$ and hence invest $\widetilde{y}/a$ capital units (recall $\kappa < K$). As a result, (gross-)capital demand is given by $\int_0^\infty (\widetilde{y}/a) \, dG(\omega) = (Y/P)a^{\sigma-1}(\rho/P)^{-\sigma}((\sigma-1)/\sigma)^\sigma$. Moreover, since all firms invest $\widetilde{y}/a$,

we must have that $K = \widetilde{y}/a$ – which implies $Y/P = aK$ (equation 6). Hence, the equilibrium interest rate is determined by $aKa^{\sigma-1}(\rho/P)^{-\sigma}\left(\frac{\sigma-1}{\sigma}\right)^{\sigma} = K$, which results in

$$\frac{\rho}{P} = a\frac{\sigma-1}{\sigma}.$$

Proof of Proposition 2. To start the proof, we introduce a number of definitions. First, we define $z \equiv P^{\sigma-1}Y$ so that (i) $p(y)$ given in (5) reads $p(y) = z^{1/\sigma}y^{-1/\sigma}$; (ii) we have $x = (\tau/a)z^{1/\sigma}$. Second, it is convenient to introduce $\underline{z}$ which is the value of z that makes $p(a\kappa)$ equal to τ. Hence, we have $\underline{z} = (a\kappa)\tau^{\sigma}$. Thirdly, we write capital demand as a function of z:

$$
\begin{aligned}
K^D(z) &= \int_0^{\omega_\kappa^I} \frac{1 - \tau^2 b/a}{1 - \lambda\tau^2 b/a}\omega dG(\omega) + \int_{\omega_\kappa^I}^{\omega_\tau^I} \frac{1 - \tau^2}{1 - \lambda\tau^2}\omega dG(\omega) + \int_{\omega_\tau^I}^{\widetilde{\omega}} \frac{\overline{y}^I(\omega; z)}{a} dG(\omega) \\
&\quad + \frac{1}{a}z\tau^{\sigma}\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}[1 - G(\widetilde{\omega}_I)] + \frac{1}{a}z\tau^{2-\sigma}G(\omega_\tau^I).
\end{aligned}
$$

Finally, note that $\overline{y}^I(\omega; z)$ is increasing in z and that $\omega_\kappa^I = \omega_\tau^I$ if $z = \underline{z}$.

We now show that – if κ is sufficiently low – $K^D(z) = K$ uniquely pins down z. The first step is to observe that, as z rises from $\underline{z}$ to infinity, $K^D(z)$ monotonically increases (to calculate the derivative note that marginal changes in ω_τ^I and $\widetilde{\omega}$ leave K^D unaffected), where $\lim_{z\to\infty} K^D(z) = \infty$. The second step is to establish that $K^D(\underline{z}) < K$ if κ is sufficiently low. Since the first term in the above expression is negative and – at $z = \underline{z}$ – the second one is zero, we have

$$K^D(\underline{z}) < \int_{\omega_\tau^I}^{\widetilde{\omega}} \frac{\overline{y}^I(\omega; \underline{z})}{a} dG(\omega) + \frac{1}{a}\underline{z}\tau^{\sigma}\left(\frac{\sigma-1}{\sigma}\right)^{\sigma}[1 - G(\widetilde{\omega})] + \frac{1}{a}\underline{z}\tau^{2-\sigma}G(\omega_\tau^I).$$

Moreover, using $\underline{z} = (a\kappa)\tau^{\sigma}$ and taking into account that $\overline{y}^I(\omega; z) \leq \widetilde{y} = \underline{z}\tau^{\sigma}((\sigma-1)/\sigma)^{\sigma}$ gives us

$$K^D(\underline{z}) < \kappa\left(\frac{\tau^2}{\sigma/(\sigma-1)}\right)^{\sigma}[1 - G(\omega_\tau^I)] + \kappa\tau^2 G(\omega_\tau^I).$$

Note that the right-hand side (RHS) of the above expression depends only on exogenous parameters (and the distribution of ω). Thus, if $\kappa < K/\max\left\{\left(\tau^2(\sigma-1)/\sigma\right)^{\sigma}, \tau^2\right\}$, we have $K^D(\underline{z}) < K$. Moreover, since $K^D(z)$ monotonically increases in z (and is unbounded), there exists a unique z which satisfies $K^D(z) = K$.

As in the proof of Proposition 1, the final step is to show that Y/P is uniquely pinned down (given that there is a unique z). To do so, we exploit again the CES price index which – in this case – can be written as

$$P^{(1-\sigma)} = \tau^{1-\sigma}G(\omega_\tau^I) + \int_{\omega_\tau^I}^{\widetilde{\omega}} \left[p(\overline{y}^I(\omega; z))\right]^{1-\sigma} dG(\omega) + \left[\frac{\sigma}{\sigma-1}\frac{1}{\tau}\right]^{1-\sigma}[1 - G(\widetilde{\omega})].$$

Note that $\overline{y}^I(\omega; z)$ as well as the thresholds ω_τ^I and $\widetilde{\omega}$ are functions of z (and the exogenous parameters of the model). As a result, P – and hence $Y/P = zP^{-\sigma}$ – are uniquely determined.

Proof of Proposition 3. To start with, consider an equilibrium where a positive mass of the poorest entrepreneurs uses the low-productivity technology. Moreover, suppose that a positive fraction of these low-productivity firms are price-constrained. Using an approach similar to the one chosen in Section 3.2, we can derive the credit market equilibrium condition that is relevant for this type of equilibrium:

$$
K = \int_0^{\omega_\tau^I} \frac{1 - \tau^2 b/a}{1 - \lambda\tau^2 b/a}\omega dG(\omega) + \int_{\omega_\tau^I}^{\omega_\kappa^I} \frac{\overline{y}^I(\omega)}{b} dG(\omega) + \int_{\omega_\kappa^I}^{\widetilde{\omega}} \frac{\overline{y}^I(\omega)}{a} dG(\omega)
$$
$$
+ \frac{1}{a}YP^{\sigma-1}\tau^\sigma \left(\frac{\sigma-1}{\sigma}\right)^\sigma [1 - G(\widetilde{\omega})] + \frac{1}{a}YP^{\sigma-1}\tau^{2-\sigma}G(\omega_\tau^I).
$$

In what follows, we will use the definition $v \equiv YP^{\sigma-1}\tau^\sigma$. Applying this definition, and using the fact that $\rho = a/\tau$, the function $\overline{y}^I(\omega)$ in the above equation is implicitly defined by

$$
\overline{y}^I(\omega) = \begin{cases} b\omega + \lambda\left[\overline{y}^I(\omega)\right]^{\frac{\sigma-1}{\sigma}} v^{\frac{1}{\sigma}} b/a & : & \omega_\tau^I \leq \omega < \omega_\kappa^I \\ a\omega + \lambda\left[\overline{y}^I(\omega)\right]^{\frac{\sigma-1}{\sigma}} v^{\frac{1}{\sigma}} & : & \omega_\tau^I < \omega_\kappa^I \leq \omega \end{cases},
$$

where the level of wealth at which the credit constraint becomes binding, ω_κ^I, is given by $\omega_\kappa^I = \kappa(1 - \lambda(v/a\kappa)^{1/\sigma})$. The level of wealth at which the price constraint becomes relevant, ω_τ^I, is given by $\omega_\tau^I = P^{\sigma-1}Y\tau^{-\sigma}\left(b^{-1} - \lambda\tau/\rho\right)$. Using again $\rho = a/\tau$, we get $\omega_\tau^I = P^{\sigma-1}Y\tau^{-\sigma}\left(b^{-1} - \lambda\tau^2/a\right)$ which, in turn, can be rewritten as $\omega_\tau^I = v\tau^{-2\sigma}\left(b^{-1} - \lambda\tau^2/a\right)$. In this context, note further that $\widetilde{y} = v\left((\sigma-1)/\sigma\right)^\sigma$ and, as usual, $\widetilde{\omega} = (1 - \lambda\sigma/(\sigma-1))\widetilde{y}/a$. Finally, we can rewrite the above credit market equilibrium condition as

$$
aK = \int_0^{\omega_\tau^I} a\frac{1 - \tau^2 b/a}{1 - \lambda\tau^2 b/a}\omega dG(\omega) + \int_{\omega_\tau^I}^{\omega_\kappa^I} a\frac{\overline{y}^I(\omega)}{b} dG(\omega) + \int_{\omega_\kappa^I}^{\widetilde{\omega}} \overline{y}^I(\omega) dG(\omega) \quad (17)
$$
$$
+ v\left(\frac{\sigma-1}{\sigma}\right)^\sigma [1 - G(\widetilde{\omega})] + v\tau^{2(1-\sigma)}G(\omega_\tau^I).
$$

This is convenient as the endogenous variables enter expression (17) only through v. The same holds for the aggregate real output, Y/P (which is equivalent to welfare, U):

$$
(Y/P)^{(\sigma-1)/\sigma} = U^{(\sigma-1)/\sigma} = v^{(\sigma-1)/\sigma}\tau^{2(1-\sigma)}G(\omega_\tau^I) + \int_{\omega_\tau^I}^{\widetilde{\omega}} \overline{y}^I(\omega)^{(\sigma-1)/\sigma} dG(\omega)
$$
$$
+ v^{(\sigma-1)/\sigma}\left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1} [1 - G(\widetilde{\omega})].
$$

The change in the aggregate real output (or welfare) in response to a change in trade costs can be decomposed into two parts. There is a direct as well as a general-equilibrium effect:

$$\frac{dU}{d\tau} = \frac{\partial U}{\partial \tau} + \frac{\partial U}{\partial v}\frac{dv}{d\tau}.$$

Taking into account that $\overline{y}^I(\omega_\tau^I) = v\tau^{-2\sigma}$, the two partial derivatives are given by

$$\frac{\partial U}{\partial \tau} = -2(\sigma-1)v^{(\sigma-1)/\sigma}\tau^{2(1-\sigma)-1}G(\omega_\tau^I) < 0$$

and

$$\frac{\partial U}{\partial v} = \frac{\sigma-1}{\sigma}v^{-1/\sigma}\tau^{2(1-\sigma)}G(\omega_\tau^I) + \frac{\sigma-1}{\sigma}\int_{\omega_\tau^I}^{\widetilde{\omega}}\overline{y}^I(\omega)^{-1/\sigma}\frac{\partial\overline{y}^I(\omega)}{\partial v}dG(\omega)$$

$$+(b^{(\sigma-1)/\sigma} - a^{(\sigma-1)/\sigma})\kappa^{(\sigma-1)/\sigma}\frac{\partial\omega_\kappa^I}{\partial v} + v^{-1/\sigma}\left(\frac{\sigma-1}{\sigma}\right)^\sigma [1 - G(\widetilde{\omega})] > 0,$$

where the latter derivative is unambiguously positive since $\partial\overline{y}^I(\omega)/\partial v > 0$ and $\partial\omega_\kappa^I/\partial v < 0$. The derivative $dv/d\tau$, on the other hand, can be found by implicitly differentiating the credit market equilibrium condition (17):

$$\frac{dv}{d\tau} = -\frac{2(\lambda-1)\int_0^{\omega_\tau^I}\frac{b\tau}{(1-\lambda\tau^2 b/a)^2}\omega dG(\omega) + 2(1-\sigma)v\tau^{2(1-\sigma)-1}G(\omega_\tau^I)}{\int_{\omega_\tau^I}^{\omega_\kappa^I}\frac{a}{b}\frac{\partial}{\partial v}\overline{y}^I(\omega)dG(\omega) + \int_{\omega_\kappa^I}^{\widetilde{\omega}}\frac{\partial}{\partial v}\overline{y}^I(\omega)dG(\omega) + \left(\frac{\sigma-1}{\sigma}\right)^\sigma [1 - G(\widetilde{\omega})] + \tau^{2(1-\sigma)}G(\omega_\tau^I)} > 0.$$

We now move on the final step of the proof which is to determine the sign of $dU/d\tau$ at $\tau = \tau^{AT}$. At this point, the constrained-optimal price of the poorest entrepreneurs (i.e, those with $\omega = 0$) is exactly τ – which implies $\omega_\tau^I = 0$. As a result, we immediately get $\partial U/\partial\tau|_{\omega_\tau^I=0} = 0$ and $\partial U/\partial v|_{\omega_\tau^I=0} > 0$. In order to find the sign of $dv/d\tau|_{\omega_\tau^I=0}$, note that

$$\lim_{\tau\to\tau^{AB}}\int_0^{\omega_{\tau I}}\frac{b\tau}{(1-\lambda\tau^2 b/a)^2}\omega dG(\omega) = -\frac{v}{4}\left(\frac{a}{b\lambda}\right)^{\sigma-1}g(\omega_\tau^I)\frac{\partial\omega_\tau^I}{\partial\tau} > 0$$

and hence $dv/d\tau|_{\omega_\tau^I=0} > 0$. As a result, we conclude that

$$\left.\frac{dU}{d\tau}\right|_{\omega_\tau^I=0} = \left.\frac{d(Y/P)}{d\tau}\right|_{\omega_\tau^I=0} > 0.$$

Proof of Lemma 1. The proof is most easily provided by a graphical argument. Consider the case $\omega < \omega_\kappa$. Whereas the left-hand side (LHS) of equation (9) is linear in $\overline{y}$ starting from zero, the RHS starts at ω and its slope reaches zero as $\overline{y}$ grows very large. Thus, $\overline{y}$ is uniquely determined. An increase in ω shifts up the RHS such that the new intersection of the LHS and the RHS lies to the right of the old one. The analogous argument holds true for $\omega \geq \omega_\kappa$. Finally, the definition of ω_κ implies that $\overline{y}(\omega_\kappa) = a\kappa > b\kappa > \lim_{\omega\to\omega_\kappa^-}\overline{y}(\omega)$. Hence, $\overline{y}(\omega)$ is strictly monotonic in ω.

Proof of Lemma 2. Suppose first $\lambda < (\sigma - 1)/\sigma$ so that $\widetilde{\omega} > 0$. Under these circumstances, entrepreneurs with $\omega \in [\omega_\kappa, \widetilde{\omega})$ have access to the efficient technology but their maximum output, $\overline{y}(\omega)$, falls short of $\widetilde{y}$. But this means that, when producing $\overline{y}(\omega)$, the marginal revenue still exceeds marginal costs. Thus, producing the maximum quantity is indeed optimal. On the other hand, entrepreneurs with $\omega \geq \widetilde{\omega}$ will not go beyond $\widetilde{y}$ because, if they chose a higher level, the marginal revenue would be lower than the cost of borrowing (if $\omega < \widetilde{y}/a$) or the income from lending (if $\omega \geq \widetilde{y}/a$). The second part of the claim is obvious and does not require further elaboration.

Proof of Lemma 3. To establish the claim, we show that the marginal revenue at the output level $b\kappa$ is not smaller than the marginal cost associated with the less efficient technology, ρ/b. This implies that for all $y < b\kappa$ marginal revenues strictly exceed marginal costs so that all entrepreneurs with $\omega < \omega_\kappa$ strictly prefer the maximum firm output. The marginal revenue at $y = b\kappa$ is given by $((\sigma - 1)/\sigma)P^{(\sigma-1)/\sigma}Y^{1/\sigma}(b\kappa)^{-1/\sigma}$, and so what we have to prove is

$$\frac{\sigma - 1}{\sigma}P^{(\sigma-1)/\sigma}Y^{1/\sigma}(b\kappa)^{-1/\sigma} \geq \frac{\rho}{b} \tag{18}$$

$$\frac{P^{(\sigma-1)/\sigma}Y^{1/\sigma}}{\rho} \geq \frac{\sigma}{\sigma - 1}\frac{1}{b}(b\kappa)^{1/\sigma}.$$

In order to do so, we will establish a lower bound for the LHS of the second line in the above expression. Note that $((\sigma - 1)/\sigma)P^{(\sigma-1)/\sigma}Y^{1/\sigma}\widetilde{y}^{-1/\sigma} = \rho/a$. Notice further that, in an equilibrium, we must have that $\widetilde{y}/a \geq K$ since there are no firms operating at a higher scale of investment. Thus, we have $((\sigma - 1)/\sigma)P^{(\sigma-1)/\sigma}Y^{1/\sigma}(aK)^{-1/\sigma} \geq \rho/a$ or, equivalently,

$$\frac{P^{(\sigma-1)/\sigma}Y^{1/\sigma}}{\rho} \geq \frac{\sigma}{\sigma - 1}\frac{1}{a}(aK)^{1/\sigma}.$$

It is now straightforward to check that, due to the parameter restriction (R1), $(1/a)(aK)^{1/\sigma} > (1/b)(b\kappa)^{1/\sigma}$. But this means that (18) must be satisfied.

<center>APPENDIX II: ANALYSIS OF THE TWO-GROUP EXAMPLE</center>

Only poor agents price-constrained (τP). We start with a characterization of the two trade equilibria in which only the poor entrepreneurs are price-constrained. Suppose first that all agents use the high-productivity technology. Then, the output by the poor entrepreneurs is $a\theta K/(1 - \lambda\tau^2)$. As a result, without facing a competitive fringe, they would charge

$P^{(\sigma-1)/\sigma}Y^{1/\sigma}\left(1-\lambda\tau^2\right)^{1/\sigma}(\theta aK)^{-1/\sigma}$. This expression must be larger than τ for the competitive fringe to be binding. To determine $P^{(\sigma-1)/\sigma}Y^{1/\sigma}$, we use the credit market equilibrium condition,

$$K = \beta\frac{1-\tau^2}{1-\lambda\tau^2}\theta K + \frac{1}{a}(1-\beta)YP^{\sigma-1}\tau^\sigma\left(\frac{\sigma-1}{\sigma}\right)^\sigma + \frac{1}{a}\beta YP^{\sigma-1}\tau^{2-\sigma},$$

which can be rearranged to obtain

$$YP^{\sigma-1} = aK\left(1-\beta\theta\frac{1-\tau^2}{1-\lambda\tau^2}\right)\left((1-\beta)\tau^\sigma\left(\frac{\sigma-1}{\sigma}\right)^\sigma+\beta\tau^{2-\sigma}\right)^{-1}. \tag{19}$$

This result allows us to express the condition for the competitive fringe to be binding in terms of exogenous variables only. In particular, we obtain

$$\theta < \left(1-\lambda\tau^2\right)\left(\beta+(1-\beta)\left(\tau^2\frac{\sigma-1}{\sigma}\right)^\sigma\right)^{-1}. \tag{20}$$

We proceed to explicitly calculate aggregate real output, Y/P, which can be interpreted as the welfare level of the average entrepreneur. To do so, we first have to determine P. Note that a share β of goods is priced at τ whereas the price of the remaining goods is $p(\tilde{y}) = \sigma/((\sigma-1)\tau)$. As a result, we have $P^{1-\sigma} = \beta\tau^{1-\sigma} + (1-\beta)\left(\sigma/((\sigma-1)\tau)\right)^{1-\sigma}$. We use this latter expression in (19) and obtain (recall $U = Y/P$)

$$U^{aE,\tau P} = aK\left(1-\beta\theta\frac{1-\tau^2}{1-\lambda\tau^2}\right)\frac{\left(\beta\tau^{2(1-\sigma)}+(1-\beta)\left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1}\right)^{\sigma/(\sigma-1)}}{\beta\tau^{2(1-\sigma)}+(1-\beta)\left(\frac{\sigma-1}{\sigma}\right)^\sigma}. \tag{21}$$

Suppose now that the the poor entrepreneurs use the low-productivity technology. This happens if $\omega_\kappa^I = \left(1-\lambda\tau^2\right)\kappa > \theta K$ and $\tau^2 > a/b$. After going through a similar series of steps, we find that aggregate real output in this case is given by

$$U^{aR,\tau P} = aK\left(1-\beta\theta\frac{1-\tau^2 b/a}{1-\lambda\tau^2 b/a}\right)\frac{\left(\beta\tau^{2(1-\sigma)}+(1-\beta)\left(\frac{\sigma-1}{\sigma}\right)^{\sigma-1}\right)^{\sigma/(\sigma-1)}}{\beta\tau^{2(1-\sigma)}+(1-\beta)\left(\frac{\sigma-1}{\sigma}\right)^\sigma},$$

which is obviously smaller than the expression in (21). The condition for the competitive fringe to be binding is $\theta < \left(1-\lambda\tau^2 b/a\right)\left(\beta+(1-\beta)\left(\tau^2(\sigma-1)/\sigma\right)^\sigma\right)^{-1}$.

All agents price-constrained (τE). We now turn to the equilibria in which all entrepreneurs are price-constrained and hence set their prices equal to τ (so that $P = \tau$). This happens if $\tau < p(\tilde{y})$ or, equivalently, $\tau < (\sigma/(\sigma-1))^{1/2}$. As in the two cases above, $YP^{\sigma-1}$ can be determined by looking at the credit market equilibrium condition. In the constellation where all entrepreneurs use the high-productivity technology, this condition reads $K = \beta(1-\tau^2)(1-\lambda\tau^2)^{-1}\theta K + a^{-1}YP^{\sigma-1}\tau^{-\sigma}(1-\beta) + a^{-1}\beta YP^{\sigma-1}\tau^{2-\sigma}$ (and there is a related

condition if the poor entrepreneurs use the low-productivity technology). Real output is then given by

$$U^{aE,\tau E} = aK \left(1 - \beta\theta\frac{1 - \tau^2}{1 - \lambda\tau^2}\right)\frac{1}{1 - \beta + \beta\tau^2}$$

if all entrepreneurs operate the high-productivity technology; by

$$U^{aR,\tau E} = aK \left(1 - \beta\theta\frac{1 - \tau^2 b/a}{1 - \lambda\tau^2 b/a}\right)\frac{1}{1 - \beta + \beta\tau^2}$$

if the poor are forced to rely on the low-productivity technology; and by

$$U^{?R,\tau E} = aK\frac{1}{1 - \beta + \beta\tau^2}$$

if the poor are no longer enterpreneurs.

Finally, note that the poor entrepreneurs must be price-constrained if the rich are since the latter run bigger firms. A fortiori this holds in the constellations where the poor use the low-productivity technology.

Group-specific real incomes. To see how individual welfare depends on trade costs, we derive the group-specific real incomes. The nominal income (revenue minus cost of borrowing) of the poor entrepreneurs, m_P, is given by $(1-\lambda)a\tau\theta K/(1-\lambda\tau^2)$ if they use the high-productivity technology; by $(1-\lambda)b\tau\theta K/(1-\lambda\tau^2 b/a)$ if they operate the low-productivity technology. Thus, the welfare level incurred by the representative poor agent, $U_P = m_P/P$, is given by

$$U_P = \begin{cases} \max\left\{\frac{(1-\lambda)b\tau}{1-\lambda\tau^2 b/a}, \frac{a}{\tau}\right\}\theta K/P & : & \theta K < \omega_\kappa^I = \kappa(1 - \lambda\tau^2) \\ \frac{(1-\lambda)a\tau}{1-\lambda\tau^2}\theta K/P & : & \theta K \geq \omega_\kappa^I = \kappa(1 - \lambda\tau^2) \end{cases}.$$
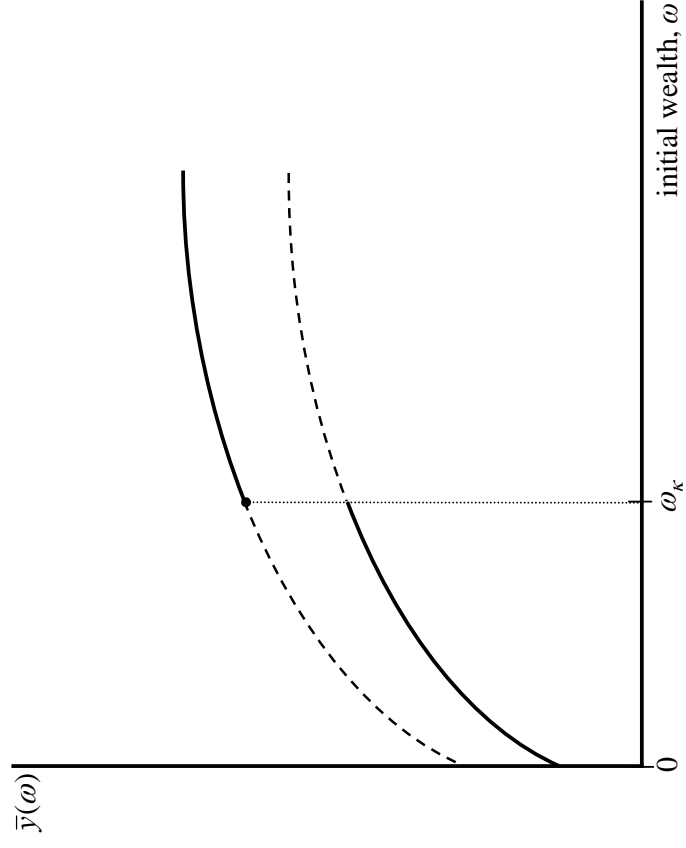
The nominal income of the rich entrepreneurs, m_R, reads $(p(\widetilde{y}) - \rho)\widetilde{y} + \rho(1 - \beta\theta)(1 - \beta)^{-1}K$. Taking into account that $\widetilde{y} = YP^{\sigma-1}\tau^\sigma\left((\sigma - 1)/\sigma\right)^\sigma$, we find that

$$U_R = \begin{cases} \left(\tau^2 - 1\right)YP^{\sigma-2}\tau^{\sigma-1}\left(\frac{\sigma-1}{\sigma}\right)^\sigma + \frac{a}{\tau}\frac{1-\beta\theta}{1-\beta}K/P & : & \tau^2 < \sigma/(\sigma - 1) \\ \frac{1}{\sigma-1}YP^{\sigma-2}\tau^{\sigma-1}\left(\frac{\sigma-1}{\sigma}\right)^\sigma + \frac{a}{\tau}\frac{1-\beta\theta}{1-\beta}K/P & : & \tau^2 \geq \sigma/(\sigma - 1) \end{cases}.$$
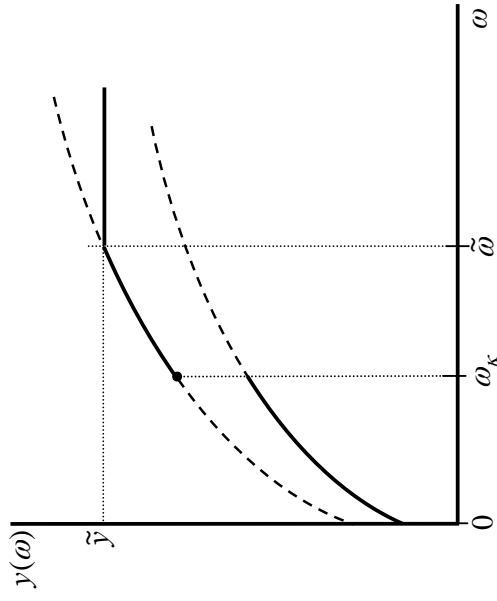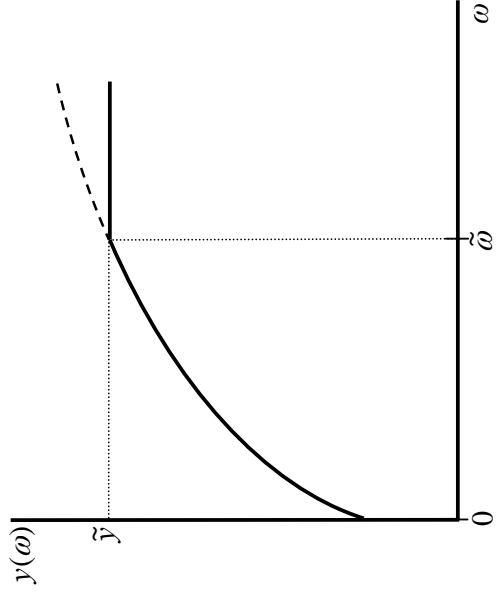
Figures

Figure 1 – Maximum firm output

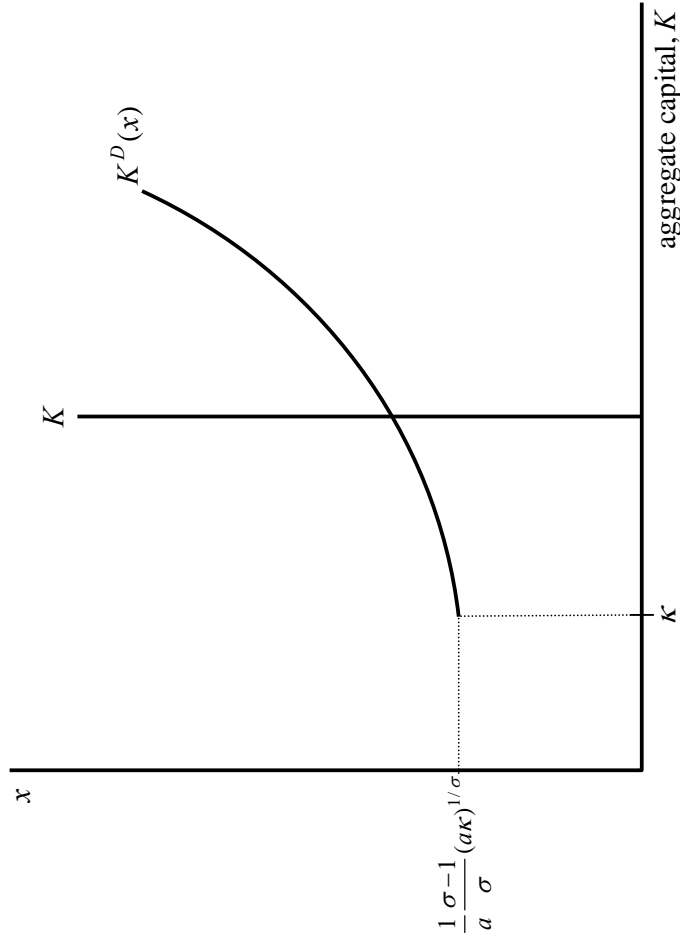**Figure 2** – Equilibrium firm outputs (assuming $\lambda < (\sigma-1)/\sigma$)

a. Some firms use the less productive technology
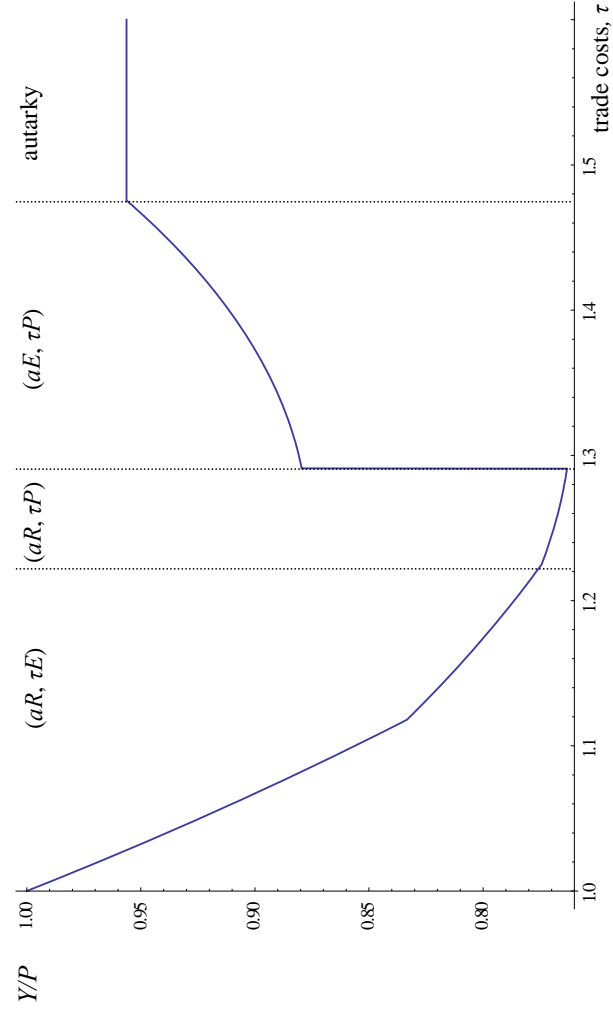

b. All firms use the more productive technology

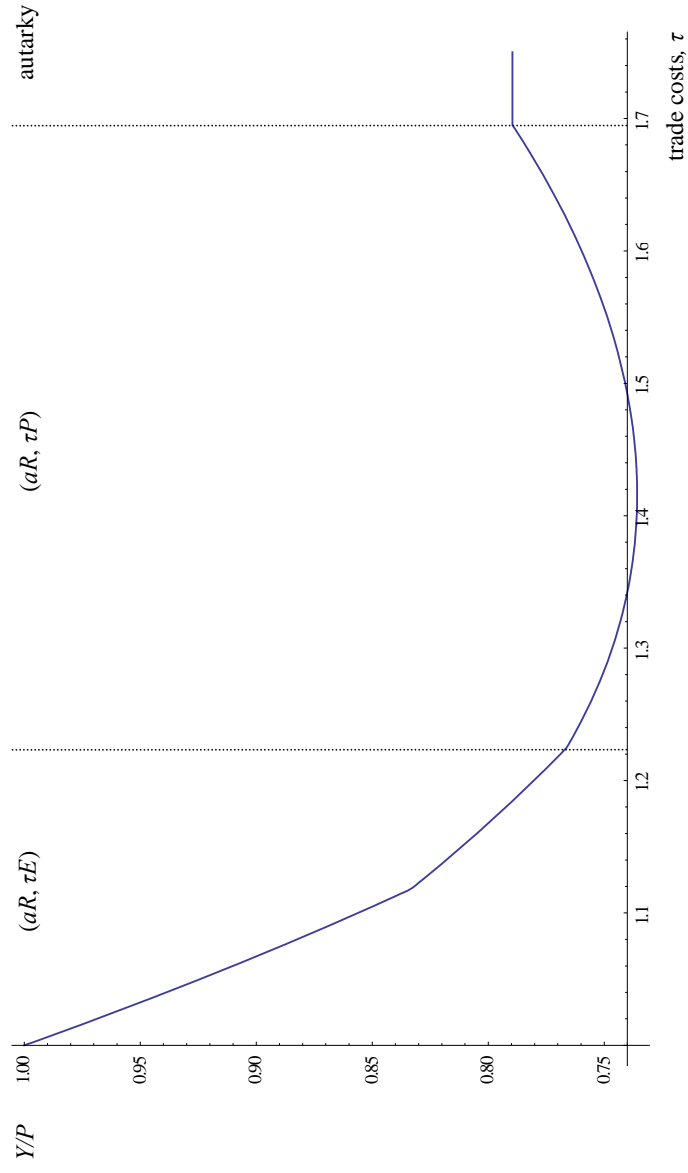*Figure 3* – Aggregate gross capital demand (assuming $\lambda < (\sigma - 1)/\sigma$)

x

$K^D(x)$

K

$\dfrac{1}{a}\dfrac{\sigma-1}{\sigma}(a\kappa)^{1/\sigma}$

κ

aggregate capital, K

Figure 4 – Real output as a function of trade costs ("mild" credit market imperfection)

Parameter values: $K = 1$, $a = 1$, $b = 0.8$, $\beta = 0.8$, $\kappa = 0.6$, $\lambda = 0.2$, $\sigma = 3$, $\theta = 0.4$

Figure 5 – Real output as a function of trade costs ("severe" credit market imperfection)

Parameter values: $K = 1$, $a = 1$, $b = 0.8$, $\beta = 0.8$, $\kappa = 0.6$, $\lambda = 0.1$, $\sigma = 3$, $\theta = 0.4$

Tables

Table 1 – Tariff protection and access to finance

	substantial reduction in tariffs (1)	no substantial reduction in tariffs (2)	substantial reduction in tariffs (3)	no substantial reduction in tariffs (4)
			PANEL A:	
	small firms		medium-sized and large firms	
Share of firms with FIN_CONS= 1 in 2006	0.020	0.138	0.106	0.114
Share of firms with *FIN_CONS* 1 in 2010	0.100	0.124	0.133	0.106
Difference estimator	0.080* (0.095)	-0.014 (0.729)	0.027 (0.541)	-0.008 (0.769)
DiD estimator (country fixed effects included)	0.111^ (0.142)		0.110* (0.059)	
Number of observations	50	145	113	236
			PANEL B:	
	small and medium-sized firms		large firms	
Share of firms with *FIN_CONS* = 1 in 2006	0.083	0.129	0.071	0.1
Share of firms with *FIN_CONS* 1 in 2010	0.132	0.125	0.095	0.057
Difference estimator	0.049 (0.215)	-0.004 (0.904)	0.024 (0.697)	-0.043 (0.350)
DiD estimator (country fixed effects included)	0.135*** (0.003)		0.006 (0.965)	
Number of observations	121	311	42	70

Note: p -values in parentheses; ***, **, *, and ^ denote significance at the 1, 5, 10, and 15% levels, respectively; the p -values are based on t -tests with unequal variances (difference estimator) or robust standard errors (difference-in-difference estimator).