Distortions in the Decision to Export in Developing Countries

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Abstract

In the standard trade literature, more productive firms should export over less productive firms, all else equal. However, we know that developing countries often suffer from market distortions, such as regulations, taxes or subsidies that affect firm behavior. This paper combines distortions into a standard trade model that accords productivity a key role. Under this model, firms facing greater distortions exhibit less of the productivity-based re-allocation that standard models predict. Plant-level data from Colombia are used to provide support for this theory. The policy implication is that reducing domestic distortions is particularly crucial in sectors conducting trade. Further, the fact that these distortions lessen the importance of productivity for plants' profitability also weakens results in the literature that find beneficial effects of trade on productivity, suggesting they may not hold when considering countries or sectors with particularly large market or other distortions. The flip side of this finding is that any estimates of the effects of trade on productivity that were made using data on firms facing significant distortions would understate the productivity gains from trade in less distorted markets.

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1 Introduction

More productive firms are generally believed to export over less productive firms, all else equal. This premise appears in Melitz (2003), Luttmer (2007), and Eaton *et al.* (2009), among others. The intuition is that more productive firms can obtain larger profits and so should be the first firms that choose to export as exporting a particular good becomes profitable. However, although productivity has historically been considered a very important determinant of a firm's choice to export, it has been shown in other fields that distortions can sometimes override the importance of a firm's productivity. Hsieh and Klenow (2009), in particular, showed that the most productive firms in China and India were using relatively little labour and capital due to distortions affecting their profitability. The theory behind this paper integrates this intuition into a Melitz-like model that accords productivity a key role. The model implies that opening to trade does not necessarily have to increase firms' productivity and may in fact decrease it if many distortions are present. Data from Colombia are used to provide support for the model.

To put this paper in the context of the literature, it will be helpful to think of a 2-by-2 matrix, with one dimension being constituted by the categories "distorted" and "not distorted" and the other consisting of the categories "closed" and "open". This matrix is represented in Figure 1. Melitz (2003) focused on the possible productivity gains of moving from the "closed, not distorted" cell to the "open, not distorted" cell; Hsieh and Klenow (2009), from the "closed, distorted" cell to the "closed, not distorted" cell.[1] This paper models the interaction of these two dimensions and hence allows us to consider the ramifications of moving in all the directions illustrated by dashed arrows, completing the matrix.

Yet this paper does more than apply Hsieh and Klenow to exporters. The difference stems from a hypothesized interaction between distortions and openness to trade. In the upper-most part of Figure 2, we see a possible distribution of firms that would export under an open economy, where ϕ represents productivity. Under Melitz, if an economy with these

[1]While Hsieh and Klenow's data were from open economies, the model did not consider trade.

potential exporters opened to trade, these firms, which are on average more productive, would gain market share and push up overall productivity in their sectors. But now consider the case in which there are distortions such that some relatively less productive firms export and some relatively more productive firms do not. The effect of first reducing these distortions is illustrated in the middle part of Figure 2, with the dashed black line representing the distribution of potential exporters under distortions and the solid black line representing the distribution of potential exporters when the distortions are reduced. The mean productivity of potential exporters rises, and so the mean productivity of firms that gain market share also rises. (The overall effect of reducing distortions on productivity gains from opening to trade is ambiguous without further assumptions, however, as it is possible that fewer firms now export.)

It should be noted that in extreme cases, the result from Melitz that opening to trade increases productivity no longer holds. Consider the bottom part of Figure 2. If the firms that export in a particular sector or economy are among those with the worst productivity, then when the country opens to trade overall productivity could actually fall.

We already know that many variables affect the decision to export aside from productivity; for example, firm size, previous export experience, spillovers and other factors have all been shown to matter in a firm's decision to export (*e.g.* Bernard and Jensen, 2004; Aitken, Hanson and Harrison, 1997). Thus, rather than repeat these findings, the empirical component of this paper will mainly focus on testing whether it is in fact true that in sectors in which productivity is less important to exporting, opening to trade results in fewer productivity gains, as the model would predict. We restrict attention to manufacturing sectors in this paper.

The results suggest that productivity gains are mediated by the importance of productivity to selection into exporting. The implication is that trade may not improve productivity in particularly distorted sectors or countries as much as has historically been assumed and, conversely, estimates of the productivity-enhancing effects of trade that are based on more distorted cases may understate the effects of trade on productivity in less distorted sectors or countries. Taking this into consideration would be very important in making policy recommendations. Further, another key policy implication is that reducing distortions could in fact enhance productivity gains from trade.

There is a large literature on trade reforms and on the potential productivity gains from trade. It has long been established that exporters are more efficient in general than non-exporters (*e.g.* Aw and Hwang, 1995; Griliches and Regev, 1995). Clerides *et al.* (1998) and Bernard and Jensen (1999) found evidence that this is largely due to more productive firms selecting into exporting. Faced with heterogeneous results, it was suggested that something other than productivity was really driving selection into exporting in particular cases (*e.g.* Aw *et al.*, 2001; Aw *et al.*, 2000). Indeed, another strand of the literature focused on the effects of firm characteristics and reductions in tariffs and other trade reforms on exporting and the productivity of exporters (Fernandes, 2007; Pavcnik, 2002; Tybout and Westbrook, 1995; Haddad, 1993). However, most of the earlier models of firms' selection into markets - not necessarily export markets - focused on productivity (Ericson and Pakes, 1995; Hopenhayn, 1992; Jovanovic, 1982). More recently, Foster *et al.* (2008) modeled selection in a domestic market to be a function of demand, productivity and factor prices that were producer-specific. This work is the closest, theoretically, to this paper, as factor prices could be hypothesized to vary across firms due to distortions.

For the purposes of this paper, we can consider two definitions of distortions - a general, liberal definition in which distortions are truly anything that determines whether a firm exports aside from productivity, and a more restrictive, conservative one, in which we only consider the subset of often-considered "bad" distortions comprising taxes and subsidies. While most policy work focuses on the latter, to understand and accurately estimate productivity gains I would argue one needs to consider all the factors entering into the decision to export. Thus, while I pay particular attention to taxes in the first part of the empirical section, my broader focus on productivity gains encourages use of the first definition. However, the paper could be read as though the second definition were used, with no modification of the model.

The rest of this paper proceeds as follows. In the next section I build a simple theoretical model extending Melitz (2003) to account for distortions of either type. Later sections describe the data and provide some first evidence supporting the theory. Finally, I conduct robustness checks, before concluding.

2 A Simple Model Integrating Distortions with Melitz

Recall that in the Melitz model consumers have preferences over goods ω given by a CES utility function:

$$U = \left[\int_{\omega \in \Omega} q(\omega)^{\rho} d\omega \right]^{\frac{1}{\rho}}$$

where $q(\omega)$ is the quantity of good ω and ρ is defined by the elasticity of substitution, σ, as $(\sigma - 1)/\sigma$. The aggregate price for aggregate good U is given by:

$$P = \left[\int_{\omega \in \Omega} p(\omega)^{1-\sigma} d\omega \right]^{\frac{1}{1-\sigma}}$$

where $p(\omega)$ is the price of good ω. The optimal consumption of and expenditure on individual goods are then given by:

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

where Q and R are the aggregate consumption and expenditures or revenues, respectively, and $r(\omega)$ is the expenditure on good ω.

In the Melitz model, firms face a fixed cost to production as well as a constant marginal cost. Firms have the same fixed cost f but have different productivity levels ϕ. ϕ is drawn from a distribution $\mu(\phi)$. Given these assumptions, labour is a function of output q as follows: $l = f + \frac{q}{\phi}$. Each firm then faces a demand curve with constant elasticity σ and has the same profit-maximizing markup: $\frac{\sigma}{(\sigma-1)} = \frac{1}{\rho}$. The pricing rule is thus: $p(\phi) = \frac{w}{\rho\phi}$, where w is the wage rate, common across firms, which will be normalized to one.

To add distortions to Melitz, assume that firms face distortions, η, drawn from a distribution $\upsilon(\eta)$ independent from ϕ and that these distortions affect marginal costs so that $l = f + \frac{q}{g(\phi,\eta)}$ where g is a function of ϕ and η. To allow η to be easily interpreted as "negative" distortions such as taxes that only increase costs, assume that whereas ϕ is decreasing in l, η is increasing in l; for example, $g(\phi, \eta) = \phi(1 - \eta)$ would be one possible functional form. Of course, η could also take on negative values to capture distortions favourable to the firm. The mark-up rule now implies $p(\phi, \eta) = \frac{1}{\rho g(\phi,\eta))}$. Profits π are given by $r(\phi, \eta) - l(\phi, \eta) = \frac{r(\phi,\eta)}{\sigma} - f$ where r is firm revenue.

Using the original equation for $r(\omega)$, we can see:

$$r(\phi, \eta) = R\left[\frac{p(\omega)}{P}\right]^{1-\sigma} = R(P(\rho g(\phi, \eta)))^{\sigma-1}$$

and consequently:

$$\pi(\phi, \eta) = \frac{R(P(\rho g(\phi, \eta)))^{\sigma-1}}{\sigma} - f$$

Now if firm 1 and firm 2 have productivity levels ϕ_1 and ϕ_2 and face distortions in their marginal costs η_1 and η_2, their outputs and revenues will differ by:

$$\frac{q(\phi_1,\eta_1)}{q(\phi_2,\eta_2)} = \left[\frac{g(\phi_1,\eta_1)}{g(\phi_2,\eta_2)}\right]^{\sigma}$$
$$\frac{r(\phi_1,\eta_1)}{r(\phi_2,\eta_2)} = \left[\frac{g(\phi_1,\eta_1)}{g(\phi_2,\eta_2)}\right]^{\sigma-1}$$

Given the opposing effects of ϕ and η, this tells us that in addition to the results from Melitz that a more productive firm, with higher ϕ, will be bigger, charge a lower price, and earn higher profits than a less productive firm, we can add the results that a firm that faces larger marginal costs from distortions, with higher η, will be smaller, charge a higher price, and earn lower profits.

We can also derive some results about the effects of trade on productivity under distortions. Melitz shows under his model that there are certain cut-off productivity levels ϕ^*_α and ϕ^* under autarky and under an open economy, respectively, below which firms will choose to exit the market, with $\phi^* > \phi^*_\alpha$. Also, only the firms with productivity levels above some threshold ϕ^*_x enter the export market, with $\phi^*_x > \phi^*$. If we define a new variable $V(\phi,\eta)$ such that it replaces ϕ in Melitz's model in determining firms' profit levels, then following the arguments in Melitz there will be certain cut-off levels V^*_α and V^* under autarky and under an open economy below which firms will choose to exit the market, with $V^* > V^*_\alpha$. Similarly, ϕ^*_x in Melitz is replaced by V^*_x.

Once a country opens to trade in Melitz, a firm's fortune is determined by its productivity. The most productive firms export and increase their market share and profits; some of the less productive firms also export and increase their market share but incur a loss in profits; still less productive firms continue to produce but do not export and lose both market share and profit; the least efficient firms exit the market. In my model, the same delineations apply, but with V rather than ϕ being the determining factor. Since V is a function of both ϕ and η, it is elementary to see that productivity is affected less by opening to trade in my model than in Melitz's. Depending on the distributions $\upsilon(\eta)$ and $\mu(\phi)$, some

$\lambda \geq 0$ fraction of firms with $\phi > \phi^*$ have $V < V^*$ due to a high, positive draw of η but exit the market, and some $\lambda' \geq 0$ fraction of less productive firms with $\phi < \phi^*$ have $V > V^*$ due to a low, negative draw of η and so stay in the market. The same arguments apply to the choice to enter or exit the export market, replacing ϕ^* with ϕ_x^* and V^* with V_x^*.

What if distortions also affect fixed costs so that firms draw both fixed costs f' and η from a distribution $\upsilon(f', \eta)$? This would only further weaken selection on productivity, since some firms with higher ϕ may have been additionally dissuaded from trying to enter by a higher draw of f' and others with lower ϕ may have received a low draw of f' and so chosen to enter. It should be noted, however, that this only affects the decision to enter, since after bearing the cost it is sunk.

The discussion has so far been very general. In the section explaining the empirical strategy, I will add structure, specifying the distortions that will be considered in this paper. First, however, I will briefly describe the data.

3 Data

This paper uses data from the Colombian annual survey of manufactures, the Encuesta Anual Manufacturera (EAM) from the Departamento Administrativo Nacional de Estadistica (DANE). These panel plant-level data cover the 1984-1994 period and include exports and variables that can be used to construct measures of productivity. Plants have been categorized into sectors represented by 4-digit ISIC codes. 14,470 plants appear in the dataset, of which 4,587 export for at least one year over the time period. Unfortunately, we only have price information at the 3-digit ISIC level for 29 sectors, limiting results if we want to adjust for sector-specific price changes. Roberts and Tybout (1997) describe the dataset in more detail.

Individual plant-level domestic taxes can be obtained directly from the data, while sector-level tariff rates are provided by the Departamento Nacional de Planeación (DNP) at the

3-digit level. Labour productivity is used as the main productivity measure, for simplicity, though results are similar using Levinsohn-Petrin. Exchange rates are the nominal effective exchange rates from the IMF, as in Goldberg and Pavcnik (2005).

Distortion measures will be described in detail in the next section, since different measures are used in each part of the empirical analysis.

4 Empirical Strategy

There are two components to the empirical portion of this paper. First, I present some basic results from OLS regressions that are not causal but serve to motivate further examination. Then I use an instrumental variables approach similar to that in Goldberg and Pavcnik (2005). The next sub-sections discuss each component in turn.

4.1 OLS Regressions

To briefly provide some suggestive evidence that the plant's decision to export is affected by market distortions, we consider the case of domestic taxes. A large literature already discusses the dependence of the decision to export on a variety of factors, but since many may be interested in distortions relating to regulations, taxes, and other policy instruments, we take a quick look at one such policy instrument here to help motivate further study.

To this end, I run the following regression, controlling for plant-level fixed effects:

$$E_{ist} = \alpha_2 + \beta_1 P_{ist} + \beta_2 S_{ist} + \sum_j \psi_j X_{jist} + \delta_t + \nu_s + \epsilon_{ist}$$

where i represents the plant, s the sector, t time, E is a binary variable representing whether a plant exports, P represents productivity, S represents domestic tax rates, X is a vector of plant characteristics, δ_t is a time dummy, ν_s is a sector dummy, and ϵ is an error term. As plant characteristics, I include whether a plant exported the previous year, the number of employees as a measure of the size of the plant, and the natural log of output, all often found to be significant in the literature.

Looking at the results in Table 1, domestic taxes do appear to affect the decision to export, though results cannot be interpreted causally. We would then want to know: do distortions like these affect the productivity gains from opening to trade? The next regressions will address this question more generally; in the future, one can also run thse regressions with reference to a more narrowly-defined distortion as in this section.

4.2 Instrumental Variables Estimation

To directly test whether distorted sectors gain less from opening to trade, we would first want a measure of distortion and an episode of opening to trade. We could then regress productivity improvements on the level of distortions, the extent of opening to trade, and the interaction of the two. The interaction term would tell us whether productivity improved less in distorted sectors.

But it is possible that which sectors open to trade under various distortions is determined by factors that directly affect productivity. For example, the government may want to encourage or shelter some low-performing, low-productivity sectors; this could lead it to alter tariffs, but tariffs here would be endogenous to productivity. To guard against this possibility, I instrument for tariff changes as in Goldberg and Pavcnik (2005), where sector-wide tariff changes represent opening to trade and the distortions to be considered in this section will be defined presently.

Colombia substantially opened to trade between 1985 and 1994. This was largely motivated by fluctuations in the exchange rate and by the trade balance, the latter of which was in turn a function of world coffee prices since Colombia was heavily dependent on coffee exports (Roberts and Tybout, 1997). More importantly, Colombia was also entering into the WTO, and as part of the process it set a goal to achieve a tariff rate of 13% across industries (Goldberg and Pavcnik, 2005). This left little room for lobbying, so initial tariff levels provide a very strong predictor of tariff declines. Further, Colombia had not participated in the GATT, so tariffs were initially high. Regressing the decline in tariffs between 1984 and 1994 on initial tariff levels in 1984, we find a coefficient on initial tariff rates of 0.84, significant at the 0.001% level with a t-stat of 44.15 and an R^2 of 0.986, again emphasizing the strong correlation of tariff declines and initial tariff levels.

Following Goldberg and Pavcnik (2005), I interact this sector-specific determinant of tariff changes with one of two other plausibly exogenous sources of variation in tariff changes, these ones varying with time: exchange rates and coffee prices. As mentioned, both exchange rates and coffee prices played an important role in determining the timing of liberalization, and both were clearly outside Colombia's immediate control. I use the interaction of initial tariff levels and exchange rates as an instrument in my main specification and, alternatively, use the interaction of initial tariff rates with coffee prices as a robustness check, since exchange rates provide more predictive power. The alternative instrument involving coffee prices serves as a particularly useful robustness check since one could imagine labour productivity could be correlated with exchange rates.

The general measure of distortions I use in the IV regressions follows naturally from the model. If we consider a world without distortions, such as in Melitz (2003), only the most productive plants would export. Thus, I ask: what percent of exporters in a sector-year are actually in the bottom 25% of plants in that sector-year by productivity? What percent of exporters are even in the bottom 10% by productivity in their respective sectors that year? These percents form my distortion indices. These measures would be misleading if, for example, 90% of plants in a sector exported. However, the mean percent of plants that export in a given sector-year is 19.3%,[2] so the measures seem reasonable, and I also try different threshold cut-offs for robustness. In the end, it will not matter which measure of distortions is used or whether exchange rates or coffee prices are used to form the instrument; the results show the same general conclusion. Again, while these measures capture anything

[2]The 5%-95% range is specified by 4.6% to 40.0%.

that affects the decision to export except productivity, they seem the right measures to use since the productivity gains from trade will depend on the universe of factors affecting the decision to export.

Since I will be interested in the interaction between opening to trade and distortions, I also interact each instrument separately with each distortion index, including this term as a second instrument in the respective regressions. I do this because when one interacts a potentially endogenous variable (tariff changes) with another variable, the resultant interaction term is itself endogenous and needs to be instrumented for. With two potentially endogenous variables, we require two first-stage models, one relating each endogenous variable to the full set of instruments and covariates. Thus, the first stage, in which I regress tariff changes and tariff changes interacted with the measure of distortions on the instruments and covariates, takes the following form:

$$\Delta T_{st} = \alpha_3 + \theta_1 I_{st} + \theta_2 D_{st} + \theta_3 I_{st} \cdot D_{st} + \sum_j \lambda_j X_{jst} + \epsilon_{st}$$

$$\Delta T_{st} \cdot D_{st} = \alpha_4 + \zeta_1 I_{st} + \zeta_2 D_{st} + \zeta_3 I_{st} \cdot D_{st} + \sum_j \iota_j X_{jst} + \epsilon_{st}$$

where ΔT_{st} is the sector-year fall in tariffs between 1984 and 1994; I_{st} is the instrument of initial 1984 tariff level interacted with exchange rates; D_{st} is the distortion index; X_{jst} are controls; and ϵ_{st} is an error term.

The second stage regression is then specified by:

$$\Delta P_{ist} = \alpha_5 + \gamma_1 \Delta T_{st} + \gamma_2 D_{st} + \gamma_3 \Delta T_{st} \cdot D_{st} + \sum_j \xi_j X_{jist} + \epsilon_{ist}$$

where ΔP is a plant's gain in productivity between periods and ΔT and $\Delta T \cdot D$ use predicted values from the first stage, with standard errors adjusted accordingly. This regression is run alternately using plant and industry-level data on the left hand side.

One might be concerned that pre-reform tariff levels, a key determinant of the drops in the tariff rate, might vary by sector in a way that drives results. Thus, as in Goldberg and Pavcnik (2005), I do these estimations in first-differences. The identification assumption is then that after sector-specific effects are purged through first-differencing, pre-reform tariff levels affect changes in productivity only through the effect the initial tariff levels have on annual tariff reductions.

To reduce the effects of measurement error, and because productivity changes might be expected to take some time, I also try using longer differences. Due to the panel already being somewhat short, however, this is limited to two-year differences, using all the even years in the dataset.

Finally, it is important to discuss non-tariff barriers (NTBs), as it is in theory possible that these could have increased to offset the reductions in tariff levels. NTBs are notoriously difficult to track, but Goldberg and Pavcnik (2005) consider information on them for the three years that measures are available (1986, 1988 and 1992) and they find that NTBs decreased, being positively correlated with tariffs, so that it does not seem that they increased to replace tariffs as was the case in the U.S. in the 1980s.

5 Results

5.1 Instrumental Variable Results

Looking at the first stage, Table 2 shows that the relationship between sector-year changes in tariffs and the instrument of initial tariff rates times exchange rates is very strong, as would be expected given Goldberg and Pavcnik's similar finding (2005). A higher value of each distortion index implies a greater distortion, due to the way they were constructed. Including, as a second instrument, the interaction of each of these distortion indices with the first instrument does not appear to overly weaken them, and this instrument proves very predictive of the interaction of the actual fall in tariffs and distortions, whichever measure of distortions is used.

In Table 3 we see that while opening to trade (a fall in tariffs) improves productivity, this effect is smaller in sectors with greater distortions, a piece of evidence directly supporting the model. In particular, to help interpret the magnitudes, the results suggest that for every additional 10% of exporters in the bottom 10% of all plants in the same sector-year, a 1% fall in tariffs raises productivity by 36% less than it would otherwise. The results using the 25% distortion index narrowly did not obtain significance, but they are still suggestive.

The productivity of plants in more distorted sectors also improved by less even independently of tariffs.

When coffee prices are used as part of the instruments rather than exchange rates, the fall in tariffs term is significant at the 5% level in the second stage with a point estimate of 28.71-31.17, but results are otherwise similar. These results, as well as those using distortion measures based on other productivity thresholds, are available upon request.

Overall, the results provide some first suggestive evidence that distortions affect the decision to export substantially and this causes plants' "churning" to depend less on productivity. This means that plants in sectors or countries with particularly high distortions stand to improve their productivity less from trade than would otherwise be expected.

5.2 Robustness Checks

It should be noted that it is possible that some plants appear to be more or less productive than others in their sector simply because they are producing different products, unobserved to us. However, it is not clear how this could have any systematic relationship that would drive results.

Just in case, we try limiting attention to relatively more homogeneous sectors. There are far fewer of these, especially since having adjusted for sector-level prices we are only dealing with a group of broad 3-digit sectors, listed in Table 6. Still, we try this exercise, restricting attention to the sectors comprising: tobacco; leather shoes; lumber, wood and cork products (excluding furniture); paper; industrial chemicals; petroleum refining; petroleum and coal products; rubber products; plastic products; pottery, china and porcelain products; glass products; iron and steel. Results are presented in Tables 4 and 5.

Despite the small sample size, we find our instruments remain reasonably strong. A fall in tariffs raises productivity, more distorted sectors improve their productivity less, independent of the tariff changes, and more distorted sectors also improve their productivity less in response to tariffs falling. Of course, due to the limited number of cases and the remaining heterogeneity within these sectors, we cannot lean too heavily on these results. Still, it is encouraging that when we move towards relatively more homogeneous sectors, results do not weaken.

This analysis will shortly be improved by the obtaining of more disaggregated data at the product level. These data will also allow us to consider price.

6 Conclusions

This paper finds that distortions lead to less productivity-based "churning" of plants through exporting. Taken to the extreme, trade need not enhance productivity and could in fact reduce it.

Evidence from ordinary least squares and instrumental variable regressions was provided in support of the model. While some of the results remain only suggestive, it appears that distortions do play an important role in mediating the effects of opening to trade on productivity gains.

The most direct implication this has is that reducing domestic distortions is particularly crucial in sectors conducting trade if the goal is to achieve productivity gains.

Provocatively, the fact that these distortions lessen the importance of productivity for plants' profitability also weakens results in the literature that find beneficial effects of trade on productivity, suggesting they may not hold when considering countries or sectors with particularly large market or other distortions. The flip side of this finding is that any estimates of the effects of trade on productivity that were made using data on firms facing significant distortions would understate the productivity gains from trade in less distorted markets. While previous work noted some situations under which productivity played a less important role in the decision to export (*e.g.* Aw *et al.*, 2001), this is the first paper to focus on this topic.

While this paper considered the decision to enter or exit the export market, results would presumably be comparable regarding entering or exiting the domestic market.[3] The effects on entry and exit examined here involved distortions η that pushed some firms with productivity above the threshold level required to export under no distortions ($\phi > \phi_x^*$) below the (joint) threshold levels of productivity and distortions required to export, V_x^*, and some firms with $\phi < \phi_x^*$ above V_x^*; obviously, if η generally has these effects that reduce the importance of productivity, it could also push some firms with sufficiently high productivity to produce under no distortions ($\phi > \phi^*$) below the threshold level to produce, V^*, and some firms with $\phi < \phi^*$ above V^*.

Future extensions could examine the effects of more specific distortions. More detailed product as well as price data would also enhance the analysis, and I plan to investigate whether the plant's ownership and structure matters (*e.g.* using the existing data to compare state and various types of private sector entities as well as using the data on management characteristics).

In summary, this paper suggests revisiting the question of how much trade affects the productivity of firms in particular countries and sectors and explicitly taking distortions into account when making these kinds of estimations or basing policy prescriptions upon past experience. Developing countries, in particular, often face relatively large market distortions (Hsieh and Klenow, 2009), and there are certainly substantial differences in these distortions across countries and sectors. Overall, this paper emphasizes that reducing distortions can

[3] I cannot observe the universe of possible plants that elect not to enter the domestic market, which is why I do not study it here. In contrast, while plants could plausibly enter the domestic and export markets simultaneously, or only export, it is likely that not much is lost by assuming that all would-be exporters produced for the domestic market - and hence appear in my sample - before exporting.

be a way for governments to improve their productivity gains from trade, a result with clear policy implications.

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Table 1: Logit Regression on Whether a Plant Exports, Plant Fixed Effects (Odds Ratio)

	(1)	(2)	(3)	(4)
	b/se	b/se	b/se	b/se
Productivity	1.554***	1.644***	1.185*	1.197*
	(0.19)	(0.21)	(0.12)	(0.12)
Domestic Taxes	0.952***	0.952***	0.955***	0.955***
	(0.01)	(0.01)	(0.01)	(0.01)
Exported Last Year	2.200***	2.185***	2.091***	2.089***
	(0.15)	(0.15)	(0.15)	(0.15)
Number of Employees		1.003***		1.001
		(0.00)		(0.00)
Ln Output			3.319***	3.266***
			(0.33)	(0.33)
N	6946	6946	6946	6946

* p<0.10, ** p<0.05, *** p<0.01

Productivity is scaled to run between 0 and 100.

Table 2: First Stage of 2SLS Estimation of the Effects of Distortions on Productivity Gains from Opening to Trade: Initial Tariffs and Exchange Rates Used as Instrument

	10% Index	25% Index
Fall in Tariffs		
Initial Tariff Rate * Exchange Rate	-0.001***	-0.001***
	(0.00)	(0.00)
Year	0.011***	0.011***
	(0.00)	(0.00)
Distortion Index: 10% Threshold	-0.069	
	(0.38)	
Initial Tariff Rate * Exchange Rate * 10% Distortion Index	0.001	
	(0.00)	
Distortion Index: 25% Threshold		0.042
		(0.08)
Initial Tariff Rate * Exchange Rate * 25% Distortion Index		-0.000
		(0.00)
Fall in Tariffs * Distortion Index		
Initial Tariff Rate * Exchange Rate	0.000	0.000**
	(0.00)	(0.00)
Year	0.000*	0.001***
	(0.00)	(0.00)
Distortion Index: 10% Threshold	0.103***	
	(0.04)	
Initial Tariff Rate * Exchange Rate * 10% Distortion Index	-0.001***	
	(0.00)	
Distortion Index: 25% Threshold		0.112***
		(0.02)
Initial Tariff Rate * Exchange Rate * 25% Distortion Index		-0.001***
		(0.00)
Observations	145	145
First Stage F-stat	21.56	14.69

* $p<0.10$, ** $p<0.05$, *** $p<0.01$

Table 3: Second Stage of 2SLS Estimation of Effects of Distortions on Productivity Gains from Opening to Trade: Initial Tariffs and Exchange Rates Used as Instrument

	10% Index	25% Index
Percent Increase in Productivity		
Fall in Tariffs	9.230	10.208
	(10.17)	(10.21)
Year	0.738***	0.743***
	(0.17)	(0.18)
Distortion Index: 10% Threshold	-15.190*	
	(7.93)	
Fall in Tariffs * 10% Distortion Index	-362.648**	
	(162.74)	
Distortion Index: 25% Threshold		-4.647
		(4.08)
Fall in Tariffs * 25% Distortion Index		-72.987
		(48.54)
Observations	145	145

* p<0.10, ** p<0.05, *** p<0.01

Table 4: First Stage of 2SLS Estimation of the Effects of Distortions on Productivity Gains from Opening to Trade: Initial Tariffs and Exchange Rates Used as Instrument, More Homogeneous Sectors

	10% Index
Fall in Tariffs	
Initial Tariff Rate * Exchange Rate	-0.001***
	(0.00)
Distortion Index: 10% Threshold	0.345
	(0.56)
Initial Tariff Rate * Exchange Rate * 10% Distortion Index	-0.005
	(0.00)
Fall in Tariffs * Distortion Index	
Initial Tariff Rate * Exchange Rate	0.000
	(0.00)
Distortion Index: 10% Threshold	0.110**
	(0.04)
Initial Tariff Rate * Exchange Rate * 10% Distortion Index	-0.001***
	(0.00)
Observations	60
First Stage F-stat	10.70

* p<0.10, ** p<0.05, *** p<0.01

Table 5: Second Stage of 2SLS Estimation of Effects of Distortions on Productivity Gains from Opening to Trade: Initial Tariffs and Exchange Rates Used as Instrument, More Homogeneous Sectors

	10% Index
Percent Increase in Productivity	
Fall in Tariffs	54.145***
	(18.09)
Distortion Index: 10% Threshold	-15.323*
	(8.87)
Fall in Tariffs * 10% Distortion Index	-494.336**
	(251.81)
Observations	60

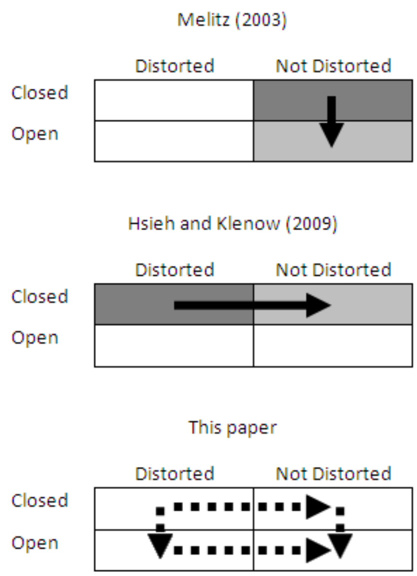
* p<0.10, ** p<0.05, *** p<0.01

Table 6: 3-Digit Classification Categories

Food Products*
Other Food Products
Beverages
Tobacco
Textiles
Clothing and Apparel
Leather Products (excl. Clothing and Shoes)
Leather Shoes
Lumber, Wood and Cork Products (excl. Furniture)
Furniture
Paper
Printing and Publishing
Industrial Chemicals
Other Chemicals
Petroleum Refining
Petroleum and Coal Products
Rubber Products
Plastic Products
Pottery, China and Porcelain Products
Glass Products
Other Products of Non-Metallic Minerals
Iron and Steel
Non-Ferrous Metals
Metal Products (excl. Machinery and Equipment)
Machinery (excl. Electrical Machinery)
Electronic Machinery and Equipment
Transportation Equipment
Professional and Scientific Equipment
Miscellaneous Manufacturing Industries

*Butchering and meat canning; dairy products; vegetable and fruit canning; fish, crustaceans, and other seafood canning; oils, and vegetable and animal fats; grain mil products; bakery products; sugar refining and sugar products; cocoa, chocolate and confectionery products.

Figure 1: Comparison of Models



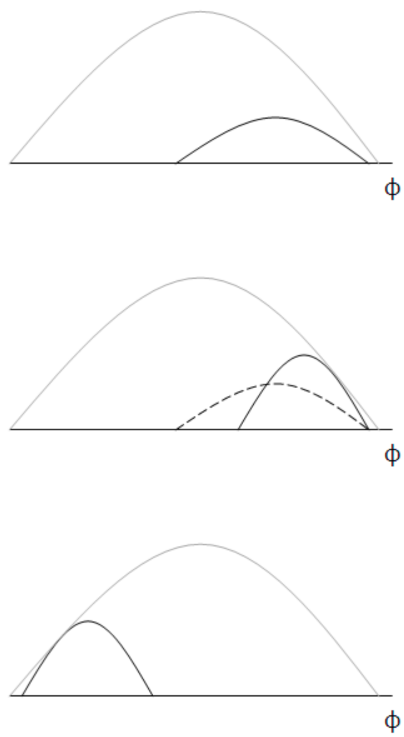


Figure 2: Exporter Productivity Distributions and Associated Gains from Trade
The gray lines in these diagrams represent the overall distribution of firms in the economy. In the upper-most diagram, the black line represents a plausible distribution of firms that would export in an open economy. In the middle diagram, we see that reducing distortions would shift this curve from the dashed black line to the solid black line. In the bottom diagram, the black line represents a possible set of would-be exporters under extreme distortions. If these firms gained market share by an opening to trade, productivity would decrease.