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THE DETERMINANTS OF TRADE STATUS

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ABSTRACT

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Exporting from China: The Determinants of Trade Status

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Abstract

This paper studies the exporting decision of Chinese manufacturing firms. The economic framework stresses the dynamic decision by both state controlled and private entities to export in a model with labor adjustment costs. In this complex environment, a simple decision rule whereby export status depends only on current productivity does not hold. Nor does this rule match data patterns. The estimated model is used to understand the factors that influence export status. The analysis highlights the economic significance of labor adjustment costs in shaping both employment and trade dynamics.

1 Motivation

China is the largest exporting country in the world. In 2019, its exports of goods reached a record high of almost 2.5 trillion U.S. dollars, accounting for 13% of goods exports in the world and around 20% of China's GDP.[1] At the plant level, China's exporters do not fit neatly into the standard patterns documented in the literature. First, although China's exporters are on average relatively larger, they are typically not more productive. Second, ownership plays a prominent role in exporting. Privately controlled firms are more likely to export and those that do sell most of their output in the foreign market. In contrast, state controlled export less frequently and earn a smaller share abroad.

This paper asks: what are the determinants of trade status? A simple and forceful answer is productivity: high productivity firms are exporters, others only sell domestically. But, at least for China, this simple prediction is inconsistent with the data.

Figure 1 shows the distributions of the average (revenue) productivity of labor across manufacturing plants in China, by ownership.[2] The left panel displays the distribution for exporters and non-exporters of state controlled enterprises, hereafter SCE, while the right focuses on privately controlled enterprises, hereafter PCE.

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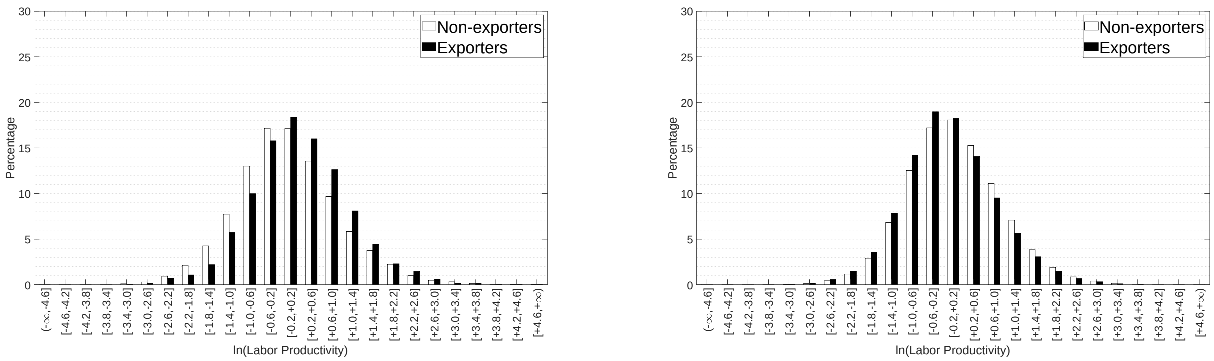
[1]Data are from China trade statistics released by World Bank: `https://wits.worldbank.org/CountryProfile/en/CHN`.

[2]Details of the data underlying this figure are provided in Section 2.



(a) SCE (b) PCE

Figure 1: Distributions of Average Labor Productivity

This figure shows the distributions of productivity, measured as average labor productivity (revenue per worker), for state and private controlled enterprises by export status. Year, industry, and location-fixed effects are removed.

There are three aspects of these figures that motivate our analysis. The first concerns selection into exporting. In static models of selection into trade the distribution of productivity by exporters would lie entirely to the right of that for non-exporters. This is clearly not the case for Chinese plants. In fact, for the PCE the two distributions are nearly indistinct.[3]

The traditional trade literature, building on Melitz (2003), stresses the selection of exporters based upon productivity. The presence of a sunk cost plays a major role. But, for our sample of Chinese manufacturing plants, the selection process is more complex. That is, the evidence is not consistent with the presence of a simple decision rule such as: export if and only productivity exceeds some threshold.

Second, ownership matters. As discussed below in terms of summary statistics, the SCE and PCE samples differ in many dimensions. In Figure 1, exporters are a larger share of productive plants for the SCE while for PCE the opposite is true. As developed further below, there are also significant differences on the intensive margin with many SCE having a low export share while almost 40% of the PCE, who export, have an export share over 95%.

Third, looking at average labor productivity, as in these figures and some of the literature, can be misleading. For many commonly used production functions, in the absence of adjustment frictions, the distribution of the average revenue product of any factor will be degenerate. That is, factor demand will offset underlying productivity differences equating marginal products (and in many specifications the average product) of a factor across producers. This leads us to consider other measures of productivity that do not reflect labor reallocation and, at the same time, to examine the role of labor adjustment costs.

Drawing upon this, the current paper adds two key elements to the standard model. First, there are explicit costs of labor adjustment which, among other things, create a mapping from the distributions of productivity (and other shocks) into the distributions of average revenue productivity.[4] In the presence

[3]Looking at distributions of productivity motivated the work of Bernard, Eaton, Jensen, and Kortum (2003) on US manufacturing plants.

[4]While a common component in firm level studies, factor adjustment costs are notably absent in trade models. Coşar,

of these costs, the sorting of firms into export status by current productivity no longer holds and the distribution of productivity by export status becomes a much richer object for study. Further, these adjustment costs interact with the export decision: firms changing export status will create large variations in employment size.

Second, we consider a rich set of firm level shocks, going beyond TFP shocks to all stochastic demand both in the home market and abroad. This allows us to generate a fraction of relatively small (size) exporters, a large dispersion of export share, and large firms with a relatively low export share, matching some features of the data. Because of the presence of both technology and demand shocks, we focus on plant-specific profitability rather than productivity.[5]

Accordingly, the plant-level optimization problem, specified in Section 3, includes both costs of adjusting labor as well as costs of entering and remaining in export markets. Further, there are shocks to productivity and demand. The choice of labor input as well as export status is a key outcome of the model.

A main finding of the paper is that labor adjustment costs matter. The estimation, through simulated method of moments as discussed in Section 4, allows us to determine the relative importance of the adjustment and export costs as well as the shock processes that best match data moments. The estimation makes clear the role of labor adjustment costs in matching moments, above and beyond the frictions created by standard trade frictions. This is established both by the statistical significance of the estimated adjustment costs and also by an alternative estimation exercise in which the adjustment costs are eliminated. There we see that the fit of the model falls dramatically, both in terms of labor **and** trade moments.

The estimation is enhanced by counterfactuals that eliminate adjustment costs, trading costs and/or sources of demand variation. In this way, we uncover the effects of adjustment and trade costs on trade status by ownership.

In Section 5, the estimated model is used to study our motivating question: what are the determinants of export status? In simulations, removing adjustment costs reduces considerably the overlap in the productivity distributions by export status.[6] Without these costs, the gap between the size (median employment) of exporters and non-exporters increases considerably for both SCE and PCE. In this experiment, the employment weighted fraction of plants who export increases by almost 60 percentage points for the SCE and by 45 percentage points for the PCE.[7] The response of export status to profitability shock increases for both ownership groups.

Demand shocks also contribute to the overlapping productivity distributions since the measured profitability of some plants may be driven by strong domestic demand. Though these plants appear productive and can be large, they are not exporters. As discussed in sub-section 5.2, this seems to be the case with

Guner, and Tybout (2016) is an important exception. The next sub-section contains a literature review and we return to these differences from the literature as the analysis develops.

[5]This follows Cooper and Haltiwanger (2006) and Decker, Haltiwanger, Jarmin, and Miranda (2018).

[6]Going further, if we re-estimate the model without labor adjustment costs, the fit worsens by a factor of 10.

[7]These large changes reflect both the increase in the fraction of plants exporting as well as a change in the size distribution of plants. And this distribution is not consistent with the data, in support of our estimates of the presence of adjustment costs.

the SCE: in the absence of demand shocks the profitability of exporters is almost entirely to the right of the non-exporters. But this is not the case for the PCE.

Moreover, removing the demand shock reduces the average export intensity from 0.21 to 0.03 for the SCE and from 0.66 to 0.16 for the PCE. After removing the demand shock, the whole size distribution of exporters shifts to the right, which significantly reduces the overlap of the size distributions between exporters and non-exporters. As a consequence, the gap between median employment between exporters and non-exporters increases dramatically.[8]

To better understand the effects of ownership, the model is estimated for both state and privately controlled enterprises. A key difference, as in Cooper, Gong, and Yan (2015), is that the SCE are more patient than their private counterparts. Further, the SCE have a higher average foreign demand (relative to average domestic demand) than PCE. For the SCE, the firing costs are significantly larger than hiring costs; for PCE, however, it is the opposite.

Given these estimates we conduct counterfactual experiments, resolving the SCE optimization problem using a subset of PCE parameters. From these experiments, a key to understanding the difference in PCE and SCE outcomes comes from the estimates of the stochastic processes and the curvature of the revenue functions. In particular, if we give the SCE the PCE shock process, determining both technology and demand, then the fit of the SCE model deteriorates. This is due to both changes in the employment adjustment distribution and in the export status choice, reflecting more volatility in the driving processes. Further, the SCE moments are very sensitive to the curvature of the revenue functions, reflecting market power. Other parameter differences, such as discounting, matter to a lesser degree.

Returning to Figure 1, why is there so much overlap in the distribution of average labor productivity by export status? First, we argue that this overlap also is present with other measures of productivity, such as the revenue based measure of profitability. Second, these patterns remain if we study a few key sectors. Third, we find that the presence of labor adjustment costs is instrumental: if these costs are removed then the distribution of profitability for exporters lies largely to the right of that for the non-exporting plants. Fourth, the presence of demand shocks also impacts these distributions. For the SCE, removing the demand shocks also improves sorting. In contrast, removing the sunk cost of exporting is not a main factor influencing these profitability distributions.

Related Literature

Alessandria, Arkolakis, and Ruhl (2020) provides a recent, comprehensive review of dynamic trade models and evidence. Sunk costs play a central role in their analysis, following Melitz (2003). They point out how sorting by productivity may be imperfect in a dynamic setting. The key is that some relative low productivity firms may remain as exporters to avoid having to repay the sunk cost of entry in the future. The magnitude of this effect will depend, *inter alia*, on the magnitude of the fixed cost of production as an exporter and the persistence of shocks. Their Table 2 indicates the persistence of export status. We return to these points below in our discussion of the Chinese data and the properties of our estimated model.

[8]It increase from 405 to 2526 for SCE and from 45 to 137 for PCE.

Clearly our motivation is similar to that of Bernard, Eaton, Jensen, and Kortum (2003), but our approach is quite different. They confront the distribution of average labor productivity with a model of Bertrand competition between firms with heterogeneous productivity. This generates variable markups. They also stress the important observation of the relatively small role of exports in total revenue for most exporters. We study that as well.

The two key elements of our model, the dynamic nature of labor demand and demand as well as productivity shocks, were not present in their framework. Further, they focus on average labor productivity while we go beyond this measure to look at overall profitability at the plant level. As the analysis proceeds, we make clear the role of these model components.

Coşar, Guner, and Tybout (2016) allows for hiring and firing cost and studies the impact of trade policy in Columbia. In that model, the only shock is to productivity and they focus on export status rather than intensity. Selection into exporting is not a point of their analysis.

Ruhl and Willis (2017) study new exporter dynamics. They find that the standard sunk cost models are unable to explain the pattern of initially exporting relatively small amounts and then, conditional on survival, expanding export activity. They introduce a richer demand structure and stochastic entry costs to match these observations. While dynamics are important, that paper does not include adjustment costs, a focus of our model.

Firooz (2020) studies the impact of trade on job turnover in a dynamic search model. Thus that framework too has labor market frictions. The focus of the paper is on the effects of trade liberalization when markups are endogenous.

2 Facts

This section provides an overview of the data used in our analysis. The point of the section is to lay out some basic facts about plants in China and to further motivate our evaluation of the determinants of export status.

The data are from Annual Surveys of Industrial Production, from (2005-2007), conducted by the National Bureau of Statistics (NBS) of China.[9] The data include observations on all public plants as well as private plants with revenue exceeding a cut-off.[10]

Tables 1 summarizes the characteristics of exporters and non-exporters in the public and private sector from our unbalanced panel from 2005-2007. Here a plant is deemed an exporter in a year if its export value is strictly positive in that year. This allows the export status of a plant to vary over time.

Following Cooper, Gong, and Yan (2015) plants are either state controlled enterprises (SCE) or private controlled enterprises (PCE). This classification is based upon the structure of ownership in 2005 through the control of shares variable. Plants whose ownership changed over the sample period are excluded.

For this sample, there are almost 15 times more private than state controlled plants. On average the SCE have almost 4 times as many workers and are also more capital intensive than the PCE. Average

[9]These are plant-level observations as each data entry has a unique physical address. Earlier periods were excluded due to the exchange rate policy change in 2005.

[10]The revenue cut-off is 5 million yuan (about $700,000).

Table 1: Data: Summary Statistics

	SCE			PCE		
	All	Exporters	Nonexporters	all	Exporters	Nonexporters
#plants	14,209	2,586	11,623	206,258	62,047	144,211
va	89,643	194,368	67,703	15,528	18,845	14,097
revenue	278,818	654,456	200,119	54,335	70,006	47,574
employment	629	1,239	501	167	237	137
va/emp	136	146	131	90	77	100
rev/emp	431	513	389	315	284	338

All monetary terms are in 1,000 RMB Yuan, deflated to 1998 level. The sample is trimmed to exclude the upper and lower 2.5% tails by employment size. Firms whose value-added, employment, capital, or revenue were negative are dropped. Value added per worker (va/emp) and revenue per worker (rev.emp) are weighted by plant size.

revenue and average value added per worker are higher for the SCE.

Exporters are a minority: about 18% of the SCE and 30% of the PCE export. For both SCE and PCE, exporters are on average larger in terms of value added, revenue, and employment. For the SCE, exporters are more productive (defined as either revenue or value added per worker) than non-exporters. For PCE, non-exporters are more productive (defined as either revenue or value added per worker) than exporters. Of course, measures of output per unit of factor input are not strictly exogenous so, as noted above, this is not direct evidence about the sorting between exporting and non-exporting plants by productivity. Refinements of these measures and through them an evaluation of the productivity differences by export status is a topic returned to below.

The analysis goes beyond Table 1 to include a set of moments that quantify both trade and employment patterns in more detail. Those moments, presented in Table 4, include the size distribution of exporting and non-exporting plants as well as the export rates and transitions in export status. These moments guide the theory model that we construct. As we shall see, there is evidence of both inaction in changes in employment as well as episodes of large job creation and job destruction, for both ownership groups. Further, though the distributions shown in Figure 1 are not included in the moments that we match, the estimated model will exhibit similar overlap and this becomes a focal point for uncovering the roles of labor adjustment costs and trade frictions. Thus it is essential that the model includes these features.

3 Dynamic Optimization

This section specifies the dynamic optimization problems of producers. It provides the framework for the estimation.

The economy is composed of private and state controlled enterprises. Cooper, Gong, and Yan (2015) argue that SCE decisions are best explained as the solution to a dynamic profit maximization problem. Thus in our analysis, all plants maximize profits though ownership type will influence the parameters.

For the following presentation, the ownership type is suppressed.

At a point in time, the plant is in state $\Omega \equiv (z, A^d, A^f, e_{-1}, x)$ where z is productivity at the plant level, A^d represents a domestic demand shock, A^f is a foreign demand shock, e_{-1} is the stock of workers employed in the previous period and $x \in \{0, 1\}$ is the (inherited) export status of the plant. If $x = 1$ then the plant exported in the previous period. The shocks to productivity and demand, (z, A^d, A^f), are assumed to follow independent AR(1) processes, estimated below.

At the beginning of a period, the plant chooses between three options: selling in the domestic market, selling in both the domestic and foreign markets or exit. The value of the plant in state Ω is given by:

$$V(\Omega) = \max\{V^d(\Omega), V^{df}(\Omega), V^{exit}(\Omega)\}. \tag{1}$$

A continuing plant has two controls: (i) the number of workers to employ in the current period, e, (ii) whether to sell only domestically or in both domestic and foreign markets. The value of a plant that sells only domestically is given by:

$$V^d(\Omega) = \max_e R^d(z, A^d, e) - \Gamma^d - e\omega - C(e_{-1}, e) + \beta E_{\Omega'|\Omega} V(\Omega'). \tag{2}$$

for all Ω. For non-exporters, the revenue function of $R^d(z, A^d, e)$ is from domestic sales only and thus depends only on productivity z and domestic demand, A^d. There is a fixed cost of production Γ^d that serves to induce exit. Labor costs are given by the $e\omega$, where ω is the wage rate.[11] The cost of labor adjustment is given by $C(e_{-1}, e)$ and is described in detail below.

The value of a plant that sells in domestic and foreign markets is given by:

$$V^{df}(\Omega) = \max_{e, s^d, s^f} \sum_{j \in \{d,f\}} R^j(z, A^j, s^j e) - \Gamma^d - \Gamma^f - e\omega - C(e_{-1}, e) - \chi \mathbb{1}(x = 0) + \beta E_{\Omega'|\Omega} V(\Omega') \tag{3}$$

for all Ω, where $j = d, f$ denotes the domestic and foreign markets respectively. Here s^j is the fraction of the workforce e involved in production for market $j = d, f$, with $s^d + s^f = 1$. We do not observe this share in the data.

In (3), χ is a sunk cost associated with entry into export. This is a traditional model component and implies that not all plants will choose to export. There is also an additional fixed operating cost that depends on export status. If, for example, $\Gamma^f > 0$, a plant may elect to exit from exporting but remain active in the domestic market.[12]

In this optimization problem, revenue is the sum of the revenues earned in the two markets. The revenue functions do not have the same curvature: $\alpha^d \neq \alpha^f$. As explained further below, one of the empirical challenges is that we do not directly observe employment by use but rather total employment for each plant.

[11] This is a point where the analysis of private and state controlled plants will differ.

[12] The literature contains models with fixed and/or sunk exporting costs. For example, Ghironi and Melits (2005) introduce a fixed adjustment cost as a type of export cost while Alessandria and Choi (2007) include both a fixed and a sunk cost. Melitz (2003) is a static model so that this distinction does not appear.

The cost of labor adjustment is represented by $C(e_{-1}, e)$.[13] The cost of adjustment function is:

$$C(e_{-1}, e) = F^{+} + \gamma^{+}(e - e_{-1}) + \frac{\nu^{+}}{2}\left(\frac{e - e_{-1}}{e_{-1}}\right)^{2} e_{-1} \tag{4}$$

if there is job creation, $e > e_{-1}$. Similarly

$$C(e_{-1}, e) = F^{-} + \gamma^{-}(e_{-1} - e) + \frac{\nu^{-}}{2}\left(\frac{e - e_{-1}}{e_{-1}}\right)^{2} e_{-1} \tag{5}$$

if there is job destruction, $e < e_{-1}$. If $e = e_{-1}$, so there are no net changes in employment, then $C(e_{-1}, e) \equiv 0$.

There are three types of adjustment costs, with differences allowed for the job creation and job destruction margins. There are quadratic adjustment cost, parameterized by (ν^{+}, ν^{-}), a fixed cost of adjustment is parameterized by (F^{+}, F^{-}) and linear adjustment costs, (γ^{+}, γ^{-}). In all cases, these costs can differ between job creation and destruction. As in Cooper, Gong, and Yan (2015), there may be a threshold for the non-convex adjustment costs.

These adjustment costs are introduced to match key features of the data. It is common to use adjustment costs to match plant-level observations on job creation and destruction. In this study, we highlight the importance of these costs for trade decisions, on both the extensive and intensive margins.

As we shall see, there is an interesting interaction between the discrete decisions regarding export status and employment adjustment. Changes in export status are highly correlated with periods of labor adjustment. Among other things, this makes clear that the cost of labor adjustment itself has an impact on export status and that the cost of exporting (beginning to export) also influences labor demand.

The revenue function depends explicitly on the labor input as other factors of production are assumed to be flexible and are optimally chosen.[14] It is common to assume constant returns to scale and constant elasticity of demand, so the revenue function takes the form:[15]

$$R^{j}(z, A^{j}, s^{j}e) = A^{j}(zs^{j}e)^{\alpha^{j}}. \tag{6}$$

The coefficient α^{j} reflects the factor shares from the production function along with the elasticity of demand. The variable A^{j} represents the demand for that plant's output. Total factor productivity is represented by z and is common to both revenue functions.

It might appear that the choice problem of an exporter can be solved as if there were two independent divisions within the plant. That is, looking at (3), total revenue and total wage bill is just the sum over the two activities. But the problems are interrelated because of the adjustment costs. This will generate a type of substitution across domestic and foreign sales in response to a demand shock in one market because a cheaper source of workers might be through variations in the share, s^{j}, rather than through adjusting the total number of workers.

[13] See Cooper, Gong, and Yan (2015) for a full discussion of labor adjustment costs for Chinese manufacturings.

[14] Cooper, Gong, and Yan (2015) contains an extensive analysis of the interaction between capital and labor adjustment at these Chinese plants.

[15] Appendix section 7.1 provides details.

There is also the prospect of entry and exit by private plants. A private entrant pays a cost κ, denominated in units of labor and multiplied by the wage, ω. By assumption, the entrant begins operation at a low level of employment and a profitability shock determined after entry. The free entry condition is

$$E_{z,A^d,A^f} V(z, A^d, A^f, e_-, 0) = \omega\kappa. \tag{7}$$

The value of entry is sensitive to labor costs.

As for exit, the third option in (1), private plants have an option to discontinue operations. There is no capital owned by the firm and no further claims on the firm upon exit. Hence the value of exit satisfies $V^{exit}(\Omega) = 0$ for all Ω.[16]

There is no entry/exit for the public sector plants. We treat this extensive margin as a policy option rather than the outcome of profit maximizing behavior.

4 Quantitative Analysis

The underlying parameters associated with the revenue function, the shock processes and adjustment costs are estimated using a simulated method of moments approach. That approach solves:

$$\pounds \equiv min_{\Theta}(M^d - M^s(\Theta))W(M^d - M^s(\Theta))'. \tag{8}$$

The vector Θ includes the parameters governing the revenue, labor adjustment costs, exporting costs and the stochastic processes. These were introduced in the model discussion and are summarized below in Table 2.

We first discuss the moments chosen for the estimation and then report results. Keep in mind that there is a sample of state controlled plants as well as a sample of private plants. The parameters are estimated separately allowing, as in Cooper, Gong, and Yan (2015), for differences in adjustment costs, exporting costs and discount factors by ownership.

4.1 Moments

The moments were selected in part for their inherent relevance for the discussion of the interaction between labor dynamics and export status and for their ability to identify key parameters. The parameter estimates are useful as inputs into subsequent policy analysis.[17]

The moments, described in Table 3 and given as the rows labeled "Data" in Table 4, are split into three groups. The first set are those that characterize labor dynamics at the plant-level. These includes the serial correlation in log employment (sc), job destruction and creation rates in excess of 30% (*JD30,JC30*) and the rate of hiring inaction (*Inact*). These moments are critical for determining the labor adjustment costs. In particular, the serial correlation in employment is influenced by the quadratic adjustment costs, while the inaction and large adjustments reflect the fixed and piecewise linear costs. These moments are

[16] In a model including exit costs, the fit did not improve.

[17] This is discussed in the conclusion.

Table 2: Parameters

Parameter	Description
Estimated: Common	
ν^+, ν^-	Quadratic adjustment costs of hiring and firing
F^+, F^-	Fixed costs of hiring and firing
γ^+, γ^-	Linear costs of hiring and firing
β	Discount factor
ω	Wage
ρ_z	Serial correlation of productivity shock
σ_z	Standard deviation of productivity shock innovation
α^d	Curvature of revenue from domestic sales
ρ_d	Serial correlation of domestic demand shock
σ_d	Standard deviation of domestic demand shock Innovation
Γ^d	Overhead cost of domestic production
Estimated: Exporters	
χ	Cost of becoming an exporter
SC^f	Mean foreign demand
α^f	Curvature of revenue from foreign sales
ρ_f	Serial correlation of foreign demand
σ_f	Standard Deviation of foreign demand shock innovation
Γ^f	Overhead cost of foreign production

size weighted. The average and median size of both exporting and non-exporting plans, labeled "emp (mean)" and "emp p(50)" are included as well.

For the private plants, we include endogenous exit in the model and thus a moment to capture the exit rate. This moment helps to pin down the overhead cost, Γ^d.

The second set of moments relate to the revenue functions. These include the curvature of the domestic and foreign revenue functions as well as the stochastic processes for the profitability shock, that combines demand and productivity shocks.[18] To compute these moments, OLS estimates of the curvature of the revenue function are obtained, for both exporting and non-exporting plants. Note that the data reports total employment for each plant, not employment to produce goods for domestic sales and exports separately. So we are estimating the curvature of the revenue for the exporting and non-exporting plants, not from the two sources of sales. These coefficients are denoted $\tilde{\alpha}^d$ and $\tilde{\alpha}^{df}$ respectively.

From these OLS estimates, the parameters for the stochastic process of the residuals from the revenue functions are obtained. These residuals are termed **profitability shocks** throughout the rest of this analysis. They include all sources of variation, both productivity and demand. From an AR(1) representation of these shocks we obtain the serial correlation and standard deviation of the innovation,

[18]See the discussion in Appendix 7.1.2 on the revenue function of an exporter and the calculation of profitability shocks.

Table 3: Moments

Moment	Description
Common	
sc	Serial correlation
JC30	Job Creation in excess of 30%
Inact	Inaction rate
JD30	Job Destruction in excess of 30%
xrate	Exit Rate (PCE only)
emp (p50)	Median employment
emp (mean)	Mean employment
Exporters	
$\tilde{\alpha}^{df}$	Curvature of revenue function
$\tilde{\rho}^{df}$	Serial correlation of profitability shock
$\tilde{\sigma}^{df}$	Standard deviation of profitability innovation
ep2nep	Export to non-export (plant fraction)
fox	Size-weighted fraction of exporters
ex int	Average share of revenue from exporting (size weighted)
small ex	Size-weighted fraction of small-exporters (less than 5% revenue from exports)
Non-Exporters	
$\tilde{\alpha}^{d}$	Curvature of revenue function
$\tilde{\rho}^{d}$	Serial correlation of profitability shock
$\tilde{\sigma}^{d}$	Standard deviation of profitability innovation
nep2ep	Non-export to export (plant fraction)

$(\tilde{\rho}^j, \tilde{\sigma}^j)$ for $j \in \{d, df\}$. These are treated as **moments** in the estimation of the underlying curvature of the revenue functions and stochastic processes.

To be clear, these curvature estimates are **not** estimates of the curvature parameters in (6) for two distinct reasons. First, the revenue functions in (6) pertain to sources of revenue, domestic and foreign sales, and not the type of plant, exporter vs non-exporter. Second, these are OLS estimates without any controls for bias due to omitted variables. The structural estimation resolves both of these issues and allows us to estimate the curvature parameters for the two revenue functions in (6).

The final set of moments relate to trade patterns and pertain mostly to exporting firms. First, there is the size weighted fraction of exporters, "foe". Conditional on exporting, there is a moment that captures the share of revenue from exporting, "ex int" as well as one that studies the size weighted fraction of small exporters, i.e. those with less than 5% of total revenue from exporting, "small ex". This returns to a point made in Bernard, Eaton, Jensen, and Kortum (2003). Finally, there are two moments to capture transitions between the states of exporting and non-exporting. The moment "ex2nex" is the fraction of (size weighted) plants that were exporters in the previous period that stopped exporting in the current period. The flows from non-export to export, "nex2ex" is included as well.

Though it is convenient to summarize the moments by these blocks, they are completely interdependent. The parameters that underlie the revenue function will impact trade decisions. The adjustment costs that underlie the labor dynamics will impact the trade decisions as well as the OLS estimates of the revenue function. This latter effect is interesting as the adjustment costs influence the responsive of labor to profitability shocks and thus the omitted variable bias in the OLS estimates.

Table 4 provides plant-level moments by export status and ownership type. There are numerous notable differences across these plants.

First, looking at the SCE, exporters have less inaction in employment adjustment than non-exporters. Second, the exporters have slightly less action in the upper tail of job destruction. Most importantly, the median employment of exporters is about 2.7 times the median employment of non-exporters. Transition rates out of exporting are quite high: about 10% of employment in plants that trade are lost each year. Almost 34% of the workers are in plants that earn revenue from sales abroad. Revenue from exporting is about 19% though 35% of the exporters are small, earning less than 5% of their revenue from exports. Also, the OLS estimate of the curvature of the revenue function is higher for exporters.

For the PCE, again exporters are less likely to be inactive. They are again larger than non-exporters. The transition rate out of exporting is also nearly 10%. The fraction of workers at plants that export is higher than the SCE at nearly 43%. For those that export, revenues from abroad are nearly 65%. Less than 8% of the plants are small exporters. The OLS estimated revenue curvature is again larger for the exporters.

Comparing the SCE and PCE plants, a couple of differences are apparent. First, the SCE are larger overall and the size difference between exporters and non-exporters is much larger. Second, the employment inaction is actually larger for PCE compared to SCE. On the trade side, the PCE are more likely to export, rely more on export revenue and there are relatively few small exporters among the PCE.

As noted, the data sample is trimmed. Thus in the calculation of the simulated moments in (8), the simulated data is trimmed as well. In particular, we simulate the real survey's selection process to drop firms whose sales below a threshold.[19]

4.2 Parameters

There are a total of 20 parameters. Some are estimated independent of export status. These include the discount factor, β, the labor adjustment costs $(\nu^+, \nu^-, F^+, F^-, \gamma^+, \gamma^-)$ and the costs of labor, ω. These adjustment costs allow for differences between hiring, denoted with a $+$, and firing, denoted with a $-$.[20] There is also a fixed cost of operating, Γ^d.

[19] This entails the following steps: (i) first calculate the ratio of 5 million RMB (the cutoff) to the median sales (around 20 million RMB), (ii) in the model simulation, we search for the threshold to set the ratio of the threshold to the median sales of the above-the-threshold sample be equal to the data counterpart, and (iii) we drop the firms whose sales below the threshold.

[20] As discussed in Cooper, Gong, and Yan (2015), the fixed cost of labor adjustment did not apply until job creation and destruction rates exceeded 5%, 10% for SCE job destruction. This allows another non-linearity to the problem and captures some institutional features. The inaction is then partly created by the piece-wise linear adjustment costs.

For all plants, there are productivity shocks, z, as well as domestic and foreign demand shocks, A^d and A^f respectively. Each of the three shocks follows an $AR(1)$ process parameterized by the standard deviation of the innovation, σ^j and a serial correlation, ρ^j for $j = d, f, z$. As it is not possible to distinguish the means of domestic demand and productivity, the product of these means is normalized to one. The parameters include SC^f which is the mean of the foreign demand process, relative to the product of mean productivity and mean domestic demand.

For exporters, there is a cost, χ, of switching to export status. There is also an additional fixed cost of selling in foreign markets, Γ^f. These costs are introduced to generate sorting into and exit from exporting, respectively.

4.3 Estimation Results

The moments and parameter estimates are given in Tables 4 and 5. The discussion of these results is broken into state controlled and privately controlled enterprises. In addition, we present results by sector.

4.3.1 Estimates for Manufacturing

These estimates are used in the subsequent section exploring the determinants of export status. In particular, that discussion will return to the motivating evidence on productivity distributions.

Table 4: Moments

							SCE								
Exporters	Moments	sc	JC30	Inact	JD30	xrate	$\tilde{\alpha}^{df}$	$\tilde{\rho}^{df}$	$\tilde{\sigma}^{df}$	emp (p50)	emp (mean)	ep2nep	fox	ex int	small ex
	DATA	0.871	0.086	0.154	0.032	-	0.955	0.937	0.964	690.993	1237.994	0.101	0.338	0.190	0.351
	Model	0.985	0.084	0.183	0.032	-	1.060	0.769	0.774	605.360	1465.009	0.094	0.341	0.210	0.386
Non-Exporters	Moments	sc	JC30	Inact	JD30	xrate	$\tilde{\alpha}^{d}$	$\tilde{\rho}^{d}$	$\tilde{\sigma}^{d}$	emp (p50)	emp (mean)	nep2ep			
	DATA	0.873	0.085	0.228	0.043	-	0.793	0.916	1.063	255.052	499.606	0.033			
	Model	0.989	0.065	0.183	0.043	-	1.250	0.795	0.893	200.427	475.962	0.035			
Stat. Value:	4319.754														
							PCE								
Exporters	Moments	sc	JC30	Inact	JD30	xrate	$\tilde{\alpha}^{df}$	$\tilde{\rho}^{df}$	$\tilde{\sigma}^{df}$	emp (p50)	emp (mean)	ep2nep	fox	ex int	small ex
	DATA	0.886	0.172	0.295	0.055	0.042	0.748	0.900	0.885	157.863	237.361	0.095	0.428	0.647	0.079
	Model	0.975	0.105	0.364	0.066	0.057	0.730	0.694	0.762	130.290	225.190	0.098	0.394	0.660	0.085
Non-Exporters	Moments	sc	JC30	Inact	JD30	xrate	$\tilde{\alpha}^{d}$	$\tilde{\rho}^{d}$	$\tilde{\sigma}^{d}$	emp (p50)	emp (mean)	nep2ep			
	DATA	0.862	0.171	0.353	0.060	0.062	0.683	0.845	0.901	85.969	136.571	0.060			
	Model	0.973	0.121	0.354	0.071	0.078	0.669	0.715	0.819	85.333	146.368	0.061			
Stat. Value:	32755.941														

Table 3 defines these moments.

Adjustment and Trade Costs As noted earlier, one of the key ingredients of the model are labor adjustment and export costs. These are reported in Table 5 and are summarized in Table 6 relative to the mean of (simulated) revenue to facilitate interpretation and comparison across plant types.

In models of dynamic factor demand, there is naturally a dependence of the distribution of, say, job creation (destruction) rates on the underlying costs of labor adjustment. But, once exporting is introducing there is an additional non-convexity stemming from the export decision that also impacts job creation and destruction. Even in the absence of labor adjustment costs, a new exporter might choose to expand operation leading to a burst in job creation.[21]

The fixed costs of hiring and firing are substantial for the SCE, reaching almost 25%. The costs are both lower for the PCE and asymmetric, with firing costs larger than hiring costs. The linear labor adjustment costs, reported in Table 5, indicate substantial firing costs for SCE and larger hiring costs for the PCE. With a low discount factor and correlated shocks, such as that for the PCE, the effects of firing costs on hiring decisions are relatively small.

[21] That said, from the evidence presented in Ruhl and Willis (2017), understanding new exporter dynamics in China is of independent interest.

Table 5: Parameter Estimates

	Γ^f	χ	SC^f	ν^+	ν^-	F^+	F^-	γ^+	γ^-	β	w	ρ^z	σ^z	α^d	ρ^d	σ^d	α^f	ρ^f	σ^f	Γ^d
SCE																				
	5.118	25.189	0.634	0.854	2.179	41.364	43.207	0.093	0.238	0.948	0.177	0.838	1.424	0.724	0.935	0.319	0.652	0.882	0.769	-
	(0.700)	(3.540)	(0.044)	(0.139)	(0.080)	(9.990)	(12.630)	(0.031)	(0.053)	(0.010)	(0.001)	(0.003)	(0.019)	(0.002)	(0.002)	(0.014)	(0.005)	(0.016)	(0.034)	-
PCE																				
	2.893	13.872	0.412	3.418	0.012	3.798	7.123	0.458	0.005	0.905	0.228	0.931	0.907	0.639	0.815	1.181	0.688	0.815	1.411	31.991
	(0.088)	(0.422)	(0.013)	(0.055)	(0.007)	(0.284)	(0.677)	(0.014)	(0.001)	(0.004)	(0.004)	(0.004)	(0.035)	(0.007)	(0.004)	(0.008)	(0.003)	(0.008)	(0.013)	(0.654)

Standard errors are shown below the parameter estimates.

For both types of plants, the sunk cost of exporting is about 15% of revenue. The fixed cost of continuing to export is about 3% and this contributes to the serial correlation in export status.[22]

Over 6% of the PCE exit each period. This is driven, in part, by the overhead production cost of nearly 12%. Of course, the exit decision is also impacted by the persistence of both demand and productivity shocks as well as the discount rate.

Table 6: Costs relative to the average revenue

	Γ^f	χ	F^+	F^-	Γ^d
SCE	0.0275	0.1356	0.2227	0.2326	-
PCE	0.0335	0.1604	0.0439	0.0824	0.1189

Average revenue is calculated from simulation.

Note that the relatively larger fixed adjustment costs for SCE do not directly translate into more inaction and more episodes of large adjustment in the moments reported in Table 4.[23] This reflects the fact that employment adjustment depends on more than just the direct cost of adjusting the number of workers. Among other things, employment adjustment is heavily influenced by the discount factor: a higher β, as with the SCE, implies that the investment dimension of employment adjustment matters more and thus, all else the same, there is less inaction. Further, as discussed below, the change of trade status has a large impact on employment growth. So, for example, a plant that chooses to become an exporter will pay a cost to do so and at the same time engage in large employment growth. In this case, the frequency of this will depend on the size of the entry cost into exporting.

At various stages of the discussion that follows, the role of labor adjustment costs on export status will be emphasized. In addition to that discussion and the point estimates (with standard errors) reported in Table 5, there is an alternative way to see the significance of adjustment costs: set them all to zero.

Appendix sub-section 7.4.1 presents simulation results, eliminating first the sunk cost and then the labor adjustment costs. Setting the sunk cost to zero leads to a deterioration of the fit by about 11.5%. Removing the sunk cost has a large effect on the size of exporters and on the flows between exporting and non-exporting states, but relatively little impact on the employment moments.

Removing labor adjustment costs, in contrast, leads to a dramatic worsening of the fit. Not only are the labor moments no longer matched but the trade moments are also very far off. In particular, eliminating the labor adjustment costs increases the fraction of exporters from 34% to 93% for the SCE and from 39% to nearly 86% for the PCE. Further the size of exporters is considerably larger for both ownership groups.

[22] Using Colombian data, Ruhl and Willis (2017) estimate the sunk cost at one year's median sales in a standard sunk cost model and 59% of one year's median sales in the extended model (including the new exporter dynamics). If we use median sales as reference, the sunk cost is 84% for SCE and 50% for PCE. In Ruhl and Willis (2017), the estimated fixed cost is around 4.7% (for the sunk cost model) and 5.7% (for the extended model) of one year's median sales. In our estimation, using median sales as reference, the estimated fixed cost is 17% for SCE and 10% for PCE.

[23] See Cooper, Gong, and Yan (2015) for a related discussion for the model estimated without an export choice.

Of course, the large effect of removing the labor adjustment costs might reflect the fact that the sunk costs were not re-estimated. The results from re-estimation of the model under that restriction is reported in Appendix sub-section 7.4.2. A key finding there is that the model fit deteriorates by a factor of 10 for both SCE and PCE. The model without labor adjustment costs surely is unable to match key features of the employment distribution, such as the inaction and bursts of job creation and destruction. But importantly, the re-estimated model also fails to capture the flows between export status.

Shocks The estimation uncovers the underlying stochastic processes for domestic and foreign demand and productivity. All of the shocks are estimated to be quite persistent, with serial correlations in excess of 0.8 for both demand and productivity shocks. The persistence influences adjustment and export decisions: the more persistent are the shocks, the more responsive will be export and labor demand choices.

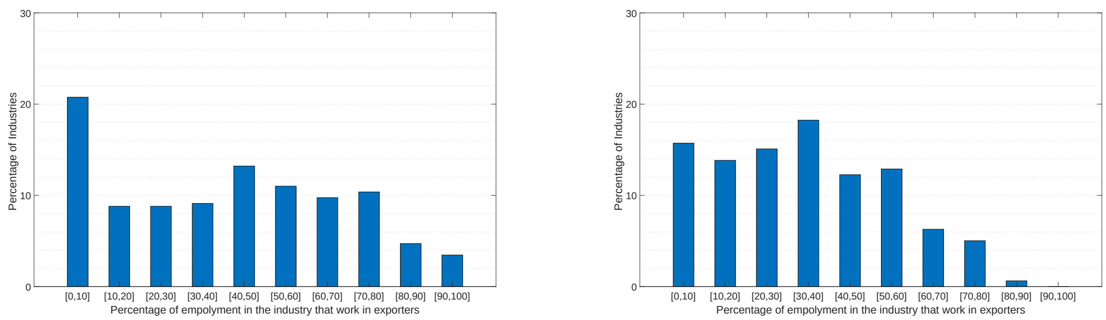
Further, there is volatility in all dimensions. That is, it is not the case that most of the fluctuations are driven, for example, by productivity shocks or one source of demand variation alone. For the SCE, the largest sources of variation is productivity. For the PCE, domestic demand is much more volatile than it is for the SCE and, for the SCE who export, foreign demand is most volatile. As we explore the factors that determine the distributions of profitability, the relative importance of technology compared to demand shocks, both domestic and foreign, will be key.

Note that by construction the productivity and two demand shocks are independent. But, as discussed earlier, the analysis uncovers profitability shocks to exporters and non-exporters. The productivity shock, z, is common to both of these profitability shocks, thus inducing correlation between them.

Curvature The estimated curvatures for demand, (α^d, α^f) in Table 5, are all less than 1, indicative of market power.[24] Interestingly, the estimated curvature for the PCE is much lower in domestic markets, reflecting more intense competition in export markets. The opposite is true for the SCE.

Again, these are the curvatures of revenues from domestic sales and exports, while the moments, such as $\tilde{\alpha}^{df}$, come from OLS estimates of the total revenue from a plant selling in both domestic and foreign markets. Though these are not directly comparable, the OLS estimates certainly play a role in identifying the structural parameters, (α^d, α^f).

Ownership The parameter estimates are reported by ownership type. As in Cooper, Gong, and Yan (2015), there are two key differences. First, the discount factor for the SCE is higher than that for the PCE, perhaps indicative of frictions in capital markets. Second, as documented in Table 6, labor adjustment costs, particularly the fixed costs and the linear firing costs, are larger for public than private plants.[25]



(a) SCE (b) PCE

Figure 2: Export Intensity by Industry

This figure shows the distribution of the fraction of workers employed in plants that export across industries by ownership.

4.3.2 Sectoral Results

The results presented thus far are for all of manufacturing. There are composition effects that could drive the findings on export and adjustment costs that arise along a couple of dimensions. First, sectors may differ by the extent of SCE presence. Second, sectors may differ by the fraction of firms, independent of ownership type, who export. These differences may also lead to sector-specific parameter estimates.

Sectoral Distributions Figure 2 presents evidence on exporting across sectors by ownership. Specifically, it looks at the fraction of workers employed at exporting plants across industries by ownership. For the SCE, in nearly 40% of the sectors more than half the workers are employed in plants that export. This is almost the same magnitude,(about 35%), for the PCE. For the SCE, but not the PCE, there are almost 10% of the industries with over 80% of the workers employed in exporting plants. This is indicative of the relatively large size of these exporting plants. That is, while there are only a small fraction of sectors with a large number of exporting plants, these plants account for a much larger fraction of workers.

It is important to note that these tables remove industries with fewer than 5 plants. Also, the figure includes sectors in which both the PCE and the SCE operate.[26]

Sectoral Estimation Tables 23 and 24 in Appendix 7.5 present parameter estimates and moments for three leading sectors: apparel, electronics and steel. The industry estimation results are consistent with the baseline estimation.

First, the estimate of β is larger for the SCE.[27] Second, adjustment costs are present in both industries and for both ownership groups. Again the fixed costs are large for the SCE. The linear firing costs are relatively large for the SCE while hiring costs dominate for the PCE. One interesting difference with the

[24]This holds under the assumption of CRS production.

[25]See Tables 11 and 12, and the surrounding discussion, in Cooper, Gong, and Yan (2015).

[26]There are 318 industries with overlapping operation. The figures are quite similar if we include sectors with overlap in operation.

[27]The standard errors are larger due to smaller sample sizes.

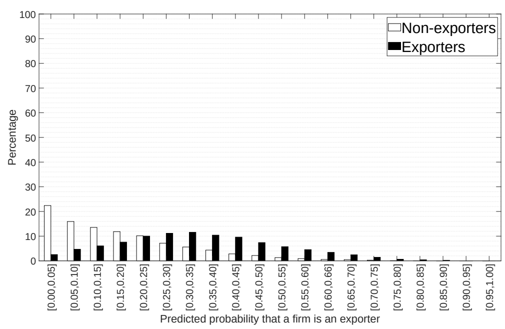
baseline, highlighted in Table 25 is that the PCE also face large fixed hiring costs in these 3 industries.

Table 25 shows the costs of adjustment, relative to mean revenue, for these industries by ownership. It is noteworthy that the fixed cost of firing is very large for the SCE compared to the PCE. This is offset a little by the larger fixed costs of hiring for the PCE.

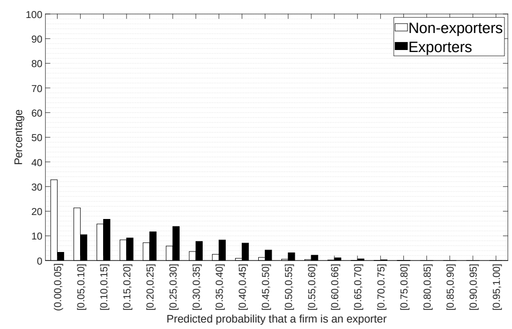
Productivity Distributions Figure 14, in the Appendix, shows the distributions of average labor productivity across export status by sector for the two ownership groups. Clearly, as in Figure 1, there is considerable overlap in these productivity distributions. The overlap though is sector specific. In the SCE producing steel, the exporters are clearly more productive while there is an exception in the PCE apparel. In short, the overlap in these distributions in Figure 1 is not reflecting composition effects.

4.4 Mismatch

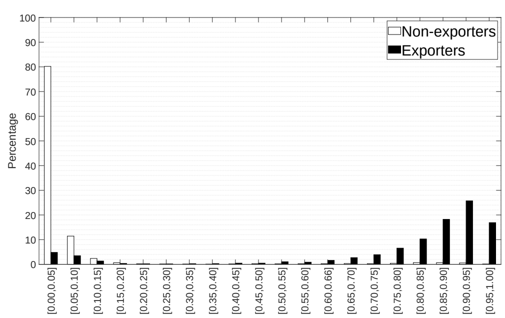
This sub-section looks at export status from the perspective of mismatch. This approach provides a quantitative method for evaluating mismatch and thus complements the visual impressions of overlapping distributions. It is traditional in the education literature, for example, to look at predictions of education relative to attainment as a basis for classifying individuals as either under- or overmatched in education.[28] Here that tool is extended to evaluate the dynamics of export status, rather than a one time choice about education.



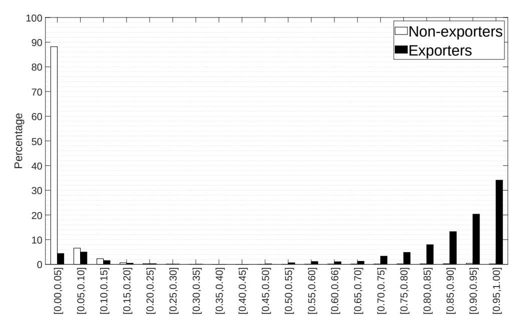
(a) DATA: $ln(\tilde{A})$



(b) Model: $ln(\tilde{A})$



(c) DATA: $ln(\tilde{A}), ln(emp_{-1}), ex_{-1}$



(d) Model: $ln(\tilde{A}), ln(emp_{-1}), ex_{-1}$

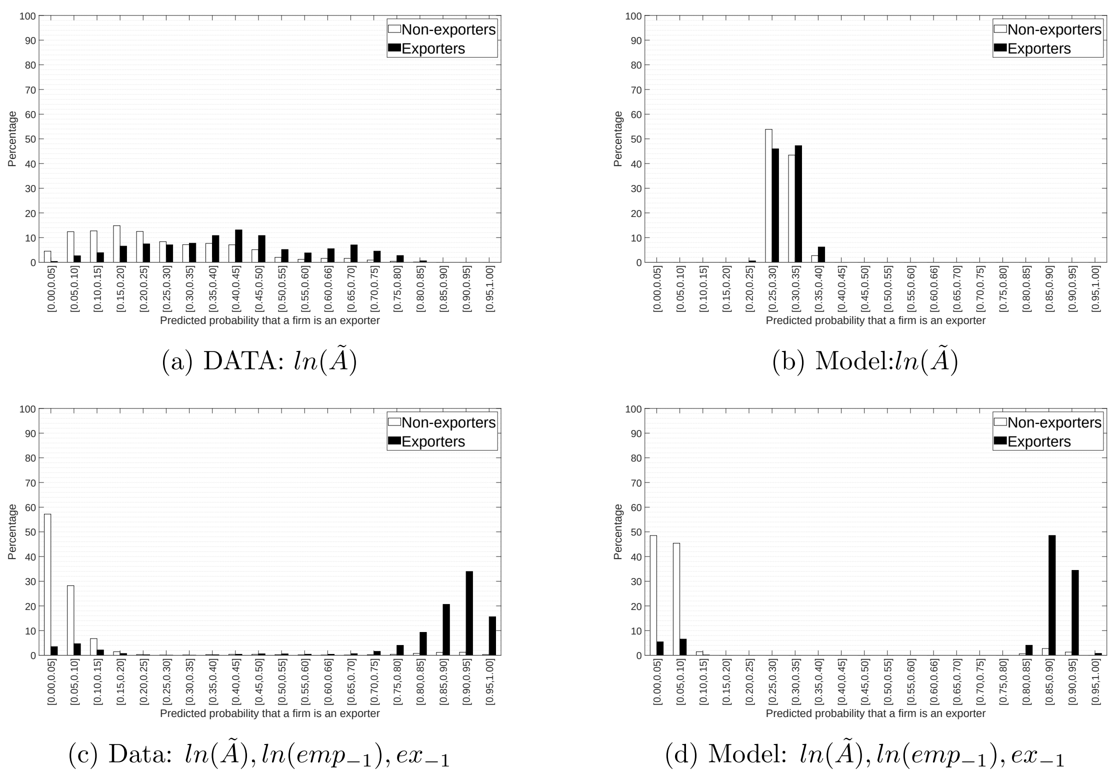
Figure 3: SCE: distribution of predicted probability of exporting, by realized export status

[28] See Cooper and Liu (2019) and references therein for applications of this approach to educational choice.

For this exercise we estimate, by ownership type, a probit model of the probability of being an exporter in two specifications. The first contains profitability, denoted $ln(\tilde{A})$, as a key regressor. The second adds the lag of log employment to capture size, $ln(emp_{-1})$, and previous export status, ex_{-1}. In both cases, time, location, and industry are included.

Figures 3 and 4 show the distributions of these predicted probabilities for these specifications, from the data and the model, by ownership status. For both SCEs and PCEs, the sorting is much better once the specification conditions on size and lagged export status as well as current profitability. That is, conditioning on profitability alone does not discriminate across plants by export status. Though in the SCE case, there is clearly a large fraction of non-exporting plants in the data who were predicted not to export

For the SCE, the model prediction is quite close to that of the data. This is not the case for the PCE: only in the case with all the regressors does the model match the data. Conditioning on profitability alone, there is not much distinction across plants in the estimated model.



(a) DATA: $ln(\tilde{A})$

(b) Model:$ln(\tilde{A})$

(c) Data: $ln(\tilde{A}), ln(emp_{-1}), ex_{-1}$

(d) Model: $ln(\tilde{A}), ln(emp_{-1}), ex_{-1}$

Figure 4: PCE: distribution of predicted probability of exporting, by realized export status

Using these predicted probabilities, a plant is categorized as: (i) undermatched, (ii) overmatched or (iii) well matched. An undermatched plant is a non-exporter with a predicted probability of exporting that exceeds the 80th percentile of exporting plants. Similarly, an overmatched plant is an exporter with a predicted probability of exporting that is below the 20th percentile of non-exporting plants. The remaining plants are well matched.

The cut-offs at the 20th and 80 percentiles are somewhat arbitrary and similar calculations can be made with other critical values. The point though it to isolate exporters (non-exporters) with a relatively low probability of being in that status, given the reference group. This measure has an important property: if there is perfect sorting, then there is no mismatch.

Table 7 summarizes the findings. The top block reports two sets of estimates from the data, both with and then without industry and time controls. The bottom block come from the model. For each, there are results by ownership.

Comparing the data results, in the case without controls there is considerably more mismatch, particularly for the PCE. Evidently this reflects differences across industries that impact export status and thus create mismatch. The discussion that follows focuses on the first data panel which are the estimates with controls.[29]

To understand the entries, consider the column labeled. "undermatch" for the SCE block. These are all plants that had a sufficiently high probability of exporting but were non-exporters. The probability of their exporting depends, of course, on the empirical model used to make that prediction. The rows correspond to the set of regressors using in the probit estimation described above. So, for example, in the data with the estimation using only profitability as a control about 3.4% of the SCE were undermatched: i.e. they were predicted to be exporters but were not. This figure drops to nearly zero once the full set of controls is used. Thus given profitability, lagged employment and lagged export status, in the data there is almost no SCE export mismatch. For the SCE, the model picks up the pattern and the magnitudes.

Note the difference in the SCE and PCE panels. There is considerably more mismatch for the PCE, particularly in the model, but also in the data. For the PCE, there are a lot of plants exporting that based on profitability alone, are predicted to be non-exporters.[30] The model predicts more mismatch than in the data, but this is resolved once the full set of regressors is used.

[29]Figures 3 and 4 were produced from the regressions with controls as well.

[30]This can be traced to the large positive adjustment costs for the PCE.

Table 7: Exporter Mismatch

	SCE			PCE	
	undermatch	overmatch		undermatch	overmatch
			Data: with controls		
$ln(\tilde{A})$	3.9%	2.0%		4.4%	3.8%
$ln(\tilde{A}), ln(emp_{-1}), ex_{-1}$	0.2%	0.4%		0.4%	0.9%
			Data: without controls		
$ln(\tilde{A})$	7.2%	5.0%		18.3%	18.6%
$ln(\tilde{A}), ln(emp_{-1}), ex_{-1}$	0.2%	0.5%		0.6%	1.3%
			Model		
$ln(\tilde{A})$	3.4%	1.3%		21.1%	25.2%
$ln(\tilde{A}), ln(emp_{-1}), ex_{-1}$	0.1%	0.0%		0.5%	0.6%

This table shows exporter mismatch, both in the data and in the model, by ownership status. The rows correspond to different sets of regressors. Here $ln(\tilde{A})$ is the log of current profitability, $ln(emp_{-1})$ is the log of lagged employment and ex_{-1} is lagged export status. The data results are presented with and without controls for industry and time effects.

4.5 Identification

There are 19 (20) parameters characterizing the SCE (PCE) plants and 23 moments for each type of plant. The large number of parameters and moments is needed to capture the production choices of plants. Yet this coupled with the highly nonlinear model makes a direct discussion of identification impossible: there is surely no one-to-one mapping between moments and parameters.

There are a couple of ways to think through identification. First, Tables 17 and 18 in Appendix 7.3 shows the elasticities of the moments with respect to the parameters at the baseline estimates by ownership. The response of moments to parameters are a key ingredient in the calculation of the standard errors.

Looking at key parameters, we see:

- an increase in fixed trade cost, Γ^f will decrease the fraction of plants transition from non-exporting to exporting, $nex2ex$, and increase the flow out of exporting, $ex2nex$;
- an increase in the sunk cost, χ, decreases both $nex2ex$ and $ex2nex$;
- an increase the mean of foreign demand, SC^f will increase the frequency of exporting, fox, and the flows into and out of export status;
- an increase the quadratic adjustment costs, ν^+, ν^- impacts the frequency of large employment adjustment;
- an increase in the linear adjustment costs, γ^+, γ^- will increase the inaction rate and impact the large job creation and destruction rates, $JC30, JD30$.

- almost all the moments are sensitive the changes in β.

Second, the estimation exercise itself uses multiple starting values. In this way, local minima of the objective are avoided.

Finally, and perhaps more importantly for the economics of the estimation, large changes in a couple of key parameters are studied to make clear how moments and the fit change in response. Appendix sub-section 7.4.1 shows these exercises with regards to adjustment and trade costs. Related findings are highlighted below in our discussion of the factors determining export status.

5 Determinants of Export Status

This section returns to a main question of the paper to study some of the key implications of the estimated model for the determination of export status. The focus is on the relevance of size, productivity and ownership for the decision to become an exporter.

The analysis, such as the regressions and distributions that follow, contain additional moments that could have been included formally in the moment matching exercise. Instead, our approach is to take the structural parameter estimates as given and explore the implications of the model off of its domain.

Throughout this discussion, the dependence of choices on profitability are highlighted. For this, profitability must be measured in both the actual and simulated data. Profitability in period is calculated in a model consistent fashion. Given the estimated curvatures for the revenue function, from Table 5, for non-exporters, the profitability measure is the difference between log(revenue) and the product of the estimated curvature and log(employment). For exporters, this residual takes into account the share of employment in domestic and foreign production.[31]

The presentation highlights the interaction between: (i) productivity, (ii) size and the (iii) distribution of export share. Though the focus on these outcomes is not unique to this paper, the framework is quite different with its emphasis on dynamics and the role of adjustment costs.

5.1 Who are the exporters?

We initially address this question through a (linear) regression on both the actual and simulated data to provide an overview of the determinants of export status. We then take these findings apart by focusing on the distributions of plant size and productivity.

Table 8 presents regression results explaining export status for both SCE and PCE.[32] Throughout the dependent variable is export status of plant i in period t.[33] The independent variables include lagged export status as well as measures of size (lagged log of employment) and the period t innovation to revenue based profitability, described above, as well as industry, time and location controls.[34]

[31] This is reviewed in Appendix 7.1.

[32] Appendix 7.6 contains more results using alternative specifications and measures of productivity.

[33] The regression structure is similar to that used in the literature on responsiveness, as in Decker, Haltiwanger, Jarmin, and Miranda (2018).

[34] The innovation for plant i in period t, $\varepsilon_{i,t}$ comes from: $ln(\tilde{A}_{i,t}) = \mu + \rho ln(\tilde{A}_{i,t-1}) + \varepsilon_{i,t}$, where $\tilde{A}_{i,t}$ is (revenue-based) profitability. The parameters μ, ρ are part of the structural estimation.

Table 8: Determinants of Export Status

	SCE		PCE	
	DATA	MODEL	DATA	MODEL
ex_{-1}	0.791	0.854	0.788	0.836
	(0.004)	(0.001)	(0.001)	(0.001)
$ln(emp_{-1})$	0.032	0.010	0.032	0.006
	(0.002)	(0.000)	(0.001)	(0.000)
ε	0.018	0.061	0.006	0.038
	(0.004)	(0.000)	(0.001)	(0.001)
N	24915	NA	360076	NA

For each plant, ex_{-1} is lagged export status, $ln(emp_{-1})$ is the log of lagged employment and ε is the innovation to the log of current profitability. Other regressors were year, industry and location. The dependent variable is export status of a plant in the current period.

For all the specifications, being an exporter in the previous period makes it more likely a plant will be an exporter in the current period. The magnitude of these effects is about the same regardless of ownership status. It is larger in the model than in the data.[35] The dynamic reflects both the labor adjustment and the trade costs.

Size, as measured by lagged (log) employment, matters. Regardless of ownership type, larger plants are more likely to be exporters. These effects are larger in the data than in the model.

Finally, plants with higher levels of productivity, measured by current innovation, are more likely to be exporters. The innovations are presumably orthogonal to lagged employment and thus provide more direct evidence of the effects of profitability on export status. The response of export status to the profitability innovation differs by ownership, with the SCE export status being more responsive to profitability shocks than the PCE.[36]

[35]Alessandria, Arkolakis, and Ruhl (2020) report similar regressions with coefficients on the lagged status of about 0.6 for Columbia.

[36]Here this is the innovation to profitability, not its level. As shown in Appendix 7.6, the response of export status to current profitability is about the same as the response to the innovation.

Table 9: Export Status: Experiments

	SCE		PCE	
	No AC	No Sunk Costs	No AC	No Sunk Costs
ex_{-1}	0.753	0.708	0.715	0.681
$ln(emp_{-1})$	0.008	0.020	0.004	0.014
ε	0.110	0.123	0.089	0.068

These estimates are based upon simulations for both PCE and SCE, eliminating adjustment and sunk trading costs. For each plant, ex_{-1} is lagged export status, $ln(emp_{-1})$ is the log of lagged employment and ε is the innovation to the log of current profitability. For the PCE, the results of the experiment are not trimmed by size.

Both the larger coefficient from the simulated compared to actual data, on lagged export and innovation can be traced to the estimates of the adjustment as well as the fixed and sunk costs of exporting. In the experiments shown in Table 9, we study how the coefficients of these responsiveness regressions depend on trade and adjustment costs. In the case of "No AC", we set all adjustment costs to zero. In the case of "No Sunk Costs", we set $\chi = 0$.[37]

Here we see that for the SCE eliminating the labor adjustment costs reduces the serial correlation in export status and increases the responsiveness to a profitability innovation. The same changes in coefficients arise when the sunk costs are set to zero.

For the PCE, the main effect of eliminating the adjustment costs is the increased responsiveness to the profitability innovation. The correlation in export status is actually a bit lower in this case. But, eliminating the sunk cost has no effect on the responsiveness of export status to the innovation.

As a final experiment, in the model we can decompose the innovation to profitability into three innovations: (i) productivity, (ii) domestic demand and (iii) foreign demand. The estimates for a linear regression with export status as the dependent variable are shown in Table 10. The response of export status to lagged status and size remains unchanged. But clearly the response of export status depends on the innovations in a different way depending on their source. Clearly a shock to domestic demand reduces the likelihood of exporting since a seller can substitute away from exporting to domestic operations and thus avoid labor adjustment costs.[38] The opposite is true when there is a shock to foreign demand. In this case the SCE response is a bit larger than the PCE response. The response to domestic demand shocks is about the same. The response to a productivity shock is positive for both ownership types but smaller than the response to demand shocks since the productivity impacts all markets. These responses reflect both the persistent effects of these shocks as well as the adjustment and trade costs.

[37] As noted earlier, the sample of PCE is trimmed to match the criteria for inclusion in the data. But, for these experiments, we do not impose that trimming in the comparative statics exercise in order to see the full effect of these changes.

[38] This reflects the non-separability in the domestic and foreign operations noted earlier.

Table 10: Decomposing Effects of Innovations on Export Status

	SCE	PCE
ex_{-1}	0.853	0.818
$ln(emp_{-1})$	0.010	0.005
productivity	0.032	0.047
domestic demand	-0.061	-0.060
foreign demand	0.138	0.119

NOTE: These estimates are based upon simulations for both PCE and SCE, decomposing the innovation to profitability into three sources. The PCE results are for the untrimmed panel.

5.2 Profitability

This sub-section returns to one of the main themes of the trade literature: sorting into exporting by some measure of productivity. Clearly, profitability, reflecting both productivity and product demand, matters in the export decision. More profitable plants, either measured as the current level of profitability or as an innovation, are more likely to export. Yet, as indicated by the figures that motivate our analysis, a simple cut-off rule linking export status to profitability does not hold in the data. This sub-section looks into more detail about the distribution of productivity by export and ownership status.

Figure 1 uses average labor productivity as a measure of productivity. While easy to measure, the distribution of average labor productivity reflects both the underlying shocks to demand and technology as well as adjustment costs.

In this sub-section, following our model, the focus is on a measure of profitability, containing both technology and demand shocks, as this summarizes the return to employment and exporting. This measure is obtained from direct analysis of the revenue function using our parameter estimates.[39]

With this alternative measure of profitability, the evidence is again not supportive of the simple theory of sorting. In particular, the distributions of productivity by trade status overlap considerably. For the PCE, the distributions of productivity for exporters and non-exporters are almost indistinguishable in the data. The model's predictions are consistent with these findings.

Our results are presented initially for all firms and then by isolating new exporters. The latter exercise allows us to see whether the lack of sorting by productivity is associated with the dynamics of being an exporter or is also present for new exporters.

5.2.1 All Plants

To substantiate this finding, Table 11 provides summary statistics and Figure 5 presents the profitability distributions from actual and simulated data by ownership type. Within each figure, the distribution by export status is provided.

From Table 11, the mean and median profitability of exporters exceeds that of non-exporters in the data. This is true for both ownership classes, but the difference is more pronounced for the SCE.

[39] See the discussion in Appendix sub-section 7.1.3.

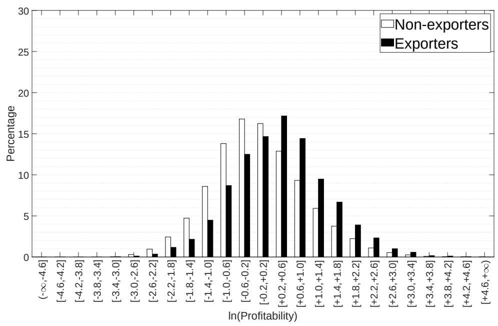
Table 11: Summary Statistics: Profitability

	SCE							
	Non-exporters				Exporters			
	Mean	Median	SD	Skewness	Mean	Median	SD	Skewness
DATA	-0.080	-0.146	1.012	0.341	0.353	0.342	1.018	0.172
BASE	-0.154	-0.142	1.054	0.010	0.915	0.967	0.869	-0.118
	PCE (Trimmed)							
	Non-exporters				Exporters			
	Mean	Median	SD	Skewness	Mean	Median	SD	Skewness
DATA	-0.012	-0.065	0.871	0.289	0.031	-0.028	0.877	0.331
BASE	-0.022	-0.104	0.821	0.186	0.053	-0.066	0.769	0.285

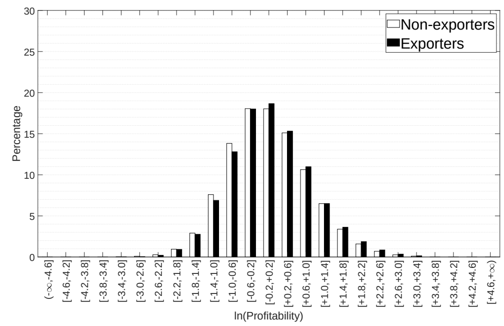
The model certainly captures these patterns. Actually, these differences are exaggerated in the model compared to the data. Further, the model understates the dispersion in profitability by exporters.

The summary table misses a key point about selection: is there complete (or nearly complete) sorting by profitability? From the figures, this is not the case as there is a noticeable overlap in the distributions of profitability. The figures do indicate some selection as the distribution of exporters is shifted to the right for the SCE. For the PCE there is almost no evidence of selection at all as the profitability distributions essentially coincide. The difference in the mean levels of profitability (exporters minus non-exporters) is only 0.0683.

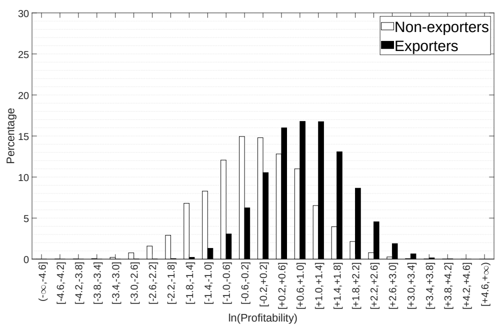
It should be understood that, though not targeted, the model reproduces these features of the data. It generates selection for the SCE. The difference in the mean profitability of exporters and non-exporters is almost twice that in the data. But the PCE distributions are very close.



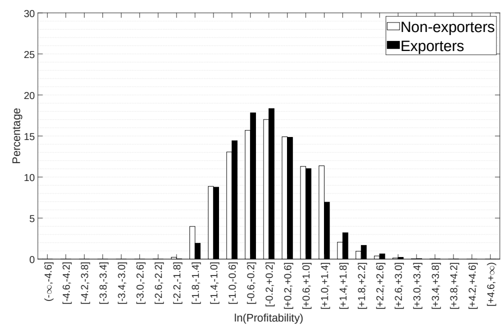
(a) SCE (DATA)



(b) PCE (DATA)



(c) SCE (Model)



(d) PCE (Model)

Figure 5: Revenue Based Profitability

This figure shows the distributions of a revenue based measure of profitability, by ownership and export status, in the model and the data.

It is interesting to explore a more common measure of productivity, the average revenue product of labor, both in the data and from the model. Note that this measure reflects exogenous variability in productivity as well as the power of adjustment frictions.

As shown in Figure 1, if profitability is measured as the log of revenue per worker, the data distributions are actually very similar to those shown in Figure 5. These distributions are not degenerate and there is more selection for the SCE. This is indicative of adjustment costs: if labor was flexible *ex post*, then the distribution of the average revenue product of labor would be degenerate given our specification.

These two measures of plant-level profitability are highly correlated: the correlation is 0.937 in the data and 0.890 in the model. This statistic is revealing: more productive plants ought to be larger to order to drive their average revenue product down and smaller plants are too large. This reallocation does not take place instantly.

This misallocation has been the topic of numerous studies since Hsieh and Klenow (2009). Here it is noteworthy that the misallocation is present regardless of trade status. From Table 15, the standard deviation of the average revenue product of labor is about the same for exporters and for non-exporters.

The following figures reflect counterfactual exercises intended to illustrate the importance of adjustment costs and demand shocks on the profitability distributions. The left side of the figures assumes no adjustment costs and the right side eliminates demand shocks.[40]

[40]To be clear, the experiment without adjustment costs are produced by model simulation setting **all** adjustment costs to

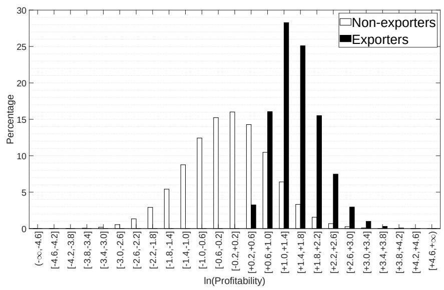
For the SCE, eliminating labor adjustment costs or the demand shocks, improves the sorting by revenue-based productivity. This is seen in the left column of Figure 6. The adjustment costs impact selection since a plant with high productivity but few workers, cannot quickly expand and start to export. And, a plant with high profitability due to high domestic demand will not necessarily choose to export.

For the PCE as well, without adjustment costs, sorting is much closer to the basic theory with little overlap in the productivity distribution by export status.[41] The sorting is not as clear in the absence of demand shocks though again the exporters are surely among the highest plants in terms of profitability.

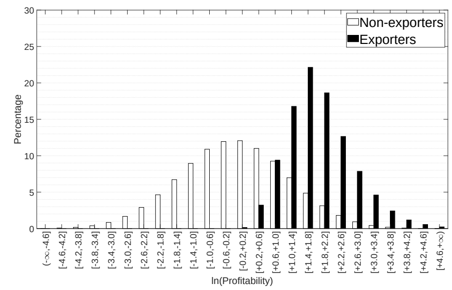
Another perspective in that Figure 6 makes clear the importance of labor adjustment costs for the sorting of plants by profitability. For the results without adjustment costs, the sorting is much closer to the static prediction than alternatives, even though here there are both sunk and fixed costs associated with exporting.

zero. In all experiments, the other parameters remain at their estimated values.

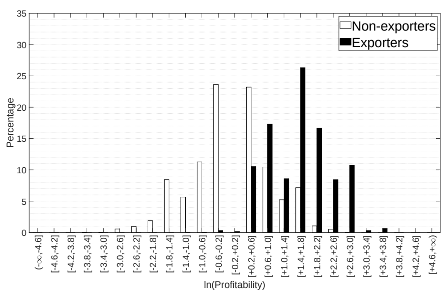
[41] This figure is for the untrimmed sample, where firms with sales below the threshold are not dropped to more fully illustrate the effects of the comparative static exercise.



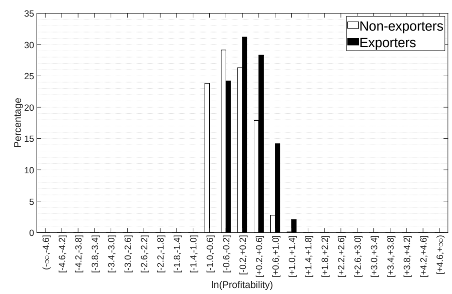
(a) SCE: no adjustment costs



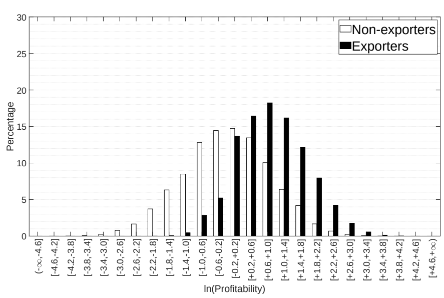
(b) PCE: no adjustment costs



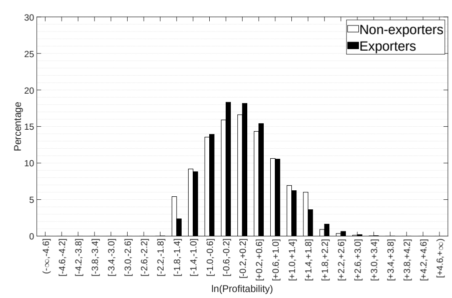
(c) SCE: no demand shocks



(d) PCE: no demand shocks



(e) SCE: no sunk cost



(f) PCE: no sunk cost

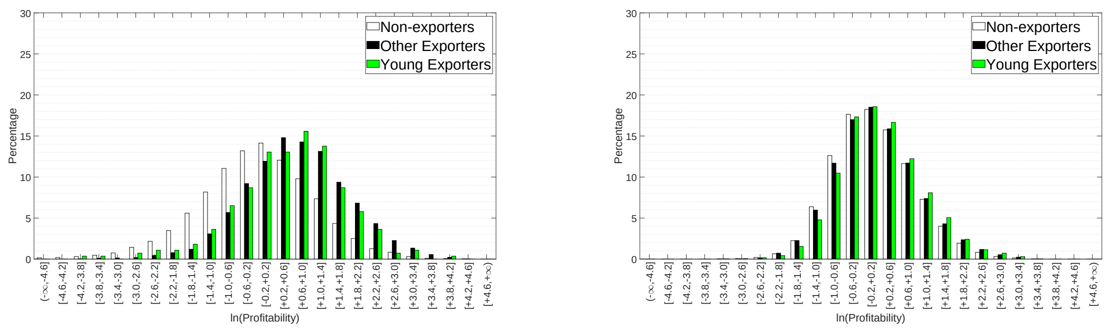
Figure 6: Revenue-Based Profitability Distribution: Experiments
This figure shows the distributions of a revenue based measure of profitability, by ownership and export status, in the model under two experiments. One removes labor adjustment costs and the other removes demand shocks.

From the bottom row of Figure 6, we see the effects of removing the sunk costs on these profitability distributions. Removing the sunk costs results in almost no change the overlap in both cases. If anything, the overlap in the profitability distributions is even larger for PCEs.

5.2.2 Young Exporters

The analysis now focuses on new exporters. Unlike Ruhl and Willis (2017) where the attention was on exporter dynamics, here the objective is to see if sorting by profitability differ for new exporters than existing plants. This is the case in dynamic models with sunk costs and only productivity shocks: the entrants into exporting are sorted by productivity. Some existing exporters may have relatively low productivity but chose to remain as exporters.

To study this, we isolate plants that currently export but were not exporters in the previous two years. We term these "young exporters". Figure 7 shows the distributions of profitability by ownership. It is indeed the case that there is more sorting on profitability for the young exporters. But this effect is quite small, regardless of ownership type.



(a) SCE DATA: Profitability

(b) PCE DATA: Profitability

Figure 7: Distribution of Profitability

5.3 Size

The profit regressions, both in the actual and simulated data made clear that lagged employment impacts export status. Here we study the size distribution of plants by export status. Of course, size is not exogenous but instead reflects the interaction of the shocks to profitability and adjustment costs.

Table 12 shows the mean and median of plant size by export status and ownership. From the data, exporters are larger, both in terms of mean and median employment. This is true for both SCE and PCE. Further, in the data the mean is about twice the size of the median.

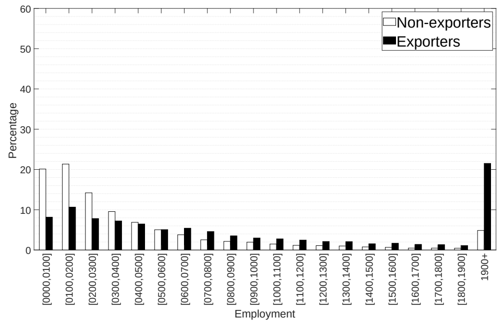
The model produces a non-degenerate size distribution because of the interaction between shocks to productivity and demand(s) as well as adjustment costs. The employment distribution, of course, reflects the endogenous response, governed by the estimated parameters for adjustment and exporting costs in the model, to the profitability shocks.

The model reproduces many of the data patterns. In particular, the mean and median employment levels are well matched as these moments were targeted in the estimation. But the standard deviation and skewness, which were not targeted are also well matched.

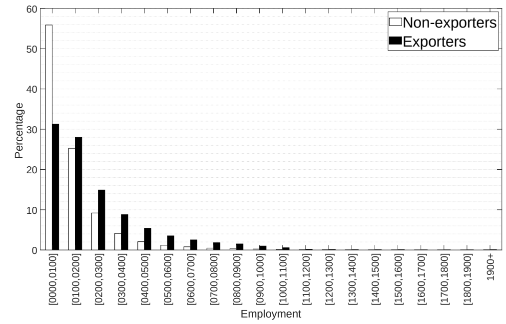
Figure 8 presents the distributions of employment in both the data and model by ownership and export status. For both ownership types, the smaller firms tend to be non-exporters and the larger ones are exporters. Yet, for SCE there are large non-exporters in the data, and this feature is reproduced by the model. As in the profitability distributions, there is no sorting by size: there are large non-exporting plants and relatively small exporters.

To better understand the lack of selection by size, the model can be used to produce two counterfactuals, shown in Figure 9. The first assumes there are no adjustment costs and the second assumes there are only productivity shocks driving variations in profitability.

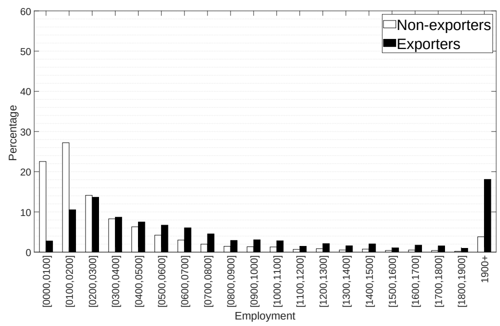
The top left panel of Figure 9 illustrates the predicted distribution of employment for the SCE if



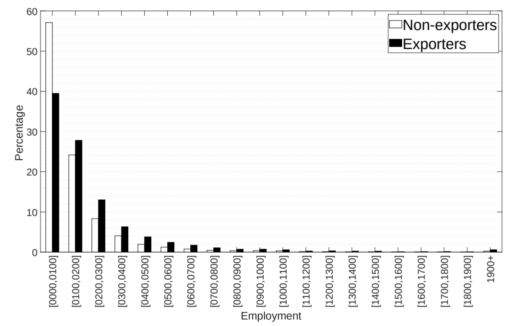
(a) SCE (Data)



(b) PCE (Data)



(c) SCE (Model)



(d) PCE (Model)

Figure 8: Employment Distributions

This figures shows employment distributions by ownership and export status, both in the data and in the model.

there are no labor adjustment costs. Here we see selection at work. Almost all of the small firms are non-exporters and also all of the large firms export. There are some exceptions though. In some cases, firm size can reflect a large domestic demand and a relatively small foreign demand.

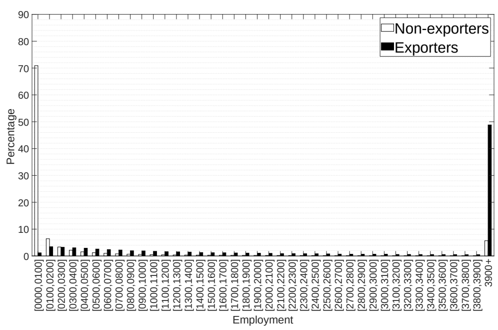
The mapping from size to trade is clearest when firms differ only in productivity. The top right panel shows the size distribution of exporters and non-exporters when only productivity shocks are present. Here the selection fits the simple static theory quite well as the sorting is nearly perfect.

The bottom panels of Figure 9 reproduces the experiments for the PCE. The sorting is again quite clear where there are only productivity shocks. Removing adjustment costs alone does not eliminate the overlap in the size distribution.

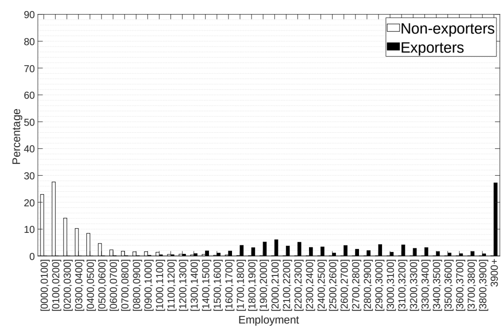
Note that from the parameter estimates, the measure of dispersion in domestic demand, σ^d, is almost four times larger for PCE compared to SCE. This, in part, explains why eliminating adjustment costs is not enough to create the degree of sorting for the PCE group as in the SCE sample.

Table 12: Export Status by Size

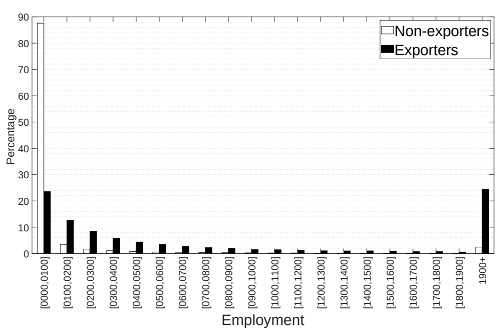
	SCE							
	Non-exporters				Exporters			
	Mean	Median	SD	Skewness	Mean	Median	SD	Skewness
DATA	499.61	255.05	696.17	3.48	1237.99	690.99	1324.81	1.70
BASE	475.96	200.43	649.37	4.41	1465.01	605.36	1170.33	2.24
	PCE (Trimmed)							
	Non-exporters				Exporters			
	Mean	Median	SD	Skewness	Mean	Median	SD	Skewness
DATA	136.57	85.97	154.14	4.76	237.36	157.86	238.46	3.81
BASE	146.37	85.33	187.61	4.26	225.19	130.29	260.62	3.22



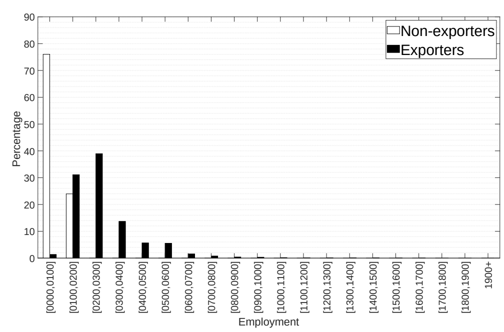
(a) SCE: no adj costs



(b) SCE: no demand shock



(c) PCE: no adj costs



(d) PCE: no demand shock

Figure 9: Effects on Plant Size of Adjustment Costs and Demand

This figure shows the distributions of plant size (employment), by ownership and export status, in the model under two experiments. One removes labor adjustment costs and the other removes demand shocks.

5.4 Ownership

Ownership matters: the exporting status of PCE and SCE differ. Starting with our motivating Figure 1 and continuing throughout the presentation, differences in the behavior of PCE and SCE have been noted. This sub-section focuses specifically on the effects of ownership.

From the estimates, there are a few key differences in parameters by ownership: (i) discounting, (ii) curvature, (iii) adjustment costs, (iv) the stochastic processes for the shocks and (v) trade costs. These differences appear in the estimates and are then reflected in their choices.

We look at those in turn through a series of counterfactual exercises. Specifically, key parameters estimated for the PCE are substituted for the estimated SCE values.[42] The SCE choice problem is resolved using these parameters and the differences with the baseline highlight the significance of the economic effects of that (those) parameter(s). For (β, α^d, α^f, ν^+, ν^-, γ^+, γ^-, SC^f), we directly use the corresponding values from the estimation of PCE in the SCE optimization problem.[43] The parameters (Γ^f, χ, F^+, F^-), were adjusted so that their value relative to average SCE revenue (in the baseline model) matched the corresponding value from the PCE estimation. In this way, the SCE problem was solved using the fraction of revenue of these costs using the PCE estimates. Finally, for the shock processes, we took the corresponding values from the estimation of PCE, adjusting the mean of domestic and foreign profitability to equal the baseline case.

[42] As the SCE model does not have exit, substituting the PCE parameters for the comparable SCE values was the exercise chosen.

[43] Importantly, variations in these parameters, such as (α^d, α^f) influence revenue. Thus it is important that the various adjustment costs are kept fixed at their absolute levels, not fixed relative to revenue, throughout these experiments.

Table 13: Moments: Counterfactuals

	Non-exporters										Exporters														stat
	sc	JC30	Inact	JD30	$\tilde{\alpha}^d$	$\tilde{\rho}^d$	$\tilde{\sigma}^d$	emp (p50)	emp (mean)	nex2ex	sc	JC30	Inact	JD30	$\tilde{\alpha}^{df}$	$\tilde{\rho}^{df}$	$\tilde{\sigma}^{df}$	emp (p50)	emp (mean)	ex2nex	fox	ex int	small ex		
Baseline	0.989	0.065	0.183	0.043	1.250	0.795	0.893	200.427	475.962	0.035	0.985	0.084	0.183	0.032	1.060	0.769	0.774	605.360	1465.009	0.094	0.341	0.210	0.386		4319.75
shocks	0.983	0.092	0.211	0.040	1.359	0.765	1.031	706.678	2889.450	0.069	0.985	0.057	0.192	0.044	1.081	0.744	0.878	1283.666	3813.973	0.109	0.315	0.319	0.392		194976.55
α	0.994	0.006	0.213	0.008	1.093	0.822	0.865	40.000	65.182	0.031	0.978	0.088	0.178	0.051	0.902	0.765	0.807	191.758	388.709	0.051	0.583	0.742	0.010		24731.94
α^d	0.992	0.011	0.268	0.003	1.195	0.820	0.866	30.000	48.388	0.019	0.972	0.076	0.190	0.026	0.914	0.750	0.762	151.484	247.772	0.077	0.345	0.668	0.008		21732.95
α^f	0.989	0.052	0.180	0.042	1.250	0.797	0.898	215.767	470.787	0.043	0.984	0.091	0.190	0.030	1.105	0.756	0.790	691.226	1612.600	0.072	0.483	0.309	0.292		5356.85
AC	0.987	0.047	0.409	0.07	1.464	0.754	0.782	88.000	206.204	0.028	0.984	0.059	0.390	0.074	1.066	0.722	0.687	325.973	675.032	0.106	0.268	0.269	0.275		14526.15
TC	0.989	0.066	0.179	0.043	1.251	0.796	0.896	200.427	486.372	0.031	0.985	0.084	0.190	0.030	1.050	0.761	0.765	661.330	1592.079	0.097	0.301	0.222	0.366		5040.87

Notes:

For each of the experiments, three types of evidence are presented. First, Table 13 reproduces the full set of moments indicating how they change with the reparameterization of the SCE model. Second, Figure 10 shows the distributions of profitability for each experiment. Finally, the responsiveness regressions, building on Table 8, are run for each experiment. The reference point is the baseline SCE model, included in each of these pieces of evidence. In addition to these experiments, we also present evidence on differences in (size weighted) export shares by ownership.

5.4.1 Moment Implications

The last column of Table 13 reports the model fit for these experiments and thus makes clear which variations matter for matching moments. Clearly, for the row labeled "shocks", the moments changed dramatically and the fit was made worse by an order of magnitude compared to the the experiments. For this exercise, we jointly change the SC^f and AR(1) processes of the two demand as well as the productivity shock, allowing the means of domestic and foreign profitability to change. From Table 5, both the domestic and foreign demand shocks for the PCE were considerably more volatile and less persistent than those impacting the SCE plants. The opposite was the case in foreign markets where the volatility was almost twice that of the SCE plants. The relative mean of foreign demand, SC^f, is about 35% lower for the PCE. As for productivity, this process is less volatile for the PCE compared to the SCE estimates but considerably more persistent.

The moments that change the most are the employment means of both exporters and non-exporters. Interestingly, the distribution of employment adjustments does not change much despite these differences in volatility and persistence. There is considerably more variation in export status in light of the increased volatility of the demand processes now faced by the SCE.

A second big factor distinguishing the PCE and SCE is the curvature in the revenue functions. The row labeled "α" is an experiment in which both of the PCE curvatures are used in the SCE problem. From Table 5, the PCE curvature for domestic revenue was over 10% lower than the SCE estimate, while the PCE curvature in foreign markets was about 5% higher than the SCE estimate. To be clear, by construction, in this experiment the substitution of the PCE for the SCE curvature measures did not influence the adjustment costs even though these are stated in terms of average revenue.

Solving the SCE problem with these parameters reduces the mean and median sizes of the both non-exporting and exporting SCE plants. The fraction of plants exporting rises considerably.

The rows labeled α^d and α^f change the curvature parameters on domestic and foreign demand separately. Here it is clear that changing the curvature of domestic revenue from the SCE to the PCE lower estimate is key. Once the SCE optimize with the reduced curvature, employment in production for the domestic market falls considerably. There is actually substitution in this case in that the size of exporters increases, as does the export share.

A third important factor are the adjustment costs, denoted "AC" in the table. Recall from Table 6, that relative to revenue the fixed costs of hiring and firing were much larger for the SCE compared to the PCE. Further both the quadratic and linear hiring costs were much higher for the PCE though the quadratic and linear firing cost were lower for those plants.

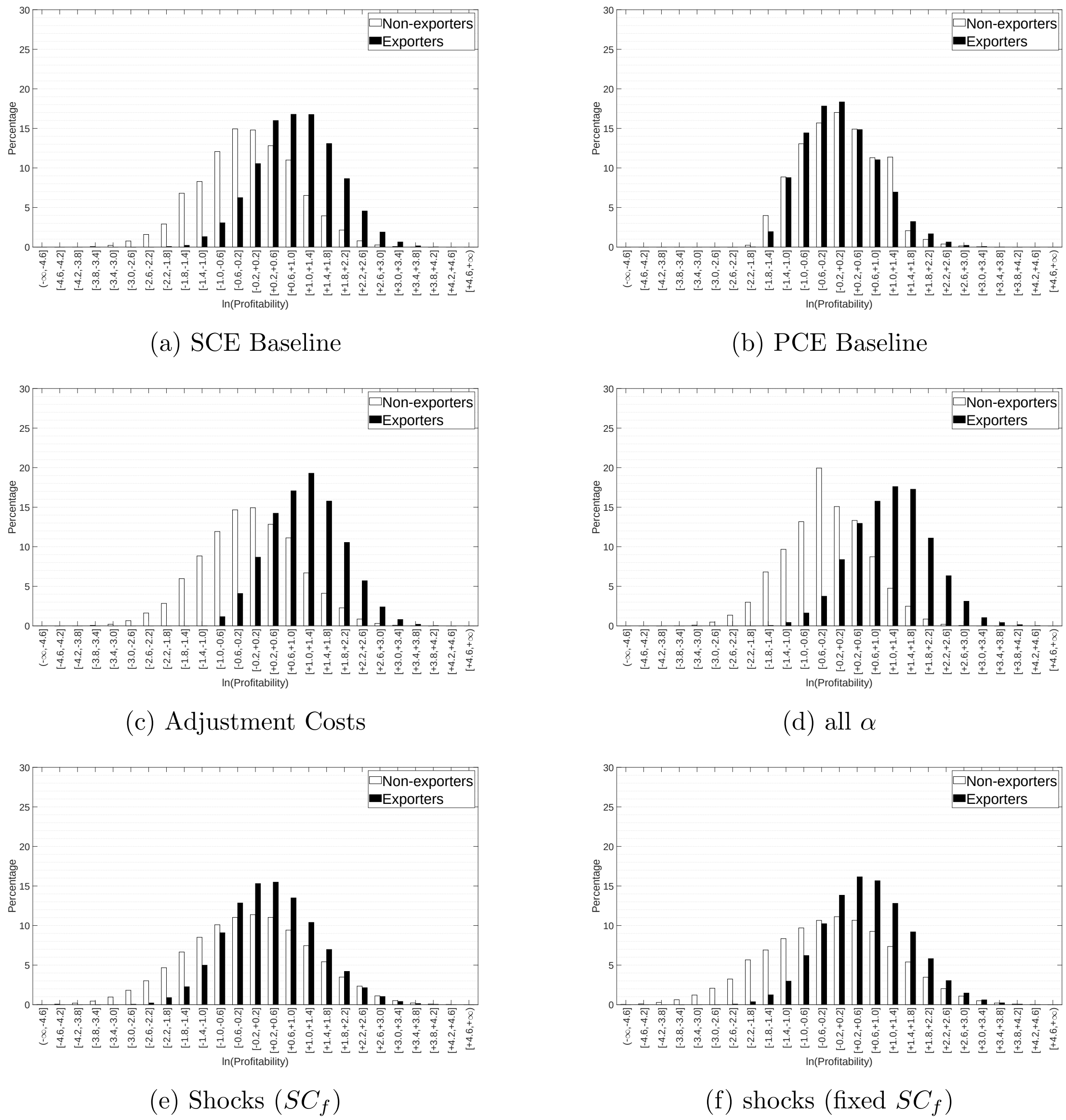
Using these adjustment costs in the SCE problem led to changes in the distributions of job creation and destruction for both exporters and non-exporting plants.[44] The inaction rate is higher for both types of plants, as is the job destruction rate (JD30). Reflecting the higher adjustment costs, plant sizes are smaller. The export share falls by about 25% and the fraction of small exporters falls too.

Interestingly, there are two factors that matter much less: (i) discounting and (ii) export costs. Reducing β from the SCE to the PCE level, a reduction of about 5 percentage points. This leads to a small deterioration of the fit, mainly from the increase in plant size. There is also a modest increase in inaction.

Further, from Table 6, both the cost of becoming an exporter, χ, as well as the overhead cost of exporting, Γ^f, are a larger fraction of average revenue for PCE. Putting these increased costs in the SCE optimization problem worsens the model fit, as indicated by the "TC" row. The fraction of exporters is lower, as is the fraction of small exporters. Both the mean and median export size is higher as there is greater selection into exporting.

[44] A large part of the effect here is through the piecewise quadratic adjustment costs and the positive linear cost.

5.4.2 Profitability Distributions



(a) SCE Baseline

(b) PCE Baseline

(c) Adjustment Costs

(d) all α

(e) Shocks (SC_f)

(f) shocks (fixed SC_f)

Figure 10: Distributions of SCE Profitability

These figures show the profitability distributions for the SCE using PCE parameters.

As indicated in the table, other experiments surely impact the model fit but the shock processes, the curvature in revenue and the adjustment costs were the most important. Focusing on these, Figure 10 shows the distributions of profitability for these experiments.

The top row shows the distribution from the SCE and PCE baselines. As noted above, the SCE case shows some overlap but also a shift to the right in the distribution for exporters while for the PCE there is much more overlap.

The cases in which the SCE operate with either the PCE estimated α or adjustment costs values, have a big impact on these distributions. For these two cases, there is much more sorting as the distribution of profitability for the exporters is shifted to the right.

The final row shows the distributions using the PCE shocks, with and without a change in mean foreign demand. In these cases, the distributions look more like the PCE baseline with considerable overlap in the profitability of exporters and non-exporters. As noted earlier, this is a consequence of the relative importance of demand shocks for the PCE.

5.4.3 Dynamic Responsiveness

A final basis for evaluating parameter differences returns to the determinants of export status regression reported in Table 8. This regression has plant-level export status as a dependent variable, explained by lagged export status, the (log) of lagged employment and the current innovation. This regression was run on actual data and simulated data by ownership, as reported in Table 8. The coefficients were all smaller for the PCE compared to the SCE in simulated data. Here the point is to link these in responsiveness to the differences in structural parameter estimates.

Table 14: SCE: Determinants of Export Status

Variable	SCE Baseline	PCE Baseline	shocks	α	AC
ex_{-1}	0.854	0.836	0.801	0.859	0.845
$ln(emp_{-1})$	0.010	0.006	0.011	0.018	0.010
ε	0.061	0.038	0.026	0.115	0.053

Notes: The dependent variable is SCE export status at period t. The table shows the baseline and three treatments.

Of these changes in the parameterization, both the shocks and α have large effects on these regression results. Giving the SCE the PCE shock processes, reduces the dependence of current export status on lagged export status and also dramatically reduces the response to profitability innovations. This can be linked to the lower persistence in the shocks for the PCE compared to the SCE plants. For the α experiment, the response to the profitability shock is almost twice that of the baseline. This reflects that there is less curvature in the PCE domestic demand compared to the SCE estimate of α^d.

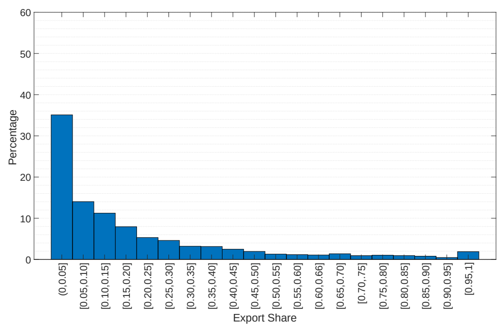
It appears that the change in adjustment costs pushes the SCE baseline in the direction of the PCE baseline. With these alternative costs both the response to lagged export status and to the innovation are muted.

5.4.4 Export Shares

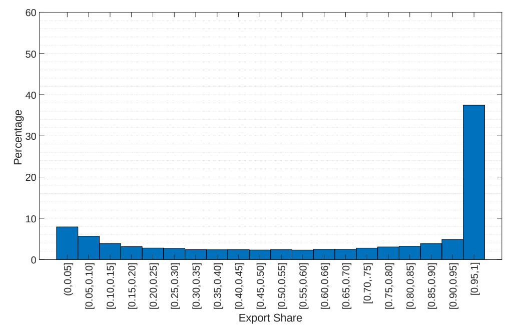
Thus far the analysis focuses on the extensive margin: to export or not. Conditional on exporting, there is the intensive margin of the share of plant activity devoted to exporting that is of interest.[45] This seems particularly instructive when looking across ownership types.

[45] The focus on the distribution of export shares follows Bernard, Eaton, Jensen, and Kortum (2003).

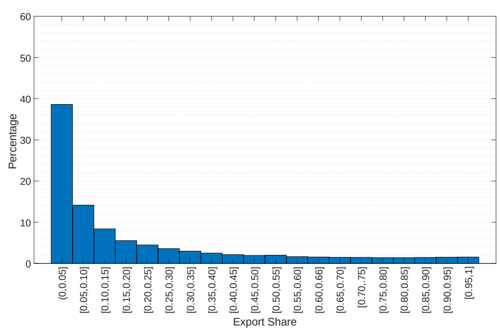
From the top row of Figure 11, the SCE and PCE distribution of (size weighted) export shares differs dramatically. For the SCE, about 50% of workers are in plants with an export share less than 10%. In contrast, for the PCE there are many more large exporters: almost 40% of the workers are in plants with an export share in excess of 95%.



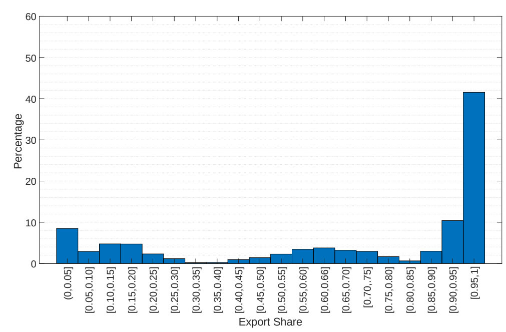
(a) SCEs (DATA)



(b) PCEs (DATA)



(c) SCEs (Model)



(d) PCEs (Model)

Figure 11: Distributions of Export Share (Size Weighted)

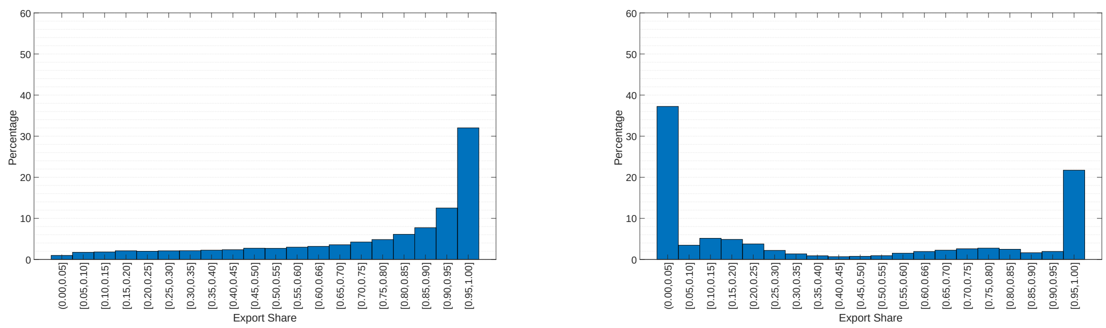
As indicated by the bottom row of the figure, our model captures this distinction between export shares by ownership. Again, in the spirit of the above counterfactual exercises, what is the source of this difference in the distribution of export shares?

Figure 12 shows the results of two experiments. In the first, the revenue curvatures from the PCE estimation are used in the SCE problem. In this case, the distribution shifts dramatically, putting much more weight on plants with very high export shares. This mimics the PCS distribution. If instead the PCE shocks are used as inputs into the SCE problem, then there is some shift of the distribution to the right but not nearly as much as in the first exercise.

6 Conclusion

The paper started with a graphical representation of the productivity distribution across plants in China, by export status and ownership. The distributions exhibit considerable overlap, in contrast to the predictions of a (too) naive model that export status is determined by productivity alone.

The analysis goes beyond the traditional model of trade costs to include labor adjustment costs as



(a) PCE α (b) PCE shocks

Figure 12: Experiments: Export share of SCEs (weighted)

well. Further, the profits of an enterprise are impacted by three shocks: (i) productivity, (ii) domestic demand and (iii) foreign demand (for exporters). The enhanced model is estimated through a simulated method of moments approach, where the moments come from Chinese manufacturing plants.

The estimated model is used, in part through a series of counterfactuals, to study the factors that impact export status. The emphasis is on the role of adjustment and trade costs in determining export status and the distribution of productivity by export status and ownership. Though the parameters of both types of frictions are, in the estimation, statistically significant, the adjustment costs overall seem to have a much larger impact on export status and the associated distributions.

One value of the Chinese data is the opportunity to distinguish plants by ownership. The estimation allows parameters to differ between SCE and PCE. And indeed the estimates do differ in a way that allows the model to explain the different patterns of ownership. Among the differences, the stochastic process for demands as well as adjustment costs were key.

There are two projects that naturally grow from these results. Though not emphasized here, in the Chinese data, the employment levels of plants that enter export status, i.e. the new exporters, do not follow the pattern of US plants detailed in Ruhl and Willis (2017). An open issue worth pursuing is understanding the differences in these dynamics.

A second exercise is to conduct an analysis of a trade war, on at least two dimensions. The first dimension concerns the effects of subsidizes for SCE. These subsidies might take multiple forms, including cheaper credit (reflected here as a higher β) and/or lower costs of exporting. The estimated model can be used as a tool to determine the effects of these interventions on trade outcomes. Second, the model is useful for determining the effects on Chinese plants of trade measures, such as recent tariff increases imposed by the US.

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7 Appendix

7.1 Revenue Functions

This section presents our analysis of revenue functions and the construction of profitability shocks.

7.1.1 Environment

Assume:

- C-D Production Function: $y = \tilde{z}k^{1-\alpha}e^{\alpha}$
- Demand Functions
  - Domestic demand : $y_d = B_d p_d^{-\sigma_d} \Rightarrow p_d = \left(\frac{B_d}{y_d}\right)^{1/\sigma_d}$
  - Foreign demand : $y_f = B_f p_f^{-\sigma_f} \Rightarrow p_f = \left(\frac{B_f}{y_f}\right)^{1/\sigma_f}$
- We denote other variable input by k whose cost is price r

7.1.2 Exporters

This is the optimization problem for exporters. Given $s^j e$, the share of employment to market j, the revenue (net of variable costs) for market j:

$$R^j(z, A^j, s^j e) = \max_{k_j} B_j^{1/\sigma_j}\left[z(s^j e)^{\alpha} k_j^{1-\alpha}\right]^{\epsilon_j} - rk_j$$
$$= [1-(1-\alpha)\epsilon_j]\left[\frac{(1-\alpha)\epsilon_j}{r}\right]^{\frac{(1-\alpha)\epsilon_j}{1-(1-\alpha)\epsilon_j}}\left[B_j^{1/\sigma_j} z^{\epsilon_j}(s^j e)^{\alpha\epsilon_j}\right]^{\frac{1}{1-(1-\alpha)\epsilon_j}}$$

where $\epsilon_j = 1 - 1/\sigma_j$.

Given a level of employment, e, the producer optimally allocates labor between production for the domestic and foreign markets. From this, the revenue of exporters can be written:

$$R(z, A^d, A^f) = \max_{s^d, s^f} \sum_{j\in\{d,f\}} R^j(z, A^j, s^j e) = \max_{s^d, s^f}\left\{A^d(z\times s^d \times e)^{\alpha_d} + A^f(z\times s^f\times e)^{\alpha_f}\right\}$$

subject to $s^d + s^f = 1$, and where

$$A^d = [1-(1-\alpha)\epsilon_d]\left[\frac{(1-\alpha)\epsilon_d}{r}\right]^{\frac{(1-\alpha)\epsilon_d}{1-(1-\alpha)\epsilon_d}} B_d^{\frac{1/\sigma_d}{1-(1-\alpha)\epsilon_d}},$$

$$A^f = [1-(1-\alpha)\epsilon_f]\left[\frac{(1-\alpha)\epsilon_f}{r}\right]^{\frac{(1-\alpha)\epsilon_f}{1-(1-\alpha)\epsilon_f}} B_f^{\frac{1/\sigma_f}{1-(1-\alpha)\epsilon_f}},$$

$z = \tilde{z}^{1/\alpha}$, $\alpha_d = \frac{\alpha\epsilon_d}{1-(1-\alpha)\epsilon_d}$, and $\alpha_f = \frac{\alpha\epsilon_f}{1-(1-\alpha)\epsilon_f}$

7.1.3 Measuring Profitability Shocks

According to the definition of revenue function, for non-exporters, the revenue-based profitability is $z^{\alpha_d} A^d$. For exporters, the revenue-based profitability is

$$\begin{aligned} & A^d z^{\alpha^d} s^{*\alpha_d} + A^f z^{\alpha^f} (1 - s^*)^{\alpha_f} e^{(\alpha_f - \alpha_d)} \\ &= \left(1 + \frac{\alpha_d}{\alpha_f} \frac{1 - s^*}{s^*}\right) s^{*\alpha_d} z^{\alpha_d} A^d \\ &= \frac{z^{\alpha_d} A^d}{\hat{s}\left(1 + \frac{1-\hat{s}}{\hat{s}} \frac{\alpha_f}{\alpha_d}\right)^{\alpha_d}} \end{aligned} \tag{9}$$

where s^* is the optimal share of output sold in the domestic market, and $\hat{s}$ is the share of revenue earned from the domestic market. We get the first equation by using the first order condition $\alpha^d z^{\alpha_d} A^d s^{*\alpha^d - 1} e^{\alpha^d} = \alpha^f z^{\alpha_f} A^f (1 - s^*)^{\alpha^f - 1} e^{\alpha^f}$. The second equation is from $\frac{1-\hat{s}}{\hat{s}} = \frac{\alpha_d}{\alpha_f} \frac{1-s^*}{s^*}$.

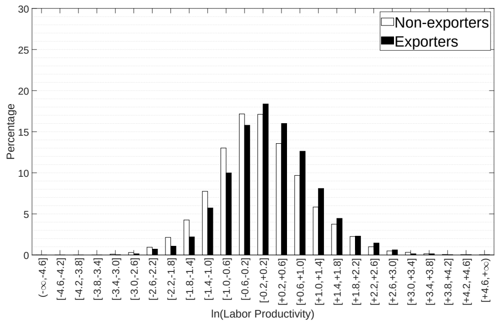
If $\alpha_d = \alpha_f$, export share s^* is independent on e, i.e.

$$s^* = \frac{1}{1 + \left(\frac{\alpha_d}{\alpha_f} \frac{A^d}{A^f}\right)^{\frac{1}{\alpha_d - 1}}}.$$

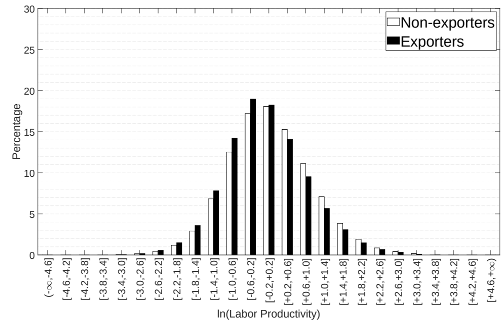
If we assume there is no heterogeneity in demand, then the distribution of s^* degenerates.

7.2 Productivity and Profitability Distributions

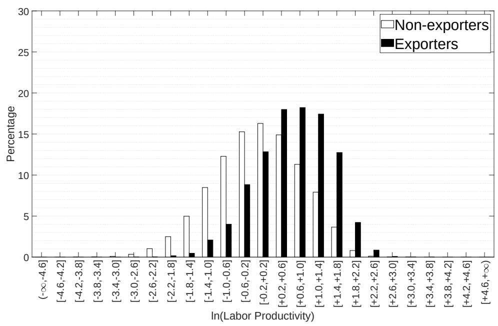
This sub-section presents statistics and distributions for the two productivity measures.



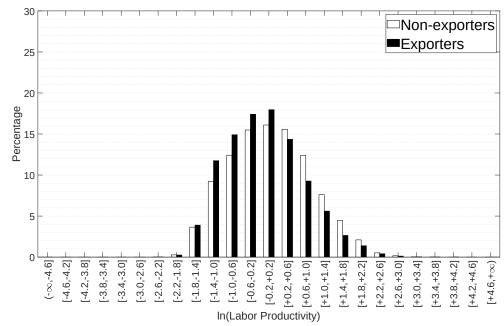
(a) SCE (DATA)



(b) PCE (DATA)



(c) SCE (Model)



(d) PCE (Model)

Figure 13: Profitability: Labor Productivity

Table 15: Profitability: Labor Productivity

	SCE							
	Non-exporters				Exporters			
	Mean	Median	SD	Skewness	Mean	Median	SD	Skewness
DATA	-0.042	-0.099	1.013	0.388	0.158	0.112	0.949	0.237
BASE	-0.111	-0.074	0.935	-0.168	0.663	0.726	0.781	-0.423
	PCE (Trimmed)							
	Non-exporters				Exporters			
	Mean	Median	SD	Skewness	Mean	Median	SD	Skewness
DATA	0.035	-0.011	0.908	0.217	-0.081	-0.133	0.891	0.269
BASE	0.025	-0.002	0.900	0.207	-0.059	-0.096	0.820	0.330

Notes: We remove industry, year and location effect from DATA

Table 16: Profitability: Revenue-Based Profitability

	SCE							
	Non-exporters				Exporters			
	Mean	Median	SD	Skewness	Mean	Median	SD	Skewness
DATA	-0.080	-0.146	1.012	0.341	0.353	0.342	1.018	0.172
BASE	-0.154	-0.142	1.054	0.010	0.915	0.967	0.869	-0.118
	PCE (Trimmed)							
	Non-exporters				Exporters			
	Mean	Median	SD	Skewness	Mean	Median	SD	Skewness
DATA	-0.012	-0.065	0.871	0.289	0.031	-0.028	0.877	0.331
BASE	-0.022	-0.104	0.821	0.186	0.053	-0.066	0.769	0.285

Notes: We remove industry, year and location effect from DATA

7.3 Identification

Table 17: SCE: Elasticity of Moments

	non-exporters					exporters							
	sc	JC30	Inact	JD30	nex2ex	sc	JC30	Inact	JD30	ex2nex	fox	ex int	small ex
Γ^f	0.00	0.08	-0.14	0.23	-0.24	0.00	0.11	0.31	-0.18	0.51	-0.51	0.26	-0.27
χ	0.00	0.11	-0.02	-0.14	-0.29	0.00	-0.06	-0.05	0.18	-0.28	-0.06	-0.01	0.00
SC^f	0.00	-1.23	0.36	-0.27	1.46	0.00	0.06	-0.48	-0.23	-0.87	1.59	0.95	-0.62
ν^+	0.01	-0.11	0.23	-0.53	-0.28	0.01	-0.10	0.23	-0.53	0.05	-0.21	0.22	-0.24
ν^-	0.01	-0.30	-0.26	-3.12	-0.11	0.01	-0.23	-0.24	-4.21	-0.01	-0.11	0.14	-0.15
F^+	0.00	-0.06	0.04	-0.04	-0.01	0.00	0.01	0.01	-0.04	0.00	-0.01	0.00	0.01
F^-	0.00	-0.06	-0.07	0.13	-0.02	0.00	-0.02	-0.05	0.27	0.00	-0.02	0.02	-0.02
γ^+	0.00	-0.06	0.21	-0.13	-0.01	0.00	-0.07	0.25	-0.07	0.01	-0.06	0.06	-0.06
γ^-	0.00	-0.14	0.57	-0.79	-0.02	0.00	-0.26	0.59	-0.75	0.02	-0.08	0.10	-0.10
β	-0.03	1.82	-2.01	15.06	-0.23	-0.04	2.22	-2.62	17.44	0.23	-0.22	0.33	-0.22

Table 18: PCE: Elasticity of Moments

PCE	non-exporters						non-exporters								
Parameters:	sc	JC30	Inact	JD30	xrate	nex2ex	sc	JC30	Inact	JD30	xrate	ex2nex	fox	ex int	small ex
Γ^f	0.00	0.10	-0.01	-0.07	0.07	-0.25	-0.01	0.13	0.10	0.20	0.00	0.60	-0.30	0.18	-1.14
χ	0.00	0.10	0.01	-0.08	0.18	-0.56	-0.01	0.14	0.05	-0.06	-0.04	-0.52	0.07	-0.09	0.76
SC^f	-0.01	-0.41	0.20	0.53	-0.61	1.28	0.02	0.12	-0.02	-0.36	-1.48	-1.13	1.46	0.27	1.32
ν^+	0.03	-0.40	-0.10	-1.09	0.42	-0.12	0.03	-0.50	-0.10	-1.04	0.63	0.05	-0.08	0.03	-0.55
ν^-	0.01	0.04	-0.01	-0.35	0.20	0.05	0.01	-0.02	-0.02	-0.08	0.18	-0.06	0.01	0.00	0.00
F^+	0.00	0.02	-0.01	-0.04	0.01	-0.04	0.00	0.06	0.00	0.02	0.03	0.02	-0.01	-0.01	-0.03
F^-	0.00	0.01	-0.01	-0.12	0.06	-0.01	0.00	0.02	-0.01	-0.11	0.09	-0.01	0.00	0.00	-0.01
γ^+	0.00	-0.01	0.65	-0.68	0.22	-0.14	0.00	-0.03	0.66	-0.45	0.36	0.07	-0.12	-0.01	-0.19
γ^-	0.00	0.03	0.09	-0.47	0.22	0.05	0.00	-0.03	0.07	-0.20	0.20	-0.07	0.01	-0.01	0.00
β	0.02	-1.82	-0.29	3.17	-5.28	0.95	0.01	-2.04	-0.29	1.06	-8.43	-0.67	0.58	0.05	0.82

7.4 Experiments without Adjustment and Trade Frictions

The first tables are the experiments, Tables 19 and 20. The second presents the re-estimation of the model without labor adjustment costs. These are discussed in the text.

7.4.1 Simulations

Table 19: Moments: SCE Experiments

	Non-exporters										Exporters													stat
	sc	JC30	Inact	JD30	$\tilde{\alpha}^d$	$\tilde{\rho}^d$	$\tilde{\sigma}^d$	emp (p50)	emp (mean)	nex2ex	sc	JC30	Inact	JD30	$\tilde{\alpha}^{df}$	$\tilde{\rho}^{df}$	$\tilde{\sigma}^{df}$	emp (p50)	emp (mean)	ex2nex	fox	ex int	small ex	
BASE	0.989	0.065	0.183	0.043	1.250	0.795	0.893	200.427	475.962	0.035	0.985	0.084	0.183	0.032	1.060	0.769	0.774	605.360	1465.009	0.094	0.341	0.210	0.386	4319
no sunk	0.990	0.050	0.171	0.047	1.247	0.800	0.894	204.907	484.581	0.073	0.984	0.108	0.205	0.020	1.066	0.748	0.714	507.229	1291.161	0.182	0.352	0.217	0.364	4812
no adj	0.757	0.154	0.000	0.769	1.000	0.827	0.000	11.890	2396.069	0.147	0.784	0.132	0.000	0.806	0.992	0.762	0.028	2201.176	210363.150	0.040	0.932	0.017	0.948	175309362

Notes: This table shows simulation results from eliminating the sunk cost of exporting and labor adjustment costs.

Table 20: Moments: PCEs Experiments

	Non-exporter											Exporter														stat
	sc	JC30	Inact	JD30	xrate	alpha	rho	sigma	emp (p50)	emp (mean)	nep2ep	sc	JC30	Inact	JD30	xrate	$\bar{\alpha}^d$	$\bar{\rho}^d$	$\bar{\sigma}^d$	emp (p50)	emp (mean)	ep2nep	foe	ex int	small ex	
BASE	0.973	0.121	0.354	0.071	0.078	0.669	0.715	0.819	85.333	146.368	0.061	0.975	0.105	0.364	0.066	0.057	0.730	0.694	0.762	130.290	225.190	0.098	0.394	0.660	0.085	32755
no sunk	0.975	0.120	0.361	0.067	0.070	0.671	0.715	0.806	80.000	140.159	0.108	0.977	0.107	0.374	0.060	0.063	0.745	0.694	0.768	109.776	196.917	0.165	0.391	0.701	0.036	46116
no adj	0.787	0.113	0.000	0.820	0.000	1.000	0.830	0.000	1.506	814.074	0.047	0.766	0.057	0.000	0.925	0.000	1.001	0.678	0.023	383.530	53726.823	0.020	0.857	0.936	0.058	9725774087

Notes: This table shows simulation results from eliminating the sunk cost of exporting and labor adjustment costs.

7.4.2 Re-estimation

Table 21: Parameter Estimates: No Labor Adjustment Costs

	Γ^f	χ	SC^f	β	w	ρ^z	σ^z	α^d	ρ^d	σ^d	α^f	ρ^f	σ^f	Γ^d
SCE														
	0.928	3.229	0.262	0.969	0.022	0.827	0.074	0.488	0.984	0.587	0.500	0.753	0.633	-
	(0.089)	(0.116)	(0.002)	(0.198)	(0.000)	(0.195)	(0.073)	(0.001)	(0.000)	(0.001)	(0.004)	(0.001)	(0.016)	-
PCE														
	9.689	33.201	0.948	0.737	0.211	0.987	0.025	0.640	0.990	0.771	0.698	0.990	0.401	0.808
	(0.052)	(4.416)	(0.001)	(0.002)	(0.000)	(0.052)	(0.000)	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)	(0.001)	(0.001)

Notes:

Table 22: Moments: No Labor Adjustment Costs

							SCE								
Exporters	Moments	sc	JC30	Inact	JD30	xrate	$\tilde{\alpha}^{df}$	$\tilde{\rho}^{df}$	$\tilde{\sigma}^{df}$	emp (p50)	emp (mean)	ep2nep	foe	ex int	small ex
	DATA	0.871	0.086	0.154	0.032	-	0.955	0.937	0.964	690.993	1237.994	0.101	0.338	0.190	0.351
	Model	0.957	0.077	0.000	0.171	-	1.003	0.653	0.005	414.989	666.868	0.108	0.328	0.192	0.319
Non-Exporters	Moments	sc	JC30	Inact	JD30	xrate	$\tilde{\alpha}^d$	$\tilde{\rho}^d$	$\tilde{\sigma}^d$	emp (p50)	emp (mean)	nep2ep			
	DATA	0.873	0.085	0.228	0.043	-	0.793	0.916	1.063	255.052	499.606	0.033			
	Model	0.984	0.060	0.000	0.087	-	1.000	0.984	0.000	271.781	525.425	0.049			
Stat. Value:	28474.9197														
							PCE								
Exporters	Moments	sc	JC30	Inact	JD30	xrate	$\tilde{\alpha}^{df}$	$\tilde{\rho}^{df}$	$\tilde{\sigma}^{df}$	emp (p50)	emp (mean)	ep2nep	foe	ex int	small ex
	DATA	0.886	0.172	0.295	0.055	0.042	0.748	0.900	0.885	157.863	237.361	0.095	0.428	0.647	0.079
	Model	0.984	0.045	0.000	0.074	0.006	0.999	0.990	0.016	171.591	268.631	0.005	0.451	0.848	0.022
Non-Exporters	Moments	sc	JC30	Inact	JD30	xrate	$\tilde{\alpha}^d$	$\tilde{\rho}^d$	$\tilde{\sigma}^d$	emp (p50)	emp (mean)	nep2ep			
	DATA	0.862	0.171	0.353	0.060	0.062	0.683	0.845	0.901	85.969	136.571	0.060			
	Model	0.986	0.125	0.000	0.195	0.007	1.000	0.967	0.000	53.428	168.967	0.002			
Stat. Value:	475539.596														

Notes: These tables show moments from the estimation without labor adjustment costs.

7.5 Sectoral Estimation Results

Table 23: Parameter Estimates (by industries)

	Γ^f	χ	SC^f	ν^+	ν^-	F^+	F^-	γ^+	γ^-	β	w	ρ^z	σ^z	α^d	ρ^d	σ^d	α^f	ρ^f	σ^f	Γ^d
SCE APPAREL	11.389	6.911	2.030	0.368	0.955	14.605	110.439	0.022	0.184	0.930	0.170	0.687	0.989	0.725	0.962	0.431	0.508	0.949	1.006	-
	(1.118)	(4.452)	(0.408)	(0.268)	(0.310)	(13.184)	(99.342)	(0.019)	(0.015)	(0.021)	(0.022)	(0.006)	(0.038)	(0.014)	(0.009)	(0.034)	(0.021)	(0.007)	(0.126)	-
SCE ELEC	2.535	5.262	0.495	0.704	2.229	12.952	32.464	0.073	0.073	0.969	0.159	0.843	1.312	0.709	0.914	0.376	0.721	0.939	0.544	-
	(1.227)	(13.387)	(0.064)	(0.329)	(0.831)	(23.679)	(14.690)	(0.221)	(0.234)	(0.043)	(0.012)	(0.012)	(0.047)	(0.005)	(0.024)	(0.059)	(0.019)	(0.052)	(0.065)	-
SCE STEEL	4.305	0.120	0.368	1.562	1.704	29.319	123.494	0.028	0.152	0.995	0.141	0.864	1.438	0.712	0.879	0.316	0.760	0.818	0.295	-
	(0.556)	(0.719)	(0.037)	(0.193)	(0.196)	(15.448)	(50.258)	(0.022)	(0.038)	(0.014)	(0.005)	(0.005)	(0.038)	(0.007)	(0.032)	(0.014)	(0.018)	(0.167)	(0.028)	-
PCE APPAREL	6.453	15.172	0.840	4.278	0.091	18.223	7.307	0.544	0.023	0.926	0.271	0.929	0.887	0.642	0.871	1.134	0.681	0.801	1.366	63.530
	(1.591)	(6.692)	(0.045)	(0.249)	(0.062)	(4.738)	(2.132)	(0.047)	(0.019)	(0.020)	(0.016)	(0.011)	(0.059)	(0.006)	(0.012)	(0.032)	(0.012)	(0.008)	(0.039)	(2.572)
PCE ELEC	1.658	0.971	0.444	1.935	0.155	19.535	0.006	0.176	0.060	0.892	0.234	0.944	0.858	0.648	0.675	1.004	0.676	0.902	1.186	17.234
	(0.632)	(3.896)	(0.040)	(0.527)	(0.147)	(1.217)	(4.547)	(0.028)	(0.015)	(0.015)	0.016)	(0.006)	(0.060)	(0.007)	(0.005)	(0.059)	(0.023)	(0.021)	(0.066)	(3.839)
PCE STEEL	1.871	5.276	0.288	2.804	0.023	17.717	0.305	0.294	0.031	0.833	0.349	0.946	0.798	0.643	0.839	1.174	0.679	0.885	1.190	31.017
	(0.513)	(2.018)	(0.059)	(0.195)	(0.121)	(2.097)	(1.039)	(0.083)	(0.065)	(0.046)	(0.015)	(0.020)	(0.045)	(0.011)	(0.030)	(0.056)	(0.061)	(0.019)	(0.138)	(3.605)

Notes:

Table 24: Moments (by industries)

		Non-exporter										
		sc	JC30	Inact	JD30	xrate	$\tilde{\alpha}^d$	$\tilde{\rho}^d$	$\tilde{\sigma}^d$	emp (p50)	emp (mean)	nex2ex
SCE APPAREL	DATA	0.828	0.151	0.229	0.074	-	0.478	0.866	0.802	372.986	553.703	0.030
	Model	0.987	0.062	0.228	0.039	-	1.126	0.677	0.698	267.160	578.641	0.035
SCE ELEC	DATA	0.876	0.107	0.172	0.074	-	0.733	0.882	0.956	199.403	441.603	0.054
	Model	0.986	0.059	0.105	0.046	-	1.248	0.794	0.794	187.566	359.347	0.055
SCE STELL	DATA	0.969	0.101	0.278	0.072	-	0.943	0.909	1.198	272.400	663.224	0.110
	Model	0.989	0.031	0.134	0.043	-	1.326	0.810	0.834	305.055	490.133	0.097
PCE APPAREL	DATA	0.851	0.175	0.340	0.077	0.075	0.640	0.830	0.840	145.133	199.974	0.137
	Model	0.977	0.105	0.352	0.065	0.076	0.624	0.774	0.727	143.626	238.379	0.107
PCE ELEC	DATA	0.883	0.229	0.258	0.071	0.063	0.692	0.864	0.974	98.095	163.730	0.139
	Model	0.963	0.132	0.255	0.070	0.095	0.668	0.602	0.753	100.442	155.175	0.141
PCE STEEL	DATA	0.893	0.198	0.335	0.061	0.096	0.903	0.774	0.970	93.599	154.183	0.025
	Model	0.968	0.202	0.279	0.078	0.108	0.675	0.731	0.697	65.667	129.318	0.030

		Exporter														stat
		sc	JC30	Inact	JD30	xrate	$\tilde{\alpha}^{df}$	$\tilde{\rho}^{df}$	$\tilde{\sigma}^{df}$	emp (p50)	emp (mean)	ex2nex	fox	ex int	small ex	
SCE APPAREL	DATA	0.981	0.045	0.237	0.079	-	0.775	0.846	0.756	398.106	679.098	0.078	0.402	0.624	0.121	
	Model	0.985	0.066	0.258	0.032	-	0.954	0.675	0.571	474.680	867.346	0.071	0.362	0.402	0.155	129.76
SCE ELEC	DATA	0.786	0.142	0.095	0.026	-	1.020	0.921	0.975	642.977	1145.098	0.052	0.605	0.282	0.203	
	Model	0.983	0.092	0.109	0.031	-	1.153	0.760	0.697	562.384	1263.827	0.057	0.592	0.296	0.261	242.53
SCE STELL	DATA	0.949	0.071	0.200	0.067	-	1.135	0.902	1.125	1044.930	1802.584	0.112	0.456	0.191	0.200	
	Model	0.984	0.086	0.139	0.046	-	1.121	0.763	0.661	1124.204	2166.529	0.145	0.487	0.203	0.252	137.92
PCE APPAREL	DATA	0.878	0.138	0.353	0.060	0.053	0.669	0.855	0.758	206.091	277.488	0.079	0.664	0.814	0.025	
	Model	0.973	0.126	0.337	0.073	0.074	0.666	0.703	0.821	205.051	356.676	0.087	0.593	0.776	0.027	1532.46
PCE ELEC	DATA	0.828	0.227	0.209	0.056	0.042	0.843	0.887	1.047	232.877	343.223	0.055	0.699	0.712	0.045	
	Model	0.981	0.132	0.263	0.066	0.053	0.864	0.743	0.667	150.755	315.124	0.062	0.703	0.731	0.043	2448.38
PCE STEEL	DATA	0.910	0.192	0.281	0.047	0.042	0.946	0.879	1.084	154.663	238.210	0.226	0.130	0.349	0.145	
	Model	0.972	0.097	0.303	0.074	0.088	0.751	0.726	0.585	98.652	176.120	0.159	0.134	0.459	0.185	1532.46

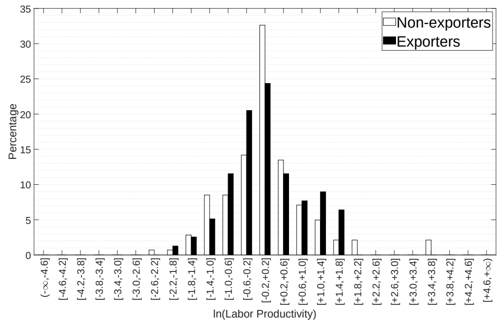
Notes:

Table 25: Costs relative to the mean value of Revenue (Industries)

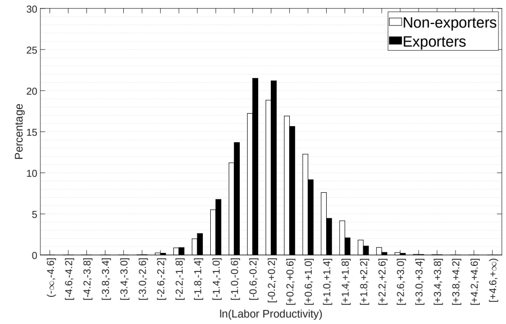
	Γ^f	χ	F^+	F^-	Γ^d
			SCE		
APPAREL	0.066	0.040	0.085	0.645	-
ELEC	0.015	0.031	0.077	0.192	-
STEEL	0.022	0.001	0.150	0.630	-
			PCE		
APPAREL	0.035	0.083	0.100	0.040	0.112
ELEC	0.019	0.011	0.220	0.000	0.066
STEEL	0.017	0.049	0.165	0.003	0.092

7.5.1 Sectoral Productivity

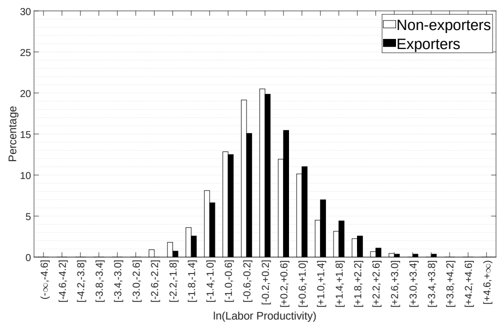
Figure 14 shows the distributions of average labor productivity by sector, export status and owernship.



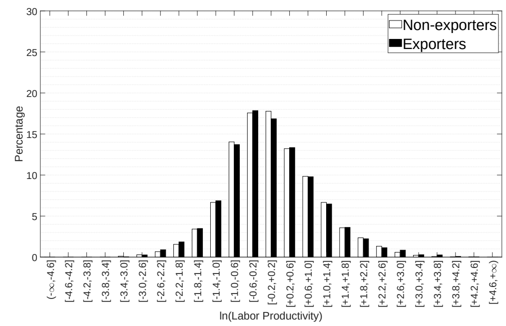
(a) SCE Apparel



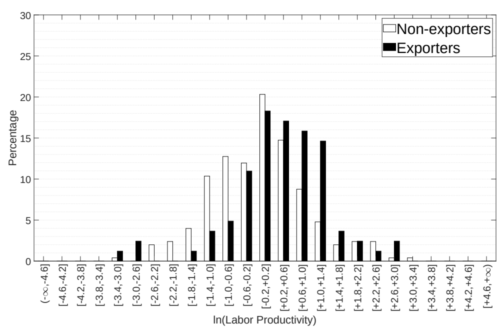
(b) PCE Apparel



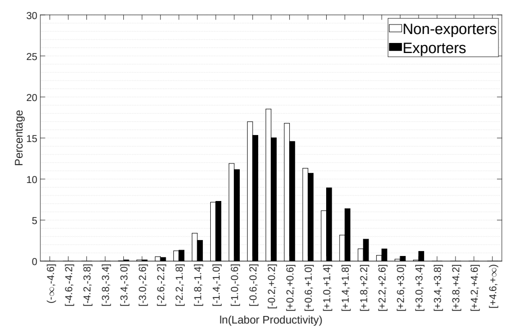
(c) SCE ELEC



(d) PCE ELEC



(e) SCE Steel

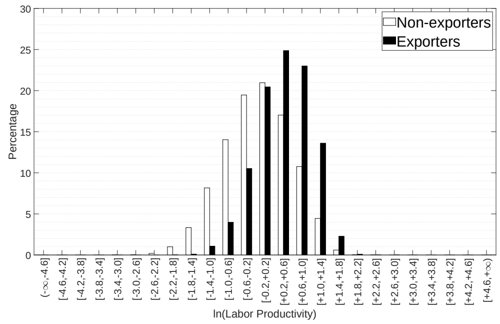


(f) PCE Steel

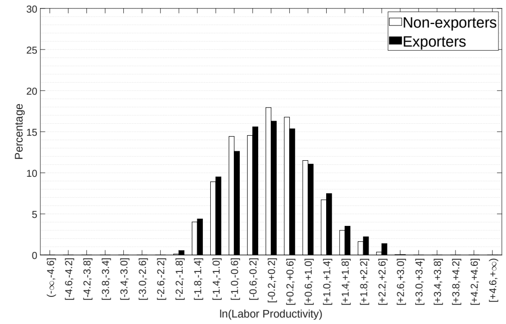
Figure 14: Data: Labor productivity Distributions

These figures show the distributions from the data of average labor productivity for the three sectors, by export status and ownership.

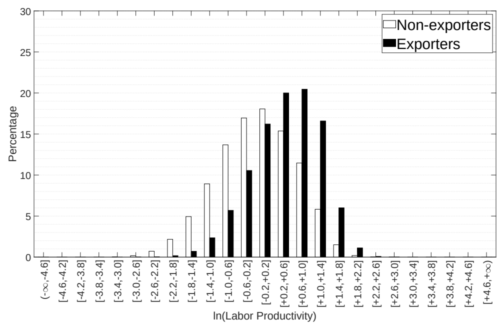
Figure 15 shows these distributions generated by the estimated model. The estimated model clearly captures the overlap in these distributions, as in the data. As before, there is little sorting produced by the model for the PCE.



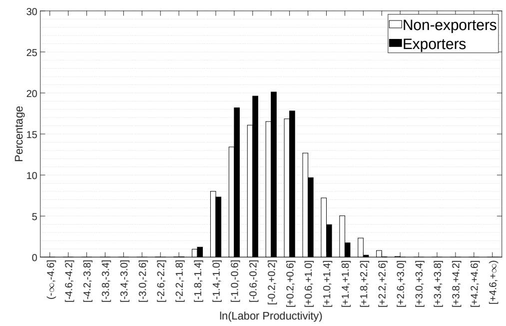
(a) SCE Apparel



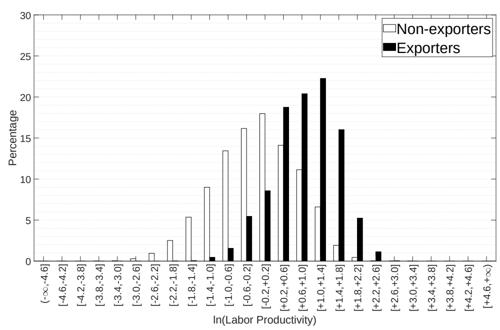
(b) PCE Apparel



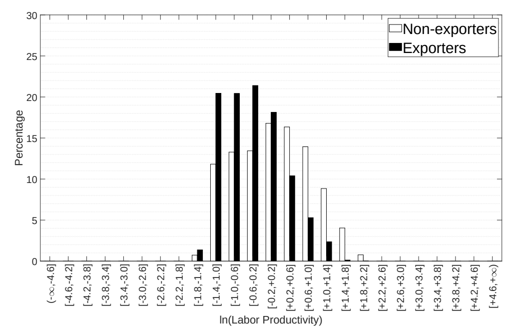
(c) SCE ELEC



(d) PCE ELEC



(e) SCE Steel



(f) PCE Steel

Figure 15: Model: Labor productivity Distributions

These figures show the distributions from the model of average labor productivity for the three sectors, by export status and ownership.

7.6 Export Status: Further Regressions

Here we replace the innovations with measures of profitability to explain export status.

	Profitability : Data							
	SCE				PCE			
	I	II	III	IV	I	II	III	IV
ex_{-1}	0.786	0.786	0.791	0.786	0.787	0.787	0.788	0.787
	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)	(0.001)	(0.001)	(0.001)
$ln(emp_{-1})$	0.026	0.026	0.032	0.026	0.032	0.032	0.032	0.032
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
$ln(\tilde{A}_{-1})$		-0.001		0.015		-0.002		0.003
		(0.004)		(0.002)		(0.001)		(0.000)
$ln(\tilde{A})$	0.016	0.017			0.004	0.006		
	(0.002)	(0.004)			(0.000)	(0.001)		
ε			0.018	0.017			0.006	0.006
			(0.004)	(0.004)			(0.001)	(0.001)
Year	YES	YES	YES	YES	YES	YES	YES	YES
Industry	YES	YES	YES	YES	YES	YES	YES	YES
Location	YES	YES	YES	YES	YES	YES	YES	YES
N	24915	24915	24915	24915	360076	360076	360076	360076
	Profitability : Model							
	SCE				PCE(Trim)			
	I	II	III	IV	I	II	III	IV
ex_{-1}	0.837	0.845	0.854	0.845	0.836	0.836	0.836	0.836
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
$ln(emp_{-1})$	-0.005	0.001	0.010	0.001	0.005	0.006	0.006	0.006
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$ln(\tilde{A}_{-1})$		-0.034		0.017		-0.022		0.005
		(0.000)		(0.000)		(0.001)		(0.001)
$ln(\tilde{A})$	0.036	0.061			0.023	0.038		
	(0.000)	(0.000)			(0.001)	(0.001)		
ε			0.061	0.061			0.038	0.038
			(0.000)	(0.000)			(0.001)	(0.001)

Notes: