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Misallocation in Open Economy

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Abstract

This paper estimates the impact of reducing export and import tariffs on firm input choices. In presence of borrowing constraints, lower export tariffs facilitate the reallocation of capital and labor inputs across firms, while a decline in import tariffs either tightens import competition or increases the availability of imported inputs; all three mechanisms suggest that a higher degree of openness should be associated with lower misallocation. To analyze the empirical relationship between openness and input misallocation, we draw on the annual surveys conducted by the Chinese National Bureau of Statistics (NBS) between 1998 and 2007. From the surveys, we construct firm-level measures of input misallocation that control for firm heterogeneity; we identify shocks to openness using industry tariff levels and firm trade shares. We find that firm facing higher tariffs in either import or export markets make less optimal input choices. We further decompose our analysis between input and output tariffs: our results suggest that the labor reallocation mainly occurs because of lower input tariffs, while the selection effect induced by changes in output tariffs does not necessarily cause more distorted firms to exit and, therefore, tends to have an insignificant effect on input allocation. Finally, we calculate the contribution of tariff changes towards aggregate misallocation and productivity: our results indicate that the impact of firm-level tariff reductions on aggregate misallocation and productivity was marginal in our sample period, but the presence of sizeable interactions between trade shocks and misallocation at the sector level suggests that our result should be interpreted as a lower bound of the overall effect.

Key words: Openness, Misallocation, Export Tariffs, Input and Output Tariffs.

JEL classification: F14.

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1 Introduction

An extensive literature documents productivity gains following tariff reductions.[1]. More recently, empirical work has delved into the channels for the realization of those gains, focusing on increasing returns to scale, on the self-selection of more efficient firms into exporting, or on the role of output vs. input tariffs.[2] This paper explores a new channel for the realization of productivity gains from trade, the extent to which tariffs affect affect input reallocation and induce productivity gains. While the fact that the reallocation of resources across firms may result in productivity gains is well-documented since the seminal work by Hsieh and Klenow [2009], there is little empirical evidence on the role that trade shocks have on resource misallocation, the central focus of our paper.[3]

Specifically, we estimate the effect of tariffs in export and import markets on labor and capital allocation decisions at the firm level. Other work suggests that lower tariffs induce lower misallocation. In particular, Tito and Wang [2017] offer a framework that ties export shocks to misallocation in presence of financial frictions; in that framework, a higher degree of openness in export markets—which is associated with lower export tariffs—eases borrowing constraints and induce capital and labor choices closer to the optimal equilibrium. Amiti and Konings [2007] and Goldberg et al. [2010] identifies the effect of import tariffs on productivity, a connection that intuitively also relates to misallocation: A decline in import tariffs could either tighten import competition, forcing the least productive firms to shrink or exit the industry, or increases the availability and quality of imported inputs. The former channel would reduce misallocation if the shrinking/exiting firms were also those facing higher frictions, while the latter could facilitate the reallocation of inputs across firms. All told, both channels intuitively imply that lower tariffs should be associated with lower misallocation.

To analyze the empirical relationship between openness and input misallocation, we draw on the annual surveys conducted by the Chinese National Bureau of Statistics (NBS) between 1998 and 2007. We construct firm-level measures of input misallocation that control for firm heterogeneity; our measures show that misallocation in labor and capital markets, on average, moved down over

[1] See Pavcnik [2002] for Chile and Tybout [2003] for a survey of trade liberalization reforms in developing countries.

[2] See Tybout et al. [1991], Tybout and Westbrook [1995], Head and Ries [1999] and Head and Ries [2001] on the role of increasing returns to scale. Trefler [2004], Badinger [2007], and Badinger [2008] analyze gains due to the self-selection of efficient firms into exporting. Amiti and Konings [2007] disentangle the effects of output and input tariffs on productivity.

[3] An exception is the work by Caggese et al. [2019] that relies on firm-specific demand shocks to explore firing decisions in presence of financial frictions. Trade data, in their case, is used to identify demand shocks in conjunction with exchange rates. They find that constrained firms that suffer an exchange rate appreciation shock fire more short-tenured than long-tenured workers, in comparison to financially unconstrained firms. As short-tenured workers, on average, have steeper productivity profiles and lower firing costs than long-tenured workers, their analysis suggests that appreciation shocks—which proxies a negative liberalization shock in export markets, but a positive liberalization shock on import markets—increase misallocation.

our sample period, a time when Chinese firms also experienced tariff declines in export and import markets. Using firm-level import and export tariffs, calculated from trade shares and industry tariffs, we identify firms that have been exposed to large shocks—that is, firms facing above the median tariffs in export and import markets—and look at the impact of those shocks on input choices and misallocation. Our results confirm the intuition that openness is negatively correlated with misallocation: We find that firm facing higher tariffs in either import or export markets—synonym of lower openness—make less optimal input choices and, thus, experience higher misallocation. In particular, firm facing above-the-median export tariffs experience 2 percent of a sd higher capital frictions, while firms facing above-the-median import tariffs experience 1.5 percent of a sd higher frictions in labor markets.

With endogeneity likely affecting the relationships between import tariffs and firm-level characteristics, we resort to an instrumental variable (IV) strategy, first proposed by Brandt et al. [2017], that uses the WTO schedules China agreed to follow upon accession to the WTO. That schedule, which sets the maximum tariff that can be charged for each products and has a compliance rate of around 97% after 2002, is known only in September 2001 and more likely to be exogenous. Our estimates of the effect of trade shocks on measures of misallocation are little changed after adopting this IV strategy.

Following Amiti and Konings [2007], we further decompose the effect of import tariffs into the effects associated with input and output tariffs. We find that labor reallocation mainly occurs because of lower input tariffs, while the selection effect induced by changes in output tariffs does not necessarily cause more distorted firms to exit and, therefore, tends to have an insignificant impact on input allocation. All our results are robust to a specification that uses the measure of misallocation, proposed by Petrin and Sivadasan [2013], that relies on the deviation between marginal benefits and costs associated with labor and capital choices.

Finally, we calculate the contribution of tariff changes towards aggregate misallocation and productivity. We confirm that our measures of misallocation are negatively correlated to sector-level productivity, but our estimates imply that the impact of firm-level tariff reductions on aggregate misallocation and productivity was marginal during our sample period. The presence of more sizeable interactions between trade shocks and misallocation in sector-level regressions, however, suggest that our firm-level estimates could be interpreted as a lower bound of the overall effect of trade shocks on misallocation.

This paper extend Tito and Wang [2017]'s analysis to offer a more complete picture on the relationship between trade openness and misallocation at the firm level. Our work complements

Bai et al. [2019]. In that paper, the authors characterize the effects of trade openness in presence of exogenous frictions in output and input markets; in particular, they highlight that, after trade liberalization, average productivity could be lower if frictions offset true firm's productivity and cause highly distorted/less productive firms to expand after opening to trade. Their prediction is confirmed in a quantification with Chinese data. The fact that our work, instead, highlights that trade liberalization could have the opposite effect on misallocation—that is, trade opening tends to decrease misallocation and increase aggregate productivity—mainly stems out of two differences. First, our analysis identifies the effect of trade on misallocation in continuing firms.[4] Second, and likely most important, our analysis allows for an endogenous response of firm-level distortions to trade shocks, following Tito and Wang [2017], thus suggesting that if frictions themselves respond to trade shocks, the effect on aggregate productivity could still be positive, as in Melitz [2003], even in presence of friction.

The rest of the paper is organized as follows. Section 2 presents the data, and section 3 describes our empirical strategy, shows our results, and discusses the implication for aggregate misallocation and productivity.

2 Empirical Analysis

2.1 Data

The empirical analysis draws on the Annual Survey of Industry (AIS) conducted by China's National Bureau of Statistics. This dataset collects the balance sheet information of all state-owned enterprises and of non-state-owned firms with revenues above five million RMB ($\sim$ USD 700,000) in the industrial sector. Our data extract is restricted to manufacturing firms sampled between 1998 and 2007; it contains 2,226,109 observations (here an observation is a firm-year combination).

The survey collects data on revenues, employment, investments, and material purchases. We follow Brandt et al. [2012] to construct a real capital stock series from investments; moreover, we use their deflators for gross output, input, and capital. Following Yu [2015], we exclude all firms with fewer than 8 employees and with long-term assets above the total reported assets. After also dropping those firms with missing observations, we are left with a working sample of 1,214,513 observations.

[4] Our sector-level regressions suggest that the effect of trade shocks on misallocation could be different in exiting firms, but further empirical work is needed to corroborate this correlation.

In addition, we combine balance-sheet information with export and import customs data for 2000 to 2007. Using matching techniques similar to Yu [2015], we are able to match around 50 percent of the total number of observations. Finally, tariff data used to construct measures of market access are downloaded from the World Integrated Trade Solution (WITS) database.

2.2 Measuring Distortions: Firm-Level Measures

Hsieh and Klenow [2009] show that frictions in input markets induce within-sector variation in the marginal revenue products of labor and capital across firms. Thus, within-sector measures of dispersion of marginal products proxy for the presence of distortions in a sector. Following a similar intuition, we propose firm-level measures of distortions that exploit the deviation of firm-level outcomes from sectoral aggregates, an approach motivated by Tito and Wang [2017]. We construct our measures in two steps. First, we normalize the firm-level input product by the sector return and take log-s; for the labor return, for example,

$$\ln \lambda_{ist} = \ln \frac{\frac{P_{ist}Y_{ist}}{L_{ist}}}{\frac{P_{st}Y_{st}}{L_{st}}}$$

This log-normalization conveniently shifts the distribution of relative labor products around zero. Second, we consider the deviation of relative labor returns from zero by constructing its absolute value; in fact, a sector with zero deviations across firms would approximate the frictionless equilibrium. In absence of heterogeneous frictions, the labor return of each individual firm would coincide with the sector return–i.e., $\ln \lambda_{ist} = 0$ for all firms in sector s at time t. Positive and negative deviations of individual returns from zero reveal the presence of heterogeneous wedges affecting labor choices. In particular, firms with $\ln \lambda_{ist} > 0$ demand less labor than the average firm in the sector, while firms with $\ln \lambda_{ist} < 0$ demand more labor than the average firm; if there were no other sources of firm heterogeneity, those differences in demand would be entirely explained by the presence of distortions. Thus, $|\ln \lambda_{ist}|$ identifies the deviation from the sectoral averages and captures firm-level frictions in the labor market. Similarly, the log product of capital relative to the sector aggregate, $\ln \kappa_{ist}$

$$\ln \kappa_{ist} = \ln \frac{\frac{P_{ist}Y_{ist}}{K_{ist}}}{\frac{P_{st}Y_{st}}{K_{st}}}$$

measures, in absolute value, distortions in capital markets.

Haltiwanger et al. [2018] point out that the measures of frictions based on Hsieh and Klenow [2009], however, require restrictive assumptions on the demand and supply system and may reflect factors other than distortions. In particular, we find that firm heterogeneity in productivity, labor shares, or markups create spurious dispersion across firm input products, and, thus, in our empirical analysis, we controls for those differences to effectively capture the presence of frictions within sectors.[5]

As an additional source of validation, we rely on Petrin and Sivadasan [2013]'s measure of misallocation, "input gaps", calculated as the gap between a firm's marginal input product and its marginal cost,

$$G_{ist}^{j} = \left| MP_{ist}^{j} - p_{ist} \right|, \quad j = L, K$$

As for our baseline measures, Petrin and Sivadasan [2013]'s gaps identify misallocation from firms' suboptimal input choices. Though Petrin and Sivadasan [2013]'s gaps are based on less restrictive assumptions than Hsieh and Klenow [2009]'s, sources of firm heterogeneity could also inflate them.

In a direct comparison across the two measures of misallocations, we find that they are positively correlated: in particular, we find a correlation of 0.25 between measures of frictions in labor markets, G_{ist}^{L} and $|\ln \lambda_{ist}|$, and a correlation of 0.46 between measures of frictions in capital markets, G_{ist}^{K} and $|\ln \kappa|$.[6] The positive correlation suggests that both measures are capturing, at least in part, common factors driving suboptimal input choices. While our analysis includes results on both measures, we rely on $|\ln \lambda_{ist}|$ and $|\ln \kappa_{ist}|$ in our baseline specification as their scale-free characterization calls for an easier interpretation.[7]

Preliminary Evidence: Frictions and Trade Openness

On average, firm-level frictions declined between 1998 and 2007. Figures 1 and 2 summarize the evolution of the average within-industry distortions in labor and capital markets. We construct these estimates by regressing $|\ln \lambda_{ist}|$ and $|\ln \kappa_{ist}|$ on time dummies after including controls that extract firm-level differences in productivity, labor shares, and mark-ups; each point estimate represents the average distortion in a particular year relative to 1998, the base year. The figures suggest some differences across input markets. While distortions in the labor market trended down in the early part of the sample but moved up after 2004, frictions in capital markets declined throughout the

[5] See Tito and Wang [2017] for more details on the role of firm observables.

[6] We proxy marginal input products with average products, the marginal wage with the average wage, and the marginal rental rate of capital with the average interest rate .

[7] $|\ln \lambda_{ist}|$ and $|\ln \kappa_{ist}|$ capture percent absolute deviation from the sector outcomes; the interpretation for G_{ist}^{L} and G_{ist}^{K}, instead, depends on the unit of measurement.

sample period: our proxy suggests that capital distortions were 40 percent lower in 2007 relative to 1998. Figures A1 and A2 highlight qualitatively similar patterns for Petrin and Sivadasan [2013]'s measures of distortions; a main difference applies to G^L_{ist} (figure A1), which displays a much larger increase over the last years in the sample, suggesting a rise in labor distortions relative to 1998.

Over the same period, Chinese firms experienced notable tariff declines, despite tariff reductions were implemented since the mid-nineties. Both export and import tariffs continued to decrease after 1998 (see figure A3); the decline accelerated around 2001, after China's entry into the World Trade Organization. Export tariffs fell 3 percentage points between 2001 and 2004, from 12.4 percent in 2001 to 9.8 percent in 2004; they continued declining to 8.9 percent by 2007, the last year in our sample. The decline is more pronounced for import tariffs, which plunged around 4 percentage points between 2001 and 2002–from 12.81 percent in 2001 to 8.21 percent in 2002–and continued to slide to 4.75 percent by the end of our sample period.

While the reduction in tariffs broadly aligns with the pattern of distortions, table 1 takes a first look at the firm-level relationship between frictions and openness, proxied by firm export and import status, in a specification that controls only for sector-year and province-year fixed effects. With the exception of the effect of import status on Petrin and Sivadasan [2013]'s labor gap, we find that firms that either export or import display lower misallocation relative to non-traders. In particular, looking within an industry, exporting firms display 4-to-12 percent of a standard deviation lower labor distortions and 4-to-7 percent of a standard deviation lower capital distortions relative to firms not engaged in foreign markets; labor misallocation at an importer is 2 percent of a standard deviation lower and capital misallocation is 9-to-19 percent of a sd lower than at a non-trader within the same industry.

This preliminary analysis is only suggestive of a relationship between frictions in input markets and trade openness due to the endogeneity of firm characteristics and important omitted variables—such as firm productivity, demand heterogeneity, and size differences—which may induce different input choices across firms. Next section explores an empirical strategy more robust to identifying a causal relationship.

3 Regression Analysis

3.1 Trade Shocks and Misallocation

To identify the impact of trade openness on input choices, our main specification relates firm-level measures of misallocation to shocks to openness in import and export markets,

$$y_{ist} = \beta_0 + \beta_1 \cdot \text{Export Shock}_{ist} + \beta_2 \cdot \text{Import Shock}_{ist} + \gamma X_{ist} + D_i + D_{st} + \varepsilon_{ist} \tag{1}$$

where y denotes a measure of firm-level distortion. In absence of frictions, measures of distortions described in section 2.1 would be zero after controlling for sources of firm heterogeneity; positive and negative deviations from zero are associated with frictions affecting labor and/or capital choices.

β_1 and β_2 are our main coefficients of interest; they investigate the impact of shocks in import and export markets on our measures of misallocation. We conjecture that shocks to openness could either affect input choices in presence of exogenous frictions or have a direct impact on the source of misallocation, a case when frictions would endogenously respond to trade shocks. To quantify shocks to openness, we rely on export and import tariffs that firms face and follow two steps to construct our main regressors. First, we create firm-specific tariffs for all firms in our sample. We assign to non-exporters/non-importers the tariff of the industry in which they are classified. For firms operating in foreign markets, instead, we compute trade-weighted tariffs, using as weights the firm-level trade shares in the first year of foreign presence.[8] In particular, our firm-level tariffs for firm i in year t,

$$\text{Exp. Tariff}_{ist} = \sum_k \frac{\text{X}^k_{i,\text{first year}}}{\sum_k \text{X}^k_{i,\text{first year}} + \text{D}^s_{i,\text{first year}}} \text{exp.}\tau^k_t + \frac{\text{D}^s_{i,\text{first year}}}{\sum_k \text{X}^k_{i,\text{first year}} + \text{D}^s_{i,\text{first year}}} \text{exp.}\tau^s_t$$

$$\text{Imp. Tariff}_{ist} = \sum_k \frac{\text{M}^k_{i,\text{first year}}}{\sum_k \text{M}^k_{i,\text{first year}} + \text{D}^s_{i,\text{first year}}} \text{imp.}\tau^k_t + \frac{\text{D}^s_{i,\text{first year}}}{\sum_k \text{M}^k_{i,\text{first year}} + \text{D}^s_{i,\text{first year}}} \text{imp.}\tau^s_t$$

where $\text{exp.}\tau^s_t$ and $\text{imp.}\tau^s_t$ denote the sector-level export and import tariffs; $\text{X}^k_{i,\text{first year}}$, $\text{M}^k_{i,\text{first year}}$, and $\text{D}^k_{i,\text{first year}}$ represent exports, imports, and domestic production in the first year of operation. Second, we exploit the within-sector tariff distribution to identify larger shocks; in particular, in our baseline regression, we construct an indicator identifying firms facing tariffs above median of the

[8] Our export/import shares are relative to total production and, thus, account for the tariff of the industry in which a firm is classified, as with domestic producers.

tariff distribution, *Tariffs Above Median*$_{ist}$.[9] Our firm-level indicators of above-the-median tariffs appropriately capture differences in openness across firms: we find a correlation of -.42 with firm export status and of -.64 with firm import status. Under this characterization, we expect $\beta_1 > 0$ and $\beta_2 > 0$, that is, firms facing above-the-median tariffs make input choices characterized by larger deviations from what is optimal.

Our baseline regression includes a large set of firm, sector-time, and province-time fixed effects; in particular, the presence of firm dummies implies that we identify the effect of openness on misallocation only for continuing firms.

In addition, our specification also includes controls of firm heterogeneity that affect input choices and that may cause spurious correlation between measures of openness and measures of distortions. In particular, we include the profit margin, $\ln \psi_{ist}$, to control for differences in mark-ups, and we use TFP_{ist} and the firm size proxies to control for heterogeneity in productivity.[10]

Finally, Tito and Wang [2017] show that older firms tend to face less binding constraints and make capital and labor choices closer to the optimal allocation; thus, in our specification, we also include firm's age to isolate the role of openness in resource allocation.[11]

3.2 Results

This sections summarizes the estimates for model (1). Table 2 analyzes the effect of higher tariffs in import and export markets on firm input allocation, measured by $|\ln \lambda_{ist}|$ and $|\ln \kappa_{ist}|$. Our sample excludes firms in processing zones as those firms face different tariff regimes. The coefficients on the tariff indicators are positive across all column, but the effect of import shocks is significant only for labor choices, and the effect of export shocks tends to be significant only for capital choices. Those results are robust to the inclusions of controls for firm heterogeneity and firm age. In terms of magnitudes, we rely on the estimates in columns (3) and (6): firm facing above-the-median export tariffs experience 2 percent of a sd higher capital frictions, while firms facing above-the-median import tariffs experience 1.5 percent of a sd higher frictions in labor markets.

Other controls tend to display expected signs. In particular, more productive firms face higher $|\ln \lambda_{ist}|$ and $|\ln \kappa_{ist}|$: this finding underlines that fact that firms with higher productivity demand more labor and capital and, thus, have a higher labor and capital products relative to the sector. Bigger firms, instead, tend to face lower frictions in input markets; this result is consistent with a

[9] Among other robustness analysis, we also investigate shocks associated with the 75th percentiles.
[10] Hsieh and Song [2015] show that the profit margin is a proxy for mark-ups.
[11] We calculate firm age as the difference between the sample year and year of birth.

model where entering in foreign markets is isomorphic to a revenue shock. Lower frictions apply also to older firms, as suggested by Tito and Wang [2017]. Finally, the profit margin exhibits opposite effects on labor and capital choices, likely reflecting some patterns of substitutability across inputs: while a higher profit margin is associated with larger deviations from optimal labor choices, the profit margin is negatively correlated with distortions in capital markets.

Results that rely on Petrin and Sivadasan [2013]'s measures of misallocation, are shown in table A1. The relation between tariffs and input gaps continues to display the expected positive sign but, with significant coefficients across all columns, appears even stronger than in our baseline. The magnitudes remain roughly similar: Relying on the estimates on columns (3) and (6), which condition on a set of controls analogous to table 2, we find that firms facing above-the-median export tariffs experience 1.6 percent of sd higher labor and 2.8 percent of a sd higher capital distortions, while facing above-the-median import tariffs is associated with 2.4 percent of a sd higher output distortions and 3.2 percent of a sd higher capital distortions. Other differences from the baseline results arise over the effect of some of the controls: we find that profit margin is negatively correlated with input gaps across all columns and that the effect of firm size switches sign between the labor gap and capital gap specification. The effects of total factor productivity and firm age, instead, are consistent across the two specifications: productivity is positively correlated with Petrin and Sivadasan [2013]'s measures of misallocation—a correlation that captures the higher input demand at more productive firms—and older firms display lower misallocation, in the spirit of Tito and Wang [2017].

The impact of larger tariff shocks—proxied by an indicator equal to 1 for firms facing tariffs above the 75th percentile of the tariff distribution, on measures of misallocation—is shown in tables A2 and A3 and is not significantly different from our baseline results. Table A3 highlights that the effect of larger export shocks is less robust on labor choices but continues to be important for capital choices.

Instrumental Variable Strategy

Our strategy of proxying trade shocks with firm-level tariffs is, however, not robust to concerns of endogeneity. While export tariffs are more likely to be exogenous since they are set by foreign governments, the political economy literature argues that firms with larger political power may influence import tariff schedules and tend to display different characteristics. Thus, this section develops an instrumental variable (IV) strategy for import tariffs. Following Brandt et al. [2017], we use the import tariff schedule that China agrees to follow upon its accession to the WTO in Dec

2001 as an instrument for applied tariffs. The schedule, which sets the maximum tariff that can be charged for each products and has a compliance rate around 97% after 2002, is known only in September 2001 and, therefore, more likely to be exogenous. With above-the-median import tariffs as our main dependent variable, we similarly construct firm-level import tariffs based on the WTO schedules and identify firms facing above-the-median WTO schedules. As in our baseline, our model includes the full set of firm-level controls as well as firm, sector-time, and province-time fixed effects that also capture political economy factors that are firm-specific or that vary at the sector-time and province-time level.

Table 3 shows the second stage results with $|\ln \lambda_{ist}|$ and $|\ln \kappa_{ist}|$ as our dependent variables.[12] Our findings on the relation between import shocks and input choices remain robust: import tariffs continue to be positively correlated with measures of misallocation, although their impact is significant only in labor markets. Furthermore, the magnitudes of the effects of both import and export tariff are unchanged relative to our baseline estimates as are the effect of other controls.

The results that use Petrin and Sivadasan [2013]'s gaps and adopt the IV strategy are shown in table A5. In this specification, the effect of import tariffs on misallocation is somewhat larger than in our baseline: firms facing above-the-median import tariffs experience 5.6 percent of sd higher labor and 6.7 percent of a sd higher capital distortions, conditioning on all other controls (columns (3) and (6)). These results suggest that the OLS estimates in table A1 may be biased downwards. If the omitted variable in the baseline specification captures the firm political influence, the higher coefficient on import shocks implies that firms investing more in lobbying or other politically oriented activities face less distortions in input market under a positive correlation between political influence and the probability to attain higher import tariffs. This characterization suggest that the unobserved relation between political influence and misallocation resembles that at larger firms, an assumption that is consistent with the fact that lobbying firms are more likely to be larger than non-lobbying firms.[13] The same type of bias does not apply to the results in table 3 because our measures of misallocation, $|\ln \lambda_{ist}|$ and $|\ln \kappa_{ist}|$, are normalized by sector-level outcomes: lobbying on import tariffs would likely benefits all firms in the sector, thus shifting the average sector-level distribution of input products. In table A5, the effect of above-the-median export tariffs and of other controls is unchanged relative to the results in table A1.

Looking into the Effect of Import Tariffs: Output and Input Tariffs

[12] First stage results are reported in table A4. Import tariffs are positively correlated with WTO import schedules; the table also reports the first-stage F-statistic, which is well above the recommended threshold characterizing weak instruments.

[13] See, for example, Borghesi and Chang [2015].

The impact of import tariff shocks on input allocation and productivity could reflect shocks to output tariffs and/or input tariffs. Those two sources of variation underscore different channels for the effect. In particular, empirical studies of the impact of trade liberalization on productivity suggest that reductions in output tariffs spur productivity via increased competition, while lower input tariff may affect productivity through the expansion in the variety of intermediate inputs available for production or the access to higher-quality inputs. We speculate that those mechanisms imply that lower tariffs are associated with lower misallocation; in fact, lower output tariffs may force the most constrained firms to shrink or exit the industry, while access to more or higher-quality intermediate inputs may affect the within-firm/within-sector allocation of inputs. This section provides evidence on these two channels.

We first document general trends of output and input tariffs. Using the concordance developed by Brandt et al. [2017], we map the HS product classification to the four-digit China Industrial Classification (CIC) system; we, then, construct firm-level output tariffs by rescaling import tariff with (first-year) export and production values weights,

$$\text{Output Tariff}_{ist} = \sum_k \frac{\text{X}^k_{i,\text{first year}}}{\sum_k \text{X}^k_{i,\text{first year}} + \text{D}^s_{i,\text{first year}}} \tau^k_t + \frac{\text{D}^s_{i,\text{first year}}}{\sum_k \text{X}^k_{i,\text{first year}} + \text{D}^s_{i,\text{first year}}} \tau^s_t$$

where k denotes a 4-digit CIC sector, τ^k_t represent the import tariff in sector k, $\text{X}^k_{i,\text{first year}}$ and $\text{D}^k_{i,\text{first year}}$ capture firm i exports and domestic production in sector k in the first year of operation. This formula extends Yu [2015]'s definition by taking into account firms' domestic production; as with import and export tariffs, we consider domestic production to construct a tariff also for firms non directly involved in foreign markets. The input tariffs are weighted averages of import tariffs, rescaled by industry input shares and using first-year import and production values as weights,

$$\text{Input Tariff}_{ist} = \sum_{k,j} \frac{\text{M}^k_{i,\text{first year}}}{\sum_k \text{M}^k_{i,\text{first year}} + D_{i,\text{first year}}} \omega^{j,k}_{2002} \tau^k_t + \sum_j \frac{D_{i,\text{first year}}}{\sum_k \text{M}^k_{i,\text{first year}} + D_{i,\text{first year}}} \omega^{j,s}_{2002} \tau^s_t$$

where $M^k_{i,\text{first year}}$ denotes firm imports in industry k for the first year of presence in import markets, and $\omega^{j,k}$ represents the share of inputs from industry j used in industry k. Input shares are obtained from China's 2002 input-output table. Figure A4 summarizes the average evolution of output and input tariffs over our sample period.[14] In the late 1990s, output tariffs were, on average, higher than input tariffs, but the gap between the two measures has shrunk overtime: output tariffs fell from 17.1 percent in 1998 to 5.7 percent in 2007, while the decline in input tariffs, from 13.5 percent in

[14] We use trade sector shares to construct tariffs prior to 2000, the first year in our custom database.

1998 to 5.8 percent in 2007, has been a little more moderate. Table A6 documents a large degree of heterogeneity across sectors: the large variability of the output and input tariff distributions notably shrinks over time, as sectors facing higher tariffs experience larger declines; by 2007, output tariffs range between 2 and 22 percent, while input tariffs span the 1-to-12 percent range.

Moving back to our regression analysis, table 4 reports the effect of output and input tariffs on measures of misallocation; as in our baseline, we focus on the impact of above-the-median tariffs. Our analysis reveals that within-sector reallocation of inputs is primarily linked to input tariff shocks; their impact is significant for measures of labor and capital misallocation: using the estimates in columns (3) and (6), firms facing above-the-median input tariffs experience 2.1 percent of sd higher labor and 1.8 percent of a sd higher capital distortions. Output tariffs are positively correlated with measures of frictions in input market, but their effect is not significant: we interpret this result as indicating that the impact of tighter import competition, associated with higher output tariffs, is either reflected mostly in sector-level measures of misallocation or exiting/shrinking firms are not necessarily those that face higher frictions in input markets. The dominant role of input tariff is also confirmed in our alternative specification that uses Petrin and Sivadasan [2013]'s measures of misallocation, shown in table A7. While output tariffs tend to be significant across all columns, the impact of input tariffs is significantly larger: above-the-median output tariffs are associated with 2.1 percent of a sd higher labor friction and 1 percent of a sd higher capital frictions compared with 5.5 percent of sd higher labor and 6.6 percent of a sd higher capital frictions for above-the-median input tariffs.

The effect of above-the-median export tariffs in both tables 4 and A7 remain consistent with our baseline.

Concerns of endogeneity we described earlier also apply to output and input tariff. We develop a similar strategy that relies on the 2001 WTO schedules to construct instruments for output and input tariffs. We present the IV results in tables 5 and A8. Table 5 confirms that shocks to input tariffs tend to significantly affect the allocation of labor inputs; the effect on capital choices is, instead, not significant once we control also for firm size and age, after having included all other firm characteristics. In table A8, both higher output and input tariffs are associated with higher misallocation, but the effect of input tariffs remains more than double that of output tariff. Relative to the specification shown in table A7, the point estimates on above-the-median output tariffs are higher, consistent with our intuition that the coefficients on import tariffs tend to be biased towards zero; however, the difference in this case is not statistically significant.[15]

[15] We expect the omitted variable bias related to political influence to have a different effect on input tariffs.

3.3 Implications for Aggregate Misallocation and Productivity

Our analysis so far has highlighted that trade shocks have a significant effect on the allocation of inputs, with a lower degree of openness inducing higher misallocation in input markets. This section investigates how the impact of trade shocks on firm-level input allocation translates into aggregate misallocation and productivity. To answer this question, we first look at the relationship between misallocation and productivity. While the effect of misallocation on productivity is well-known since the seminal work by Hsieh and Klenow [2009], we quantify that effect in our data. Table 6 looks at the sector-level relation between misallocation and total factor productivity (TFP). We find that capital misallocation has a negative and significant impact on TFP, a result that is robust to the inclusion of sector-level controls, such as age and the profit margin. Relying on the estimates in column (4) to characterize the magnitudes, a one-standard-deviation decline in capital misallocation is associated with a 7 percent of a sd increase in productivity. The effect of labor misallocation on productivity tends, instead, not to be significantly different from zero, with a point estimate that shows a negative sign only in the column (1).[16] Thus, combining our firm-level estimates on misallocation with aggregate effects on productivity, our results imply that facing above the median tariffs lowers productivity by 0.15 percent of a sd through firm-level input choices.

This magnitude, however, implies that the share of firms facing above-the-median tariffs declined from one to zero over our sample period. To precisely calibrate the effect on productivity over the period, we look at the actual change in the share of firms facing above-the-median tariffs across sectors. The share of firms facing above-the-median export tariffs declined, on average, 2 percentage points (pp) between 2001 and 2007; over the same period, a 2pp decline also occurred in the share of firms facing above-the-median output tariffs, while the share of firms facing above-the-median input tariffs declined 4 pp. Thus, using the estimates in table 5, we find that shocks to openness reduced labor misallocation by 0.06 percent and capital misallocation by 0.02 percent between 2001 and 2007; those effects map to an increase in productivity of 0.004 percent.[17] While those magnitudes suggest that the effect of facing above-the-median tariffs was marginal on both aggregate misallocation and

Continuing to assume a negative correlation between political influence and measures of misallocation, politically connected firms are likely to petition for lower tariffs in input markets. However, depending on the number of inputs used in the production process, lobbying on output tariffs might be an easier investment. We find some evidence of upward bias on input tariff coefficients in the results for labor misallocation— tables A7 and A8; the difference between the two set of estimates is, however, not significant. Furthermore, the bias seem to go the other way for capital misallocation.

[16] This result could account for the fact that positive trade shocks might not lower misallocation if focusing on the extensive margin of entry and exit, consistent with the findings in Bai et al. [2019].

[17] Using the estimates from table A8, we find that shocks to openness reduced labor misallocation by 3.5 percent and capital misallocation by 0.7 percent; however, Petrin and Sivadasan [2013]'s measure of labor misallocation was little change, while their measure of capital misallocation showed 20 percent decline.

productivity, our estimates, however, focus on firm-level effects and abstract from declines in the median tariff, as well as other changes in the distribution of tariffs.[18] We argue that those estimates likely represent a lower bound of the effects of trade shocks on aggregate misallocation.

To provide some suggestive evidence of the broader interaction between tariffs and misallocation, we looked at the relationship between sector-level measures of misallocation and tariffs. Table A10 presents our results for import and export tariffs, where we continue to use WTO schedules to instrument import tariffs.[19] While export tariffs do not have a significant effect on sector level misallocation, higher import tariff are associated with higher misallocation; in particular, a one-standard-deviation higher import tariffs lower labor misallocation by 30 percent of a sd (column (1)). Within our sample, with import tariffs declining 6 percentage points between 2001 and 2007, the decline accounts for nearly all of the decline in labor misallocation.[20] The decline in import tariffs also contributed to lower capital misallocation if looking at the results using the Petrin and Sivadasan [2013]'s measure (column (4)): a one-standard-deviation higher import tariffs lower capital misallocation by 15 percent of a sd (column (4)), accounting for more than half of the decline in G^K. The fact that the sector-level effects tend to be much larger than the firm-level effects suggests that our firm-level results precisely identify and isolate only part of the relation between trade shocks and misallocation, confirming our intuition that the effect we document should be considered a lower bound.

4 Conclusions

This paper estimates the impact of openness on the reallocation of inputs across firms, a channel for the realization of the gains from trade. We find that firms' input choices significantly respond to trade shocks quantified by firm-level tariffs in export and import markets. In particular, we find that firm facing above the median tariffs in import market tend to face larger distortions in labor markets, while the effect of above-the-median export tariffs is mainly directed at capital allocation. The import tariff effect is robust to an instrumental variable strategy that relies on the schedules China agreed to follow upon accession to the WTO. Our decomposition of the effect of import shocks into output and input tariffs indicates a larger role for input tariffs: in our baseline specification,

[18] Over the same period, labor and capital misallocation declined 3 percent and 10 percent, respectively, while total factor productivity rose around 25 percent.

[19] We do not include output and input tariffs separately due to their high collinearity at the sector level.

[20] While column (2) also indicates a significant interaction between import tariffs and labor misallocation using Petrin and Sivadasan [2013]'s measure, this result is not consistent with the fact that G^L rose over our sample period.

output tariffs do not significantly affect input choices, while input tariffs significantly reduce labor misallocation. All told, facing above the median tariff lower productivity, but we estimate that the impact of firm-level tariff reductions on productivity through misallocation was marginal in our sample period. The channel that we identify, however, operates only via firm-level choices and, looking at sector-level correlations, likely represent a lower bound of overall effect of trade shocks on misallocation and productivity.

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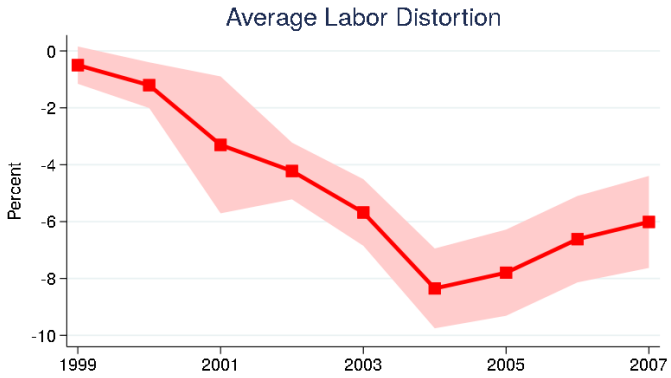
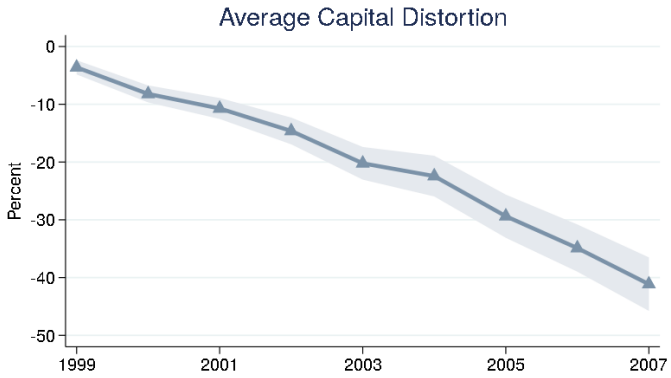


Source: China's NBS, AIS Data, 1998-2007.
Notes: the average output distortion is obtained from a regression of residual labor returns on time dummies; the estimates are relative to 1998. Red-shaded area denotes the 95 percent confidence interval.

Figure 1: Dispersion across Labor Returns



Source: China's NBS, AIS Data, 1998-2007.
Notes: the average capital distortion is obtained from a regression of residual capital returns on time dummies; the estimates are relative to 1998. Red-shaded area denotes the 95 percent confidence interval.

Figure 2: Dispersion across Capital Returns

Table 1: Misallocation, Exporters, and Importers: Descriptive Evidence

Variables	(1) $\lvert\ln\lambda\rvert$	(2) G^L	(3) $\lvert\ln\kappa\rvert$	(4) G^K
Export	-0.028***	-2.954***	-0.065***	-0.149***
	(0.003)	(0.113)	(0.004)	(0.018)
Import	-0.011***	4.925***	-0.082***	-0.708***
	(0.003)	(0.185)	(0.004)	(0.019)
Sector-Year	y	y	y	y
Prov-Year	y	y	y	y
Obs.	1,181,051	1,181,051	1,181,051	1,181,051
R^2	0.043	0.100	0.026	0.062
ln_age				

$\ln\lambda$: log return to labor relative to the sector.
G^L: labor gap from Petrin and Sivadasan [2013].
$\ln\kappa$: log return to capital relative to the sector.
G^K: capital gap from Petrin and Sivadasan [2013].
Export_t: export status for firm i at time t.
Import_t: import status for firm i at time t.
Legend: *** significant at 1%, ** at 5%, * at 10%.
Notes: OLS regressions, 1998-2007. Firm-level clustered standard errors are reported in parenthesis.

Table 2: Misallocation, Export Tariffs, and Import Tariffs

Variables	(1)	(2)	(3)	(4)	(5)	(6)
		$\lvert\ln\lambda\rvert$			$\lvert\ln\kappa\rvert$	
Exp Tariffs Above Median	0.005	0.005	0.003	0.026***	0.025***	0.018***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
Imp Tariffs Above Median	0.012***	0.013***	0.011***	0.013***	0.012**	0.004
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
TFP	0.066***	0.066***	0.066***	0.267***	0.268***	0.309***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
$\ln\psi$		0.011***	0.012***		-0.014***	-0.014***
		(0.001)	(0.001)		(0.001)	(0.001)
ln Age			-0.031***			-0.193***
			(0.003)			(0.004)
$\ln K$			-0.027***			
			(0.001)			
ln Empl						-0.146***
						(0.003)
Sector-Year	y	y	y	y	y	y
Prov-Year	y	y	y	y	y	y
Firm FE	y	y	y	y	y	y
Obs.	1,205,375	1,205,375	1,205,375	1,205,375	1,205,375	1,205,375
R^2	0.015	0.015	0.016	0.057	0.058	0.073
Number of Firm IDs	406,170	406,170	406,170	406,170	406,170	406,170

$\ln\lambda$: log return to labor relative to the sector.
$\ln\kappa$: log return to capital relative to the sector.
Exp Tariffs Above Median: dummy equal to one if firm export tariff is above the 50th percentile within an industry.
Imp Tariffs Above Median: dummy equal to one if firm import tariff is above the 50th percentile within an industry.
TFP: total factor productivity, calculated according to the Wooldrige (2009) extension to the Levinshon-Petrin methodology.
$\ln\psi$: profit margin.
ln Age: log firm age.
$\ln K$: log capital.
ln Empl: log employment.
Legend: *** significant at 1%, ** at 5%, * at 10%.
Notes: FE firm-level regressions, 2000-2006. Our sample excludes processing exporters and importers. Standard errors are clustered at the firm level.

Table 3: Misallocation and Tariffs: Instrumenting Import Tariffs with WTO Schedules

Variables	(1)	(2)	(3)	(4)	(5)	(6)
		$\lvert\ln\lambda\rvert$			$\lvert\ln\kappa\rvert$	
Exp Tariffs Above Median	0.005	0.005	0.003	0.026***	0.025***	0.018***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
Imp Tariffs Above Median	0.013***	0.013***	0.010**	0.013**	0.013***	0.000
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
TFP	0.066***	0.066***	0.066***	0.267***	0.268***	0.309***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
$\ln\psi$		0.011***	0.012***		-0.014***	-0.014***
		(0.001)	(0.001)		(0.001)	(0.001)
ln Age			-0.031***			-0.193***
			(0.003)			(0.004)
$\ln K$			-0.027***			
			(0.001)			
ln Empl						-0.146***
						(0.003)
Sector-Year	y	y	y	y	y	y
Prov-Year	y	y	y	y	y	y
Firm FE	y	y	y	y	y	y
Obs.	1,205,375	1,205,375	1,205,375	1,205,375	1,205,375	1,205,375
R^2	0.015	0.015	0.016	0.057	0.058	0.073
Number of Firm IDs	406,170	406,170	406,170	406,170	406,170	406,170

$\ln\lambda$: log return to labor relative to the sector.
$\ln\kappa$: log return to capital relative to the sector.
Exp Tariffs Above Median: dummy equal to one if firm export tariff is above the 50th percentile within an industry.
Imp Tariffs Above Median: dummy equal to one if firm import tariff is above the 50th percentile within an industry.
TFP: total factor productivity, calculated according to the Wooldrige (2009) extension to the Levinshon-Petrin methodology.
$\ln\psi$: profit margin.
ln Age: log firm age.
$\ln K$: log capital.
ln Empl: log employment.
Legend: *** significant at 1%, ** at 5%, * at 10%.
Notes: FE firm-level regressions, 2000-2006. Our sample excludes processing exporters and importers. Standard errors are clustered at the firm level.

Table 4: Misallocation and Tariffs: Input and Output Tariffs

Variables	(1)	(2)	(3)	(4)	(5)	(6)
		$\lvert\ln\lambda\rvert$			$\lvert\ln\kappa\rvert$	
Exp Tariffs Above Median	0.004	0.004	0.002	0.023***	0.022***	0.017***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
Out Tariffs Above Median	0.006	0.006	0.005	0.012**	0.012**	0.004
	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)
Inp Tariffs Above Median	0.019***	0.020***	0.015***	0.031***	0.031***	0.014**
	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)
TFP	0.066***	0.066***	0.066***	0.268***	0.268***	0.309***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
$\ln\psi$		0.011***	0.012***		-0.014***	-0.014***
		(0.001)	(0.001)		(0.001)	(0.001)
ln Age			-0.029***			-0.193***
			(0.003)			(0.004)
$\ln K$			-0.027***			
			(0.001)			
ln Empl						-0.146***
						(0.003)
Sector-Year	y	y	y	y	y	y
Prov-Year	y	y	y	y	y	y
Firm FE	y	y	y	y	y	y
Obs.	1,214,513	1,214,513	1,214,513	1,214,513	1,214,513	1,214,513
R^2	0.015	0.015	0.016	0.057	0.058	0.073
Number of Firm IDs	409,213	409,213	409,213	409,213	409,213	409,213

$\ln\lambda$: log return to labor relative to the sector.
$\ln\kappa$: log return to capital relative to the sector.
Exp Tariffs Above Median: dummy equal to one if firm export tariff is above the 50th percentile within an industry.
Out Tariffs Above Median: dummy equal to one if firm output tariff is above the 50th percentile within an industry.
Inp Tariffs Above Median: dummy equal to one if firm input tariff is above the 50th percentile within an industry.
TFP: total factor productivity, calculated according to the Wooldrige (2009) extension to the Levinshon-Petrin methodology.
$\ln\psi$: profit margin.
ln Age: log firm age.
$\ln K$: log capital.
ln Empl: log employment.
Legend: *** significant at 1%, ** at 5%, * at 10%.
Notes: FE firm-level regressions, 2000-2006. Our sample excludes processing exporters and importers. Standard errors are clustered at the firm level.

Table 5: Misallocation and Tariffs: Instrumenting Input and Output Tariffs

Variables	(1)	(2)	(3)	(4)	(5)	(6)
		$\lvert\ln\lambda\rvert$			$\lvert\ln\kappa\rvert$	
Exp Tariffs Above Median	0.002	0.002	0.001	0.024***	0.023***	0.019***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
Out Tariffs Above Median	0.008	0.008	0.007	0.009	0.009	-0.002
	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
Inp Tariffs Above Median	0.032***	0.032***	0.028***	0.022***	0.022***	0.001
	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)
TFP	0.066***	0.066***	0.066***	0.268***	0.268***	0.309***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
$\ln\psi$		0.011***	0.012***		-0.014***	-0.014***
		(0.001)	(0.001)		(0.001)	(0.001)
ln Age			-0.029***			-0.193***
			(0.003)			(0.004)
$\ln K$			-0.027***			
			(0.001)			
ln Empl						-0.146***
						(0.003)
Sector-Year	y	y	y	y	y	y
Prov-Year	y	y	y	y	y	y
Firm FE	y	y	y	y	y	y
Obs.	1,214,513	1,214,513	1,214,513	1,214,513	1,214,513	1,214,513
Number of Firm IDs	409,213	409,213	409,213	409,213	409,213	409,213

$\ln\lambda$: log return to labor relative to the sector.
$\ln\kappa$: log return to capital relative to the sector.
Exp Tariffs Above Median: dummy equal to one if firm export tariff is above the 50th percentile within an industry.
Out Tariffs Above Median: dummy equal to one if firm output tariff is above the 50th percentile within an industry.
Inp Tariffs Above Median: dummy equal to one if firm input tariff is above the 50th percentile within an industry.
TFP: total factor productivity, calculated according to the Wooldrige (2009) extension to the Levinshon-Petrin methodology.
$\ln\psi$: profit margin.
ln Age: log firm age.
$\ln K$: log capital.
ln Empl: log employment.
Legend: *** significant at 1%, ** at 5%, * at 10%.
Notes: FE firm-level regressions, 2000-2006. Our sample excludes processing exporters and importers. Standard errors are clustered at the firm level.

Table 6: Aggregate Misallocation and TFP

Variables	(1)	(2)	(3)	(4)
	Total Factor Productivity			
Avg $\lvert\ln\lambda\rvert$	-0.023		0.078	0.057
	(0.055)		(0.054)	(0.047)
Avg $\lvert\ln\kappa\rvert$		-0.178***	-0.206***	-0.200***
		(0.052)	(0.052)	(0.048)
Avg $\ln\psi$				0.110***
				(0.029)
Avg Age				-0.334***
				(0.046)
Year	y	y	y	y
Sector FE	y	y	y	y
Obs.	4,180	4,180	4,180	4,180
R^2	0.902	0.904	0.904	0.916
Number of Industries	423	423	423	423

TFP: average sector-level total factor productivity, calculated according to the Wooldrige (2009) extension to the Levinshon-Petrin methodology.
Avg $\lvert\ln\lambda\rvert$: average dispersion across absolute relative labor returns within sector.
Avg $\lvert\ln\kappa\rvert$: average dispersion across absolute relative capital returns within sector.
Avg $\ln\psi$: average profit margin within sector.
Avg Age: average firm age within sector.
Legend: *** significant at 1%, ** at 5%, * at 10%.
Notes: Sector-level FE regressions. Standard errors, clustered at the sector levels, are reported in parenthesis.

A Additional Empirical Results

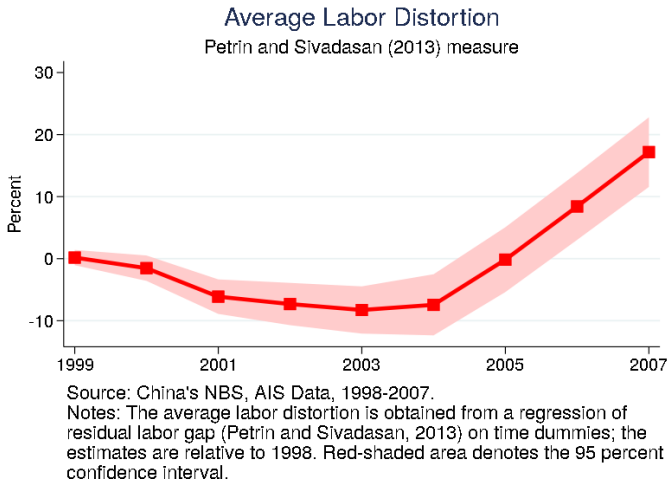


Figure A1: Dispersion across Labor Returns

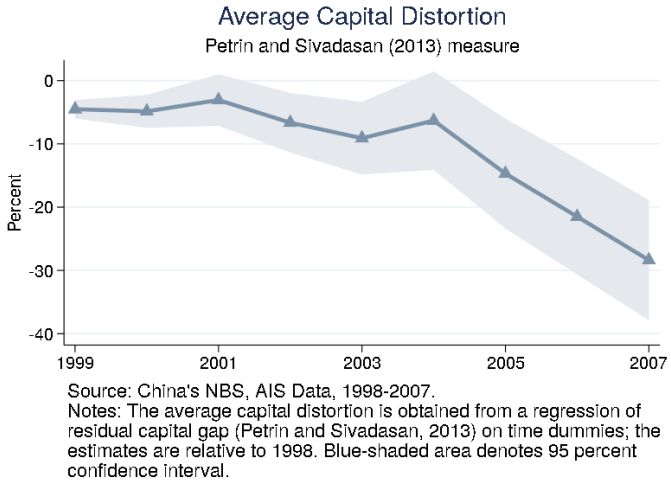
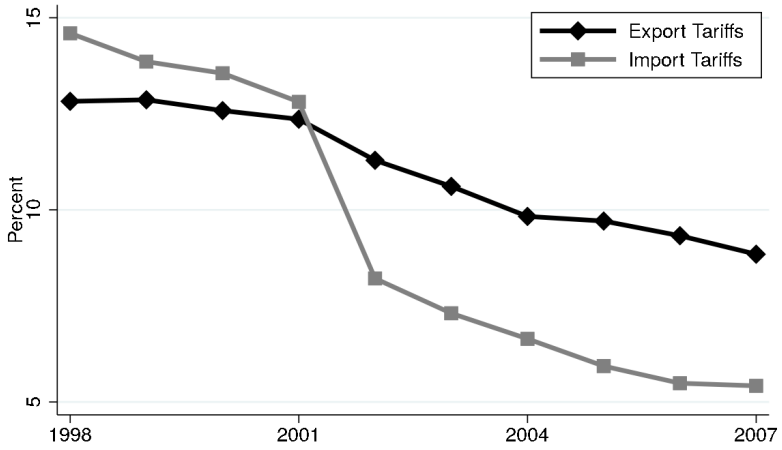
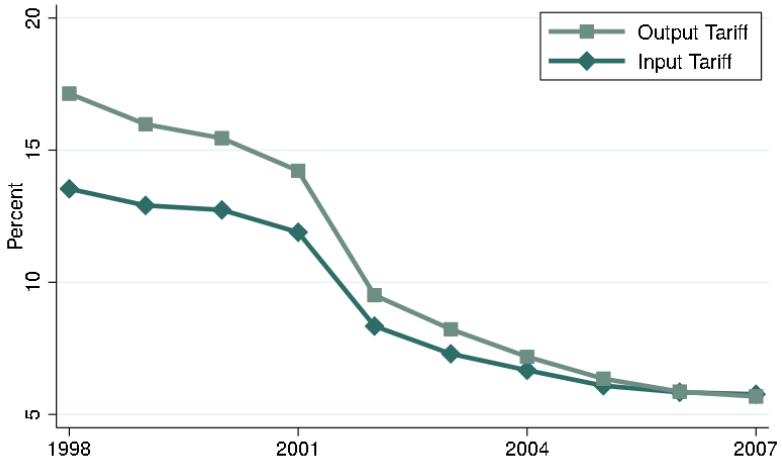


Figure A2: Dispersion across Capital Returns



Source: World Integrated Trade Solution (WITS), UNCTAD Trade Analysis Information System, 1998-2007.
Note: Tariffs are weighted averages across countries and sectors, using trade flows as weights.

Figure A3: Export and Import Tariffs, 1998–2007



Source: WITS, AIS, and Input-Output Tables.
Note: Output tariffs are weighted averaged of import tariffs using export and production values as weights; input tariffs are weighted averages of import tariffs, using cost shares, imports, and production values as weights.

Figure A4: Output and Input Tariffs, 1998–2007

Table A1: Misallocation and Tariffs: Petrin and Sivadasan [2013]'s Measure

Variables	(1)	(2)	(3)	(4)	(5)	(6)
		G^L			G^K	
Exp Tariffs Above Median	0.346**	0.342**	0.398**	0.130***	0.129***	0.105***
	(0.163)	(0.163)	(0.164)	(0.018)	(0.018)	(0.017)
Imp Tariffs Above Median	0.510***	0.505***	0.578***	0.155***	0.154***	0.120***
	(0.168)	(0.168)	(0.168)	(0.017)	(0.017)	(0.016)
TFP	14.810***	14.819***	14.833***	2.443***	2.445***	2.624***
	(0.088)	(0.088)	(0.089)	(0.012)	(0.012)	(0.013)
$\ln \psi$		-0.333***	-0.349***		-0.051***	-0.049***
		(0.023)	(0.023)		(0.003)	(0.003)
ln Age			-0.261**			-0.643***
			(0.125)			(0.017)
$\ln K$			1.156***			
			(0.065)			
ln Empl						-0.606***
						(0.011)
Sector-Year	y	y	y	y	y	y
Prov-Year	y	y	y	y	y	y
Firm FE	y	y	y	y	y	y
Obs.	914,553	914,553	914,553	914,553	914,553	914,553
R^2	0.228	0.229	0.230	0.247	0.248	0.262
Number of Firm IDs	329,719	329,719	329,719	329,719	329,719	329,719

G^L: labor gap from Petrin and Sivadasan [2013].
G^K: capital gap from Petrin and Sivadasan [2013].
Exp Tariffs Above Median: dummy equal to one if firm export tariff is above the 50th percentile within an industry.
Imp Tariffs Above Median: dummy equal to one if firm import tariff is above the 50th percentile within an industry.
$\ln \psi$: profit margin.
TFP: total factor productivity, calculated according to the Wooldrige (2009) extension to the Levinshon-Petrin methodology.
$\ln K$: log capital.
ln Empl: log employment.
Legend: *** significant at 1%, ** at 5%, * at 10%.
Notes: FE firm-level regressions, 2000-2006. Our sample excludes processing exporters and importers. Standard errors are clustered at the firm level.

Table A2: Misallocation and Tariffs, Tariffs above the 75th Percentile

Variables	(1)	(2)	(3)	(4)	(5)	(6)
		$\lvert\ln\lambda\rvert$			$\lvert\ln\kappa\rvert$	
Exp Tariffs Above 75^{th} Pctile	0.002	0.002	0.001	0.019***	0.018***	0.013***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Imp Tariffs Above 75^{th} Pctile	0.013***	0.013***	0.011***	0.013***	0.013***	0.004
	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)
TFP	0.066***	0.066***	0.066***	0.267***	0.268***	0.309***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
$\ln\psi$		0.011***	0.012***		-0.014***	-0.014***
		(0.001)	(0.001)		(0.001)	(0.001)
ln Age			-0.031***			-0.193***
			(0.003)			(0.004)
$\ln K$			-0.027***			
			(0.001)			
ln Empl						-0.146***
						(0.003)
Sector-Year	y	y	y	y	y	y
Prov-Year	y	y	y	y	y	y
Firm FE	y	y	y	y	y	y
Obs.	1,205,375	1,205,375	1,205,375	1,205,375	1,205,375	1,205,375
R^2	0.015	0.015	0.016	0.057	0.058	0.073
Number of Firm IDs	406,170	406,170	406,170	406,170	406,170	406,170

$\ln\lambda$: log return to labor relative to the sector.
$\ln\kappa$: log return to capital relative to the sector.
Exp Tariffs Above 75^{th} Pctile: dummy equal to one if firm export tariff is above the 75th percentile within an industry.
Imp Tariffs Above 75^{th} Pctile: dummy equal to one if firm import tariff is above the 75th percentile within an industry.
$\ln\psi$: profit margin.
TFP: total factor productivity, calculated according to the Wooldrige (2009) extension to the Levinshon-Petrin methodology.
$\ln K$: log capital.
ln Empl: log employment.
Legend: *** significant at 1%, ** at 5%, * at 10%.
Notes: FE firm-level regressions, 2000-2006. Our sample excludes processing exporters and importers. Standard errors are clustered at the firm level.

Table A3: Misallocation and Tariffs, Tariffs above the 75th Percentile, Petrin and Sivadasan [2013]'s Measure

Variables	(1)	(2)	(3)	(4)	(5)	(6)
		G^L			G^K	
Exp Tariffs Above 75^{th} Pctile	0.221	0.219	0.263*	0.104***	0.104***	0.091***
	(0.142)	(0.142)	(0.142)	(0.018)	(0.018)	(0.017)
Imp Tariffs Above 75^{th} Pctile	0.517***	0.512***	0.585***	0.157***	0.156***	0.122***
	(0.167)	(0.167)	(0.167)	(0.017)	(0.017)	(0.016)
TFP	14.809***	14.818***	14.832***	2.443***	2.445***	2.624***
	(0.088)	(0.088)	(0.089)	(0.012)	(0.012)	(0.013)
$\ln \psi$		-0.333***	-0.349***		-0.051***	-0.049***
		(0.023)	(0.023)		(0.003)	(0.003)
ln Age			-0.263**			-0.644***
			(0.125)			(0.017)
$\ln K$			1.156***			
			(0.065)			
ln Empl						-0.606***
						(0.011)
Sector-Year	y	y	y	y	y	y
Prov-Year	y	y	y	y	y	y
Firm FE	y	y	y	y	y	y
Obs.	914,553	914,553	914,553	914,553	914,553	914,553
R^2	0.228	0.229	0.230	0.247	0.248	0.262
Number of Firm IDs	329,719	329,719	329,719	329,719	329,719	329,719

G^L: labor gap from Petrin and Sivadasan [2013].
G^K: capital gap from Petrin and Sivadasan [2013].
Exp Tariffs Above 75^{th} Pctile: dummy equal to one if firm export tariff is above the 75th percentile within an industry.
Imp Tariffs Above 75^{th} Pctile: dummy equal to one if firm import tariff is above the 75th percentile within an industry.
$\ln \psi$: profit margin.
TFP: total factor productivity, calculated according to the Wooldrige (2009) extension to the Levinshon-Petrin methodology.
$\ln K$: log capital.
ln Empl: log employment.
Legend: *** significant at 1%, ** at 5%, * at 10%.
Notes: FE firm-level regressions, 2000-2006. Our sample excludes processing exporters and importers. Standard errors are clustered at the firm level.

Table A4: Instrumenting Import Tariffs with WTO Schedules: First Stage

Variables	(1)	(2)	(3)	(4)
	Imp Tariffs Above Median			
WTO Imp Sched. Above Median	0.012***	0.013***	0.011***	0.013***
	(0.004)	(0.004)	(0.004)	(0.005)
TFP	0.066***	0.066***	0.066***	0.267***
	(0.002)	(0.002)	(0.002)	(0.003)
ln ψ		0.011***	0.012***	-0.014***
		(0.001)	(0.001)	(0.001)
ln Age			-0.031***	-0.193***
			(0.003)	(0.004)
ln K			-0.027***	
			(0.001)	
ln Empl				-0.146***
				(0.003)
Sector-Year	y	y	y	y
Prov-Year	y	y	y	y
Firm FE	y	y	y	y
F-stat	12,464	12,464	12,459	12,453
Obs.	1,205,375	1,205,375	1,205,375	1,205,375
R^2	0.015	0.015	0.016	0.057
Number of Firm IDs	406,170	406,170	406,170	406,170

Imp Tariffs Above Median: dummy equal to one if firm import tariff is above the 50th percentile within an industry.
WTO Imp Schedules Above Median: dummy equal to one if firm import tariff is above the 50th percentile within an industry.
TFP: total factor productivity, calculated according to the Wooldrige (2009) extension to the Levinshon-Petrin methodology.
ln ψ: profit margin.
ln Age: log firm age.
ln K: log capital.
ln Empl: log employment.
Legend: *** significant at 1%, ** at 5%, * at 10%.
Notes: First-stage regression for tables 3 and A5, 2000-2006. Columns (1)-(2) are first stage estimates for columns (1)-(2) and (4)-(5), column (3) contains the first stage estimate for column (3), and column (4) reports the first-stage estimates for column (6). Our sample excludes processing exporters and importers. Standard errors are clustered at the firm level.

Table A5: Misallocation and Tariffs, Petrin and Sivadasan [2013]'s Measure: Instrumenting Import Tariffs with WTO Schedules

Variables	(1)	(2)	(3)	(4)	(5)	(6)
		G^L			G^K	
Exp Tariffs Above Median	0.311*	0.307*	0.358**	0.120***	0.119***	0.099***
	(0.164)	(0.164)	(0.164)	(0.018)	(0.018)	(0.018)
Imp Tariffs Above Median	1.204***	1.208***	1.375***	0.352***	0.353***	0.251***
	(0.380)	(0.380)	(0.381)	(0.038)	(0.038)	(0.037)
TFP	14.814***	14.823***	14.837***	2.444***	2.446***	2.624***
	(0.088)	(0.088)	(0.089)	(0.012)	(0.012)	(0.013)
$\ln \psi$		-0.332***	-0.349***		-0.051***	-0.049***
		(0.023)	(0.023)		(0.003)	(0.003)
ln Age			-0.262**			-0.643***
			(0.125)			(0.017)
$\ln K$			1.161***			
			(0.065)			
ln Empl						-0.605***
						(0.011)
Sector-Year	y	y	y	y	y	y
Prov-Year	y	y	y	y	y	y
Firm FE	y	y	y	y	y	y
Obs.	914,553	914,553	914,553	914,553	914,553	914,553
R^2	0.015	0.015	0.016	0.057	0.058	0.073
Number of Firm IDs	329,719	329,719	329,719	329,719	329,719	329,719

G^L: labor gap from Petrin and Sivadasan [2013].
G^K: capital gap from Petrin and Sivadasan [2013].
Exp Tariffs Above Median: dummy equal to one if firm export tariff is above the 50th percentile within an industry.
Imp Tariffs Above Median: dummy equal to one if firm import tariff is above the 50th percentile within an industry.
TFP: total factor productivity, calculated according to the Wooldrige (2009) extension to the Levinshon-Petrin methodology.
$\ln \psi$: profit margin.
ln Age: log firm age.
$\ln K$: log capital.
ln Empl: log employment.
Legend: *** significant at 1%, ** at 5%, * at 10%.
Notes: FE firm-level regressions, 2000-2006. Our sample excludes processing exporters and importers. Standard errors are clustered at the firm level.

Table A6: Input and Output Tariffs across Sectors, 1998 and 2007

	1998		2007	
Industry	Output	Input	Output	Input
Food	35.78	15.56	13.63	8.07
Beverages	41.74	6.93	18.63	3.28
Tobacco	55.39	16.42	21.74	9.81
Textile	25.32	22.20	9.13	9.86
Apparel	33.61	8.02	14.34	4.25
Leather	12.93	22.02	10.97	12.07
Wood	12.26	8.41	3.91	2.90
Furniture	22.00	2.94	2.50	1.38
Paper	16.63	12.77	6.08	6.11
Printing	1.73	4.15	3.17	2.03
Recreational	19.65	8.54	7.78	3.82
Petroleum & Coal	7.10	3.86	5.57	2.15
Chemicals	12.35	12.52	6.56	7.07
Pharmaceuticals	10.78	2.91	5.32	1.42
Synthetic Fibers	19.29	20.44	4.76	8.46
Rubber	18.54	15.80	10.13	7.86
Plastics	17.73	15.69	8.40	8.00
Clay, Stone, and Glass	17.00	6.40	10.64	3.80
Metals	9.56	10.69	5.52	5.82
Metal Products	12.75	9.44	8.39	5.23
Machinery	13.26	11.79	7.71	5.58
Equipment	12.51	6.22	6.88	3.07
Transportation Eq	26.30	16.01	10.05	7.64
Electronic Products	15.22	9.53	7.75	4.45
Computer & Comm Eq	14.97	9.63	3.96	3.62
Other Mfg	27.12	8.96	16.03	4.99

Source: WITS and 2002 Input-Output Tables, 1998 and 2007.

Table A7: Misallocation and Tariffs, Petrin and Sivadasan [2013]'s Measure: Output and Input Tariffs

Variables	(1)	(2) G^L	(3)	(4)	(5) G^K	(6)
Exp Tariffs Above Median	0.220	0.216	0.262	0.109***	0.108***	0.091***
	(0.163)	(0.162)	(0.163)	(0.018)	(0.018)	(0.018)
Out Tariffs Above Median	0.506***	0.510***	0.533***	0.058***	0.059***	0.035*
	(0.192)	(0.191)	(0.192)	(0.020)	(0.020)	(0.020)
Inp Tariffs Above Median	1.191***	1.181***	1.347***	0.311***	0.310***	0.245***
	(0.196)	(0.196)	(0.197)	(0.022)	(0.022)	(0.021)
TFP	14.786***	14.796***	14.812***	2.452***	2.453***	2.632***
	(0.088)	(0.088)	(0.088)	(0.012)	(0.012)	(0.013)
$\ln \psi$		-0.331***	-0.348***		-0.051***	-0.049***
		(0.022)	(0.022)		(0.003)	(0.003)
ln Age			-0.278**			-0.646***
			(0.125)			(0.017)
$\ln K$			1.165***			
			(0.065)			
ln Empl						-0.607***
						(0.011)
Sector-Year	y	y	y	y	y	y
Prov-Year	y	y	y	y	y	y
Firm FE	y	y	y	y	y	y
Obs.	919,339	919,339	919,339	919,339	919,339	919,339
R^2	0.228	0.228	0.229	0.247	0.248	0.262
Number of Firm IDs	331,509	331,509	331,509	331,509	331,509	331,509

G^L: labor gap from Petrin and Sivadasan [2013].
G^K: capital gap from Petrin and Sivadasan [2013].
Exp Tariffs Above Median: dummy equal to one if firm export tariff is above the 50th percentile within an industry.
Out Tariffs Above Median: dummy equal to one if firm output tariff is above the 50th percentile within an industry.
Inp Tariffs Above Median: dummy equal to one if firm input tariff is above the 50th percentile within an industry.
TFP: total factor productivity, calculated according to the Wooldrige (2009) extension to the Levinshon-Petrin methodology.
$\ln \psi$: profit margin.
ln Age: log firm age.
$\ln K$: log capital.
ln Empl: log employment.
Legend: *** significant at 1%, ** at 5%, * at 10%.
Notes: FE firm-level regressions, 2000-2006. Our sample excludes processing exporters and importers. Standard errors are clustered at the firm level.

Table A8: Misallocation and Tariffs, Petrin and Sivadasan [2013]'s Measure: Instrumenting Output and Input Tariffs

Variables	(1)	(2)	(3)	(4)	(5)	(6)
		G^L			G^K	
Exp Tariffs Above Median	0.182	0.177	0.238	0.103***	0.102***	0.087***
	(0.155)	(0.155)	(0.156)	(0.019)	(0.019)	(0.018)
Out Tariffs Above Median	0.674***	0.677***	0.708***	0.092***	0.092***	0.056**
	(0.254)	(0.254)	(0.255)	(0.029)	(0.029)	(0.028)
Inp Tariffs Above Median	1.148***	1.146***	1.312***	0.338***	0.338***	0.260***
	(0.207)	(0.207)	(0.207)	(0.024)	(0.024)	(0.024)
TFP	14.965***	14.975***	15.039***	2.508***	2.509***	2.684***
	(0.083)	(0.083)	(0.084)	(0.013)	(0.013)	(0.013)
$\ln \psi$		-0.323***	-0.341***		-0.053***	-0.051***
		(0.021)	(0.021)		(0.003)	(0.003)
ln Age			-0.316***			-0.655***
			(0.118)			(0.018)
$\ln K$			1.307***			
			(0.059)			
ln Empl						-0.612***
						(0.011)
Sector-Year	y	y	y	y	y	y
Prov-Year	y	y	y	y	y	y
Firm FE	y	y	y	y	y	y
Obs.	1,084,155	1,084,155	1,084,155	935,474	935,474	935,474
Number of Firm IDs	373,191	373,191	373,191	334,394	334,394	334,394

G^L: labor gap from Petrin and Sivadasan [2013].
G^K: capital gap from Petrin and Sivadasan [2013].
Exp Tariffs Above Median: dummy equal to one if firm export tariff is above the 50th percentile within an industry.
Out Tariffs Above Median: dummy equal to one if firm output tariff is above the 50th percentile within an industry.
Inp Tariffs Above Median: dummy equal to one if firm input tariff is above the 50th percentile within an industry.
TFP: total factor productivity, calculated according to the Wooldrige (2009) extension to the Levinshon-Petrin methodology.
$\ln \psi$: profit margin.
ln Age: log firm age.
$\ln K$: log capital.
ln Empl: log employment.
Legend: *** significant at 1%, ** at 5%, * at 10%.
Notes: FE firm-level regressions, 2000-2006. Our sample excludes processing exporters and importers. Standard errors are clustered at the firm level.

Table A9: Aggregate Misallocation and TFP, Petrin and Sivadasan [2013]'s measures

Variables	(1)	(2)	(3)	(4)
	TFP			
Avg G^L	0.010***		0.009***	0.008***
	(0.002)		(0.002)	(0.002)
Avg G^K		0.040***	0.014	0.000
		(0.012)	(0.013)	(0.012)
Avg $\ln \psi$				0.079***
				(0.028)
Avg Age				-0.321***
				(0.057)
Year	y	y	y	y
Sector FE	y	y	y	y
Obs.	3,453	3,453	3,453	3,453
R^2	0.905	0.901	0.905	0.914
Number of Industries	350	350	350	350

TFP: average sector-level total factor productivity, calculated according to the Wooldrige (2009) extension to the Levinshon-Petrin methodology.
Avg G^L: average dispersion across labor gap (Petrin and Sivadasan, 2013) measure.
Avg G^K: average dispersion across capital gap (Petrin and Sivadasan, 2013) measure.
Avg $\ln \psi$: average profit margin within sector.
Avg Age: average firm age within sector.
Legend: *** significant at 1%, ** at 5%, * at 10%.
Notes: Sector-level FE regressions, 1998-2007. Standard errors, clustered at the sector levels, are reported in parenthesis.

Table A10: Tariffs and Aggregate Misallocation

	(1)	(2)	(3)	(4)
	Labor		Capital	
Variables	Avg $\lvert\ln\lambda\rvert$	Avg G^L	Avg $\lvert\ln\kappa\rvert$	Avg G^K
Imp Tariffs	0.005***	0.147**	0.001	0.018***
	(0.001)	(0.070)	(0.001)	(0.006)
Exp Tariffs	0.000	-0.054	-0.001	-0.002
	(0.001)	(0.039)	(0.001)	(0.002)
Controls*	y	y	y	y
Year	y	y	y	y
Sector FE	y	y	y	y
Obs.	2,421	2,421	2,421	2,421
R^2	0.162	0.461	0.245	0.548
Number of Industries	349	349	349	349

* Controls include TFP, average age, capital stock, employment, and profit margin (sector-level averages).
Avg $\lvert\ln\lambda\rvert$: average dispersion across absolute relative labor returns within sector.
Avg G^L: average dispersion across labor gap (Petrin and Sivadasan, 2013) measure.
Avg $\lvert\ln\kappa\rvert$: average dispersion across absolute relative capital returns within sector.
Avg G^K: average dispersion across capital gap (Petrin and Sivadasan, 2013) measure.
Imp Tariffs: import tariffs (HS schedules matched to CIC classification).
Exp Tariffs: export tariffs (HS schedules matched to CIC classification).
Legend: *** significant at 1%, ** at 5%, * at 10%.
Notes: Sector-level FE regressions, 1998-2007. All columns include year dummies and sector-level averages of firm characteristics. Standard errors, clustered at the sector levels, are reported in parenthesis.