Trade Liberalization and Labor Shares in China

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**Abstract**

Labor’s share of Chinese manufacturing value added, the sector that provides almost all of its export production, is low by international comparison and getting lower: falling from 40% in 1998 to 30% by 2004 (Qian and Zhu, 2012). One explanation for the decline is import competition intensified by China’s WTO entry and cuts from an average tariff of 20 percent in 1998 to 2 percent by 2007. Using the Annual Survey of Industrial Production, we estimate the extent to which firms altered labor’s share of value in response to tariff reductions. Our theoretical framework permits trade reform to affect labor’s share both through changes in input choices and through rent sharing. We calculate markups and show that as De Loecker et al. (2012) found for India, Chinese trade reform led to higher rents as input tariff cuts raised markups more than output tariff cuts reduced them. Labor-share regressions indicate that trade reform raised labor’s share, both through changes in input choices and sharing of higher rents. Our main estimates imply that a firm experiencing the average tariff reduction increased the wage share of sales by 0.65 percentage points. Moreover, we find that the positive impact of tariffs on labor shares is stronger where access to international markets is better. We also find significant differences when a labor union is present and whether the firm is a domestic or foreign enterprise. Overall, our results imply that workers share part of the gains from China’s WTO accession documented by Brandt et al. (2012).
1. Introduction

China’s opening to the world economy greatly expanded the global supply of labor. The complementarity of China’s middle-skilled labor with physical capital unleashed rapid growth and export expansion that influenced labor markets throughout the world.\(^1\) Outside China, this rapid expansion of global labor supply was seen as an explanation for stagnant or falling real wages for competing workers, alongside dramatic reordering of the international division of labor. Within China, real income appears to have grown by more than 10 percent per annum between 1990 and 2007.\(^2\)

Perhaps surprisingly given the continued growth of real wages, Chinese labor’s share of national income has fallen steadily at least since the late 1990s. China is far from alone: Karabarbounis and Neiman (2013) document a significant decline in the global labor share over the last 30 years. A recent International Labor Organization report (ILO, 2013) confirms that since the 1980s a majority of countries have experienced falling labor shares and finds that this has happened most frequently where wages have stagnated but also in some countries, such as China, where real wages have grown strongly.\(^3\)

The share of Chinese GDP accounted for by labor income has long been low by international comparison and is getting lower: compared to a labor share of 65% in the United States, China’s labor share fell from 50% in 1998 to only 40% in 2007.\(^4\) Labor’s share of Chinese manufacturing value added, the sector that provides almost all of its export production, is even more of an outlier, falling from 40% in 1998 to 30% by 2004 (Qian and Zhu, 2012).

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\(^1\) China’s National Bureau of Statistics (NBS) reports that in 1975 the primary school enrollment rate was 95% and the middle school enrollment rate was 60%. Heckman and Yi (2012) argue that this abundant middle-skill labor was complementary to physical capital and a key factor in China’s economic growth.

\(^2\) Growth rate estimates from World Bank, Economic Indicators. Knight and Ding (2012, pp. 6-8) discuss problems with Chinese GDP statistics and revisions by Western scholars and by the NBS.

\(^3\) Atkinson (2009) identifies three reasons for studying factor shares and suggests avenues for future research.

\(^4\) Bai and Qian (2010) calculate a drop of 12.5 points in China’s labor share of national income using official data for 1995 to 2007, but after adjusting for changes in accounting methods, they estimate a drop of 7.2 points.
These trends present a puzzle because a simple application of the Stolper-Samuelson Theorem suggests that the labor share should have risen in China, as labor intensive industries expanded.\footnote{Huang, Xu, and Lu (2011) term the falling labor share in China a “Stolper-Samuelson deviation.”}

Given the importance of international trade and investment to China’s development strategy, it is natural to seek explanations for the declining labor share in changing commercial policy. The most prominent change during this time period is China’s accession to the WTO in 2001, and in this paper we investigate the relationship between the associated tariff cuts and manufacturing labor shares. As noted by Brandt \textit{et al}., (2012), changes in import tariffs affect firm behavior via two channels: through the local price and variety of imports that compete directly with locally manufactured goods and through the price and variety of intermediate inputs. These channels have complex and sometimes opposing influences on firms’ choices of factor intensity, productivity, and markup and, thus, the share of value accruing to labor. The net effect of these influences on labor shares is, ultimately, an empirical question and one that we address with a large panel of firms during a ten-year period of declining tariff rates.

Reforms surrounding China’s WTO accession produced significant liberalization despite the fact that China was already integrated into global production networks by 1995. Protection of domestic firms remained strong in industries for which domestic supply was deemed “sufficient,” state enterprises played a dominant role, or industrial policy or national security supported domestic expansion. Through its accession agreements, China committed to the reduction of both tariff and non-tariff barriers to industrial goods, including many of the most protected industries.\footnote{As Branstetter and Lardy (2008, p. 633) stress, China’s drive to liberalize trade and foreign direct investment dramatically accelerated in the late 1990s. China unilaterally reduced tariffs on imports, dramatically cut quantitative restrictions on imports, eliminated many restrictions on foreign direct investment, and expanded public investment in roads, ports, airports and communications capacity.} Tariff reductions were phased over a period of ten years but generally the
bulk of reductions took place immediately on January 1, 2002. From a simple average tariff rate of 23% in 1996, Chinese duties were reduced to an average of 14% in 2001 and 10% by 2010 (Hong, 2010). The average effectively applied tariff rate on manufactured goods was lowered from about 20 percent in 1998 to about 2 percent by 2007.

Using China’s Annual Survey of Industrial Production, we estimate the extent to which changes in manufacturing firms’ labor shares are associated with these tariff reductions. Our theoretical framework permits trade reform to affect labor’s share both through changes in input choices and through changes in rents shared with workers. Regressions estimated with a large panel of manufacturing firms provide evidence of a positive and statistically significant effect of tariff cuts on labor share of output and, alternatively, labor share of value added. Thus, our findings are consistent with the view that workers share part of the productivity gains from China’s WTO accession identified by Brandt et al. (2012). This is also consistent with findings of Ahsan and Mitra (2012) on India showing that the wage share of sales in relatively small firms increased with trade reforms, possibly through contraction of the wedge between the marginal product and the wage.

A feature of our empirical analysis is that we measure rents by calculating a firm-level markup using the method proposed by De Loecker, Goldberg, Khandelwal, and Pavcnik (2012). We include this estimated markup as an additional regressor in our labor share equations, testing whether tariff cuts operate directly as well as indirectly through changes to firm-level rents. As De Loecker et al. find in their analysis of Indian firms, we also find that markups are positively correlated with output tariffs, but negatively correlated with input tariffs. Overall, our empirical results indicate that tariff cuts raise markups and that higher markups lead to higher labor shares.
To enhance identification, we allow the effect of tariff reform to vary by firm location and we find that the positive impact of tariff reductions on labor share is stronger where access to global markets is better. Using information on which firms have a labor union present in the enterprise, we are also able to explore the role of a union in shaping the firm response to trade reforms. Regression results indicate that while lower output tariffs lead to a higher labor share, the magnitude of the effect is smaller when a union present. Interestingly, we find a significant and positive relationship between firm markups and labor shares only in domestic private firms in which a union is present, suggesting that a collective voice for workers does influence the degree of rent sharing within the firm. In contrast, foreign-invested enterprises with a union present exhibit no significantly different rent sharing behavior than do those without a union present. Lastly, we test the hypothesis that changes in labor share are stronger for non-state firms than for state firms, and find that there is no difference between state firms and domestic private firms in the degree to which trade liberalization raises labor shares, but we do find a significantly larger response among foreign-invested enterprises.\textsuperscript{7}

Declining labor shares in national income are a widely shared phenomenon, but the cause is not well understood. A majority of the 59 countries studied by Karabarbounis and Neiman (2013) experienced a decline in labor’s share between 1975 and 2007. Using data from both developed and developing countries, they document a 5 percentage point decline in the share of global corporate gross value added paid to labor over the last 30 years. The corporate labor share fell in all four of the world’s largest economies: the United States, Japan, China, and Germany.\textsuperscript{8}

\textsuperscript{7} Kamal and Lovely (2012) estimate the marginal revenue product of labor for all firms in the Annual Survey of Industrial Production and find that labor employed in state firms has lower marginal productivity in most industries than do non-state firms, evidence consistent with over-manning in the state sector.

\textsuperscript{8} Karabarbounis and Neiman (2013) report finding similar trends for the overall labor share.
Explanations for changes in the factor income distribution largely fall into three categories: changes in relative factor prices, changes in factor market distortions, and changes in goods markets distortions (Bentolila and Saint-Paul, 2003). Karabarbounis and Neiman (2013) focus on the relative price of labor to capital and argue that a decline in the cost of capital beginning around 1980 induced firms to shift away from labor and toward capital. For China, they estimate that enterprises experienced a large decline in the relative cost of capital, which in the presence of a suitably large elasticity of substitution between capital and labor, could explain the large labor share declines.

Although investment rates in China are very high by international comparisons, rising capital/labor ratios are not uniformly seen as an important reason for the declining labor share. Bai and Qian (2010), among others, find evidence consistent with a unity elasticity of substitution and argue that changes in relative factor prices are not to blame. Bai and Qian focus, instead, on factor market distortions caused by differences in wage setting between state-owned and non-state-owned enterprises. They dismiss explanations based on another type of factor market distortion, the bargaining power of workers, as inappropriate for China in that formal bargaining between labor and management is rare. Bai and Qian also find evidence for the third type of explanation, goods market distortions. They calculate firm-level markups using data on the ratio of sales revenue to sales cost and they find that firm markups have risen since 1998 and that increased monopoly power has led to reductions in firms’ labor share when controlling for firms’ capital to output ratios.

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9Shen and Whalley (2013) estimate nested CES production functions with alternative nesting structures and conclude that the elasticity of substitution between labor and capital is less than unity in Chinese manufacturing.

10Rodrik (1997) argues that greater openness reduces the bargaining power of workers because their services become more substitutable.
These discussions allow no significant role for input prices as a determinant of labor shares. However, Bentolila and Saint-Paul (2003) show theoretically that changes in imported materials prices can influence labor shares, with the direction of influence theoretically ambiguous. This channel of influence is potentially of importance for China given the large share of output value, particularly in traded goods sectors, accounted for by imported inputs. Koopman, Wang, and Wei (forthcoming) estimate that the share of domestic content in Chinese exports was about 50% before its accession to the WTO.

We turn next to a brief overview of labor market reform in China. We argue that existing evidence supports both the view that wages are market driven and that wages reflect some element of rent sharing. The third section presents a simple theoretical model with these elements and we use this model to develop an estimating equation for labor shares. The fourth section describes the data we use to estimate the labor share equations, with our results presented and discussed in the fifth section. We conclude with a consideration of the implications of our findings for understanding the distributional effects of trade reform in China.

2. Labor Market Reforms in China

Extensive labor market reforms were undertaken by China during the 1990s, both to increase mobility of workers across jobs and to reduce the role of state enterprises as employers and as a source of social insurance. In 1994, China passed the Labor Law, which established the legal framework for market-based worker-employer relations in the context of expanded employment flexibility.\(^{11}\) In addition to providing a framework for safeguarding workers’ rights, the Law calls for equal treatment of workers across ownership sectors and permits no-fault dismissal of workers. Toward the end of the decade and in recognition of the employment

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mobility unleashed by the Labor Law, the Chinese government began strengthening social
insurance programs and improving conditions for the increasingly large number of migrant
workers. Although far from fully realized, these regulatory and policy changes represent
significant steps toward market-mediated labor relations.

As noted by Cai, Park, and Zhao (2008), the 1994 Labor Law facilitated the massive
restructuring of state-owned enterprises, which led to layoffs of at least 10 million workers by
1997 and 27 million more from 1998 to 2004. Giles, Park, and Zhang (2005) estimate that the
unemployment rate for all urban residents rose from 6.8 percent in 1996 to 11.1 percent in 2002.
Workers remaining in the state sector were subject to removal of most administrative controls on
the determination of wages and benefits. Thus, over the period, wages were largely freed to
adjust to market-determined levels.12

In our theoretical framework, we treat wages as market determined, while allowing for
rent sharing with workers in a fair wage, as distinct from union-management bargaining,
context.13 The All-China Federation of Trade Unions (ACFTU) is the sole national trade
union federation of the People’s Republic of China. About the ACFTU, one knowledgeable
observer writes, “Contemporary union organizing in China is different from its counterparts in
Western countries and other authoritarian states around the world. As a formal part of the
communist political structure, the ACFTU bases its power on its quasigovernment status rather

12 During this time period, workers also became increasing mobile across labor markets, particularly between
urban and rural areas of the same province. Between 1995 and 2002, controls were loosened on domestic migration,
including migration without formal changes in household registration (non-hukou migration). Cai, Park, and Zhao
(2008) use the 2000 census to calculate the stock of migrants, defined as the share of persons residing in a location
for more than six months in the prior year whose hukou is from outside the city or county. By this definition, they
estimate that by the turn of the century migrants comprised 14.6 percent of the population and 19.6 percent of the
employment in China’s cities (p. 191).

13 In our empirical work, we account for labor market reforms by identifying the effect of tariff cuts on labor
shares using firm-level deviations from the general economy-wide time trends in manufacturing. This modeling
choice implies that we rely for identification on changes in firm-level labor shares relative to average trends.
than on organized labor and does not operate by mobilizing the support of grassroots labor” (Liu, 2011). Chen (2009) also notes the lack of union bargaining power in China, “…even though unions have come to support workers' economic demands in certain selective ways, this by no means suggests that they are capable of making claims directed at the state on behalf of workers.” Given this understanding of labor unions in China, our approach allows for the possibility of rent sharing, not as a result of formal bargaining, but as a fair wage strategy to retain experienced workers.

The hypothesis that firms share surplus with workers is consistent with recent work by Nee and Opper (2012). Based on interviews and financial data from over 700 manufacturing firms in the Yangzi region, they find that “Work compensation and firm success are closely linked. Controlling for other factors (firm size, firm age, employment structure, location, and industry), there is a substantive and significant positive association between the average wage rate and a firm’s return on assets (p.181).” Nee and Opper conclude, “In other words, the more profitable the firm, the higher the labor compensation and thus the better a firm’s chances to recruit and retain skilled workers (p. 181).”

While unions appear to wield limited bargaining power over wages, in our empirical work we allow for the possibility that the presence of a labor union alters a firm’s response to trade liberalization. Ge (2013) agrees that Chinese unions lack a “monopoly” function, in that they have weak power in bargaining with management, but he highlights their roles as a “collective voice” for workers. This collective voice function includes mediating labor disputes, monitoring implementation of the Labor Law, providing various services and welfare benefits to employees, promoting technology innovation and employee training, and participating in
corporate governance and policy making (Ge, p. 2). These roles allow for the possibility that a union can facilitate or resist changes to production processes, such as the introduction of imported inputs when they are made more accessible with trade liberalization. We discuss the possible influence of a labor union in the rent sharing model below and in our empirical work we test for different responses to trade liberalization by union status.


A Model of Input Choice with Rent Sharing

Consider a firm with the following production function:

\[ Q = F(N, \nu), \]  

(1)

where \( N \) is firm’s employment of labor and \( \nu \) is the vector of all other factor inputs. This production function is assumed to exhibit constant returns to scale and, thus, diminishing marginal product of labor. The profits of a firm can be written as:

\[ \pi(w, N, \nu) = P(Q)Q - wN - \nu p_\nu, \]  

(2)

where \( w \) is the wage paid by the firm, \( p_\nu \) is the vector of prices of other factor inputs and \( P \) is the output price, which depends on quantity, \( Q \), as the firm is assumed to have some market power and that power depends on how protected its market is. In other words, \( P(Q) \) is the inverse demand function.

We assume that the firm takes the prices of all factors other than labor as given. In the case of labor, let \( w_a \) be the alternative or outside wage, which the firm also takes as given. This is the expected wage a worker would receive if he or she looked outside. We assume that the firm

\[^{14}\text{Using a cross-section of firms from the 2004 National Economic Census, Ge (2013) finds that union presence in an enterprise is positively associated with average wage and benefits levels and output per worker, but negative associated with firm profitability. Using a different data source, the 2006 Private Enterprise Survey, Lu, Tao, and Wang (2010) find no relationship between the average wage paid by the firm and union status, but they confirm a positive relationship between union presence and labor productivity.}\]
pays a fair wage to its workers because it promotes goodwill among workers and minimizes worker turnover. We assume that workers consider the wage fair if the firm shares a fraction of its profits, $\gamma$, with its employees. The fraction of profits a firm divides among employees will depend on norms. However, this fraction could also depend on firm-specific skills and experience of the workforce and the scarcity of these skills in the labor market.

The fair wage, therefore, is written as:

$$w = w_a + \gamma \frac{\pi}{N}, \quad (3)$$

which in turn can be written as

$$w = w_a + \gamma \left[ \frac{P(Q)Q - wN - vp_v}{N} \right]. \quad (4)$$

Equation (4) can be rewritten as

$$w = w_a + \frac{\gamma R}{1 + \gamma N}, \quad (5)$$

where $R$ is the rent earned by the firm over the outside value of the factors of production employed in the firm, defined as

$$R = P(Q)Q - w_aN - vp_v. \quad (6)$$

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15 Two recent papers introduce a fair wage that is internal to the firm. Egger and Kreickemeier (2009) offer a one-factor model where the constant marginal cost is inversely related to a productivity parameter. Wages are assumed to be increasing in this productivity parameter. Since profits are increasing in productivity, the wage rate is increasing in profits. Note that since productivity at the firm level is represented by a parameter, the firm ends up taking the wage as given. Amiti and Davis (2011) directly take the fair wage as an increasing function of the firm’s profits. They show that internalizing the dependence of the wage on the profits in the firm’s optimization problem does not yield an outcome that is different from the one where the wage is taken as given by the firm in its optimization problem. Our assumption that the fair wage incorporates profit sharing makes the fair wage an increasing linear function of the profits per worker (rather than the total profits of a firm). This fair-wage specification has the flavor of both profitability and productivity at the same time.

16 An alternative interpretation of equations (4) and (5) is based on union-firm bargaining, which leads to a sharing of rents between the firm and the members of the union, namely the workers employed by the firm. With that alternative interpretation, $\gamma$ becomes an increasing function of the bargaining power of the workers.
Using equations (5) and (6) to restate the expression for profits in (2) we have

\[ \pi = \frac{1}{1+\gamma} R. \]  

(7)

Equation (7) shows that profit maximization and rent maximization are equivalent optimization problems in our model.

The first-order condition with respect to \( N \) gives us:

\[ w_N = MRF_N, \]  

(8)

where \( MR \) is marginal revenue and \( F_N \) is the marginal product of labor. Using (5) in combination with (8) and the first-order conditions for all other factors of production, we can express the share of wages in total revenue as:

\[ S^N = \frac{e_{Q,N}}{\mu} + \frac{\gamma}{1+\gamma} \left( 1 - \frac{1}{\mu} \right), \]  

(9)

where \( e_{Q,N} \) is the elasticity of output with respect to employment and \( \mu \) is the price-marginal cost (or the price-marginal revenue) ratio, also called the markup. In equation (9), \( \frac{e_{Q,N}}{\mu} \) is the share of wages in output when workers are paid their marginal revenue product (MRP). The existence of rent shared by workers leads to an additional portion for workers, given by \( \frac{\gamma}{1+\gamma} \left( 1 - \frac{1}{\mu} \right) \). The fraction \( \frac{\gamma}{1+\gamma} \) reflects the degree of rent sharing and it depends on the parameter \( \gamma \).

**Tariff Cuts and the Labor Share of Output**

Given the degree of rent sharing, equation (9) indicates that labor’s share of output depends on the elasticity of output with respect to labor input and the markup. Trade liberalization influences these two determinants in sometimes conflicting ways. Let us first

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17 A recent paper by Ahsan and Mitra (2012) arrives at a similar expression for the labor share by explicitly modeling union-firm bargaining. In many other respects, the structure of their model is similar to ours.
consider how trade liberalization affects the elasticity of output with respect to labor, conditional on a given markup over marginal cost.

To be concrete, consider a constant-elasticity-of-substitution production function,

\[
Q = \left[ \alpha_N N^{\sigma/(\sigma-1)} + \sum_{i=1}^{n} \alpha_i v_i^{\sigma/(\sigma-1)} \right]^{(\sigma-1)/\sigma},
\]

where \( \sigma \) is the elasticity of substitution between the different factors of production. With this production function, the elasticity of output with respect to labor takes the form:

\[
\varepsilon_{Q,N} = \alpha_N \left[ \frac{Y}{N} \right]^{1-\sigma},
\]

which depends on average labor productivity and the elasticity of factor substitution. If we assume that some other inputs become cheaper because the tariffs on their importation fall, then more of these inputs will be combined with each unit of labor. As a result, average labor productivity will rise. If these inputs are complementary to labor, \( \sigma < 1 \), the elasticity of output with respect to labor, \( \varepsilon_{Q,N} \), will rise with trade liberalization. Through this channel, we expect that conditional on the markup, trade liberalization will increase labor’s share of output.

We seek additional identification of the impact of trade liberalization on labor shares by allowing the effect to vary with access to international markets, conditional on the markup. If tariff cuts affect the MRP of labor through the prices and variety of imports, it is likely that these pressures are strongest where access to foreign markets is strongest. To allow for this possibility, we posit that the impact of tariff cuts on labor shares moderates as the distance of the firm from international markets increases.

Next, consider a tariff-policy-driven change in the markup, holding \( \varepsilon_{Q,N} \) fixed. While the MRP-driven component of the labor share, given by \( \frac{\varepsilon_{Q,N}}{\mu} \), is decreasing in the markup, the
component of labor share attributed to rent sharing, given by \( \frac{\gamma}{1+\gamma} \left(1 - \frac{1}{\gamma} \right) \), is increasing in the markup. Thus, a change in the markup may lead to an increase or decrease in labor’s share.

In addition to this ambiguity, the impact of tariff reductions on the markup is itself uncertain. Trade liberalization may lead to lower markups due to greater import competition, but recent evidence (DeLoecker, Goldberg, Khandelwal, and Pavcnik, 2012) indicates that higher markups may result from incomplete pass-through to consumers of input price reductions brought about by tariff cuts. DeLoecker et al. find in a sample of Indian firms that input price reductions dominate greater direct competition from imports and, thus, that trade reform leads to higher markups. As mentioned earlier, an increase in markups again has effects on the two components of labor share that work in opposite directions. If rent sharing is an important component of wage determination, then the wage share may actually increase with the markup.

So far, we have treated \( \gamma \) as if it is the same for every firm. However, many firms in China do have a union present in the workplace and the union may change the degree of rent sharing. According to Trade Union Law, a union may be established in an enterprise as a result of a request from an “above-level” union or by a request from employees, although only the former requests are thought to be effective (Ge, 2013, p. 17). Previous authors have emphasized the role of unions in bargaining over disposition of firm rents. In this view, the pass-through of changes in market rents to workers will be stronger in unionized firms.

Another view of unions is that they play a role on the shop floor. Indeed, Ge (2013) emphasizes the role of the union in representing the workers’ “collective voice.” In this view, a union may prevent a firm from importing complementary inputs (or implicitly make it more costly to import these inputs) and they may demand in-house production of these inputs. In this
respect, the presence of unions can weaken the positive effect of trade liberalization on the labor share, conditional on the markup.

While wage setting in state firms has been largely deregulated, there remain important aspects of labor relations in state firms that do not conform to profit maximizing behavior. Kamal and Lovely (2012) find that labor productivity varies systematically within industries by ownership type, with state owned firms exhibiting significantly lower marginal revenue products of labor. Even though ownership differentials have diminished over time, Kamal and Lovely find that the marginal labor productivity of private firms is an average of 60% higher than state firms during the 2004-2007 period, controlling for both industry and location. This evidence suggests that state firms pursue employment as well as profit objectives and that their response to competitive changes due to trade reform may be muted. To allow for this possibility, we posit that the impact of tariff cuts on labor shares varies by firm ownership type.

**Tariff Cuts and the Labor Share of Value Added**

This simple discussion implies that trade liberalization creates many channels by which the labor share of output may be affected. While we have discussed the share of the wage bill in total sales, many of these channels of influence apply to the share of the wage bill in value added as well. The production function in the model above is an output production function. Alternatively, we could think of the production function above as a value added production function. In the former case, there are both factor and non-factor inputs appearing as arguments in the production function. In the latter, we will only have factor inputs. For the value added production function case, the arguments in favor of wage share expansion in response to trade liberalization should be even stronger in that there would be less of a concern about the expanding share of imported and import-competing non-factor inputs crowding out the share of
labor. We argued above that as long as other inputs are complementary to labor ($\sigma < 1$), i.e., as long as labor and other inputs are not highly substitutable, the output elasticity with respect to labor will rise with an increase in labor productivity measured by real sales or output per worker. Similarly, the elasticity of value added with respect to labor will also increase with trade liberalization as long as cheaper non-factor inputs (due to trade liberalization) bring about an increase in labor productivity measured by value added per worker and as long as other factors cannot substitute for labor very easily.

The markup channels and the rent sharing channels would work very similarly for both the wage share in output as well as in value added. In fact, the rents (and profits) defined in terms of output or, alternatively, in terms of the value added are exactly the same. So the rent-sharing based arguments above hold also for the share in value added as long as both output markups and value added markups move together. Of course, if all the markup increase is brought about by reductions in the prices of non-factor inputs that are passed less than proportionally on to consumers, then the value added markup might not move in the same direction as the output markup. However, markups of both kinds (output and value added) are measures of a firm’s market power and in most cases, therefore, should be positively associated with each other. In our empirical work, we will estimate the response of both the output share of wages and the value added share and, thus, we test whether they behave in the same way with respect to our variables of interest.

**Estimation Strategy**

Our empirical strategy uses variation in tariff rates across industries and over time to identify the effect of trade reform on labor shares. It relies on the maintained assumption that the evolution of industry-level tariffs is exogenous to that of firm labor shares. Brandt et al. (2012)
provide extensive documentation of the evolution of Chinese tariffs over 1995 to 2007. They highlight several patterns in the data. First, there is important variation across industries. Differences in effective rates of protection across industries narrowed dramatically over time, with the 25/75 quartile range dropping from approximately 20-120% in 1995 to 5-30% in 2007.\textsuperscript{18} Secondly, Brandt \textit{et al.} conclude that tariff reform over the period can be well described as tariff compression, with initially highly protected industries receiving the largest cuts. Moreover, they show that the relationship between tariff reductions and initial protection is almost one-for-one, implying that the decline in tariffs was mostly proportional and subject to little policy discretion. Additionally, tariff cuts after 2001 were fixed by China’s WTO accession agreement. In light of these findings, we control for the initial level of protection using firm fixed effects, and otherwise treat tariff cuts as exogenous to the evolution of labor shares.\textsuperscript{19}

To examine the effect of trade liberalization on the share of wages in output, \textit{wages/sales}, we use the following specification,

\[ \left( \frac{wages}{sales} \right)_{it} = \alpha + \beta_1 Output Tariff_{j,t-1} + \theta_t + \theta_t + \epsilon_{it}, \]  

(10)

where \( i \) indexes firms, \( j \) industry, and \( t \) time. \textit{Output Tariff}_{j,t-1} captures the level of protection placed on the final good in the industry in which firm \( i \) operates. The measure of protection is lagged one period. We include firm fixed effects, \( \theta_i \), to control for time-invariant firm characteristics, such as skill intensity, and year effects, \( \theta_t \), to capture economy-wide changes in factor markets, especially the outside wage. We also estimate our regressions by substituting the year effects with region by year effects, \( \theta_{rt} \) (where the subscript \( r \) denotes region), thereby

\textsuperscript{18} Brandt \textit{et al.} also show that output tariffs are higher than input tariffs, implying that effective rates of protection are higher than stated tariff rates.

\textsuperscript{19} They also find tariff rates in 1995 and 2001 were negatively correlated with industry skill intensity, as measured using US industry characteristics, which may imply that tariff cuts were larger for unskilled labor intensive sectors. We address this possibility in our empirical strategy by our use of firm fixed effects.
controlling for regional variation in factor market trends. Finally, $\varepsilon_{it}$ represents an idiosyncratic error term. Because our key variable of interest, output tariff, is constructed for each 4-digit industry, we cluster standard errors at the same level of aggregation.

The coefficient $\beta_1$ achieved by fixed effects estimation of (10) gives us an estimate of the overall average effect of tariff reform on firm-level labor shares, relative to a non-linear time trend. As discussed in section 3 above, tariff cuts influence labor share by their impact on firm input choices and markups. To isolate the effect of changes in markups on labor shares from the effect of tariff cuts on firm input choices, we estimate (10) including an estimated year-specific firm markup. This alternative specification is:

$$
\left( \frac{\text{wages}}{\text{sales}} \right)_{it} = \alpha + \beta_1 \text{Output Tariff}_{jt,t-1} + \beta_2 \text{Markup}_{jt,t-1} + \theta_t + \theta_i + \varepsilon_{it},
$$

If firm’s share rents with workers, we expect the estimated coefficient, $\beta_2$, to be positive and significantly different from zero. Since the firm-level markup is an estimated regressor, in addition to clustering at the four-digit ISIC level, we bootstrap the standard errors in all specifications that include markup.

**Allowing the impact of trade reforms to vary with market access**

To test the hypothesis that the effect of tariffs attenuates as access to international markets falls, we estimate the following variation on equation (10):

$$
\left( \frac{\text{wages}}{\text{sales}} \right)_{it} = \alpha + \beta_1 \text{Output Tariff}_{jt,t-1} + \beta_2 \text{Output Tariff}_{jt,t-1} \ast \text{Market Access}_i + \theta_t + \theta_i + \varepsilon_{it}.
$$

---

20 Regions are designated as comprised of the following provinces – (i) Coastal: Beijing, Fujian, Guangdong, Hainan, Jiangsu, Shandong, Tianjin, Zhejiang, Hebei; (ii) Inland: Shanxi, Anhui, Jiangxi, Henan, Hubei, Hunan; (iii) Northeast: Liaoning, Jilin, Heilongjiang; (iv) Southwest: Guangxi, Sichuan, Guizhou, Yunnan, Chongqing; (v) Northwest: Inner Mongolia, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang. These regional assignments follow those used by Démurger et al. (2002), in a contribution on the role of location in China’s development.

21 We report bootstrapped errors using 400 repetitions. See Cameron and Trivedi (2005), Chapter 11, for a discussion on selecting number of bootstrap replications.
Market Access\textsubscript{i} is the distance to the nearest international port – either Shanghai, Tianjin, or Guangzhou -- from the city in which the firm i is located.\textsuperscript{22} We are able to test the hypothesis that less exposure to global markets reduces the impact of trade reform on firm behavior through the estimated coefficient on the interaction of output tariff and market access. We expect the estimated coefficient to have the opposite sign from that for the output tariff alone. Greater distance from an international port is expected to push the impact of the tariff toward zero.

A measurement concern is that the output tariff does not fully reflect the full impact of protection on an industry because tariffs also influence the price of intermediate goods. An obvious solution may seem to be including both input and output tariff rates as regressors when estimating (10). Given the high correlation (0.72) we observe in the data between output tariffs and input tariffs (which we calculate using output tariffs and information from a Chinese input-output table, as described in the Appendix), it is not feasible to obtain separate estimates of the effect of these two types of tariffs. In other words, cutting output tariffs is to a very large extent synonymous with cutting input tariffs and the data does not allow us to isolate the effect of one from the other in an equation such as (10).\textsuperscript{23}

An important feature of China’s industrial development over the past decade is the entry of new firms (Brandt and Zhu, 2010). These new firms are significantly more productive than exiting firms and this suggests that they are different from incumbent firms. To ensure that our results are not being driven by entry, we estimate (10) and (11) with a balanced panel comprised of firms present in in the last eight years of the sample.

\textsuperscript{22} Distance, in 1,000 kilometers, is calculated as the arc distance between the geographic centroid of each city and that of the nearest international port, using ArcGIS software. We thank Siping Luo for generating this dataset.

\textsuperscript{23} We do estimate (10) and (11) with input and output tariffs included and we also replace the output tariff with an effective rate of protection measure, as shown below. Our conclusions are unchanged by these substitutions.
We also estimate (10) and (11) replacing labor’s share of sales with labor’s share of value added. To the extent that tariff cuts reduce the cost of imported inputs, labor’s share of sales may rise without any significant behavioral response. Therefore, we test whether the results we estimate when deflating the wage bill by sales carry over to the share of wages in value added.

Many studies, including Brandt et al. (2012), investigate the effect of tariff reform on firm behavior using an effective rate of protection (ERP) measure. The effective rate of protection for a sector is formally defined as \((V_T - V_W)/V_W\), where \(V_W\) is value added in the sector at world prices and \(V_T\) is value added in the presence of trade policies. An important drawback to the use of ERP, however, is that it may lead to misleading interpretations. To see this, consider a cut on tariffs that lowers the cost of imported intermediates for a firm. The firm may respond to cheaper inputs so as to increase labor’s share due to higher productivity of complementary labor. In such a case, a higher labor share results from lower protection. Such an effect cannot be adequately captured using ERP as a measure of protection, however, because of the way in which it is calculated.

Using the ERP formula, it is easy to see that on the one hand, other things being equal, a reduction in the input tariff leads to an increase in the ERP, while on the other hand, the input tariff itself is constructed as a weighted average of output tariffs, with weights coming from the input-output table. The latter relationship, coupled with the fact that diagonal elements of the input-output matrix are large, ensures that output and input tariffs move in the same direction. Thus, the positive correlation between output and input tariffs and between the ERP and the output tariff together with a negative correlation between the ERP and the input tariff complicate inference using the ERP. In other words, using ERP to measure protection obscures the effect of
tariff cuts that reduce input prices from those that raise output prices and, thus, significantly complicates interpretation.

Nevertheless, when our dependent variable is the labor share of value added, \( \frac{\text{wages}}{VA} \), the output tariff may not adequately capture the impact of tariff cuts on value added, for reasons that justify use of ERP measures generally. Therefore, in addition to measuring protection using the output tariff, we test the robustness of our results by also estimating:

\[
\left( \frac{\text{wages}}{VA} \right)_{it} = \alpha + \beta_1 IERP_{j,t-1} + \theta_t + \theta_t + \epsilon_{it},
\]

where \( IERP \) is a calculated measure of the industry effective rate of protection and we include both firm and time fixed effects as before.

**Allowing parameters to vary with ownership type**

To test the hypothesis that the effect of tariffs varies with ownership type, we estimate the following variation on equation (10):

\[
\left( \frac{\text{wages}}{sales} \right)_{it} = \alpha + \beta_1 \text{Output Tariff}_{j,t-1} + \beta_2 \text{Output Tariff}_{j,t-1} \times \text{Market Access}_i \\
+ \beta_3 \text{Output Tariff}_{j,t-1} \times \text{Private}_i + \beta_4 \text{Output Tariff}_{j,t-1} \times \text{Foreign}_i \\
+ \theta_t + \epsilon_{it}.
\]

\( \text{Private}_i \) is a dummy variable that takes the value unity if the firm is private-owned and \( \text{Foreign}_i \) is a dummy variable that takes the value unity if the firm is foreign-owned. State ownership is the left-out category and thus we are able to test whether the impact of tariffs differs between private and state firms and between foreign and state firms.

**Allowing parameters to vary with firm union status**

To test the hypothesis that the effect of tariffs varies by a firm’s union status, we estimate the following variation on equation (11):
\[
\frac{\text{wages}}{\text{sales}}_{it} = \alpha + \beta_1 \text{Output Tariff}_{j,t-1} + \beta_2 \text{Markup}_{j,t-1}
+ \beta_3 \text{Output Tariff}_{j,t-1} \times \text{Union}_i + \beta_4 \text{Markup}_{j,t-1} \times \text{Union}_i + \theta_i + \theta_t + \epsilon_{it}.
\]

\(\text{Union}_i\) is a dummy variable that takes the value unity if the firm hosts a registered union. We expect that the presence of a union will use its “collective voice” function to mute the impact of tariff reform on input choices, so we expect \(\beta_3\) to take the opposite sign from \(\beta_1\). If a union also plays a role in negotiating the extent of rent sharing, either by way of setting a fair wage norm or by exerting monopoly bargaining power, the presence of a union in the enterprise will raise the degree of rent sharing, so we expect \(\beta_4\) to be positive.\(^{24}\)

**Estimating firm-level markups**

Estimation of equation (11) requires a measure of the firm-level markup in each year. To create these measures, we follow the approach proposed by De Loecker *et al.* (2012).\(^{25}\) This approach to estimating firm-level markups relies on cost-minimization by producers and the existence of at least one variable input. In our application of the method, this variable input is taken to be material inputs and the markup, defined as the ratio of price to marginal cost, is calculated as the ratio of the (estimated) elasticity of output with respect to material inputs and the material expenditure share, taken from the data.\(^{26}\) We exclude observations with markups

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\(^{24}\) Given that labor unions are subordinate to the state-party in China, we do not explore the hypothesis that trade reforms have reduced union power. Such studies have largely been done for developed countries and are framed in terms of union bargaining over employment and wages. For example, Brock and Dobbelare (2006) use an efficient Nash bargaining approach and they find no significant negative relationship between trade and bargaining power. Similarly, Arbache (2004), using data from Brazil, finds no significant effect of trade on bargaining power. Conversely, Dumont, Raype and Willeme (2006) use data from five EU countries and conclude that trade liberalization does reduce the bargaining power of workers.

\(^{25}\) The method used by De Loecker, Goldberg, Khandelwal, and Pavcnik (2012) is similar to that of De Loecker and Warzynski (2012).

\(^{26}\) In the case of labor adjustment costs, as suggested by our fair wage framework, De Loecker and Warzynski (2012) suggest reliance on a gross output production function and the use of information on the expenditure share of materials to estimate markups. In our regressions, the variable *markup* is the firm level markup constructed by
that are above and below the 1st and 99th percentiles within each four-digit Chinese Industrial Classification (CIC) industry.

We test whether tariff levels influence firm level markups by estimating:

\[
(\text{markup})_{it} = \alpha + \gamma_1 \text{Output Tariff}_{j,t-1} + \gamma_2 \text{Input Tariff}_{j,t-1} + \theta_t + \theta_i + \nu_{it},
\]

where \text{markup} is the firm level markup estimated using the de Loecker et al method. As discussed above, output tariff cuts are expected to lower markups while input tariff cuts are expected to increase markups and this gives us sign predictions for \( \gamma_1 \) and \( \gamma_2 \). As in the labor share regressions, we include firm fixed effects, \( \theta_i \), to control for time-invariant firm characteristics and year effects, \( \theta_t \), to capture economy-wide changes in product and input markets. Finally, \( \nu_{it} \) represents an idiosyncratic error term. Because our tariff measures are constructed for each 4-digit ISIC industry, we cluster standard errors at the same level of aggregation.

4. Data

The data in this study are drawn from the Annual Surveys of Industrial Production conducted by the Chinese government’s National Bureau of Statistics (NBS) between 1998 and 2007. The Annual Surveys of Industrial Production include all state-owned enterprises and all non-state-owned firms whose annual sales exceed 5 million RMB (referred to as “above-scale” industrial firms). From this dataset, we use detailed information for each firm: identification code, four-digit CIC industry code, six-digit geographic administrative code, ownership classification, gross industrial output value, value added, total sales, union status, total employment, total wages, capital stock, and intermediate inputs.

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estimating production function coefficients for every two-digit CIC industry and using the firm’s material share of revenue. See Appendix for details on markup construction.

27 The NBS classifies non-state-owned enterprises to include collectively-owned enterprises, Chinese indigenous privately-owned enterprises, and foreign-owned enterprises operating in China. The sales cut-off for non-state firms is approximately $ US 600,000 over this period.
We impose several restrictions on the raw data to generate our analysis dataset. We filter the raw data to exclude observations with missing information and improbable values for certain variables. We exclude those firms that employ eight or fewer workers since most improbable values are associated with smaller firms. We further restrict the sample to include firms that have non-negative values for value added, total wages, total sales, total intermediate input use, gross industrial output value and capital. The final sample is an unbalanced panel spanning 1998 to 2007. Additionally, we consider a balanced panel of firms for which we have continuous data from 2000 to 2007.

Our dependent variable is the wage bill divided by total sales revenue or, alternatively, divided by value added. The wage share of sales, averaged over all firm-years, is 9.15 and the average wage share of value added is 28.17. Bannister (2005) emphasizes the importance of the non-wage share of compensation and these non-wage items may explain China’s unusually low wage share. To understand the extent to which our measure of labor’s income share is underestimated by excluding non-wage compensation we reconstruct the measure, following Ge (2007), to include pension and health insurance, housing subsidy, and labor and unemployment insurance. Since we use the Annual Surveys, we have limited information about these variables and not all variables are available in all years. Information on unemployment insurance, medical insurance, and housing provident funds are available for the years 2005-2007. Using these three variables we construct labor’s non-wage compensation, add it to wage compensation, and recalculate annual average labor shares. Pooling all three years, the average labor share of sales (value added) is 9.10 (28.95). For the same years, the average labor share in sales (value added), using wage compensation only, is 8.28 (27.02). The small differences in these two methods of

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28 Individual businesses (getihu) are owned by private individuals or households and legally not considered enterprises. These businesses are officially limited to member of a family and up to seven non-family employees.
calculation lead us to conclude that our measure of labor shares is not sensitive to exclusion of non-wage compensation.

We also use information from the Annual Surveys to designate each firm as having a union present in the enterprise or not. This indicator variable is only available for firms present in the 2004 Benchmark survey. Consequently, when we include union status as a regressor, we estimate our regressions using all firm-years for those firms present in the survey in 2004. Among state-owned firms in this reduced sample, 70% indicate the presence of a labor union. This union presence is significantly less for private domestic firms, at 46%, and foreign-invested firms, at 48%.

Output tariff data at the HS6 digit level are obtained from the World Integrated Trade Solution (WITS). We concord these data to four-digit ISIC Rev. 3 and then to four-digit CIC.\footnote{We thank Xuepeng Liu for sharing the output tariff data and the concordance between ISIC Rev. 3 and CIC. The concordance between HS6 and ISIC Rev.3 is available through WITS.} We use effectively applied tariffs, which are simple tariff rates weighted by imports. The rates for 2002 are missing and we use average tariffs in 2001 and 2003 to replace the missing values. We also impute tariffs for missing values in some ISIC Rev. 3 industries. Input tariffs are constructed as a weighted average of the output tariffs where the weights are obtained from the 2002 Chinese input-output table. The construction of this variable is detailed in the Appendix.

Table 1 provides a list of variables used in our regression analysis, as well as basic descriptive statistics. The unbalanced panel contains over 1.7 million firm-year observations. The number of firms in the sample increases over time, in large part because of rapid growth in the Chinese manufacturing sector. The number of unique firms more than doubled from 129,579 in 1998 to 309,657 in 2007. There are about 300,000 firm-year observations in the balanced...
panel we create using firms present throughout the period 2000 to 2007, representing 40,112 unique firms.

5. Results

Figure 1 illustrates the trends in the average output tariff and input tariff series constructed for the period 1998-2007. Average output and input tariffs generally decline over time. The only exception is 1999-2000, when we see a slight increase. Over the entire period, the average output tariff falls from 20 percent to nearly 2 percent while the average input tariff falls from slightly over 16 percent to roughly 2 percent. These trends mirror those found by Brandt et al. (2012) who report that output tariffs exceed input tariffs and that the difference between them falls over time. Coupled with evidence from Brandt et al. (2012) of their exogeneity, these tariff declines provide us with an ideal opportunity to look at the impact of trade liberalization on labor shares.

Figure 2 illustrates the trend in the average wage bill relative to sales in the unbalanced panel. In 1998, the average labor share of sales is about 11 percent and it declines throughout the period to about 8 percent in 2007. We also illustrate the trend in average labor share for two groups – those that experience above average tariff cuts over the period, and those that experience below average tariff cuts over the period. Both groups experience fairly steady downward trends in average labor share. However, the decline is steeper in the group of industries that experienced less pronounced tariff reduction. This is consistent with our regression results below in that industries with deeper tariff cuts are found to have experienced smaller drops in wage share, i.e., the changes in wage shares and the change in tariffs are negatively correlated. Figure 2 also shows that industries with larger tariff drops initially had a slightly higher average wage bill share, raising concern about the relation between tariff cuts and
initial conditions. We address this concern in two ways in our empirical work: first, by including firm fixed effects in our labor share regression and, secondly, by taking long differences of the data and including initial tariffs among the regressors.

Figure 3 illustrates the trend in the markup, estimated using firm-level data and then averaged for the full sample in each year. Interestingly, the markup trend bottoms out in 2001, the year China enters the WTO and begins rising thereafter as the accession-related tariff cuts are implemented.

Table 2 provides a regression of the estimated firm-level markups on both the one-year lagged output tariff and one-year lagged input tariff. As controls, we include firm fixed effects and year effects or, alternatively, firm fixed effects and region-year fixed effects. The two tariff measures are highly correlated (correlation coefficient of 0.72), and therefore multicolinearity is suspect. Nevertheless, we estimate a positive relationship between the firm’s markup and the industry output tariff and a negative and highly significant relationship between the markup and the industry input tariff. Because the two tariff series move in the same direction and by approximately the same magnitude, the much larger (in absolute value) coefficient on the input tariff implies that trade reform raised the markup for Chinese firms.

These results are qualitatively similar to those reported by De Loecker et al. (2012, Table 9) where Indian firm-level markups are positively correlated with output tariffs but negatively correlated with input tariffs. They argue that the positive coefficient on output tariffs is consistent with the view that import competition leads to output price declines and reduced markups. However, they also find that improved access to cheaper and more varied imported inputs reduces marginal costs and that these savings are not fully passed-through to consumers.
and thus raise markups. Although the Chinese data does not permit us to observe ex-factory prices, our findings are consistent with this pricing behavior observed for India.

In Table 3, we present our basic regression results using an unbalanced panel. The dependent variable is the share of the wage bill in sales. We include firm fixed effects to control for time-invariant cross-sectional variation in labor shares. While trade reform may be part of economy-wide changes that influence wage trends, it is difficult to separate the impact of tariff changes from ongoing domestic reforms to labor and product markets that also impact general wage levels and firm input decisions. Therefore, we estimate (10) using year dummies, as shown in columns 1 and 2 of Table 3. In columns 3 and 4, we substitute the year fixed effects for region-by-year fixed effects. This set of controls allows macroeconomic conditions to vary by region as well as year.30

In Table 3, we begin by including both output and input tariffs as separate measures of protection. Given the high correlation between industry input and output tariff rates, it is difficult to separate the independent influence of each type of protection. Regardless of the set of controls used, the estimated coefficient on the lagged output tariff and lagged input tariff is always negative and, when we control for both firm and region-year fixed effects, it is statistically significant for the input tariff. The estimated coefficients of -1.109 and -3.232 in column (3), estimated with region-year fixed effects, implies that a one standard deviation decline in the output tariff leads to a 0.013 standard deviation increase in the wage share and that a one standard deviation decline in the input tariff leads to a 0.026 standard deviation increase in

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30 Some researchers, including Bai and Qian (2011) also include a measure of the capital stock in labor share regressions. We choose not to include a measure of the capital input because tariff changes should lead to changes in all factor input choices and if we control for these, or control only for capital inputs, we remove that part of the response to tariffs out of the tariff coefficient. We include firm fixed effect, so we do control for the time-invariant capital stock of the firm. Estimating equation (10) including a measure of firm-level capital and, alternatively, capital and a measure of firm size, does not affect the signs or significance of our variables of interest.
the wage share. Another way to understand the magnitude of the estimated effect is that the tariff reductions over the nine-year period led to an increase in the wage share of sales by 0.65 percentage points.

When we include the estimated markup (lagged one period) as an additional control, as seen in the even-numbered columns, the estimated coefficient on the output (input) tariff becomes about 30% (15%) larger, and both remain negative. The markup itself has a positive and highly significant coefficient, suggesting that some part of the additional rent created by trade liberalization is passed along to labor. The estimated coefficient on markup of approximately 0.22 implies that a one standard deviation increase in the markup raises the wage share of sales by 0.008 of a standard deviation.

Given the high correlation between input and output tariff rates, we include only the output tariff as a measure of protection in columns 5 and 6. The estimated coefficient is negative and significant at the 5% level. The coefficient on the lagged markup, in column 6, remains virtually unchanged. The beta coefficient indicates that a one standard deviation reduction in the output tariff raises labor share by 0.03 of a standard deviation. This effect is similar to that implied by reducing both the input and output tariff by the output tariff alone. As seen by comparing columns 4 and 6, inclusion of the input tariff does not raise the adjusted $R^2$ of the estimated equation. Given these considerations, henceforth we present regressions that use the output tariff to capture the effect of liberalization on firms.\footnote{To test whether our findings are robust to alternative protection measures, we substitute industry-level effective rate of protection (IERP) for the tariff. The estimated coefficient on IERP for regressions that include firm and region-year fixed effects is negative and statistically significant at the 5% level. Again, when we add markup as a control, the estimated coefficient for the protection measure becomes somewhat larger, but remains negative and significant. The markup itself is positive and significant. Results available from the authors on request.}

Table 4 presents the same regressions as appear in Table 3, except that we now estimate (10) and (11) on the balanced panel. We do this to ensure that our results are not being driven by
the rapid entry of new firms over the sample period. Looking at the estimates in Table 4, the estimated impact of output tariffs on the wage share of incumbent firms is larger (a coefficient of -3.096 versus -1.109, using estimates that include firm and region-year fixed effects), but qualitatively the same. Indeed, the beta coefficient implies that a one standard deviation decline in the output tariff leads to a 0.035 standard deviation increase in the wage share of incumbents, very similar in magnitude to the impact estimated for the full sample. We also continue to find evidence of rent sharing, as indicated by the positive and highly significant estimated coefficient on the markup. In contrast to the full sample, these coefficients suggest that incumbents pass a larger share of rents along to workers – the beta coefficient rises from 0.008 for the full panel to 0.022 for the balanced panel.

We allow for heterogeneous effects by interacting the output tariff with the firm’s market access, as measured by its distance to the nearest international port. As seen in Table 5, looking across all columns, accounting for a spatial dimension does not change the sign, magnitude or significance of the markup variable. The impact of the level of protection on the wage share of sales now depends on the firm’s location. The estimated coefficients shown in column 4 imply a marginal effect of -2.152 for firms in Fuzhou, located in the Coastal region, a marginal effect of -1.978 for Huangzhou, located in the Central region, -0.426 for Xi’an, located in the Northwestern region, and 1.569 for Chengdu, located in the Southwestern region. As expected, we find that tariff cuts have their strongest impact on labor shares in those regions most exposed to international trade and, indeed, our estimates suggest that tariff cuts reduce labor shares in interior provinces.

Given that tariff reductions reduce the cost share of imported materials, increases in the wage share of sales may not translate into increases in the wage share of domestic value added.
Table 6 checks the robustness of our results by using the labor share of value instead of labor
share of sales as the dependent variable and by substituting the industry effective rate of
protection (IERP) for the output tariff. Looking across the column, we see that regardless of the
controls added, we estimate a negative and significant coefficient for our measure of protection,
whether or not we control for firm-level markup. The estimated coefficients shown in column 4
imply a marginal effect of -0.761 for firms in Fuzhou, located in the Coastal region, -0.658 for
Huangzhou, located in the Central region, 0.256 for Xi’an, located in the Northwestern region,
and 1.432 for Chengdu, located in the Southwestern region. Compared to the results shown in
Table 5, an increase in the effective rate of protection raises labor’s share of value added, but the
positive impact falls off more quickly with distance than we see in the results for labor share of
sales. In sum, substituting value added for sales in our dependent variable leads to the same
conclusion: reductions in protection lead to higher labor shares, *ceteris paribus*, and this effect
attenuates with distance from international markups. Firms pass through a share of rents to
workers.

Because available evidence suggests that state firms may have less flexibility in adjusting
employment, we expect tariff cuts to have a larger impact on non-state firms than on those in the
state sector. Table 7 allows the impact of trade protection on the wage share of sales to differ for
domestic private firms and for foreign-invested enterprises from that estimated for state firm.
Looking at column 2, which includes firm and year effects, we find that the impact of protection
on domestic private firms is not significantly different from that estimated for state firms. The
impact of tariff cuts on the wage share of sales in foreign-owned firms, however, is much larger:
for a firm located in a port city, the estimate coefficient for output tariff increases from -0.032 to
-0.126, almost a 300% increase in magnitude. It may be that foreign firms use larger shares of
imported intermediates or are better able to compete with imported varieties. We leave for future research an exploration of these differences between these firm types.

Table 8 provides evidence concerning the role of labor unions in rent sharing and adjustment to liberalization. When we estimate our regression on the entire sample, as in columns 1 and 2, we find that lower output tariffs raise labor share for all firms, but the magnitude of the effect is smaller for enterprises with a union present. This result is consistent with a process in which the union uses its “collective voice” to slow the introduction of imported intermediates, but such an interpretation cannot be directly tested with our data. Given that most state-owned firms have a union present, we estimate the regression separately for private enterprises (columns 3 and 4) and for foreign-invested enterprises (columns 5 and 6). As for the full sample, we find that the effect of tariff cuts is smaller for union firms. Interestingly, we find a significant relationship between firm markups and labor shares only in private firms in which a union is present. In contrast, foreign-invested firms with a union present exhibit no significantly different rent sharing behavior than do those without a union present. One possible explanation is that foreign firms already pay a wage premium (Harrison and Scorse, 2009) and thus do not need to offer further wage concessions. Since foreign-invested firms try to attract and keep the highest quality workers (irrespective of whether there is a union or not), such firms will pay a fair wage to their workers to promote goodwill among them and minimize worker turnover.

Our final empirical explorations consider long-differences in the data. These may be interpreted as long-run effects and they provide additional support for a causal interpretation of our findings. 32 We calculate five-year differences in the labor shares and regress them on five-year differences in lagged output tariffs. We also include the change in markups, which given

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32 Because we estimate the level equations with firm fixed effects, they are close to estimates obtained from first-difference regressions. Consequently, we interpret differences between the five-year-difference results and the fixed-effect regression results as differences between short-run and long-run impacts.
fixed output elasticities are measured by the negative of the change in log material share, to test the robustness of our findings regarding rent sharing. In additional specifications, we again allow the impact of output tariffs to attenuate with market access.

Table 9 presents results using output tariff as the measure of trade protection. As in the level regressions, cuts in output tariffs are associated with increases in the wage share of sales. Without additional controls, as shown in column 1, the estimated coefficient on the change in output tariff implies that a one percentage point cut in the output tariff raises labor share by 0.05 percentage points. This estimate is about double that implied by the level regressions shown in Table 3, and it suggests that the long-run impact of tariff cuts may exceed the one-year impact. Again, we find that the estimated coefficient on output tariff is not much affected by the inclusion of the firm-level markup. The markup continues to have a positive relationship with labor’s share of sales. When we allow the tariff coefficient to vary with market access, we again find that weaker market access significantly reduces the pro-labor impact of tariff cuts.

Our last regressions are shown in Table 10, where we estimate five-year differences with initial tariff levels included as additional controls. Evidence assembled by Brandt et al. (2012) suggests that the initial distribution of protection was not random and thus under a policy of tariff compression, these industries may be those receiving the largest proportional cuts. The results in Table 10 show that controlling for the initial tariff level does not alter our findings regarding the significant and positive impact of tariff cuts on labor shares. The initial tariff level is never a significant determinant of changes in labor shares.

6. Conclusion

Labor shares have fallen over the last decade in China and trade liberalization associated with China’s accession to the WTO is a plausible contributing factor to this trend. China is
unlike many other countries, however, in its lack of effective collective bargaining, extensive use of imported materials, and disproportionate presence of state enterprises in protected sectors. Drawing upon a theoretical model that permits trade reform to affect firm’s input choices and the extent of rent sharing with labor, we find support for a positive and significant effect of liberalization on the wage share of sales and the wage share of value added, operating both through input choices and through rent sharing. These results imply that workers share part of the gains from China’s WTO accession documented by Brandt et al. (2012).

Our approach does not allow investigation of the mechanisms by which firms alter input choices in response to liberalization. The results are consistent with a complementarity between domestic labor and imported intermediates, so that lower tariffs raise labor productivity and lead to a higher wage share. Although we cannot test this hypothesis directly as the ASIP does not provide the imported intermediates share, previous research has shown the importance of intermediate imports to domestic capabilities. In their study of Indian trade liberalization, Goldberg, Khandelwal, Pavcnik, Topalova (2010) find that new imported varieties generated an annual 4.7 percent decline in the imported input price index, and that firms’ access to new imported inputs increased their ability to manufacture new products. Topalova and Khandelwal (2011) further find that lower tariffs on final goods, as well as access to better inputs, due to lower input tariffs, increased firm-level productivity, with input tariffs having a larger impact. Given the productivity enhancing effect of trade reforms in China (Brandt et al., 2012), it is possible that some share of these gains came through input prices and led to larger labor shares.

Other possible explanations also bear serious investigation. An important alternative to labor-intermediate-input complementarity focuses on skill upgrading. Firms that face increased import competition may respond by increasing the education or experience of the workforce.
More highly educated or more experienced workers would earn higher wages and, thus, we may observe a higher wage bill in liberalized sectors. Such a response is consistent with our interpretation of the coefficient we estimate for the output tariff as evidence of changes in firms’ input choices, but it focuses on changes in the type of worker hired, not incumbents.

Our empirical findings indicate that firms share rents with workers and this may be somewhat surprising given the view that workers have no bargaining power in China. However, these results are consistent with the recent empirical contributions of Ge (2013) and Nee and Opper (2012). By separating firms into two groups depending on whether or not there is a union present in the enterprise, we are able to further expand on this newer view of rent sharing in the developing world. We find that union presence in domestic private firms leads to more generous rent sharing than that found in firms without unions. Foreign-invested firms share rents and to a larger extent, but we find no difference between union and non-union foreign enterprises.

As documented in a recent International Labour Organization (2013) report, declining labor shares are found in a majority of countries across the globe. The rapid entry of China and other low income countries into global markets for manufactured goods is often mentioned as one source of significant downward pressure on real wages worldwide. Whatever the impact of trade flows on labor shares in other countries, we find no evidence that tariff cuts undertaken by China to fulfill WTO accession agreements reduced labor’s share disproportionally in those industries facing market opening. Indeed, we find evidence consistent with adjustment in factor input choices that raised labor shares in these sectors as well as evidence of reform-associated higher rents, part of which were shared with workers. Given deep concern about rising within-country inequality, these finding suggest that factors other than trade liberalization may be driving observed trends in labor shares.
Appendix

Construction of Markups

The method proposed by De Loecker, Goldberg, Khandelwal, and Pavcnik (2012) to estimate markups requires estimation of a production function but does not require the specification of how firms compete in the product market. To implement the method with the ASIF, we begin by estimating production functions for every two-digit CIC industry to obtain output elasticities and input shares in total revenue.

Assuming a translog production function, the estimating equation is,

\[ y_{it} = \beta_0 + \beta_1 l_{it} + \beta_2 l_{it}^2 + \beta_k k_{it} + \beta_{kk} k_{it}^2 + \beta_m m_{it} + \beta_{mm} m_{it}^2 + \beta_m m_{it} + \beta_m m_{it} + \beta_{kl} k_{it} + \beta_{mk} m_{it} + \omega_{it} + e_{it} \]  

(A1)

where \( y_{it} \) is log of real gross industrial output value for firm \( i \) in period \( t \), \( l_{it}, m_{it}, k_{it} \) are the log values of labor, real intermediate inputs (or materials), and real capital, \( \omega_{it} \) is the component of productivity shock observed by the firm but not the econometrician, and \( e_{it} \) is the component of productivity shock that is unobserved by both the firm and the econometrician.

To control for \( \omega_{it} \), the Olley and Pakes (1996) method employs the investment decision function. This is based on the assumption that future productivity is strictly increasing with respect to current productivity, so that conditional on current capital usage, firms that observe a positive productivity shock in period \( t \) will invest more in that period.

\[ y_{it} = \beta_1 l_{it} + \beta_2 l_{it}^2 + \beta_m m_{it} + \beta_{mm} m_{it}^2 + \beta_m m_{it} + \phi(i_{it}, k_{it}, l_{it}, m_{it}) + e_{it} \]  

(A2)

where \( i_{it} \) is log investment and

\[ \phi(i_{it}, k_{it}, l_{it}, m_{it}) = \beta_0 + \beta_k k_{it} + \beta_{kk} k_{it}^2 + \beta_{kl} k_{it} + \beta_{mk} m_{it} + h(i_{it}, k_{it}) \]

and \( h(.) \) is approximated by a second order polynomial series in capital and investment so that,

\[ \phi(i_{it}, k_{it}, l_{it}, m_{it}) = \beta_0 + \beta_k k_{it} + \beta_{kk}(2k_{it}^2) + \beta_{kl} k_{it} + \beta_{mk} m_{it} + \beta_i i_{it} + \beta_{ii} i_{it}^2 + \beta_{ki} k_{it}. \]
Equation (2) is estimated using OLS and the coefficient estimates for the variable inputs will be consistent because $h(.)$ controls for unobserved productivity.

To control for selection bias, a survival probability, $\hat{P}_{it}$, is estimated for each firm as a function of lagged $i$ and $k$, their squares and cross products. To consistently estimate the capital coefficients we regress,

$$y_{it} - \hat{\beta}_t l_{it} - \hat{\beta}_{lt} l_{it}^2 - \hat{\beta}_m m_{it} - \hat{\beta}_{mm} m_{it}^2 - \hat{\beta}_{ml} m l_{it} =$$

$$\beta_k k_{it} + \beta_{kk} (2k_{it}^2) + \beta_{kl} k l_{it} + \beta_{mk} m k_{it}$$

$$+ g(\tilde{\theta}_{t-1} - \beta_k^* k_{it-1} - \beta_{kk}^* (2k_{it-1}^2) - \beta_{kl}^* k_{it-1} - \beta_{mk}^* m k_{it-1}, \hat{P}_{it}) + e_{it},$$

(A3)

where $g(.)$ is approximated by a second order polynomial series in $(\tilde{\theta}_{t-1} - \beta_k^* k_{it-1} - \beta_{kk}^* (2k_{it-1}^2) - \beta_{kl}^* k_{it-1} - \beta_{mk}^* m k_{it-1}, \hat{P}_{it})$ and $\hat{P}_{it}$.

The coefficients, $\hat{\beta}_t, \hat{\beta}_{lt}, \hat{\beta}_m, \hat{\beta}_{mm},$ and $\hat{\beta}_{ml}$ are consistent estimates for the variables from the first stage. $\beta_k^*, \beta_{kk}^*, \beta_{kl}^*$, and $\beta_{mk}^*$ can be any candidate value so that a prediction for the unobserved productivity can be computed up to a scalar constant. We use a non-linear estimation routine in this stage and set the initial parameters to the OLS estimates from the first stage.

Once all coefficients of the translog production function have been consistently estimated, the markups are estimated as the output elasticity, $\hat{\theta}_{it}^j$, with respect to an input, $j$, divided by the input’s share in revenue, $\alpha_{it}^j$. Since we focus on material markups, output elasticity for material is given by $\hat{\theta}_{it}^M = \hat{\beta}_m + 2\hat{\beta}_{mm} m_{it} + \hat{\beta}_{lm} l_{it} + \hat{\beta}_{mk} k_{it}$ and the markup with respect to materials is given by $\hat{\theta}_{it}^M / \alpha_{it}^M$, where $\alpha_{it}^M$ is drawn from the data.
Input Tariff Construction

Data on output tariffs available at the HS6 product level are converted to ISIC Rev. 3 industry level. These data are linked to the Chinese firm level data using a concordance between the four-digit Chinese Industrial Classification (CIC) and ISIC Rev. 3. For majority of the manufacturing industries at the CIC level, there is a many to one mapping between CIC and ISIC.33 Once output tariffs have been assigned to each four-digit CIC, they are aggregated to the five-digit IO sector level using output in 2003 as weights (Du, Harrison, Jefferson, 2011).

The following steps were carried out to construct the input tariffs. First, the 2002 Chinese input-output (IO) table was used to generate an input-output share matrix. The IO table consists of 122 sectors of which 71 belong to manufacturing. A typical cell $ij$ in this matrix lists the share of inputs in industry $i$ that come from industry $j$. These shares are multiplied by output tariffs as follows,

$$ Input Tariff_i = \sum_j s_{ij} \times Output Tariff_j $$

The weights $s_{ij}$ represents the share from the IO share matrix. For instance, if industry $i$ uses 70% plastic and 30% glass in its production, then it faces an input tariff that gives a weight of 70% to the output tariff on plastic and 30% to the output tariff on glass.

33 Four-digit CIC industries of 1529 “Manufacture of Fruit Wine”, 1533 “Manufacture of Fruit and Vegetable Juice”, and 1469 “Manufacture of Other Condiments and Fermented Products” map into two different ISIC industries each. Specifically, 1529 maps into 1552 “Manufacture of wines” and 1551 “Distilling, rectifying and blending of spirits; ethyl alcohol production from fermented materials”; 1533 maps into 1554 “Manufacture of soft drinks; production of mineral waters” and 1513 “Processing and preserving of fruit and vegetables”; and 1469 maps into 1514 “Manufacture of vegetable and animal oils and fats” and 1549 “Manufacture of other food products n.e.c.”. The output tariffs at the ISIC level are weighted equally to arrive at output tariffs at the four-digit CIC level. For example, a weight of 0.5 is assigned to output tariffs in ISIC sectors 1552 and 1551 to create an output tariff measure for four-digit CIC industry 1529.
References


<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Mean</th>
<th>St. Dev.</th>
</tr>
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<tr>
<td><strong>Firm Level</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Wage Bill/Sales</td>
<td>Share of wage bill in total sales x 100</td>
<td>9.149</td>
<td>10.034</td>
</tr>
<tr>
<td>Wage Bill/Value Added</td>
<td>Share of wage bill in total value added x 100</td>
<td>28.166</td>
<td>21.389</td>
</tr>
<tr>
<td>Market Access</td>
<td>Distance from city in which firm is located to nearest port (Shanghai, Tianjin, or Guangzhou) in 1,000 km</td>
<td>0.380</td>
<td>0.357</td>
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<tr>
<td>Markup</td>
<td>Ratio of price to marginal cost, estimated using translog production functions (See Appendix 1)</td>
<td>1.296</td>
<td>0.353</td>
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<td>Material Share</td>
<td>Log of the share of intermediate inputs in gross industrial output value</td>
<td>0.747</td>
<td>0.134</td>
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<td>Union</td>
<td>Categorical variable that takes the value 1 if a union is present in the enterprise and 0 otherwise</td>
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<td>0.500</td>
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<td><strong>Industry Level</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Tariff</td>
<td>Effectively applied tariff weighted by imports at the four-digit ISIC Rev. 3 level; concorded to four-digit CIC by authors.</td>
<td>0.126</td>
<td>0.116</td>
</tr>
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<td>Industry Effective Rate of Protection (IERP)</td>
<td>Effective rate of protection at the four-digit ISIC Rev. 3 level; concorded to four-digit CIC by authors.</td>
<td>0.194</td>
<td>0.366</td>
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<tr>
<td>Input Tariff</td>
<td>See text for details on construction of this variable at the five-digit IO level; concorded to four-digit CIC by authors.</td>
<td>0.104</td>
<td>0.064</td>
</tr>
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</table>

Notes: Summary statistics are based on the unbalanced panel between 1998 and 2007; Chinese Industrial Classification (CIC); Input-Output (IO). See Madariaga and Poncet (2007) for definition of city. †IERP calculated as \( \text{Output Tariff}_{jt} \div \left( 1 - \alpha_{jt} \right) \times \text{Input Tariff}_{jt} \) where \( \alpha_{jt} \) is the material share in industry \( j \) at time \( t \).
Table 2: Markups and Trade Liberalization

<table>
<thead>
<tr>
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<th>(1) Markup</th>
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<td>Lag Output Tariff</td>
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<td>0.0651</td>
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<tr>
<td></td>
<td>(0.051)</td>
<td>(0.052)</td>
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<tr>
<td>Lag Input Tariff</td>
<td>-0.476***</td>
<td>-0.461***</td>
</tr>
<tr>
<td></td>
<td>(0.142)</td>
<td>(0.143)</td>
</tr>
<tr>
<td>Constant</td>
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<td>1.347***</td>
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<tr>
<td></td>
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<td>(0.020)</td>
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<td>1,691,791</td>
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<td>Adjusted $R^2$</td>
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<td>0.45</td>
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<tr>
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</tr>
<tr>
<td>Region-Year FE</td>
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</table>

Notes: The dependent variable is markup. See text for details on how markups are calculated from firm-level data. Outliers in the 99th and 1st percentile of the markup distribution are excluded. The regressions are run on an unbalanced panel from 1998-2007. Standard errors are clustered at the four-digit ISIC level. Significance: *10%, **5%, ***1%.
Table 3: Labor Share of Sales and Tariffs

<table>
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<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
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<td>Lag Output Tariff</td>
<td>-1.269</td>
<td>-1.606</td>
<td>-1.109</td>
<td>-1.446</td>
<td>-1.993**</td>
<td>-2.475**</td>
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<td></td>
<td>(0.873)</td>
<td>(1.768)</td>
<td>(0.744)</td>
<td>(2.009)</td>
<td>(0.904)</td>
<td>(1.184)</td>
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<td></td>
<td>(2.055)</td>
<td>(2.817)</td>
<td>(1.858)</td>
<td>(2.433)</td>
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<td>0.212**</td>
<td>0.219***</td>
<td>0.220***</td>
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<td></td>
<td>(0.072)</td>
<td>(0.057)</td>
<td>(0.049)</td>
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<tr>
<td>Constant</td>
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<td>8.920***</td>
<td>8.966***</td>
<td>8.530***</td>
<td>8.632***</td>
<td>8.130***</td>
</tr>
<tr>
<td></td>
<td>(0.365)</td>
<td>(0.665)</td>
<td>(0.306)</td>
<td>(0.671)</td>
<td>(0.235)</td>
<td>(0.429)</td>
</tr>
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<td>Observations</td>
<td>1,763,062</td>
<td>1,307,177</td>
<td>1,763,062</td>
<td>1,307,177</td>
<td>1,768,083</td>
<td>1,310,984</td>
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<tr>
<td>Adjusted R²</td>
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<td>0.65</td>
<td>0.62</td>
<td>0.65</td>
<td>0.62</td>
<td>0.65</td>
</tr>
<tr>
<td>Firm FE</td>
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</tbody>
</table>

Notes: The dependent variable is (wage bill/sales x 100). Outliers in the 99th and 1st percentile of the markup distribution are excluded. The regressions are run on an unbalanced panel from 1998-2007. Standard errors are clustered at the four-digit ISIC level and in specifications that include firm-level markups, bootstrapped using 400 repetitions. Significance: *10%, **5%, ***1%.
Table 4: Labor Share of Sales and Output Tariffs, Balanced Panel

<table>
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</thead>
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<td>Lag Output Tariff</td>
<td>-3.271**</td>
<td>-3.221</td>
<td>-3.096**</td>
<td>-3.033</td>
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<tr>
<td></td>
<td>(1.515)</td>
<td>(2.228)</td>
<td>(1.291)</td>
<td>(1.879)</td>
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<td>Lag Markup</td>
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<td>0.558***</td>
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<td>0.566***</td>
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<tr>
<td></td>
<td></td>
<td>(0.193)</td>
<td></td>
<td>(0.185)</td>
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<td>Constant</td>
<td>9.783***</td>
<td>8.851***</td>
<td>9.644***</td>
<td>8.638***</td>
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<tr>
<td></td>
<td>(0.255)</td>
<td>(0.466)</td>
<td>(0.249)</td>
<td>(0.447)</td>
</tr>
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<td>Observations</td>
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<td>291,795</td>
<td>309,467</td>
<td>291,795</td>
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<td>0.65</td>
<td>0.66</td>
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<tr>
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<td>Year FE</td>
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<tr>
<td>Region FE</td>
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<td>Region-Year FE</td>
<td>-</td>
<td>-</td>
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Notes: The dependent variable is (wage bill/sales x 100). Outliers in the 99th and 1st percentile of the markup distribution are excluded. The regressions are run on a balanced panel from 2000-2007. Standard errors are clustered at the four-digit ISIC level and in specifications that include firm-level markups, bootstrapped using 400 repetitions. Significance: *10%, **5%, ***1%.
Table 5: Labor Share of Sales and Output Tariffs: Effect of Market Access

<table>
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<tbody>
<tr>
<td>Lag Output Tariff</td>
<td>-3.790*</td>
<td>-5.866**</td>
<td>-4.830**</td>
<td>-5.306**</td>
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<tr>
<td></td>
<td>(1.927)</td>
<td>(2.351)</td>
<td>(1.929)</td>
<td>(2.752)</td>
</tr>
<tr>
<td>Lag Output Tariff x Market Access</td>
<td>4.831**</td>
<td>5.618**</td>
<td>5.284**</td>
<td>5.343**</td>
</tr>
<tr>
<td></td>
<td>(2.131)</td>
<td>(2.211)</td>
<td>(2.112)</td>
<td>(2.395)</td>
</tr>
<tr>
<td>Lag Markup</td>
<td>0.209**</td>
<td></td>
<td>0.213**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.069)</td>
<td></td>
<td>(0.070)</td>
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</tr>
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<td>Constant</td>
<td>9.242***</td>
<td>9.075***</td>
<td>9.225***</td>
<td>8.716***</td>
</tr>
<tr>
<td></td>
<td>(0.150)</td>
<td>(0.475)</td>
<td>(0.241)</td>
<td>(0.523)</td>
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<td>1,309,056</td>
<td>1,765,550</td>
<td>1,309,056</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
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<td>0.65</td>
<td>0.62</td>
<td>0.65</td>
</tr>
<tr>
<td>Firm FE</td>
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<td>Y</td>
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</tr>
<tr>
<td>Year FE</td>
<td>-</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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</tbody>
</table>

Notes: The dependent variable is (wage bill/sales x 100). Outliers in the 99th and 1st percentile of the markup distribution are excluded. The regressions are run on an unbalanced panel from 1998-2007. Standard errors are clustered at the four-digit ISIC level and in specifications that include firm-level markups, bootstrapped using 400 repetitions. Significance: *10%, **5%, ***1%.
Table 6. Labor Share of Value Added and the Effective Rate of Protection

<table>
<thead>
<tr>
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<tbody>
<tr>
<td></td>
<td>Wage Bill/VA</td>
<td>Wage Bill/VA</td>
<td>Wage Bill/VA</td>
<td>Wage Bill/VA</td>
</tr>
<tr>
<td>Lag IERP</td>
<td>-1.522*</td>
<td>-2.618**</td>
<td>-2.279**</td>
<td>-2.619**</td>
</tr>
<tr>
<td></td>
<td>(0.838)</td>
<td>(1.085)</td>
<td>(0.922)</td>
<td>(1.142)</td>
</tr>
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<td>Lag IERP x Market Access</td>
<td>2.279**</td>
<td>3.182***</td>
<td>2.729***</td>
<td>3.148***</td>
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<tr>
<td></td>
<td>(0.954)</td>
<td>(1.178)</td>
<td>(1.001)</td>
<td>(1.062)</td>
</tr>
<tr>
<td>Lag Markup</td>
<td></td>
<td>0.370**</td>
<td></td>
<td>0.372**</td>
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<td></td>
<td>(0.140)</td>
<td></td>
<td>(0.145)</td>
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<td>27.71***</td>
<td>28.80***</td>
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<td>(0.105)</td>
<td>(0.947)</td>
<td>(0.435)</td>
<td>(0.807)</td>
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<td>1,151,123</td>
<td>1,628,397</td>
<td>1,151,123</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
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<td>0.58</td>
<td>0.54</td>
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</tr>
<tr>
<td>Year FE</td>
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<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is (wage bill/value added x 100). Outliers in the 99th and 1st percentile of the markup distribution are excluded. The regressions are run on an unbalanced panel from 1998-2007. Standard errors are clustered at the four-digit ISIC level and in specifications that include firm-level markups, bootstrapped using 400 repetitions. Significance: *10%, **5%, ***1%.
<table>
<thead>
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<tr>
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<td>(1.162)</td>
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</tr>
<tr>
<td>Lag Output Tariff x Private</td>
<td>1.253*</td>
<td>0.909</td>
</tr>
<tr>
<td></td>
<td>(0.747)</td>
<td>(1.014)</td>
</tr>
<tr>
<td>Lag Output Tariff x Foreign</td>
<td>-7.884***</td>
<td>-9.416***</td>
</tr>
<tr>
<td></td>
<td>(1.907)</td>
<td>(2.090)</td>
</tr>
<tr>
<td>Lag Output Tariff x Market Access</td>
<td>3.792**</td>
<td>3.380**</td>
</tr>
<tr>
<td></td>
<td>(1.518)</td>
<td>(1.614)</td>
</tr>
<tr>
<td>Lag Markup</td>
<td></td>
<td>0.209***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.066)</td>
</tr>
<tr>
<td>Constant</td>
<td>9.307***</td>
<td>8.820***</td>
</tr>
<tr>
<td></td>
<td>(0.214)</td>
<td>(0.512)</td>
</tr>
<tr>
<td>Observations</td>
<td>1,765,550</td>
<td>1,309,056</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.62</td>
<td>0.65</td>
</tr>
<tr>
<td>Firm FE</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Year FE</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is (wage bill/sales x 100). Outliers in the 99th and 1st percentile of the markup distribution are excluded. The regressions are run on an unbalanced panel from 1998-2007. “Private” denotes privately owned domestic firms and “foreign” denotes foreign invested enterprises. Standard errors are clustered at the four-digit ISIC level and in specifications that include firm-level markups, bootstrapped using 400 repetitions. Significance: *10%, **5%, ***1%.
Table 8. Labor Share of Sales and Output Tariffs: Effects of Union Presence

<table>
<thead>
<tr>
<th></th>
<th>All Enterprises</th>
<th>Private Enterprises</th>
<th>Foreign Invested Enterprises</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Lag Output Tariff</td>
<td>-2.982**</td>
<td>-4.521*</td>
<td>-1.356**</td>
</tr>
<tr>
<td></td>
<td>(1.388)</td>
<td>(2.593)</td>
<td>(0.670)</td>
</tr>
<tr>
<td>Lag Output Tariff x Union</td>
<td>1.110*</td>
<td>2.843**</td>
<td>0.906</td>
</tr>
<tr>
<td></td>
<td>(0.654)</td>
<td>(1.361)</td>
<td>(0.635)</td>
</tr>
<tr>
<td>Lag Markup</td>
<td>0.170**</td>
<td>-0.003</td>
<td>0.370**</td>
</tr>
<tr>
<td></td>
<td>(0.082)</td>
<td>(0.059)</td>
<td>(0.147)</td>
</tr>
<tr>
<td>Lag Markup x Union</td>
<td>0.134</td>
<td>0.242*</td>
<td>0.119</td>
</tr>
<tr>
<td></td>
<td>(0.091)</td>
<td>(0.139)</td>
<td>(0.159)</td>
</tr>
<tr>
<td>Constant</td>
<td>9.217***</td>
<td>8.555***</td>
<td>7.823***</td>
</tr>
<tr>
<td></td>
<td>(0.234)</td>
<td>(0.465)</td>
<td>(0.167)</td>
</tr>
<tr>
<td>Observations</td>
<td>1,208,830</td>
<td>970,105</td>
<td>640,091</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.61</td>
<td>0.65</td>
<td>0.57</td>
</tr>
<tr>
<td>Firm FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Year FE</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is (wage bill/sales x 100). Outliers in the 99th and 1st percentile of the markup distribution are excluded. The regressions are run on an unbalanced panel from 1998-2007 and only include firms present in 2004. Standard errors are clustered at the four-digit ISIC level and in specifications that include firm-level markups, bootstrapped using 400 repetitions. Significance: *10%, **5%, ***1%.
<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in Lag Output Tariff</td>
<td>-5.169**</td>
<td>-4.900**</td>
<td>-7.447***</td>
<td>-7.419***</td>
</tr>
<tr>
<td></td>
<td>(2.041)</td>
<td>(2.154)</td>
<td>(2.540)</td>
<td>(2.525)</td>
</tr>
<tr>
<td>Change in (Lag Output Tariff x Market Access)</td>
<td>5.011***</td>
<td>5.585***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.652)</td>
<td>(1.597)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-(Change in Log Material Share)</td>
<td>1.449***</td>
<td>1.456***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.275)</td>
<td>(0.269)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>283,341</td>
<td>270,249</td>
<td>280,637</td>
<td>267,644</td>
</tr>
</tbody>
</table>

The dependent variable is the five-year change in (wage bill/sales x 100). Standard errors are clustered at the four-digit ISIC level and in specifications that include firm-level markups, bootstrapped using 400 repetitions. Significance: *10%, **5%, ***1%.
## Table 10: Labor Share of Sales and Output Tariffs, Five-Year Difference Regressions with Controls for Initial Tariffs

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Change in Lag Output Tariff</strong></td>
<td>-4.760**</td>
<td>-4.764**</td>
<td>-7.062***</td>
<td>-7.256***</td>
</tr>
<tr>
<td></td>
<td>(1.838)</td>
<td>(2.139)</td>
<td>(2.031)</td>
<td>(2.227)</td>
</tr>
<tr>
<td><strong>Initial Output Tariff</strong></td>
<td>0.305</td>
<td>0.102</td>
<td>0.288</td>
<td>0.122</td>
</tr>
<tr>
<td></td>
<td>(1.692)</td>
<td>(1.891)</td>
<td>(1.617)</td>
<td>(1.978)</td>
</tr>
<tr>
<td>-(Change in Log Material Share)</td>
<td>1.449***</td>
<td>1.456***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.265)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Change in (Lag Output Tariff x Market Access)</strong></td>
<td>5.012***</td>
<td></td>
<td>5.586***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.652)</td>
<td></td>
<td>(1.604)</td>
<td></td>
</tr>
<tr>
<td><strong>Observations</strong></td>
<td>283341</td>
<td>270249</td>
<td>280637</td>
<td>267644</td>
</tr>
<tr>
<td><strong>Adjusted R²</strong></td>
<td>0.00</td>
<td>0.01</td>
<td>0.00</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Notes: The dependent variable is the five-year change in (wage/sales x 100). Standard errors are clustered at the four-digit ISIC level and in specifications that include firm-level markups, bootstrapped using 400 repetitions. Significance: *10%, **5%, ***1%.
Figure 1: Trends in Average Tariffs, 1998-2007

Notes: Output tariff is the effectively applied tariff weighted by imports at the four-digit ISIC Rev. 3 level. Input tariff is a weighted average of the output tariffs at the five-digit IO sector level where weights are obtained from the 2002 Chinese input-output matrix. See Appendix for details on input tariff construction.
Figure 2: Wage Share Trends for Two Industry Groups, 1998-2007

Note: Industries are categorized as experiencing above (below) average change in tariffs over our sample period if the absolute difference in the tariff rates between 2007 and 1998 exceeds (falls below) the average of the absolute difference across all industries.
Figure 3: Estimated Average Markup, 1998-2007

Notes: Markups estimated using the De Loecker, Goldberg, Khandelwal, and Pavcnik (2012) method and an unbalanced panel from the ASIP. See text for details.