Worker Adjustment to Trade Shocks: Where you Work or What you do?

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Abstract

I study the adjustment of Brazilian workers to rising import competition from China. I compare the impact of trade exposure based on workers' initial industries, geographic regions, and occupations on long-term earnings and employment. Occupation-based exposure to this trade shock leads to the largest adjustment costs in terms of both earnings and employment. I show these adjustment costs are heterogeneous and depend on workers' educational attainment and tenure at their initial employers. I disentangle the impact of trade on earnings at workers' initial employers or industries versus the impact on earnings outside of these.

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1. Introduction.

I study workers' adjustment to trade shocks in the context of the dramatic increase in Chinese import competition in Brazil during the period 1998-2013. Starting in the late 1990's, and in a similar pattern to that observed in many other countries, Brazil's imports from China increased from a negligible share to more than 15 percent of total imports a decade later, creating an ideal quasi-natural experiment.[1] Using a longitudinal matched employer-employee administrative census of Brazil's labor force, I study the long-term effects of this shock on the labor market outcomes of workers facing different degrees of exposure to this shock. Exposure to this large trade shock can impact workers based on their industries of employment, the local labor markets where they work, or their occupations at the time the shock begins. I compare the magnitude of adjustment costs to trade based on each of these sources of exposure, finding that occupation-based exposure is the most important source of adjustment costs.

This comparison is motivated by recent influential findings by Autor et al. (2014) who find economically meaningful adjustment costs borne by U.S. workers due to growth in Chinese import competition. Recent longitudinal analysis of the response of earnings of individual workers to trade shocks has not considered occupations as a source of trade exposure. Ebenstein et al. (2014), however, find that occupational exposure to offshoring from low wage countries leads to lower average wages in more exposed occupations, while industry-based exposure does not lead to a significant impact. While Ebenstein et al. (2014) do not track workers over time to measure adjustment costs, their work suggests occupations are an important source of trade exposure.[2]

This paper is also motivated by the need to compare the response of the U.S. labor market to this "China shock" to the experience of other countries, and especially developing

[1] In 2013, China was Brazil's main source of imports accounting for 15% of total imports. In 1998, China's import share was 2.1%.

[2] Occupation-based exposure cannot be measured in Autor et al. (2014) work due to the lack of data on this dimension in the U.S. data used by them.

countries that often have a pattern of comparative advantage closer to China's. The case of Brazil, aside from its size and economic relevance, is interesting for several other reasons. First, it has a large manufacturing sector that seems to have been fairly resilient to import competition from low-wage countries. Second, the "China shock" has been to the Brazilian economy has been as large as that faced by the U.S, and some of the most exposed industries, such as textiles, have a very important share of manufacturing employment. Third, its labor markets are very different than those of the U.S. and other developed countries: it ranks as one of the most rigid labor markets in the world due to its regulations, firing costs, and payroll taxes. Lastly, it has one of the highest indices of inequality in the world, making the study of the distributional consequences of trade particularly relevant.

My findings show, first, that there are large adjustment costs in terms of foregone long-term earnings to Brazilian manufacturing workers due to rising Chinese imports associated with industry, region, and occupation-based exposure. Second, I find that occupation-based exposure to this shock generates adjustment costs significantly larger than those generated by industry or region-based exposure. Comparing workers at the 75th and 25th percentiles of industry-based exposure, my estimates reflect losses in cumulative earnings of 6% of average annual pre-shock earnings borne over the 15 year period 1999-2013.[3] This effect is larger in magnitude (14 percent of initial annual earnings lost) but not statistically significant for region-based exposure. For occupation-based trade exposure, the 75-25 percentile difference in earnings corresponds to 23 percent of initial annual earnings lost. The main message then is the importance of occupations as a source of trade exposure in generating adjustment costs to workers. This is consistent with the findings of Ebenstein et al. (2014) - in a different context - regarding the impact of occupation-based trade exposure on average wages. A

[3]The magnitude of the impact of the trade shock on earnings for industry-based exposure can be compared to Autor et al. (2014)'s results for the U.S. They find a larger magnitude reflecting a reduction in earnings when comparing the 75th and 25th percentiles of trade exposure of 46 percent of initial annual earnings in their main result. These are losses over a 16 year period (to compare it to my 15 year period the equivalent would be adjusted by 15/16 (43%)). The difference is possibly due to the much larger set of fixed effects I include in my estimation. In particular, my estimate is obtained comparing within occupations and within regions. Autor et al. (2014) do not include occupation or region fixed effects due to data limitations.

potential explanation behind these results is that it is more difficult for workers to move away from highly-exposed occupations than away from highly-exposed industries, perhaps due to human capital that is occupation-specific rather than industry-specific.[4]

The impact of rising Chinese competition on long-term employment is negative and statistically significant in the case of industry-based exposure, but the magnitude is smaller. The difference between the 75th and 25th percentiles of industry-based exposure is associated to 3.7% of lost days of employment in terms of annual pre-shock employment.[5] The coefficient is again much larger for occupation-based exposure (8.1%). It is negative but is much smaller and not statistically significant for region-based exposure.

Beyond measuring the average impact on workers, I study how the response of workers' labor market outcomes to this shock depends on their educational attainment and on their tenure at their employer at the start of the shock. I find that workers with higher educational attainment bear significantly larger adjustment costs in terms of earnings, for which two potential explanations stand out. First, the low education group (with at most primary schooling) has a very low educational attainment for international standards, and possibly performs simpler jobs within the manufacturing sector that are not highly specialized or very specific to their initial employer, making them less vulnerable to trade-led displacement. A second possible explanation is that the earnings of low-educational attainment workers have little margin to fall in a period in which the minimum wage expanded significantly. Regarding job tenure, I find that while differences between workers are smaller along this margin, workers with a long tenure at their initial employers experience somewhat smaller earnings losses due to the trade shock. This suggests that short-tenure workers are less-attached to their employer and could be displaced more easily. This hypothesis could be

[4]Kambourov and Manovskii (2009) provide evidence in favor of the occupation-specific nature of human capital.

[5]Autor et al. (2014) find a negative but not statistically-significant impact on years with positive employment, of similar magnitude. Instead of measuring years with positive employment, I can measure cumulative days of employment. The magnitude of their estimates is 3.6% of one (pre-shock, average) year's employment lost when comparing the 75th and 25th percentiles of industry-based exposure (the 15-year equivalent, comparable to my estimate, is 15/16*3.6% (3.4%).

stronger than one in the opposite direction in which long-tenure workers have accumulated more employer-specific human capital that trade-led displacement can destroy.

In a third set of results, I decompose earnings losses due to the trade shock into earnings within workers' initial employers, within their initial industries, within the manufacturing sector, or outside manufacturing. A common pattern between industry, region, and occupation-based trade exposure is that earnings losses within workers' initial firms or industries are offset with higher earnings in other manufacturing industries. In the case of region-based and occupation-based exposure, earnings outside the manufacturing sector decline, suggesting that workers do not migrate outside of regions or occupations depressed by import competition.

The empirical strategy exploits variation across industries in the growth in import competition from China during 1998-2013. This variation then maps into variation across regions or occupations. I construct region and occupation specific measures of exposure to this shock weighting industry-level imports by the pre-shock employment shares of industries in each region or occupation. The identification strategy relies on the assumption that the variation across industries in the growth in Brazil's imports from China is determined by developments in China and does not depend on the circumstances of specific Brazilian industries. The overall growth in Chinese exports to Brazil is similar to that of Chinese exports to many other countries and has been driven largely by China's productivty growth and integration to world markets. The composition across industries of Brazilian imports from China, however, could potentially be driven by productivity shocks to a given Brazilian sector that could impact both the evolution of imports and of labor market outcomes. I address this concern by implementing an estimation strategy where industry-level imports from China by Brazil are instrumented by industry-level imports from China by a set of countries similar to Brazil. A natural choice for this auxiliary set of countries used to construct the instrumental variables is the nine other countries in South America - including large countries such as Argentina and Colombia - which have a similar income level to Brazil.

Related Literature. This paper is related to a growing literature on the adjustment of workers to trade liberalization using longitudinal worker-level data to study the response of workers to trade shocks.[6] Autor et al. (2014) measure the adjustment of U.S. workers to import competition from China using social security records over the period 1992-2007, finding economically-significant consequences of trade exposure on earnings. Differently than the previous literature, their work pioneers the longitudinal analysis of labor market outcomes of individual workers to trade shocks. Autor et al. (2014) do not measure the consequences of occupational exposure to trade, which is the main contribution of my paper.[7] In related work, Dauth, Findeisen, and Suedekum (2016) study the adjustment of workers in Germany import competition, measuring industry and region-based exposure to this "China shock". Using Brazilian data and focusing on shocks to local labor markets, Dix-Carneiro and Kovak (2015) study wage and employment dynamics after the Brazilian trade liberalization of the early 1990's based on individual workers' exposure to regional trade shocks. Focusing on the impact of trade exposure on Danish workers, Utar (2015) studies the labor market consequences of the removal of textile quotas.[8] Common to all this work is the methodology of tracking workers over time to measure their labor outcomes in response to trade shocks.[9] The main contribution of my paper in this context is comparing the consequences of industry, region, and occupation-based exposure. An additional contribution is providing more evidence of the results found initially by Autor, et al. (2014) for a large developing country with a more similar pattern of comparative advantage to China.

[6]The broader empirical literature on the labor market consequences of trade is surveyed by Goldberg and Pavcnik (2007), and Harrison, McLaren, and McMillan (2011). In parallel to this empirical work examining the consequences of trade liberalization on labor market outcomes of individual workers, theoretical work seeks to incorporate heterogeneous workers into trade models (see for example Helpman, Itskhoki, and Redding (2010)). Empirical work on trade and firm-level wages includes Amiti and Davis (2012) and Utar (2014) among others.

[7]Workers' occupations are not recorded in the U.S. SSA data used by Autor et al. (2014).

[8]In related work, all using Danish data, Keller and Utar (2016) study the impact of import competition (generated by removal of textile quotas) on job polarization, and Hummels et al. (2014) estimate the impact of offshoring and exporting on workers' wages.

[9]Another set of papers (Artuç, Chaudhuri, and McLaren (2010), Dix-Carneiro (2014), Artuç and McLaren (2015) and Caliendo, Dvorkin, and Parro (2015)) also seek to measure adjustment costs to trade but estimating structural models rather than following actual trade shocks.

This paper is also connected to a number of papers that have studied the response of Brazilian labor markets to international trade in different contexts, mostly during Brazil's unilateral trade liberalization in the late 1980s and early 1990s. Menezes-Filho and Muendler (2011) study the reallocation of workers in response to the liberalization episode. Blom et al. (2004) study the impact of this episode on industry-level wages, while Kovak (2013) measures the response of regional wages to liberalization. Costa, Garred, and Pessoa (2016) study the impact of import competition from China on various regional outcomes including average wages and inequality. Krishna, Poole, and Senses (2012 and 2014) and Helpman et al. (2016) highlight the role of worker heterogeneity and mobility across firms in shaping the relationship between trade liberalization and wages..

Methodologically, this paper is also related to the following literatures. The use of regional shocks follows Chiquiar (2008), Topalova (2010), Kovak (2013), Autor, Dorn, and Hanson (2013), and Hakobyan and McLaren (2016), while the use of occupational shocks follows Ebenstein et al. (2014). The analysis of job displacement in response to trade follows a well-established literature on consequences of job displacement, pioneered among others by Jacobson, Lalonde, and Sullivan (1993).

Finally, this paper is related to work that seeks to understand the impact of China's productivity growth and integration to world markets on many countries throughout the world. This phenomenon has caused a decline in manufacturing employment in the U.S. and elsewhere and has brought important distributional consequences with it.[10] While this literature has focused primarily on the impact on developed countries, the analysis of the Brazilian case - a large developing country with a pattern of comparative advantage more similar to China's than that of the U.S. or other developed countries - provides an interesting point of comparison. Further, unlike in the U.S., manufacturing employment has not fallen or slowed down in Brazil during this "China shock", suggesting that some element in

[10] Pierce and Schott (2016) calculate the decline in U.S. employment caused by the elimination of potential tariff increases to China after its WTO entry. Autor, Dorn, and Hanson (2016) survey the literature on the impact of this shock to the U.S. on various outcomes.

developing economies (possibly labor market frictions that impede labor reallocation) makes their experience different.

Outline. The paper is organized as follows. In section 2, I illustrate the econometric framework and define industry, region, and occupation-based exposure to rising Chinese import competition. In section 3, I describe the Brazilian longitudinal linked employer-employee census and other data sources. I report the baseline results in section 4.1, comparing the adjustment costs associated to each source (industries, regions, or occupations) of trade exposure. In 4.2, I explore the heterogeneous impact of this shock differentiating between workers with high and low educational attainment and long or short tenure at their original employers. Finally, in 4.3 I study the margins along which these adjustment costs occur, separating the impact of trade on foregone earnings at workers' initial employers or industries versus the impact on earnings outside of these.

2. Econometric Framework.

During the past two decades, Brazil has faced dramatic growth in Chinese imports in many of its manufacturing industries. As figure 1 shows, imports from China during 1998-2013 grow considerably faster than imports from the rest of the world. China became Brazil's largest source of imports in 2010, with a 15 percent share in total imports. In contrast, in 1998, China's share was barely 2.1 percent. This growth in Chinese import competition is not unique to Brazil. It is driven primarily by China's development, transition to free market policies, and producitivty growth during the period. This trade shock, however, is particularly threatening to Brazilian manufacturing employment, which is concentrated in several industries in which China has comparative advantage, such as textiles and leather.

As the manufacturing sector faces growing import competition, workers reallocate across jobs. The econometric framework outlined below seeks to determine the nature of this adjustment and whether workers bear significant adjustment costs in this process.

Consider two workers of similar observable characteristics employed in two different industries at the time exactly before the start of the dramatric growth in Chinese import competition faced by Brazil. Under perfectly flexible labor markets, theory would predict that the subsequent long-term earnings and time employed of these two workers should be independent of their industry of employment. Alternatively, the existence of labor market frictions could lead to lower earnings or time employed for the worker initially employed in the industry suffering a larger import competition shock. There are various reasons why workers employed in highly-exposed industries could face earnings losses or time out of employment.

Labor market rigidities - in the form for example of hiring or firing costs - could obstruct the reallocation of workers across jobs. This explanation could be especially important since Brazil's labor market is ranked among the most rigid in the world.[11]

[11] Brazilian labor markets are highly rigid due to a series of regulations including large firing costs and payroll taxes. An index of labor market rigidity developed by Campos and Nugent (2012) ranks Brazil within the top 10 percent of most-rigid labor markets.

Additionally, human capital specific to industries, firms, or occupations could be lost in the process and reduce earnings or employment outside workers' original employers or industries. In Brazil's case, this explanation could be relevant given its numerous employment in heavy manufacturing industries - such as motor vehicle manufacturing - that require significant industry-specific skills. Additionally, costly regional mobility could prevent the transition away from declining industries to new employment. In a country of Brazil's size, this could also be a relevant factor.

In addition to exposure of the industries at which workers are employed, exposure to import competition shocks of workers' geographic local labor markets or of workers' occupations could also be of importance. Consider first the role of regions. Regardless of his industry of employment, a worker in a region concentrating industries highly exposed to Chinese import competition will face a declinining demand for labor, which can reduce opportunities for all workers in the local labor market. Workers' occupation could also be an independent source of trade exposure. Consider a worker performing an occupation found commonly in highly-exposed industries. Rising import competition will reduce the demand for these occupations, regardless of the industry in which the worker is employed.

To test this hypothesis that adjustment to trade shocks is costly, I estimate regressions of workers' long-term cumulative outcomes during the time of the shock (1999 -2013) on the trade exposure of their original industries, regions, or occupations of employment in 1998.

The dramatic growth in import competition from China faced by Brazil during the period 1998-2013 is largerly exogenous to developments in Brazil and is a common experience shared by many other countries. The variation in the growth of imports across industries, however, could be in part due to productivity shocks to Brazilian industries, which could simultaneously impact imports and labor market outcomes. To correct for the possible omitted variable bias this would imply, my empirical strategy considers using an instrument for the growth in import competition from China. Following Autor et al. (2014), I instrument for the growth in Brazil's industry-level imports from China with Chinese exports to a set of countries similar to Brazil. This strategy seeks to isolate the variation in industry-level import growth due to China's export capabilities and exclude the component possibly due to unobserved shocks to Brazilian industries.

2.1 Trade Shocks to Workers' Industries, Regions, and Occupations.

The growth in Chinese import competition faced by Brazilian workers can impact their labor market opportunities depending on the type of job they perform at the time when the shock originates. I construct measures of exposure to growth in Chinese imports depending on workers' industries of employment, geographic local labor markets, and occupations, and define instruments for each of these measures.

Existing work on adjustment to trade shocks uses measures of trade exposure based on workers' industries (Autor et al. (2014), Utar (2015), Dauth, Findeisen, and Suedekum (2016)) or regions (Autor et al. (2014), Dix-Carneiro and Kovak (2015)) but not on occupations, which are a source of trade exposure that has not been previously examined in this context. The only papers using occupations as a source of trade exposure - with different goals than mine - are Ebenstein et al. (2014), who study the impact of import competition and offshoring on wages of workers in different industries and occupations and Harrigan, Reshef, and Toubal (2016) who measure occupational exposure to firm-level imports to study its impact on firm-level polarization.

2.1.1 Industry-Level Trade Shocks.

To measure the growth in import competition faced by workers originally employed in the manufacturing sector, I construct standard measures of the industry-level change in import penetration during 1998-2013, which I will later assign to workers based on their industry of employment in 1998. This measure, shown in equation 1, is the change in Brazil's imports from China ($\Delta M_{j\,1998-2013}^{CHINA \to BRA}$) normalized by domestic consumption (production plus exports minus imports) in the initial year (1998).

$$\Delta IP_j^{BRA} = \frac{\Delta M_{j\,1998-2013}^{CHINA \to BRA}}{Y_{j\,1998}^{BRA} + M_{j\,1998}^{BRA} - E_{j\,1998}^{BRA}} \tag{1}$$

Following the previos discussion, the instrument for this variable is defined as the growth in Chinese imports by a set of 9 South American countries ($\Delta M_{j\,1998-2013}^{CHINA \to BRA}$), normalized by domestic consumption in Brazil.[12] Chinese exports to this other set of countries is driven by Chinese productivity growth and not by unobservable shocks to Brazilian industries.

$$\Delta IP_j^{OTHER} = \frac{\Delta M_{j\,1998-2013}^{CHINA \to OTHER}}{Y_{j\,1998}^{BRA} + M_{j\,1998}^{BRA} - E_{j\,1998}^{BRA}} \tag{2}$$

2.1.2 Region-Level Trade Shocks.

To measure the exposure of workers in local labor markets to Chinese import competition, I weight the measure of industry-level imports defined in equation 1 by the employment share of each industry in each region. These weights are computed in 1996 - before the rise in import competition. In the equation below, L_{jr} represents employment in regin r and industry j in 1996 and L_r represents the total employment in region r in 1996. Based on this definition, a region's labor market will face a large shock if its employment is concentrated in industries experienceing large increases in imports from China.

$$\Delta IP_r^{BRA} = \sum_j \frac{L_{jr}}{L_r} \cdot IP_r^{BRA} \tag{3}$$

As in the case of industries, I construct an instrument for this variable based on Chinese exports to the set of similar South American countries. I weight Chinese exports to these

[12] The set of South American countries is: Argentina, Bolivia, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay, and Venezuela. This group of countries shares with Brazil a similar level of development and similar bilateral trade costs with China.

countries defined in equation 2 by regional employment shares.

$$\Delta IP_r^{OTHER} = \sum_j \frac{L_{jr}}{L_r} \cdot IP_r^{OTHER} \tag{4}$$

2.1.3 Occupation-Level Trade Shocks.

Finally, to measure the exposure of workers in to Chinese import competition depending on the occupation they perform, I weight the measure of industry-level imports defined above by the employment share of each industry in each occupation.

$$\Delta IP_o^{BRA} = \sum_j \frac{L_{jo}}{L_o} \cdot IP_o^{BRA} \tag{5}$$

As before, I construct an instrument for this variable based on Chinese exports to the set of similar South American countries.

$$\Delta IP_o^{OTHER} = \sum_j \frac{L_{jo}}{L_o} \cdot IP_o^{OTHER} \tag{6}$$

2.1.4 Descriptive Statistics.

Figure 1 shows the fast growth of Brazil's imports from China and compares it to imports from the rest of the world over 1996-2013. Beyond this aggregate trend, there is wide variation in the growth in imports from China across manufacturing industries. Table 1 lists the 1998-2013 import growth - normalized by domestic consumption - across two-digit manufacturing industries. The industries facing the largest increases in import competition are office and computing machinery, radio and television equipment, electrical machinery, and textiles, while on the other hand tobacco, coke and refined petroleum and food and beverages face the smallest increases in Chinese import competition.

There is also variation in trade exposure across regions and occupations. The states of Sao Paulo, Santa Catarina, and Rio Grande do Sul, all among the five most populated in the sample, are among those facing the largest exposure. The Federal District, which includes Brasilia and smaller states in the North West are among the least exposed. Highly-exposed occupations, according to the trade-shock measure in equation 5, are metal machinery workers and spinners and weavers, while low-exposure occupations are those with a very low employment participation in manufacturing.

Table 2 reports descriptive statistics on the trade exposure measures for industries, regions, and occupations. The standard deviation is highest for industry-based trade exposure, followed by occupation-based exposure.

These three measures of exposure to rising Chinese import competition based on workers' initial industries, regions or occupations are largely orthogonal. Table 3 displays the correlation coefficients between each of these. The highest correlation is between industry-based and occupation- based shocks (0.36). The correlation between the occupation-based measure and the region-based measure; and the correlation between industry and region based shocks are both 0.17.

3. Data Sources and Context.

3.1. Matched Employer-Employee Census.

I use an annual longitudinal administrative census of workers and their employers in Brazil spanning the period 1996 to 2013. These data (Relação Anual de Informações Sociais - RAIS) is collected annually by the Brazilian Labor Ministry.[13] It is estimated to include about 97 percent of the labor force in the formal sector.[14]

The data includes a rich set of variables describing workers and firms. The information on workers I use in this paper includes their occupations, their educational attainment, their gender and age, and the geographic regions where they are employed. Information on their labor market outcomes includes their earnings and employment status. Information on firms and establishments includes the industries in which they operate and their total employment.

RAIS has several key advantages for the goals of this paper. The first one is its longitudinal nature, allowing me to follow workers as they transition across employers. Second, the availability of workers' occupations and educational attainment distinguishes these data from similar datasets for other countries. Both these variables are not recorded, for example, in the U.S. SSA records used by Autor et al. (2014) to study workers' trade adjustment to Chinese import competition in the U.S. An important limitation of RAIS is that it is designed to include only formal sector employment in a country where the informal sector is large. The notion of formal sector included in RAIS, however, is broad: it includes many employment categories such as temporary workers and apprentices.

I describe each variable of interest in detail below.

Occupations. Information on workers' occupations in each job spell is described by detailed five-digit codes following the 1994 version of the Brazilian Occupational Classification

[13] This dataset has been used by Dix-Carneiro (2014), Helpman et al. (2016) and Alvarez et al. (2016) among others.

[14] According to documentation provided by the Brazilian Statistical Institute, IBGE.

(CBO), which is designed to follow closely - with minor variations - the International Labor Organization's International Standard Classification of Occupations. There are more than two thousand different occupational categories in the data at the highest level of disaggregation. In my analysis, I define occupations at the three-digit level, consisting of 339 categories.

Educational Attainment. Educational attainment is divided into nine categories, ranging from no formal education to higher education. I group these categories the following four groups: workers with complete or partial higher education, workers with complete or partial high-school education, workers with complete or partial middle-school education, and workers with less educational attainment than that.

Industry. The industrial classification of establishments' activities is reported according to the Brazilian National Classification of Economic Activities (CNAE). Industries are reported at the five-digit level. Throughout the paper I aggregate these detailed codes into three-digit industries. This is the most detailed level at which I can match the labor market data to the trade data on Brazilian imports and production data to create measures of import competition. There are 93 different three-digit industries within the manufacturing sector.

Geographic Regions. The data reports the municipality in which workers' establishments are located. Since municipalities are often very small, I use a larger geographic unit, Brazilian microrregions, as the unit of analysis. These match better the concept of local labor market. There are 533 microregions in the sample. These geographic areas resemble - in terms of size and population - U.S. commuting zones, which Autor, Dorn, and Hanson (2013) use to define local labor markets. Microregions are officially defined by the Brazilian Statistical and Geographical Institute (IBGE), which provides a mapping between these and the municipalities reported in RAIS.

Labor Market Outcomes. For each job spell in each year, I observe its start and end date and its duration. Each year, the data reports the average monthly earnings in each spell, which I multiply by job duration to obtain total earnings in each job each year. This includes labor market earnings of several types aside from salaries, including bonuses and other forms of compensation. I deflate nominal earnings using Brazil's consumer price index.

Sample Selection. As in Autor et al. (2014), I focus on workers with high labor force attachment originally employed in the manufacturing sector. This includes workers employed continuously in manufacturing sector jobs in each of the pre-shock years 1996, 1997, and 1998. Further, I restrict the sample to workers aged 25 to 44 in 1998, such that they have not reached typical retirement age by the end of the period under study in 2013.

These restrictions lead to a sample of 1.361 million workers. I track this set of workers over time up to 2013, regardless of whether they remain employed in the manufacturing sector. I observe their earnings and employment status in each year in every job they hold. It is important to mention that the absence of one these workers from the data is not necessarily a synonym of unemployment, since they could migrate to the informal sector, not covered by the RAIS dataset.

Descriptive Statistics. Descriptive statistics for this sample are reported in table 5. It reports employment figures in 1998 by age group, by educational attainment, and in the five largest industries, states and occupations. It also shows annual earnings in the pre-shock period, computed as the 1996-1998 average.

These figures show that most of these workers have a low educational attainment, with 64 percent having at most completed their primary education. Also, there is a substantial skill premium: workers with completed or partial tertiary education receive 2.1 times what those with completed or partial secondary education earn, and 3.5 times what those with at most primary schooling do. Employment is concentrated in the younger cohorts, with 27 percent of the sample in the age group 25-29 years old and another 28 percent in the age group 30-34 years old. Average earnings are 1.75 times higher in the oldest group compared to the youngest one. There is also important variation in earnings across industries. Within the largest 5 industries reported in the table, average earnings for workers in motor vehicles manufacturing are more than twice as large as those for workers in food and beverage manufacturing. Geographically, employment is heavily concentrated in the largest states (Sao Paulo accounts for 44% of employment and the five largest states account for 77%). Earnings vary substantially across states, with higher earnings concentrated in the coastal, more industrialized states. Finally, the table indicates that no single occupation captures a very large share of employment. Similarly to industries and regions, there is also large variation in earnings across occupations.

3.2 Trade Data.

To measure the growth in import competition faced by Brazilian workers as outlined in section 2.1, I use industry-level imports by Brazil from China from the United Nations' COMTRADE database and reported following the ISIC (revision 3) industrial classification at the four-digit level of disaggregation. To match these trade data to the Brazilian labor market data, which uses the Brazilian CNAE classification for industries, I use a concordance provided by the Brazilian Institute of Geography and Statistics (IBGE). This mapping is relatively straightforward since the Brazilian CNAE classification is modelled after ISIC, with minor variations. To measure domestic consumption (used to normalize imports), Brazil's industry-level exports to the world and imports from the world are obtained from COMTRADE and production is obtained from IBGE and based on Brazil's annual industrial survey PIA-Empresa. I translate trade data in US Dollars to Brazilian Reasis using year-average exchange rates. I deflate all nominal figures to 1996 Reais using year-average CPI.

4. The Impact of Import Competition on Workers' Earnings and Employment.

In this section, I measure the adjustment costs borne by workers originally employed in the manufacturing sector due to the growth of Chinese import competition during the period 1998-2013 in terms of cumulative earnings and cumulative days of employment. Workers are exposed to trade based on their industries of employment, their geographic local labor markets, and their occupations. I compare the adjustment costs due to trade exposure along each of these dimensions. Secondly, I ask which types of workers face larger adjustment costs. I explore workers' heterogeneous outcomes based on their educational attainment and the length of their tenure at their employer at the time of the shock. Finally, I study the margins along which these adjustment costs occur. I ask whether workers exposed to import growth receive lower earnings at their original employers, industries, or sectors.

4.1 Trade exposure and adjustment costs: industries, regions, and occupations.

I study the impact of import competition on workers' long-term, cumulative, labor market outcomes estimating regressions linking these outcomes to growth in import competition from China based on workers' industries, regions, or occupations at the beginning of the trade shock in 1998.

I focus on two cumulative labor market outcomes: earnings and days of employment. I am concerned with the impact of the trade shock on long-term outcomes, and in each case, I aggregate these outcomes over the fifteen year period 1999-2013. To facilitate the interpretation of the results I normalize these labor market outcomes by their annual pre-shock equivalents during 1996-1998. I compute cumulative outcomes including workers' earnings and employment in any sector, even if they move to non-manufacturing jobs after 1998. I include earnings and employment from all jobs, even when a worker holds more than one job at the same time. It is important to highlight that lack of employment in the RAIS dataset could imply either unemployment or employment in the informal sector.

The baseline regression of cumulative earnings or employment on, for example, industry-level growth in import competition is the following. Each observation represents a worker i initially employed in industry j, working in region r, and performing occupation o.

$$E_{ijro}^{1999-2013} = \beta_1 \cdot \Delta IP_j^{1998-2013} + X'_{ijro} \cdot \beta_2 + \epsilon_{ijro} \tag{7}$$

The dependent variable $E_{ijro}^{1999-2013}$ represents the labor market of interest - cumulative earnings, employment - over the period 1999-2013. It is expressed as a multiple of average annual pre-shock earnings or employment, which are calculated over the period 1996-1998. Summary statistics for each of these outcomes are provided in table 4.

Exposure to growth in Chinese imports is measured with the three different variables defined in section 2.1. The first one ($\Delta IP_j^{1998-2013}$, defined in equation 1) captures trade exposure based on workers industries of employment in 1998. The second one ($\Delta IP_r^{1998-2013}$, defined in equation 3) assigns the trade shock to workers based on their geographic regions of employment at that time. Finally the third measure ($\Delta IP_o^{1998-2013}$, defined in equation 5) is assigned to workers based on their original occupations.

I control for a large set of worker, industry, region, and occupation-level variables, represented in equation 7 by the term X_{ijro}.

When the independent variable is industry-level trade exposure, I include region and occupation fixed effects. While the industry-level trade variable varies at the three-digit level, I include fixed effects for two-digit industries, such that I compare industries within narrow sectors. When the independent variable is region-level trade exposure, I include industry and occupation fixed effects. In this case I compare regions within the 27 Brazilian states by including state-level fixed effects. Finally, when the independent variable is occupation-level trade exposure I control for industry and region fixed effects. I also include broader two-digit occupation fixed effects to compare across relatively similar occupations facing different degrees of trade exposure.

In regressions with trade exposure defined at the industry level, I control for the initial level of import competition from China and from the rest of the world. In regressions with region or occupation-based trade exposure, I construct regional or occupational weighted averages of these industry-level variables, with weights equal to industries' employment shares in each region or occupation.

Worker-level controls include workers' age, educational attainment, and tenure in 1998, as well as average annual pre-shock labor market outcomes during 1996-1998. Educational attainment is captured by nine categorical variables, ranging from absence of formal education to tertiary education. I compare workers within age cohorts by including fixed effects for workers' year of birth. I include fixed effects for workers' tenure at their 1998 employer.[15]. Additionally I control for firm size, also based on workers' 1998 employer.[16]

To summarize, the empirical strategy compares workers of similar characteristics and pre-shock labor market histories employed in different industries, regions, or occupations in 1998. Following the very large increase in imports from China after 1998, a theory featuring costless labor market adjustment would predict that workers' subsequent labor market outcomes are independent of their initial industries, regions or occupations as they could costlessly relocate. On the other hand, differences in cumulative earnings or days of employment between otherwise similar workers employed in industries, regions, or occupations facing different degrees of growth in import competition are indicative of adjustment costs.

The growth in China's market share in the imports of Brazil - and of many other countries - during this period is largely exogenous to developments in Brazilian industries and has been experienced by many countries. The composition of this growth in imports across industries, however, could be partly driven by shocks to Brazilian industries, regions,

[15] I group workers by tenure at their 1998 employer into the following bins: less than a year of tenure, 1 to 2 years, 2 to 5 years, 5 to 10 years,10 to 20, and 20 or more years

[16] I divide firm size into the following categories: less than 10 workers, 10 to 50 workers, 50 to 100 workers, 100 to 500 workers, 500 to 1000 workers, 1000 to 5000 workers, and more than 5000 workers.

or occupations that impact both imports and labor market outcomes. To account for this possible endogeneity of industry-level imports from China, I estimate equation 7 using the instruments defined in section 2.1. These instruments are based on Chinese exports to a set of South American countries similar to Brazil. Unless there are common industry-level shocks occurring at the South American rather than national level this strategy should isolate the effect of Brazilian imports from China driven by the growth of Chinese industries than by developments in Brazilian industries.

RESULTS. The first set of results, for both earnings and employment, is shown in table 6. The 2SLS estimates show that workers originally employed in highly-exposed industries, regions and occupations face large adjustment costs in terms of foregone long-term earnings and employment. In the case of trade exposure based on workers industries of employment, the magnitude of the adjustment costs is such that moving from the 25th to the 75th percentile of exposure is associated with the loss of 6% of initial annual earnings.[17] Trade exposure based on workers local labor markets leads to results that are larger in magnitude - a 14% difference in cumulative earnings between the 25th and 75th percentiles of exposure - but not statistically significant. The largest impact is caused by occupation-based exposure. The 75th - 25th percentile difference in earnings - 23% of initial annual earnings - is roughly three times as large as that for industry-based exposure. This new finding - the importance of occupations when measuring adjustment costs to trade - is a key contribution of this paper. There are no similar results to compare this finding in previous work, which does not consider occupation-based trade exposure.

Adjustment costs in terms of employment are also economically meaningful. Industry-based exposure generates a difference of (annual, pre-shock) days of employment of 3.7%

[17]This magnitude can be compared with the case of the U.S. Autor et al. (2014) find that an equivalent measure of adjustment costs for manufacturing workers during the period 1992-2007 is 46 percent of annual pre-shock earnings in their preferred specification (the 15 year period equivalent - comparable with my estimates would be 43% (15/16 times 46%). The larger adjustment costs found in the case of the U.S. could be due to the larger set of fixed effects I use. My estimate is obtained comparing workers within occupations and within regions while Autor et al. (2014) do not include occupation or region fixed effects due to data limitations.

between the 25th and 75th percentiles. As in the case of earnings, the occupation-based exposure has the largest impact: a 8.1% difference. Region-based exposure is associated to much smaller, not statistically-significant employment losses.

4.2 Worker heterogeneity.

In this subsection, I ask whether the impact of trade exposure on labor market outcomes depends on workers' i) educational attainment or ii) tenure at their initial employers. I focus on cumulative earnings given the much larger impact of trade exposure on these rather than on employment.

Heterogeneous Impact by Educational Attainment. I first examine the heterogeneous impact of industry, region and occupation-based trade exposure on workers with different degrees of educational attainment. I split the sample in two groups consisting of workers with at least complete primary education and those with lower educational attainment. These groups account for 46 percent (the low education group) and 54 percent (the high education group) of workers in my sample. In international comparison, educational attainment in Brazil is low, and the distribution is concentrated in the left tail; a majority of workers do not have complete secondary schooling.

The results in table 7 show that the impact on cumulative earnings of trade exposure based on workers' industries, regions, or occupations is much larger on the group with higher educational attainment. The difference in cumulative earnings (in terms of annual initial earnings) between the 25th and 75 percentiles of industry-based trade exposure is 8.2% for the high-attainment group and 2.2% for the low attainment group. A similar difference exists for region-based exposure (23.5% inter-quartile difference for the high attainment group and 6% for the low-attainment group). While in the earlier full-sample results region-based exposure did not lead to a statistically-significant impact on cumulative earnings, splitting the sample in these two groups generates a statistically-significant impact on both. Finally, for occupation-based exposure, the inter-quartile differences are 27% for the high-attainment group and 12.1% for the low-attainment group.

A possible interpretation of these results is that low education workers (with at most primary schooling) perform simpler jobs that are not highly specialized or specific to their initial employers and have thus less to lose from trade-led displacement. An alternative explanation is that there is little space for the earnings of workers with low educational attainment to fall, particularly since this period saw significant increases in the minimum wage.

Heterogeneous Impact by Tenure. I also ask whether the impact of this trade shock on long-term earnings and employment is shaped by workers' tenure at their initial employers. One hypothesis is that short-tenure workers are less attached to their employer and could lose their job more easily suffering a larger impact from trade exposure. A different hypothesis pointing in the opposite direction is that long-tenure workers have more employer-specific or industry-specific human capital to lose in response to trade-led displacement.

I divide the sample into workers with above-median and below-median tenure at their 1998 employers (median tenure is 64.7 months) and estimate equation 7 for each of these groups.

The results in table 8 indicate that for all measures of trade exposure (industry, region, or occupation-based) the impact is larger on short-tenure workers. This difference is small in the case of industry-based exposure but more marked in the case of region and especially occupation-based exposure. In this last case, the difference in cumulative earnings between the 25th and 75th percentiles of exposure is 28.4% for short-tenure workers and 13.9% in the long-tenure group.

4.3 Decomposing the adjustment process.

To further understand the adjustment process in response to this trade shock, I decompose its impact on long - term earnings along the following four margins: earnings within workers' initial employers, outside their initial employers but within their initial industries, outside their initial industries but within manufacturing, and finally earnings outside of the manufacturing sector. I compute cumulative earnings and employment in each of these cateogiries (as before, normalized by initial annual earnings). I then estimate equation 7 on each of these margins. The coefficients add up to the overall impact of trade on earnings described in section 4.1.

The results are reported in table 9. In the case of industry-based shocks, there is a very strong negative impact on earnings in workers' initial industries. Almost all of this impact occurs outside workers' initial employers; the impact on earnings within workers' initial employers is small and not statistically significant. This loss is partly compensated by larger earnings in other industries within manufacturing. While the impact on out-of-manufacturing earnings is positive, it is not statistically significant.

The conclusions are to some extent different in the case of region-based trade exposure. This shock leads to a negative impact on long-term earnings in workers' initial employers and/or industries, which are, however, not statistically significant. These are offset by a positive impact (a 16% interquartile difference) on earnings within manufacturing but outside workers' initial industries. There is finally a large negative impact on earnings obtained outside of the manufacturing sector. A likely explanation for this is that region-based import competition affects not only the manufacturing sector but, by definition, all sectors in workers' local labor markets. Understandably then this could lead to difficulty finding employment or to reduced earnings outside of the manufacturing sector.

In the case of occupation-based trade exposure, there are large losses in workers' original employers (a 14% interquartile difference) and much smaller, not statistically-significant losses in the initial industries but at a different employer. There is a positive impact (a 5% interquartile difference) of trade exposure on earnings in manufacturing but outside workers' initial industries, and a negative impact (a 13% intequartile difference) on earnings outside manufacturing. A possible explanation for the reduced earnings outside the manufacturing sector is that these workers search for employment in other industries without switching away out of their initial occupations, which suffer from the import competition shock.

5. Conclusion.

This paper documents the adjustment of Brazilian workers to the large and rapid increase in import competition from China during the period 1998-2013. Workers initially employed in more exposed industries, regions, and occupations accumulate lower long-term earnings and to a lesser extent - spend less time employed. I find that occupation-based trade exposure is the most relevant source of adjustment costs.

A detailed longitudinal linked employer-employee census allows me to study the heterogeneous adjustment costs across workers as a function of their educational attainment and their tenure at their initial employers. Workers with low educational attainment (with at most primary schooling) face lower adjustment costs. Two potential explanations stand out: that these low-education workers perform simpler occupations that involve less employer-specific human capital (that job displacement would destroy); or that there is no room for earnings losses for these workers in a period of large minimum-wage expansions. On the other hand, workers with short tenure at their employer at the start of the shock bear larger adjustment costs, suggesting that they are more loosely attached to their firms and at a higher risk of loosing from trade-led displacement.

Finally, I also find that industry, region, and occupation-based trade exposure leads to earnings loses in workers' initial firms and industries. While in the case of industry-based shocks workers can partly recover earnings outside of the manufacturing sector, this is not the case with region-based or occupation-based shocks, presumably because workers do not migrate or switch away from depressed regions or occupations.

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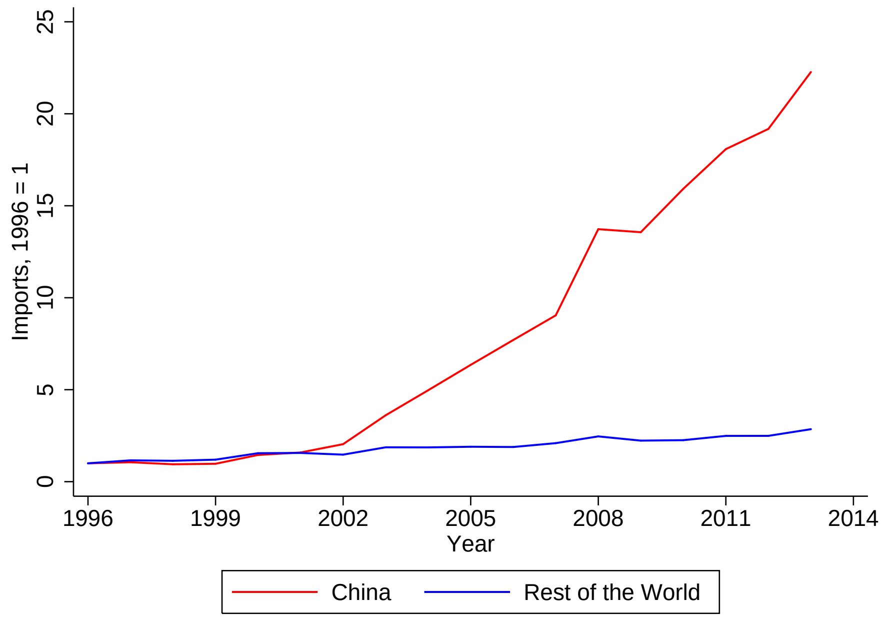
Figure 1: Brazilian Imports from China and from the World, 1996-2013



Notes: This figure shows Brazilian imports from China (red) and from the world (blue) from 1996 to 2013. Both are normalized to a value of 1 in 1996. Source: United Nations' COMTRADE database.

Table 1: Trade Exposure across Industries.

	Industry	Import Growth
15	Food and Beverages	0.003
16	Tobacco	0.000
17	Textiles	0.147
18	Apparel	0.137
19	Leather	0.072
20	Wood	0.008
21	Paper	0.013
22	Printing	0.009
23	Coke; Petroleum; Fuel	-0.003
24	Chemicals	0.044
25	Rubber; Plastics	0.058
26	Non-Metallic Minerals	0.070
27	Basic Metals	0.050
28	Fabricated Metal	0.082
29	Machinery and Equip.	0.132
30	Office Machines	0.469
31	Electrical Machinery	0.188
32	Radio, T.V. and Comm. Equip.	0.288
33	Medical and Optical Instr.	0.169
34	Motor Vehicles	0.027
35	Other Transportation Equip.	0.131
36	Furniture and Other	0.08

Notes: This table reports the growth in Brazil's imports from China - normalized by domestic consumption - across Brazilian manufacturing industries during the period 1998-2013. This measure of import competition is defined in equation 1. Import competition by two-digit level industries is computed as the employment-weighted average of the three-digit level measures of import competition used throughout the paper. Two-digit industry codes in the first column are based on Brazil's CNAE classification.

Table 2: Trade Exposure by Industries, Regions, and Occupations: Summary Statistics

	Mean	St. Deviation	p25	p75
Industry	6.202	10.70	0.441	8.728
Region	1.911	1.324	1.035	2.429
Occupation	4.023	4.104	1.186	5.766

Notes: This table reports summary statistics for the measures of trade exposure by industries, regions and occupations. Figures in this table correspond to $100 \cdot \Delta IP$ defined in equations (1), (3) and (5) in section 2. The sample is restricted to workers aged 25-44 in 1998 and high attachment to the manufacturing sector as described in section 3.

Table 3: Correlation of Measures of Trade Exposure

	Industry	Region	Occupation
Industry	1	.	.
Region	0.174	1	.
Occupation	0.363	0.165	1

Notes: This table reports the correlation between the industry, region, and occupation-based measures of trade exposure defined in equations (1), (3) and (5) in section 2.

Table 4: Cumulative Earnings and Employment: Summary Statistics

	Mean	St. Deviation	p25	p75
Earnings	13.44	9.489	6.444	18.41
Employment	10.49	4.975	6.828	14.73
Earnings Same Firm	7.099	8.115	0.932	11.55
Earnings Diff. Firm; Same Industry	1.939	6.495	0	1.933
Earnings Diff. Industry; Same Sector	1.840	4.945	0	0.456
Earnings Diff. Sector	2.562	5.878	0	2.508

Notes: This table reports summary statistics for the measures of cumulative earnings and employment over 1999-2013 normalized by pre-shock average earnings or employment during 1996-1998. These are the dependent variables in equation 7 in section 4.

Table 5: Descriptive Statistics: Employment and Earnings by Groups.

Variable	Group	Employment	Employment Share	Earnings
Age				
	25 to 29	370.9	0.273	7124
	30 to 34	386.3	0.284	9394
	35 to 39	332.6	0.244	11105
	40 to 44	271.2	0.199	12509
Education				
	Upto Primary Ed.	871.9	0.641	6892
	Upto Secondary Ed.	350.8	0.258	11352
	Upto Tertiary Ed.	138.2	0.102	24343
Industry				
	Food and Beverages	239.6	0.176	7467
	Motor Vehicles	123.8	0.0910	16154
	Machinery and Equip.	94.63	0.0695	12234
	Chemicals	93.20	0.0685	15551
	Textiles	89.71	0.0659	6621
Occupation				
	Clerical Workers	108.4	0.0797	8967
	Metal Machinery Workers	101.2	0.0743	10528
	Food Processing Workers	83.97	0.0617	5059
	Machinery Mechanics	73.14	0.0537	11843
	Tailors, Sewers, etc.	68.00	0.0500	3448
State				
	Sao Paulo	593.4	0.436	12603
	Minas Gerais	140.3	0.103	8124
	Rio Grande do Sul	133.2	0.0978	7878
	Rio de Janeiro	96.87	0.0712	9780
	Santa Catarina	93.88	0.0690	7421

Notes: This table reports descriptive statistics for groups of workers by age, educational attainment, the five largest industries, the five largest occupations and the five largest states in 1998. It reports employment in 1998 for each group (in thousands), the employment share for each group, and mean annual earnings (in real Reais (domestic currency) of 1996) averaged over the pre-shock period 1996-1998. The four age groups are for workers aged 25-29, 30-34, 35-39, and 40-44 in 1998. The three groups by educational attainment consist of workers with completed primary education or less, completed or partial secondary education, and completed or partial tertiary education.

Table 6: Impact on Cumulative Earnings and Employment.

	Earnings		Employment	
	2SLS	OLS	2SLS	OLS
Industry	-0.777*	-0.589***	-0.446**	-0.271***
	(0.424)	(0.0901)	(0.180)	(0.0482)
[p25-p75]	-0.0636*	-0.0483***	-0.0365**	-0.0222***
Region	-10.27	-5.318***	-0.596	-3.350***
	(10.94)	(0.0875)	(4.903)	(0.468)
[p25-p75]	-0.140	-0.0727***	-0.0082	-0.0458***
Occupation	-4.295***	-4.612***	-1.523***	-1.686***
	(0.399)	(0.293)	(0.139)	(0.157)
[p25-p75]	-0.227***	-0.244***	-0.0805***	-0.0891***

Notes: This table reports the results of the 2SLS and OLS estimation of equation 7. The top, middle and bottom panels correspond to results for industry, region, and occupation-based trade exposure. The first two columns on the left correspond to cumulative earnings as the dependent variable and the second two correspond to cumulative employment. I report estimated coefficients, and standard errors, followed by normalized coefficients reflecting the difference in the dependent variable associated with moving from the 25th to the 75th percentiles of trade exposure. The number of observations is N = 1.361 million. The sample is restricted to workers employed in the manufacturing sector in 1996-1998, as described in the text. Standard errors are clustered by broad industry groups (top row), states (second row), or broad occupation groups (bottom row). ***, **, and * denote statistical significance at a 1, 5 and 10 percent confidence level.

Table 7: Impact on Cumulative Earnings and Employment for Workers with High and Low Educational Attainment.

	2SLS		OLS	
	Low Ed.	High Ed.	Low Ed.	High Ed.
Industry	-0.286**	-1.000***	-0.141	-0.866***
	(0.143)	(0.159)	(0.122)	(0.133)
[p25-p75]	-0.0222**	-0.0819***	-0.0110	-0.0710***
Region	-4.810***	-16.56***	-1.366	-8.928***
	(1.450)	(1.792)	(1.070)	(1.411)
[p25-p75]	-0.0596***	-0.235***	-0.0169	-0.127***
Occupation	-2.028***	-6.373***	-2.538***	-6.525***
	(0.393)	(0.491)	(0.364)	(0.465)
[p25-p75]	-0.121***	-0.270***	-0.152***	-0.277***

Notes: This table reports the results of the 2SLS and OLS estimation of equation 7. The sample is split into workers with high and low degrees of educational attainment. The high-attainment group includes workers with at least complete primary education. The low-attainment group consists of those who have not reached a complete primary education. The top, middle and bottom panels correspond to results for industry, region, and occupation-based trade exposure. The first two columns on the left correspond to cumulative earnings as the dependent variable and the second two correspond to cumulative employment. I report estimated coefficients, and standard errors, followed by normalized coefficients reflecting the difference in the dependent variable associated with moving from the 25th to the 75th percentiles of trade exposure. The number of observations is N = 741 thousand for the group with high educational attainment and N= 619 thousand for the group with low educational attainment. The sample is restricted to workers employed in the manufacturing sector in 1996-1998, as described in the text. Standard errors are clustered by broad industry groups (top row), states (second row), or broad occupation groups (bottom row). ***, **, and * denote statistical significance at a 1, 5 and 10 percent confidence level.

Table 8: Impact on Cumulative Earnings for Workers with Long and Short Tenure at their Initial Employers.

	2SLS		OLS	
	Short Tenure	Long Tenure	Short Tenure	Long Tenure
Industry	-0.935***	-0.770***	-0.525***	-0.769***
	(0.155)	(0.151)	(0.131)	(0.126)
[p25-p75]	-0.0766***	-0.0631***	-0.0430***	-0.0630***
Region	-11.23***	-7.989***	-5.089***	-4.610***
	(1.739)	(1.518)	(1.285)	(1.187)
[p25-p75]	-0.148***	-0.109***	-0.0671***	-0.0630***
Occupation	-5.057***	-2.817***	-5.190***	-3.428***
	(0.488)	(0.414)	(0.409)	(0.427)
[p25-p75]	-0.284***	-0.139***	-0.292***	-0.170***

Notes: This table reports the results of the 2SLS and OLS estimation of equation 7. The sample is split into workers with long (above-median) and short (below-median) periods of tenure at ther initial employers in 1998. Median tenure in this sample in 1998 is 64.7 months. The top, middle and bottom panels correspond to results for industry, region, and occupation-based trade exposure. The first two columns on the left correspond to cumulative earnings as the dependent variable and the second two correspond to cumulative employment. I report estimated coefficients, and standard errors, followed by normalized coefficients reflecting the difference in the dependent variable associated with moving from the 25th to the 75th percentiles of trade exposure. The number of observations is N = 680 thousand for the group with long tenure and N= 681 thousand for the group with short tenure. The sample is restricted to workers employed in the manufacturing sector in 1996-1998, as described in the text. Standard errors are clustered by broad industry groups (top row), states (second row), or broad occupation groups (bottom row). ***, **, and * denote statistical significance at a 1, 5 and 10 percent confidence level.

Table 9: Impact on Cumulative Earnings in Original or Different Firms, Industries, and Sectors.

	Same Firm	Same Industry Diff. Firm	Same Sector Diff. Industry	Diff. Sector
Industry	-0.0916	-3.431**	1.750**	0.996
	(0.847)	(1.422)	(0.759)	(0.910)
[p25-p75]	-0.00751	-0.281**	0.143**	0.0816
Region	-7.448	-4.830	11.35***	-9.343**
	(7.320)	(6.260)	(3.764)	(3.634)
[p25-p75]	-0.102	-0.0660	0.155***	-0.128**
Occupation	-2.701***	-0.148	0.995*	-2.441**
	(0.528)	(0.309)	(0.423)	(0.886)
[p25-p75]	-0.143***	-0.00783	0.0526*	-0.129 **

Notes: This table reports the results of the 2SLS and OLS estimation of equation 7. The dependent variables in each column are cumulative earnings in the workers' initial employers in 1998, cumulative earnings in the workers' initial industries but not in their initial employers in 1998, cumulative earnings in the workers' initial sector (manufacturing) but not in their initial industries in 1998, and cumulative earnings outside of their initial sector (manufacturing) in 1998. The top, middle and bottom panels correspond to results for industry, region, and occupation-based trade exposure. I report estimated coefficients, and standard errors, followed by normalized coefficients reflecting the difference in the dependent variable associated with moving from the 25th to the 75th percentiles of trade exposure. The number of observations is N = 1.361 million. The sample is restricted to workers employed in the manufacturing sector in 1996-1998, as described in the text. Standard errors are clustered by broad industry groups (top row), states (second row), or broad occupation groups (bottom row). ***, **, and * denote statistical significance at a 1, 5 and 10 percent confidence level.