# Trade and labor markets: Evidence from the Colombian trade liberalization process *

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**Abstract**

The objective of this paper is to measure the impact of trade on the sectoral labor markets. Using the National Household Survey (Encuesta Nacional de Hogares, hereafter ENH) and comparable trade-related data, we study how trade activity affects the firms' hiring decision. We consider the effects of changes in tariff levels on the sectoral demand for labor, as measured by the change in wages and employment. We estimate these effects in separate reduced-form specifications to determine an elasticity between measures of sectoral trade and labor demand. The data used covers the period of 1984 through 1999. This allows us to take advantage of the natural experiment that was the Colombian trade liberalization process of the early nineties.

The results suggest that average sector tariff levels over the period are correlated with their employment levels, but the changes in tariffs over time are not correlated with changes in employment. In the case of wages, the coefficients of interest are not statistically significant.

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# 1 Introduction

The increasing globalization over the past 25 years has led to many unresolved questions in international trade. One of the main concerns in developing countries has to do with the expected effects of increasing international trade on the labor market. Despite an abundant literature, whether trade liberalization will benefit the levels of employment and wages remains an empirical question.[1] Previous studies have found diverse answers, and no robust conclusion can yet be extracted.

There are several ways in which the literature attempts to estimate the effects of a trade liberalization process on the labor market. The bulk of the existing literature concentrates on the effects of trade on the manufacturing sector, mostly due to the availability of data. This paper attempts to estimate such effects over the entire economy.

The 1990s trade reforms in Colombia offer an excellent experiment to test the effects on the labor market because the reforms were implemented over a very short period of time. As a measure of trade reforms we use tariff data, the most direct approach available. In Colombia, high tariffs predominated in the period from 1984 to 1991, followed by a much more open economy in the 1990s.

After deriving a structural model based on the firms profit maximization problem, we derive a reduced form to estimate the impact of tariffs on the level of employment and wages. Our results suggest a positive effect of average tariffs on the level of employment. However, we were unable to find corresponding effects on wages.

[1] See for example Attanasio et alter (2004), Curie and Harrison (1997), Fajnzylber and Maloney (forthcoming), Goldberg and Pavcnik (2005), Hanson and Harrison (1999), Rama (1994) or Verhoogen (2004).

## 1.1 Theoretical effects of trade on the labor market

In its simplest form, the Hecksher-Ohlin model states that a country will tend to export goods whose production is intensive in those factors it has in abundance. The model argues that trade produces a convergence in relative prices, which in turn are linked with relative factor prices through the Stolper-Samuelson theorem. Thus, trade affects wages through changes in product prices.

The simple 2x2 model assumes that a developed country has relatively abundant skilled labor, while the developing country has relatively abundant unskilled labor. If the developing country engages in trade reforms, prices of skilled-labor intensive goods (imported goods) will drop. The wages of skilled workers will then decrease relative to those of unskilled workers (employed intesively by the export sector). Simultaneously, as relative prices increase in the export sector, demand for unskilled labor will increase. Provided there is enough labor mobility, workers will move towards the unskilled-labor intensive sector and its return will increase.[2]

As discussed below, the empirical evidence suggests that in developing countries reforms have led to an increase in the skill premium and growing inequality in the aftermath of trade liberalization. [Hanson and Harrison (1999)] and [Attanasio et alter (2004)] argue that in Mexico and Colombia this result is perfectly consistent with the Stolper-Samuelson theorem, given the circumstances of their respective trade liberalization processes. They note that the largest tariff reductions happened in sectors that employed a higher fraction of unskilled workers. In consequence, they claim, the corresponding prices and relative factor prices fell, thus increasing wage inequality. This, of course, leads to a very disturbing prediction: trade liberalization in developing countries will cause wage inequality to increase.

In addition to the wage effects, the Hecksher-Ohlin model predicts a change in the level of employment across sectors. For this to be a significant effect, it is

[2]The predictions of a 2x2 model are not necessarily robust when it is extended. However, the example serves the purpose here.

implicitly necessary that there be either an increase in the workforce or enough labor mobility.

As we discuss below, the empirical research, using mostly manufacturing data, has found little evidence of employment effects across sectors due to trade. However, we argue that by considering all sectors of the economy, including those indirectly affected by tariff reductions, we can better test whether those effects are significant. In the Colombian case, for instance, the retail trade sector is of particular importance because it employs a important share of the workforce, but it is not directly affected by tariffs.[3]

## 1.2 Empirical evidence of the impact of trade on labor markets

One of the major issues when deciding whether to open an economy, particularly in developing countries, has to do with the effects that reduction in tariffs and non-tariff barriers may have on the labor market. There are two main strands of research dealing with this issue. One has to do with the (puzzling) increase in wage inequality in trade-reformist developing countries. The other is focused directly on the effects of trade on employment. Although this paper belongs to the latter literature, we review the results of both.

Earlier we mentioned that the traditional Hecksher-Ohlin approach predicts that wage inequality between skilled and unskilled labor should drop when a country is abundant in unskilled labor. As developing countries are expected to be unskilled-labor abundant, trade reforms are supposed to reduce wage inequality. Nevertheless, several Latin American countries seem to have responded with higher wage inequality to the implementation of trade reforms [Arbache (2001)].

[Goldberg and Pavcnik (2005)] analyze the Colombian case and find that wage

[3]During the period of analysis the retail trade sector represented on average over 25% of employment.

premiums fell in sectors with large tariff reductions.[4] They argue that unskilled workers were thus hit twice. First, skill premiums were rising in the 1980s and 1990s; and second, tariff cuts were concentrated in sectors with a majority of unskilled labor, causing the wage premiums of unskilled-intensive industries to drop relative to those of skilled-intensive industries. [Attanasio et alter (2004)] also find that trade reforms affected the wage distribution but only in a very small magnitude. They argue that the increase in wage premiums was due to other factors, particularly skill-biased technological change.

Other relevant papers include [Hanson and Harrison (1999)] and [Verhoogen (2004)] who show that wage inequality increased drastically in Mexico following trade reforms. The former, as in [Goldberg and Pavcnik (2005)], explains this behavior arguing that Mexico had higher protection in sectors intensive in the use of unskilled labor. Correspondingly, tariff reductions were greatest in these sectors and the price of unskilled-labor intensive goods fell more than that of skill-intensive ones. This, they claim, is consistent with the Stolper-Samuel theorem. Verhoogen follows a different approach. Taking into account product differentiation and firm heterogeneity he argues that such wage inequality might obtain because the most productive firms enter the export market, and they pay higher wages.

The second strand of literature deals with the direct effects of trade on the level of employment. [Harrison and Hanson (1999)] show in a short survey how the linkages are relatively weak in developing countries. Most studies, like those cited below, use data on the manufacturing industry.

In a highly unionized labor market, [Rama (1994)] finds that trade reforms had a significant impact on the level of employment across manufacturing sectors. He finds, however, very little impact on real wages. Using plant level data, [Curie and Harrison (1997)] find very little impact of trade reforms on the level of

[4]Goldberg and Pavcnik (2005) define wage premium as "the portion of individual wages that cannot be explained by worker, firm, or job characteristics, but can be explained by the worker's industry affiliation."

employment. They justify such sluggish behavior by arguing that instead of adjusting the employment levels, many firms chose to reduce profit margins and increase productivity. [Revenga (1997)] uses aggregate data for the mexican case and finds that tariffs and employment are negatively related: as tariffs fall, employment increases in the industry. She does not find any statistically significant relation between the level of employment and tariffs when using plant level data. However, she does find a negative and significant effect between the reduction of quotas and firm level employment.

In their paper on the effects of tariff reductions on wage inequalities in Colombia, [Attanasio et alter (2004)] found no evidence of labor reallocation across sectors. They reached this conclusion by regressing industry employment shares on industry tariffs and other controls.

In summary, the matter of how trade influences labor markets remains an open question. Moreover, as [Behrman (1999)] notes, one of the issues that need to be explored has to do with the impact of trade reform on the total labor force, not only on the manufacturing sector.

[Attanasio et alter (2004)] have reviewed this for the Colombian case in a limited way. However, our paper differs from theirs in several aspects. First, we explicitly develop a model in order to determine the proper estimation equation. Second, our focus is on the level of employment as opposed to the employment shares exercise that they run. Third, as [Goldberg and Pavcnik (2005)] note, it is important to account for general equilibrium effects when analyzing the effect on the labor market.[5] We attempt to capture these effects in two ways. One one hand, we had access not only to nominal but also to effective tariff rates, which allow us to capture – indirectly – the intermediate input linkages. On the other hand, as discussed in detailed in the data section, we attach tariffs to sectors for which no tariff data was available previously.

[5]In order to do so, they propose to take into account tariff changes in other industries as a way to capture the intermediate input linkages across industries

## 1.3 Trade reforms in Colombia

As was the rest of Latin America, Colombia's economy was affected by the financial crisis of the early 1980s.[6] The main consequence was that its access to international loans was suspended and Colombia's government was forced to engage in negotiations with several multilateral organizations, particularly the IMF and the World Bank. By 1985, Colombia reached an agreement with both organizations. In exchange for a one billion dollar loan, the IMF would monitor Colombia's quarterly macroeconomic indicators, while the World Bank would monitor its trade policy. Despite the fact that Colombia was neither a GATT or WTO member, the World Bank pressed strongly for the implementation of trade reforms in Colombia.

It was the Barco administration (1986-1990) who decided to engage in tariff reduction. In 1989 the government decided to implement several structural economic reforms, including trade and labor reforms. However, the political situation – including the assassination of several presidential candidates and the collapse of the international coffee agreement – prevented the reforms to actually take place that year.

Early 1990, still under the Barco administration, the idea of the trade reform was retaken seriously. The government decided to begin a gradual liberalization program. According to this program, during the first phase – which should last two years beginning in February 1990 – the quantitative restrictions would be progressively eliminated. This increment in international exposure would be compensated with tariff increases and especially with a depreciation of the exchange rate. The second phase would last three years and would reduce tariffs gradually until they reached an average of 25%.

The expected nominal depreciation of the exchange rate happened in 1990, but early in 1991 the real exchange rate began an appreciation process that would last several years. The Gaviria administration that came into power in August 1990

[6]The discussion in this section follows closely [Garay et alter (1998)].

decided in the last quarter of that year that the trade reforms had to be pushed forward in a more decisive way. By October 1990 the government argued that both nominal and effective tariffs were still too high and rescheduled the trade liberalization program. As a consequence, by 1990 over 96% of the tariff universe had no import license requirements. The government also decided to simplify the tariff structure, reducing the number of levels from seven to four in a three year period. Finally, the it decided to gradually lower tariffs aiming at an average level of 16% by the end of the Gaviria administration.

However, a year after coming into power, in August 1991, the situation was not as expected. Inflation was high, imports and particularly exports were not behaving as they were supposed to. Average imports had fallen, in terms of nominal dollars, by 11%. Only imports of retail goods had increased (10%). This, of course, was not the objective of the structural trade reform, as exports were stagnant and the share of trade variable in GDP was not increasing. Furthermore, due to the behavior of imports, there seemed to be no significant advance in access of domestic firms to foreign inputs and technology.

Policymakers argued at the time that the reason for the imports behavior was the decision of the private sector to postpone investment decisions for the time when tariffs were at its lowest. Moreover, there was a significant inflow of capitals to Colombia due in part to interest rate differentials. As a consequence of all this, the government decided to finish the graduality in the liberalization process and decided, in the last quarter of 1991, to adjust the tariff levels to those originally planned for 1994, the last year of the Gaviria administration.[7] Nominal tariffs dropped by 1992 to an average of just below 11% and effective rates decreased to 17.5%.

Since then, tariffs have remained relatively constant. Nevertheless, there has been some activity, mainly the reactivation of the Andean pact and the trade agreement between Colombia, Mexico and Venezuela.

[7]There was no reelection in Colombia at the time.

# 2 The model

The model derived is similar in spirit to those in [Grossman (1986, 1987)] and [Curie and Harrison (1997)]. We are trying to measure the effects on the level of employment across all sectors in the economy, so we must emphasize that we have no plant-level information. We are aware that industry-level employment and wage responses might hide significant variations at the firm level, but neither plant-level nor firm-level data sets are available beyond the manufacturing sector for Colombia. Therefore, we derive reduced-form expressions for labor and wages which we estimate using aggregate industry data at the 2-digit ISIC level

In the rest of this section we present this paper's underlying theoretical model, a corresponding structural empirical specification and, finally, the reduced-form specifications for employment and wages.

## 2.1 Theoretical model

Our theoretical model has three types of elements: firms, a labor market and product demand functions.

The firms in our model are indexed by $i$, and each one belongs to an economic sector, indexed by $j$. Within each sector, the product of the firms is assumed homogeneous. Each firm uses capital $K$ and labor $L$ sell an output $q$ according to a Cobb-Douglas function[8]

$$q_{ij} = A_j L_{ij}^{\beta_1^j} K_{ij}^{\beta_2^j} \tag{1}$$

[8]Notice that this is not a production function in the usual sense, as the firm may have imported the good rather than actually made it. This is most evident in the case of retail commerce, where the goods sold may be home or foreign made, and one would like to isolate the value added by its seller.

A firm may have some degree of market power in its product market. It takes the price of capital $r$ as given, but it faces an upward sloping labor supply given by

$$w_{ij} = \tilde{w}_j^{\beta_3^j} L_{ij}^{\beta_4^j} \tag{2}$$

where $w_{ij}$ is the wage paid by the firm and $\tilde{w}_j$ is the alternative wage: the wage that the firm's employees could earn somewhere else. The subscript $j$ allows for the possibility that this alternative wage, as well as the labor supply parameters $\beta_3^j$ and $\beta_4^j$, be different for firms in different sectors. The firm's objective function is then

$$\max_{L_{ij}} P_j\left(Q_j\right) q_{ij} - w_{ij} L_{ij} - r K_{ij} \tag{3}$$

where $Q_j$ is the aggregate demand for the sector.

The product demand for sector $j$ is similar to that of Grossman, [Grossman (1986)][Grossman (19 and is given by[9]

$$Q_j = D e^{\pi t} \left[\frac{E P_j^* \left(1+\tau_j\right)}{P_j}\right]^{\eta_1^j} \left[\frac{\bar{P}}{P_j}\right]^{\eta_2^j} \tag{4}$$

here, $E$ is the exchange rate, $P_j$ is the price of the product of sector $j$, $P_j^*$ is the price of the same product abroad, $\tau_j$ is the prevailing tariff for imports of this product and $\bar{P}$ is the domestic aggregate price level, $\pi$ is the rate of secular demand shift and $D$ is a constant. The demand parameters $\eta_1^j$ and $\eta_2^j$ could in principle differ across sectors.

The first order condition for the firm's problem is:

$$\frac{\partial P_j}{\partial Q_j}\frac{\partial Q_j}{\partial L_{ij}} q_{ij} + P_j \frac{\partial q_{ij}}{\partial L_{ij}} - w_{ij} - \frac{\partial w_{ij}}{\partial L_{ij}} L_{ij} = 0 \tag{5}$$

Using equations (1) through (5) one can reach

$$P_j\left[\left[\frac{1}{\varepsilon_j}+1\right]\frac{\partial q_{ij}}{\partial L_{ij}} - \frac{q_{ij}}{\varepsilon_j s_{ij}}\frac{\partial s_{ij}}{\partial L_{ij}}\right] = w_{ij}\left[1+\beta_4^j\right]$$

[9]The interpretation of this demand is somewhat ambiguous. Ideally, this is the demand for the output of the domestic firms in the sector, and that is how we treat it in this paper. While this is straightforward in the case of manufacturing, the aggregate output price of a sector like retail commerce embodies a mix of home and foreign elements.

where $s_{ij} = \frac{q_{ij}}{Q_j}$ is the share of sector $j$'s output produced by firm $i$, and $\varepsilon_j$ is the own-price elasticity of sector $j$'s market demand.

At this point, it is necessary to assume that the firms within each sector are symmetric in order to be able to aggregate their output into a sector output. This assumption implies

$$\begin{aligned} L_j &= n_j L_{ij} \\ K_j &= n_j K_{ij} \\ w_{ij} &= w_j \\ q_{ij} &= q_j \end{aligned} \tag{6}$$

and a more useful form of (5)

$$\beta_1^j A_j \left[\frac{L_j}{n_j}\right]_{ij}^{\beta_1^j - 1} \left[\frac{K_j}{n_j}\right]^{\beta_2^j} P_j \left[\frac{1}{\varepsilon_j} + 1\right] = w_j \left[1 + \beta_4^j\right] \tag{7}$$

Equations (1) through (4) together with (7) are the basis for our empirical specifications.

## 2.2 Empirical model

In what follows we derive first a structural specification. Then we eliminate the endogenous variables $P_j, Q_j$ and $w_j$ to get a reduced form model for $L_j$. Finally, we specify an analogous model for $w_j$.

### 2.2.1 Structural form

The central equation for our empirical specification is a log-linearized version of (7)

$$\begin{aligned} &\left[\beta_1^j - 1\right] \ln L_j + \ln P_j - \ln w_j \\ &= -\beta_2^j \ln K_j - \ln \mu_j + \left[\beta_1^j + \beta_2^j - 1\right] \ln n_j - \ln A_j - \ln \beta_1^j + \ln\left[1 + \beta_4^j\right] \end{aligned} \tag{8}$$

where we have defined a mark-up parameter $\mu_j \equiv \frac{1}{\varepsilon_j} + 1$ and rearranged the terms so that all the endogenous variables are on the left hand side.

A second equation comes from (4)

$$\ln Q_j + \left[\eta_1^j + \eta_2^j\right] \ln P_j = \ln D + \pi t + \eta_1^j \ln EP_j^* + \eta_1^j \ln\left(1+\tau_j\right) + \eta_2^j \ln \bar{P} \qquad (9)$$

A third equation comes from (1) and (6)

$$\ln Q_j - \beta_1^j \ln L_j = \ln n_j + \ln A_j + \beta_2^j \ln K_j \qquad (10)$$

From (2) and (6) we get a fourth equation:

$$\ln w_j - \beta_4^j \ln L_j = \beta_3^j \ln \tilde{w}_j \qquad (11)$$

Finally, to complete our system, we add three empirical equations of a structural nature that

reflect the impact of trade reform:

$$\ln \mu_j = \gamma_1^j \ln\left(1+\tau_j\right) + \tilde{\nu}_j \qquad (12)$$

$$\ln A_j = \gamma_2^j \ln\left(1+\tau_j\right) + \nu_j \qquad (13)$$

$$\ln n_j = \gamma_3^j \ln\left(1+\tau_j\right) + \hat{\nu}_j \qquad (14)$$

### 2.2.2 Reduced form

Solving (8) through (14) for $L_j$ yields

$$\begin{aligned}
\Omega_j \ln L_j = & -\phi_j \pi t - \left[1-\psi_j\right] \ln \bar{P} \qquad (15)\\
& + \left[\phi_j - 1\right] \beta_2^j \ln K_j - \psi_j \ln EP_j^* + \beta_3^j \ln \tilde{w}_j \\
& - \left[\psi_j + \gamma_1^j - \left[\phi_j - 1\right] \gamma_2^j + \left[\beta_1^j + \beta_2^j + \phi_j - 1\right] \gamma_3^j\right] \ln\left(1+\tau_j\right) \\
& - \nu_j + \left[\phi_j - 1\right] \tilde{\nu}_j + \left[\beta_1^j + \beta_2^j + \phi_j - 1\right] \hat{\nu}_j \\
& - \ln \beta_1^j + \ln\left[1+\beta_4^j\right] - \phi_j \ln D
\end{aligned}$$

where we have defined for simplicity

$$\phi_j \equiv \frac{1}{\eta_1^j + \eta_2^j} \qquad \psi_j \equiv \frac{\eta_1^j}{\eta_1^j + \eta_2^j}$$

$$\Omega_j \equiv \beta_1^j \left[1-\phi_j\right] - \beta_4^j - 1$$

For purposes of estimation, one must decide which parameters are common to all sectors, and which are different across them. There are two sets of production function parameters $\beta_1^j, \beta_2^j$, two sets of labor supply parameters $\beta_3^j, \beta_4^j$, two sets of sector demand parameters $\eta_1^j, \eta_2^j$ (or equivalently $\phi_j$ and $\psi_j$) and three sets of "trade liberalization" parameters $\gamma_1^j, \gamma_2^j$ and $\gamma_3^j$. There are also fixed effects stemming from the empirical equations (13)-(14). We assume that all these parameters are common to all sectors, i.e. $\left(\beta_1^j, \beta_2^j, \beta_3^j, \beta_4^j, \phi_j, \psi_j, \gamma_1^j, \gamma_2^j, \gamma_3^j\right) = (\beta_1, \beta_2, \beta_3, \beta_4, \phi, \psi, \gamma_1, \gamma_2, \gamma_3)$.

This assumption of common parameters across sectors is quite strong, since the reason to aggregate the economy by sectors is presumably that they differ in technology, market demand and, if labor is not fully mobile, labor supply. However, with respect to the trade liberalization parameters – the focus of this paper –, there is no clear prediction in any direction. Thus, the assumption that they are homogeneuos across sectors is simply a place to start.

The same is not true of the fixed effects $(\nu_j, \tilde{\nu}_j, \hat{\nu}_j)$, as it is likely that market power, number of firms and technological advances differ from sector to sector due to unobservable factors unrelated to trade. The issue here is the maximum level of aggregation one can afford before this biases the results. The model does not make any clear prescriptions in this regard.

These considerations and (15) translate into the following reduced-form model for $L_j$:[10]

$$\begin{aligned} \ln L_j = \alpha_0 + \alpha_1 t + \alpha_2 \ln \bar{P} + \alpha_3 \ln K_j + \alpha_5 \ln EP_j^* + \alpha_6 \ln \tilde{w}_j \\ + \alpha_7 \tau_j + \alpha_8 \ln n_j + fe_j \end{aligned} \tag{16}$$

We also regress an analogous reduced-form specification for $w_j$, derived from (15) and (11):

$$\begin{aligned} \ln w_j = \theta_0 + \theta_1 t + \theta_2 \ln \bar{P} + \theta_3 \ln K_j + \theta_5 \ln EP_j^* + \theta_6 \ln \tilde{w}_j \\ + \theta_7 \tau_j + \theta_8 \ln n_j + fe_j \end{aligned} \tag{17}$$

[10] We've set $\ln(1 + \tau_j) = \tau_j$

According to our model, the expected signs of the $\alpha_k$ and $\theta_k$ depend on the sign of $\Omega$. Thus, nothing can be said a priori about the effect of trade on employment and wages.

We also include a number of demographic control variables in our regressions, to be described in the next sections.

# 3 Data

The paper uses two datasets. One is the National Household Survey (NHS), originated in the Colombia's national statistical agency, DANE. The survey is prepared quarterly and although it is currently representative at the national level, historically it is not. In order to have a consistent dataset for the period 1984 to 1999 we use the NHS data for the seven major cities.[11] The NHS survey provides us with information on employment, wages and several demographic characteristics at a 2-digit ISIC level. It also allows us to determine whether workers are skilled or unskilled depending on their years of education.

The dependent variables in our models are the log of employment (*logemploy*) and the log of wages (*logWi*), both at the 2-digit level. We use two approaches to define the alternative wages. For most regressions we use the log of the simple average of wages at a one digit ISIC level (*logaltW*), but we also consider the log of the average wage of the economy (*logaltW_agg*), which varies only year to year.

The data on tariffs (both nominal and effective) was provided by the National Planning Department (DNP) and was available at an eight digit NANDINA level. Each NANDINA code was correlated with its corresponding 4 digit ISIC.[12] We organized the data in order to be representative for the maximum number of sectors possible. Initially, the raw data had no tariffs for some 4-digit ISIC sectors prior

[11]The cities included are Bogotá, Cali, Medellín, Barranquilla, Bucaramanga, Pasto and Manizales.

[12]NANDINA is the Andean equivalent of the harmonized international trade classification.

to 1991. The reason is that after 1991 some NANDINA sectors were reclassified in different ISIC sectors and showed up under new codes. For example, some activities that show up as sub sectors of the wholesale trade sector since 1991 are typically embedded in some manufacturing codes prior to that year.

We take advantage of the level of disaggregation of the dataset to identify the corresponding NANDINA sectors that appear in the dataset after 1991 but did not show up prior to 1991. Once identified, these NANDINA sectors are matched with the corresponding 4-digit ISIC prior to 1991. Using this approach the DNP data is pulled back to the 1980s. This dataset is what we refer to as the DNP tariff data base and is identified in Fig.3 as the DNP tariffs.[13]

To take into account the effects of a trade liberalization process on all possible sectors of the economy we impute tariffs to sector that had no explicit tariffs before. For example, in the original database, there are sectors such as sector ISIC 62, retail trade, which has no tariffs assigned. As Fig.1 shows this is one of the main employment generators in Colombia. However, given the characteristics of this sector, it is of no surprise that no tariffs are attached to it. We argue that there should be effects of tariff reductions on such type of sectors. An example makes our argument easier to understand. The tariff of an imported car is classified in sector SIC 3843, manufacture of motor vehicles. The imported car clearly was not built in Colombia, but still the tariff is classified in the manufacturing sector, not in the retail trade sector. Normally this is not much of an issue, but we believe it is an issue when we deal with the labor market and the potential effects of a trade reform.

In the particular example of cars, as [Tover (2005)] shows, there were no imports prior to the 1990s trade reforms. This implies that there were no car retailers beyond those of the three existing domestic firms. However, as imported cars flooded the market, new retailer centers selling exclusively imported cars were opened. This

[13]Rigorously speaking there was one classification for the harmonized system in the 1980s (NABANDINA) and one in the 1990s (NANDINA). The correlation between both was done using [Valderrama (1990)].

means that new personnel had to be hired. This kind of effect is in no way captured if we regress employment on tariffs, as the latter are traditionally taken.

Following this idea, we have carefully attached to each sector the relevant tariffs that affect those sectors that per se have no tariffs. In the example, we have classified the tariff of an imported car as relevant for the retail trade sector, and therefore we try to directly capture the effects of the trade reforms on the level of employment taking into account the totality of the labor force. This type of tariff measure is hereafter referred to as *JT*.

We also use a measure of effective tariff rate provided by the DNP. In this case, given the definition of effective rates, it made no sense to reorganize the data and so we limited ourselves to pull back tariffs to the 1980s were possible.

As robustness checks, we used simple and weighted averages for nominal and effective tariffs at the 2-digit level in the regression exercises. The latter is weighted by imports at the 4-digit level. These were also provided by the National Planning Department.

Although the dataset set is rich in variation and information, it has one important restriction that has to do with the level of disaggregation available at the NHS, our source for employment measures. While tariff data (both nominal and effective) is available at the 4-digit ISIC level, employment data is only available at the 2-digit ISIC level. We are therefore forced to aggregate tariff data to match the employment data.

In order to test the robustness of our measure of tariffs we present a set of regressions with several tariff measures. The tariff variables included in our regressions are *tariff_wnJT, tariff_wnDNP, tariff_nJT, tariff_DNP, tariff_eff* and *tariff_long*. *tariff_wnJT* stands for weighted (by imports) nominal tariff using the *JT* methodology described above. *tariff_wnDNP* stands for the nominal tariff using the DNP methodology also described above. *tariff_nJT* and *tariff_DNP* are simple averages of the nominal tariffs. The latter, in particular, is the measure commonly

used in the literature. *tariff_eff* are the effective tariffs as described above. Finally, *tariff_long* is an attempt to capture the effects of past tariffs on current employment. It is the average of *tariff_wnJT* over the previous two years and the current one.

Other explanatory variables in the regressions are the log of the Consumer Price Index (*logcpi*) and a time trend (*trend*).

As standard control variables we use the share of women at a two digit level (*woman*), the log of the number of years educated (*logeduc*) and the log of age (*logage*). We also run regressions with the square of the trend (*trend2*) and an interaction of the trend and a dummy for the period starting in 1992 (*trendapert*).

## 3.1 Descriptive statistics

The liberalization process in Colombia was radical. The data in Figs. 3, 4 and 5 is clear evidence of this. They illustrate the deepness of the liberalization process in Colombia. Fig. 3 shows that the simple weighted average prior to the liberalization process was above 25%, no matter what measure of tariffs we use. The effective tariffs at this time were above 40%. Once the reforms were implemented, nominal tariffs dropped to less than 11% on average, leaving the effective tariffs at 15%.

Fig. 3 shows also that our constructed tariff measure is similar on average to the one provided by DNP, both before and after the reforms. The main difference, of course, has to do with those sectors that had no direct tariff data. Analyzing each sector at an 8-digit NANDINA level, we assigned tariffs at a corresponding 4-digit ISIC to retail trade, transport and storage, communications, financial institutions and social and related community services. As with the other sectors, the data shows that tariffs dropped substantially with the trade reforms.

According to our estimates, the sectors with the largest tariffs are transport and storage and the more traditional textile and apparel, wood, and food in the manufacturing sector. Nominal tariffs for the transport and storage sector, prior

to the trade reforms, are on average extremely high. In fact, the average for 1984 through 1989 is 116%, much higher than the rest of the economy. This sector includes some vehicles that had, for some years, nominal tariffs of over 700%.

An interestingly counterintuitive sector is recreational and cultural services were tariffs actually increased. With respect to trade – but not to employment –, this sector essentially includes motion pictures products.

In terms of weighted average of tariffs some sectors had particularly high levels in the 1980s. Among these are the manufacture of food, beverages and tobacco with over 100% and textiles with an effective tariff of 94%. After the reforms, these two sectors retained the highest effective tariffs but the overall dispersion was much smaller. On average the effective rate dropped from 41.5% to 15.5%.

Figs. 4 and 5 show that prior to the reforms tariffs – either $JT$ or $DNP$ weighted tariffs – were much more disperse than afterwards. If one defines tariff structure as the relative ordering of tariff levels, the graphs show that this is essentially maintained after the reforms were implemented, with consumer goods still having the highest rates.

The evolution of employment and wage is displayed at a 1-digit level in Fig. 6. The left vertical axis stands for number of employed individuals, while the right vertical axis represents the wage in 1994 constant Colombian pesos. Three sectors stand out in terms of employment levels: manufacturing; wholesale and retail trade; and community, social and personal services. The latter includes public administration and defense, social and related community services and personal and household services. Together, these three sectors represent around 70% of the total employed population. Other relevant sectors are transport and storage, and financing, insurance, real estate and business services.

Not surprisingly, the sector with the highest wages is mining. Included here are the capital intensive coal and petroleum sectors. However, in terms of the number

of employed individuals it is one of the smallest in the sample, just ahead of the agricultural and hunting sector.[14]

For ease of comparison across sectors, the right axis in Fig. 6 is top-normalized to 500.000 pesos, except for the petroleum sector. Other than this outlier, the graphs show that the financing sector tends to be the best paid, while the agricultural sector has the highest volatility.

Fig. 7 presents the employment share of each sector before and after the trade reforms were implemented. It clearly illustrates that the three largest sectors remain around 70% of total employment over the entire period of analysis. More interestingly, these pies show no evidence, at least at an aggregate level, of a significant reallocation of labor across sectors.

Finally, Figs. 1 and 2 present some summary statistics for the control variables included in the regressions. Women participation is high in the textile industry, the restaurant and hotels sector and in social and related community services. There is no apparent significant variation of either average age per sector or women participation before and after the reforms. Education, on the other hand has strong dispersion across sectors, and the years of education increase slightly in the post reform period.

In summary, the tariff data clearly shows the effect of the structural changes that took place in the late 1980s and early 1990s. The same overview, however, does not reveal any structural effects on the level of employment or on the real wages.

# 4 Estimation results

We present the results of six sets of reduced-form regressions based on (16) and (17). The first four sets include the natural logarithm of employment (*logemploy*)

[14]The small number of workers in the agricultural sector should be of no surprise, as the NHS is representative of the seven main cities.

as the dependent variable, the last two use the wage specification. Capital stock $K_j$ and foreign prices $EP_j^*$ by sector are not included as explanatory variables because we currently lack data on them. We include controls for average age and education of the workers in each sector, as well as the percentage of women in the sector employment. All the $t$-statistics reported are based on the Huber (robust) estimator.

The first two sets of OLS regressions introduce the right-hand-side variables used in this paper. They all include fixed effects for each ISIC 1-digit sector. In Fig. 8, the measure of tariffs used is *tariff_wnJT* in all columns. Column (1) includes no control variables. In columns (2)-(4) the controls *woman, logeduc, logage* are succesively added. None of the controls has a large impact on the tariff coefficients. Throughout the analyses in this section, our main specification is the one in column (4).

Column (5) includes *trend* squared and (6) includes the interaction of *trend* and a dummy for the period after 1992. Neither has much impact on the coefficients of interest.

Fig. 9 compares the performance of the six alternative measures of tariffs described in the data section. The tariff measure used for our analyses is *tariff_wnJT* (column 1 in the table), and the one used in most of the literature is *tariff_nDNP* (column 3). *tariff_long*, in the last column, captures medium-term effects of tariff levels. It has a much lower coefficient than any of the other measures. All but one of the tariff variables are significant at the 1% level, indicating a positive relationship between the tariff levels and the employment level across sectors within each 1-digit sector. According to our main specification (column 1), a reduction in tariffs of 1% corresponds to a drop in the sector employment of approximately 2%.

Fig. 10 shows the regression results under different specifications of sector fixed effects. The first column is our main specification with ISIC 1-digit sector dummies, included for comparison. Columns (2) through (4) include dummies for each ISIC 2-digit sector. None of the tariff measures has significant coefficients in these regressions, and the coefficient values are close to zero. These results suggest that whatever

factors influenced employment in each sector were relatively constant throughout the period 1984-1999 (while tariffs were not).

The remaining columns in Fig. 10 don't use fixed effects, i.e. all observations are pooled. The coefficients are larger in absolute value than in the first column, but the direction of the effects is the same. Again, these results suggest that a part of the variation across sectors is a time-invariant effect captured by the ISIC 1-digit sector dummies in our main specification.

The regressions in Fig. 11 use as the alternative wage the variable *logaltW_agg*, the simple mean of all sector wages, rather than their mean within ISIC 1-digit sectors. We present results using each one of the tariff measures. The results are similar with both definitions of alternative wage.

The last two sets of regressions are analogous to those in Fig. 8 and Fig. 9, except that the dependent variable is the log of wages (*logWi*) rather than *logemploy*. Fig. 12 shows the effect of the control variables on the coefficients of interest. The introduction of *logeduc* (column 3) makes the coefficient on the tariff measure not statistically significant. This suggests that the relative usage of skilled vs. unskilled labor in the sector is an important feature and calls for a model where both types of labor are measured separately.

Finally, Fig. 13 compares the effect on the estimated coefficients of using different tariff measures. Overall, the results confirm the absence of an impact of trade on wages.

# 5 Concluding remarks

Although the Colombian trade liberalization process of the early 1990's seems an ideal event to detect an impact of trade on wages and the level of employment in labor markets, the research presented in this paper does not yield conclusive results.

We use two datasets, the Colombian National Household Survey and tariff data from the Colombian National Planning Department. We match them to generate time series of tariffs, employment and wages by 2-digit ISIC sectors of the economy, as well as of a number of relevant explanatory variables and demographic controls. The data spans the period between 1984 and 1999, which covers the trade reforms that took place in Colombia starting 1991.

For the analysis, we derive a structural model based on the firms profit maximization problem. Then we specify reduced-form equations to estimate the impact of tariffs on the level of employment and wages. Our results suggest a positive effect of average tariffs on the level of employment. However, we were unable to find corresponding effects on wages. Overall, the results are not robust to the regression specifications.

Due to the lack of data, the regressions in this paper do not include some explanatory variables suggested by the structural model, namely the stock of capital in each 2-digit ISIC sector and the foreign prices corresponding to each sector's output. We aim to include this variables in future versions of our research. Additionally, the results in some regressions suggest that one should consider skilled and unskilled labor separately. This is in line with the existing literature and calls for an extension of our structural model.

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**MEANS**
**(Standard Deviation)**

| | 1984-1991 | | | | | 1992-1999 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **employment** | **real wage** *(1994 pesos)* | **woman** *(% per sector)* | **age** | **education** *(years)* | **employment** | **real wage** *(1994 pesos)* | **woman** *(% per sector)* | **age** | **education** *(years)* |
| **Electricity, Gas and Steam** | 19343 | 287136 | 0.16 | 35.56 | 10.39 | 24827 | 369355 | 0.21 | 36.66 | 11.81 |
| | (4966) | (20927) | (0.05) | (0.55) | (0.78) | (2942) | (67903) | (0.04) | (0.82) | (0.62) |
| **Water Works and Supply** | 8203 | 255606 | 0.15 | 37.89 | 8.99 | 7943 | 302149 | 0.19 | 36.67 | 10.61 |
| | (1590) | (27159) | (0.05) | (1.4) | (0.99) | (1518) | (51822) | (0.07) | (2.65) | (1.16) |
| **Construction** | 239069 | 193633 | 0.05 | 34.36 | 6.73 | 338042 | 219117 | 0.06 | 35.20 | 7.76 |
| | (11896) | (12992) | (0.01) | (0.52) | (0.47) | (41036) | (38479) | (0.01) | (0.69) | (0.45) |
| **Wholesale Trade** | 41831 | 373083 | 0.31 | 34.33 | 10.50 | 84678 | 362659 | 0.36 | 34.82 | 10.96 |
| | (12070) | (67609) | (0.03) | (0.39) | (0.52) | (12515) | (77936) | (0.02) | (1.2) | (0.66) |
| **Retail Trade** | 794693 | 178581 | 0.38 | 35.05 | 7.90 | 1044351 | 191784 | 0.43 | 36.09 | 8.97 |
| | (82843) | (4407) | (0.01) | (0.27) | (0.55) | (98515) | (28741) | (0.01) | (0.75) | (0.311) |
| **Restaurants and Hotels** | 145259 | 152515 | 0.56 | 33.33 | 6.89 | 202899 | 164988 | 0.60 | 34.82 | 8.60 |
| | (17118) | (6412) | (0.01) | (0.55) | (0.53) | (21470) | (22917) | (0.01) | (0.64) | (0.98) |
| **Transport and Storage** | 219764 | 227937 | 0.075 | 37.16 | 7.59 | 327935 | 255314 | 0.09 | 37.63 | 8.98 |
| | (22522) | (10358) | (0.01) | (0.3) | (0.68) | (45519) | (25094) | (0.01) | (0.61) | (0.29) |
| **Communication** | 21502 | 290043 | 0.329 | 35.01 | 11.01 | 40010 | 307644 | 0.36 | 33.38 | 11.79 |
| | (3922) | (25997) | (0.03) | (1.33) | (1.12) | (11099) | (79066) | (0.03) | (1.41) | (1) |
| **Financial Institutions** | 81134 | 308755 | 0.405 | 32.40 | 12.02 | 111792 | 384507 | 0.51 | 31.88 | 13.37 |
| | (6110) | (11033) | (0.04) | (0.46) | (0.37) | (20421) | (49367) | (0.02) | (0.84) | (0.847) |
| **Insurance** | 22240 | 314084 | 0.484 | 34.14 | 11.66 | 32792 | 373958 | 0.51 | 34.83 | 13.03 |
| | (3641) | (33506) | (0.04) | (1.27) | (0.58) | (6952) | (59737) | (0.06) | (2.43) | (0.37) |
| **Real Estate and Business Services** | 173271 | 308317 | 0.313 | 35.46 | 10.98 | 290868 | 363116 | 0.32 | 36.48 | 11.74 |
| | (37640) | (18392) | (0.01) | (0.35) | (0.28) | (58055) | (57917) | (0.01) | (0.81) | (0.54) |
| **Public Administration and Defence** | 141354 | 268704 | 0.31 | 35.83 | 10.94 | 172235 | 347675 | 0.36 | 35.16 | 12.61 |
| | (9103) | (11583) | (0.02) | (0.4) | (0.69) | (19803) | (56363) | (0.01) | (0.89) | (0.75) |
| **Sanitary and Similar Services** | 7897 | 167832 | 0.12 | 38.93 | 6.63 | 10939 | 239860 | 0.29 | 36.37 | 8.26 |
| | (1913) | (9489) | (0.04) | (1.48) | (0.77) | (2616) | (133212) | (0.123) | (2.13) | (1.45) |
| **Social and Related Community Services** | 323074 | 267326 | 0.63 | 35.38 | 12.31 | 480806 | 318006 | 0.65 | 36.72 | 13.29 |
| | (33657) | (11267) | (0.01) | (0.41) | (0.31) | (78253) | (43679) | (0.012) | (0.43) | (0.44) |
| **Recreational and Cultural Services** | 57846 | 224535 | 0.30 | 32.72 | 9.32 | 84231 | 264880.00 | 0.33 | 32.95 | 10.66 |
| | (10399) | (26030) | (0.03) | (0.48) | (0.56) | (14987) | (51802) | (0.05) | (0.81) | (0.54) |
| **Personal and Household Services** | 603426 | 104357 | 0.57 | 32.00 | 5.87 | 741321.00 | 123749 | 0.60 | 34.42 | 7.19 |
| | (57617) | (4898) | (0.02) | (0.6) | (0.53) | (94793) | (16462) | (0.01) | (1.02) | (0.37) |
| **Extra-Territorial Bodies** | 1980 | 534155 | 0.42 | 37.49 | 11.36 | 2596 | 852194 | 0.59 | 38.79 | 13.19 |
| | (663) | (295591) | (0.251) | (2.67) | (1.37) | (943) | (478066) | (0.349) | (6.2) | (1.76) |
| **Total Economy** | 114550 | 245395 | 0.29 | 34.50 | 13.65 | 150263 | 302688 | 0.34 | 35.72 | 13.66 |
| | (174265) | (129840) | (0.19) | (3.45) | (26.96) | (227324) | (222426) | (0.19) | (4.21) | (23.42) |

Source: National Household Survey

Figure 1: General descriptive statistics

CONT'D

**MEANS**
**(Standard Deviation)**

| | 1984-1991 | | | | | 1992-1999 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **employment** | **real wage** *(1994 pesos)* | **woman** *(% per sector)* | **age** | **education** *(years)* | **employment** | **real wage** *(1994 pesos)* | **woman** *(% per sector)* | **age** | **education** *(years)* |
| **Agriculture and Hunting** | 53639 | 302622 | 0.18 | 39.59 | 7.29 | 55510 | 319576 | 0.60 | 41.07 | 8.76 |
| | (4818) | (73982) | (0.02) | (0.96) | (0.50) | (4688) | (70101) | (0.01) | (1.68) | (0.52) |
| **Forestry and Logging** | 636 | 153927 | 0.12 | 34.89 | 6.08 | 2085 | 233447 | 0.24 | 37.17 | 8.60 |
| | (430) | (47407) | (0.14) | (5.08) | (2) | (2413) | (87012) | (0.22) | (6.62) | (3.9) |
| **Fishing** | 804 | 142393 | 0.06 | 36.07 | 4.06 | 2345 | 220741 | 0.26 | 37.87 | 7.03 |
| | (474) | (76157) | (0.13) | (5.2) | (2.48) | (1530) | (147290) | (0.17) | (4.59) | (2.4) |
| **Coal Mining** | 4692 | 414469 | 0.16 | 34.09 | 10.86 | 3618 | 508884 | 0.27 | 39.04 | 11.42 |
| | (1585) | (64621) | (0.09) | (1.47) | (0.35) | (1035) | (236833) | (0.13) | (1.88) | (2.81) |
| **Crude Petroleum and Natural Gas Production** | 7326 | 604548 | 0.17 | 37.19 | 12.14 | 9927 | 748249 | 0.24 | 37.91 | 12.83 |
| | (2109) | (132435) | (0.03) | (2.14) | (0.86) | (3227) | (257351) | (0.137) | (2.3) | (0.99) |
| **Metal Ore Mining** | 851 | 30970 | 0.24 | 38.14 | 9.23 | 1019 | 816215 | 0.22 | 47.11 | 11.67 |
| | (675) | (118338) | (0.34) | (4.19) | (2.77) | (494) | (547940) | (0.15) | (5.86) | (3.61) |
| **Other Mining** | 3753 | 178337 | 0.12 | 36.09 | 10.21 | 3895 | 209032 | 0.06 | 38.47 | 5.57 |
| | (1089) | (46692) | (0.04) | (3.09) | (12.9) | (1478) | (99083) | (0.06) | (4.15) | (1.13) |
| **Manufacture of Food, Beverages and Tobacco** | 136209 | 192067 | 0.32 | 32.66 | 8.06 | 172898 | 219708 | 0.36 | 33.57 | 9.51 |
| | (17738) | (13097) | (0.03) | (0.4) | (0.67) | (19355) | (29552) | (0.02) | (0.35) | (0.40) |
| **Textile, Wearing Apparel and Leather Industries** | 328607 | 149841 | 0.60 | 34.03 | 7.65 | 412118 | 164872 | 0.64 | 35.75 | 8.80 |
| | (34726) | (8375) | (0.02) | (0.28) | (0.52) | (27049) | (24727) | (0.01) | (1.05) | (0.58) |
| **Manufacture of Wood and Wood** | 72666 | 165494 | 0.09 | 33.52 | 7.25 | 88440 | 179127 | 0.11 | 34.79 | 7.88 |
| | (9432) | (11112) | (0.01) | (0.61) | (0.54) | (7417) | (15599) | (0.01) | (0.85) | (0.19) |
| **Manufacture of Paper and Paper** | 60134 | 226316 | 0.30 | 32.88 | 9.68 | 70510 | 244316 | 0.35 | 33.93 | 10.83 |
| | (5237) | (6672) | (0.03) | (0.66) | (0.65) | (7198) | (16680) | (0.02) | (1.33) | (0.60) |
| **Manufacture of Chemicals and** | 98642 | 248660 | 0.35 | 32.72 | 9.34 | 128568 | 258054 | 0.40 | 33.40 | 10.73 |
| | (12672) | (19252) | (0.02) | (0.28) | (0.62) | (7778) | (27089) | (0.03) | (0.8) | (0.65) |
| **Manufacture of Non-Metallic Mineral Products** | 42005 | 187480 | 0.24 | 33.64 | 7.68 | 50393 | 218463 | 0.29 | 35.00 | 9.42 |
| | (3409) | (15485) | (0.02) | (0.3) | (0.50) | (4305) | (15306) | (0.02) | (1.92) | (0.63) |
| **Basic Metal Industries** | 19382 | 203257 | 0.12 | 33.94 | 8.56 | 26795 | 202423 | 0.11 | 35.35 | 9.06 |
| | (5570) | (21567) | (0.05) | (1.23) | (1.74) | (13518) | (42943) | (0.027) | (1.57) | (1) |
| **Manufacture of Fabricated Metal** | 119965 | 220899 | 0.14 | 32.84 | 8.69 | 134006 | 221643 | 0.17 | 34.34 | 9.72 |
| | (18396) | (17316) | (0.01) | (0.52) | (0.62) | (13188) | (26688) | (0.01) | (1.47) | (0.61) |
| **Other Manufacturing Industries** | 26744 | 175267 | 0.49 | 32.57 | 8.27 | 32727 | 181966 | 0.50 | 34.69 | 9.54 |
| | (6524) | (40062) | (0.05) | (1.01) | (0.56) | (4758) | (32301) | (0.05) | (1.64) | (0.94) |
| **Total Economy** | 114550 | 245395 | 0.29 | 34.50 | 13.65 | 150263 | 302688 | 0.34 | 35.72 | 13.66 |
| | (174265) | (129840) | (0.19) | (3.45) | (26.96) | (227324) | (222426) | (0.19) | (4.21) | (23.42) |

Source: National Household Survey

Figure 2: General descriptive statistics (cont'd)

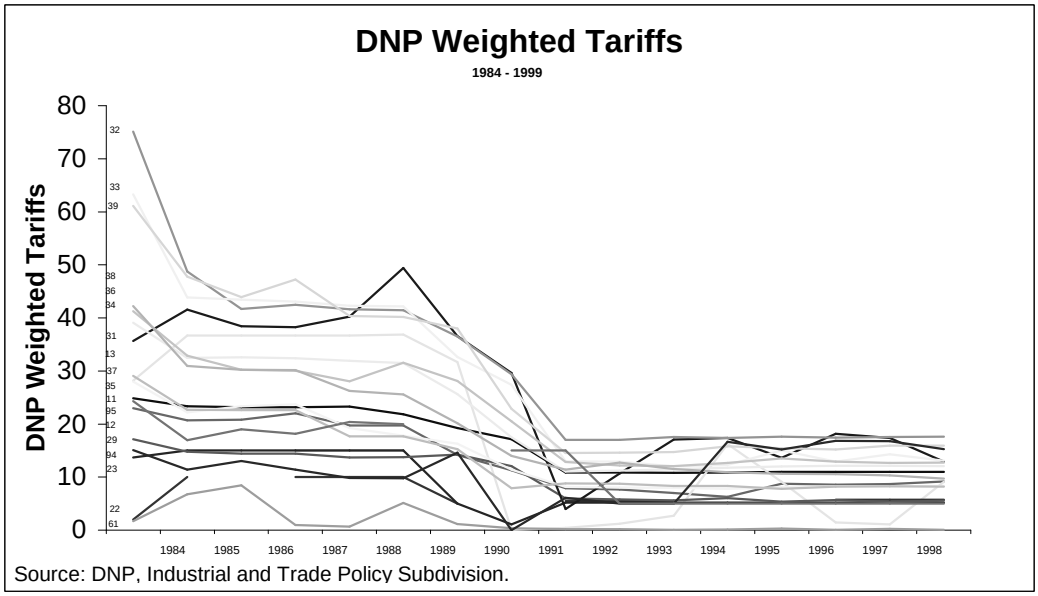
**TARIFFS MEANS (%)[1]**
**(Standard Deviation)**

| | 1984-1991 | | | | | 1992-1999 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Weighted Tariffs | | | Simple Average | | Weighted Tariffs | | | Simple Average | |
| | Nominal JT | Nominal DNP | Effective | Nominal JT | NominalDNP | Nominal JT | NominalDNP | Effective | Nominal JT | NominalDNP |
| Agriculture and Hunting | 30.28 | 22.01 | 34.95 | 28.06 | 26.39 | 12.63 | 10.91 | 13.87 | 8.82 | 8.68 |
| | (3.89) | (2.54) | (4.45) | (5.22) | (6.33) | (0.51) | (0.07) | (0.70) | (0.25) | (0.57) |
| Forestry and Logging | 28.38 | 18.94 | 21.28 | 31.15 | 19.81 | 9.22 | 8.00 | 10.93 | 9.48 | 7.66 |
| | (9.95) | (4.05) | (4.46) | (7.30) | (2.64) | (0.87) | (0.98) | (1.70) | (0.68) | (0.18) |
| Fishing | 30.45 | 30.43 | 57.50 | 27.87 | 34.10 | 15.51 | 5.15 | 11.28 | 11.51 | 12.66 |
| | (3.02) | (12.6) | (25.3) | (3.94) | (6.66) | (4.75) | (5.71) | (12.9) | (0.39) | (2.04) |
| Coal Mining | 15.00 | 15.00 | 19.22 | 15.13 | 15.13 | 5.00 | 5.00 | 5.65 | 5.00 | 5.00 |
| | (0) | (0) | (1.77) | (0.35) | (0.35) | (0) | (0) | (0.05) | (0) | (0) |
| Crude Petroleum and Natural Gas Production | 22.82 | 7.83 | 11.41 | 19.93 | 7.39 | 9.17 | 5.61 | 6.83 | 8.54 | 5.66 |
| | (5.64) | (3.48) | (5.48) | (8.56) | (3.71) | (2.04) | (0.11) | (0.13) | (2.26) | (0.14) |
| Metal Ore Mining | 11.84 | 11.85 | 14.43 | 11.48 | 11.49 | 5.00 | 5.21 | 5.88 | 5.00 | 5.11 |
| | (5.91) | (5.55) | (7.39) | (5.80) | (5.65) | (0.00) | (0.01) | (0.84) | (0) | (0) |
| Other Mining | 14.69 | 14.31 | 17.01 | 14.74 | 14.58 | 5.26 | 5.66 | 6.90 | 5.18 | 5.54 |
| | (2.01) | (1.41) | (1.97) | (2.59) | (2.32) | (0.39) | (0.26) | (0.73) | (0.25) | (0.17) |
| Manufacture of Food, Beverages and Tobacco | 37.33 | 38.72 | 120.89 | 38.74 | 40.45 | 16.98 | 13.90 | 42.85 | 16.38 | 17.25 |
| | (6.94) | (5.62) | (24.6) | (6.05) | (6.40) | (1.53) | (4.81) | (16.0) | (1.43) | (0.79) |
| Textile, Wearing Apparel and Leather Industries | 43.89 | 44.61 | 94.92 | 53.04 | 52.92 | 16.74 | 17.39 | 31.19 | 17.41 | 17.35 |
| | (13.0) | (13.5) | (31.2) | (17.3) | (17.5) | (0.28) | (0.23) | (0.55) | (0.29) | (0.03) |
| Manufacture of Wood and Wood Products, Including Furniture | 37.60 | 42.26 | 79.31 | 38.57 | 44.94 | 13.29 | 13.19 | 24.59 | 13.68 | 15.46 |
| | (8.96) | (10.4) | (20.9) | (9.35) | (11.6) | (1.25) | (0.99) | (2.24) | (0.44) | (0.10) |
| Manufacture of Paper and Paper Products, Printing and Publishing | 26.19 | 30.39 | 48.13 | 35.00 | 37.07 | 10.07 | 11.74 | 18.40 | 13.10 | 12.99 |
| | (5.88) | (6.34) | (9.61) | (6.87) | (7.65) | (0.99) | (0.43) | (0.56) | (0.63) | (0.24) |
| Manufacture of Chemicals and Chemical, Petroleum, Coal, Rubber and Plastic Products | 20.94 | 20.25 | 27.16 | 26.96 | 26.90 | 9.34 | 8.10 | 11.95 | 10.96 | 10.56 |
| | (5.55) | (5.16) | (6.17) | (6.03) | (6.10) | (0.58) | (0.18) | (0.69) | (0.32) | (0.20) |
| Manufacture of Non-Metallic Mineral Products, except Products of Petroleum and Coal | 26.53 | 30.33 | 47.09 | 27.61 | 31.28 | 10.55 | 12.69 | 19.13 | 10.64 | 12.61 |
| | (5.00) | (5.78) | (8.50) | (5.67) | (6.30) | (0.40) | (0.45) | (0.81) | (0.15) | (0.20) |
| Basic Metal Industries | 20.59 | 19.45 | 29.54 | 22.61 | 21.11 | 8.80 | 8.34 | 9.34 | 8.16 | 7.56 |
| | (5.75) | (6.32) | (8.90) | (5.90) | (6.00) | (0.20) | (0.31) | (2.98) | (0.21) | (0.28) |
| Manufacture of Fabricated Metal Products, Machinery and Equipment | 27.87 | 27.44 | 45.47 | 27.68 | 28.50 | 10.51 | 10.97 | 18.77 | 10.60 | 10.80 |
| | (7.71) | (8.33) | (12.0) | (8.31) | (9.26) | (1.52) | (0.91) | (3.47) | (0.47) | (0.19) |
| Other Manufacturing Industries | 42.83 | 42.69 | 69.70 | 37.54 | 36.77 | 12.38 | 15.28 | 25.44 | 11.89 | 14.74 |
| | (9.96) | (10.7) | (16.6) | (9.79) | (8.61) | (0.67) | (0.60) | (1.04) | (0.26) | (0.05) |
| Electricity, Gas and Steam | 0.00 | NA | NA | 0.00 | 0.00 | NA | NA | NA | 0.63 | 0.63 |
| | | | | | | | | | (1.76) | (1.76) |
| Wholesale Trade | 27.41 | 3.13 | 4.37 | 35.20 | 24.47 | 11.34 | 0.14 | 0.21 | 12.97 | 8.14 |
| | (5.82) | (3.16) | (4.45) | (8.64) | (9.25) | (1.15) | (0.09) | (0.13) | (0.25) | (0.47) |
| Retail Trade | 26.21 | NA | NA | 33.22 | NA | 10.77 | NA | NA | 12.54 | NA |
| | (10.3) | | | (9.41) | 0.00 | (3.90) | | | (1.19) | |
| Transport and Storage | 94.41 | NA | NA | 56.17 | NA | 14.82 | NA | NA | 15.35 | NA |
| | (44.1) | | | (18.7) | | (11.6) | | | (1.98) | |
| Communication | 29.57 | NA | NA | 29.57 | NA | 10.48 | NA | NA | 10.48 | NA |
| | (9.60) | | | (9.60) | | (1.01) | | | (1.01) | |
| Financial Institutions | 26.51 | NA | NA | 23.82 | NA | 6.90 | NA | NA | 6.92 | NA |
| | (10.4) | | | (12.2) | | (1.42) | | | (1.31) | |
| Real Estate and Business Services | NA | NA | NA | NA | 0.00 | NA | NA | NA | NA | 8.44 |
| . | | | | | | | | | | 4.80 |
| Social and Related Community Services | 13.24 | NA | NA | 11.75 | NA | 8.42 | NA | NA | 6.99 | NA |
| | (3.41) | | | (5.65) | | (3.78) | | | (1.97) | |
| Recreational and Cultural Services | 9.28 | 9.64 | 4.70 | 3.66 | 3.22 | 12.45 | 12.11 | 15.89 | 10.99 | 11.67 |
| | (3.80) | (4.63) | (9.37) | (0.86) | (1.53) | (5.73) | (5.63) | (13.1) | (3.28) | (4.71) |
| Personal and Household Services | 18.96 | 18.55 | 21.97 | 18.96 | 18.55 | 7.60 | 6.25 | 7.45 | 7.60 | 6.25 |
| | (2.98) | (3.16) | (3.96) | (2.98) | (3.16) | (3.06) | (3.53) | (6.20) | (3.06) | (3.53) |
| Total Economy | 28.74 | 24.02 | 41.46 | 27.42 | 25.39 | 10.75 | 9.44 | 15.52 | 10.08 | 9.75 |
| | (19.9) | (13.8) | (34.0) | (14.8) | (14.9) | (4.39) | (4.83) | (11.6) | (4.01) | (4.64) |

[1] JT tariffs are those that constructed as described in the text. DNP tariffs are the original tariff with the adjustments described in the text
Source: DNP, Own Calculations

Figure 3: Descriptive statistics of tariffs (1984-1999)

**Panel (a)**




**Panel (b)**

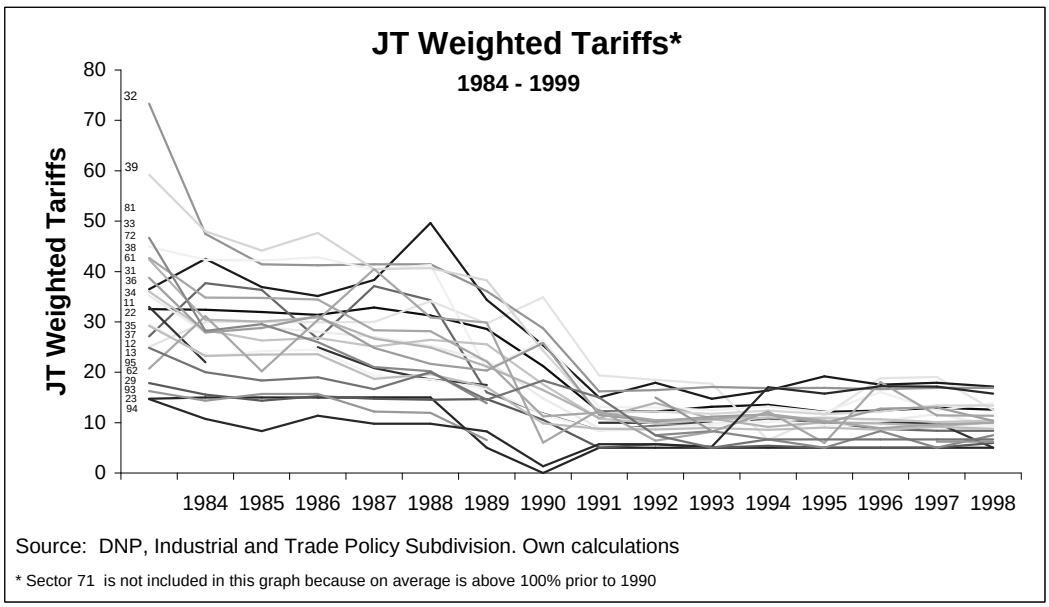
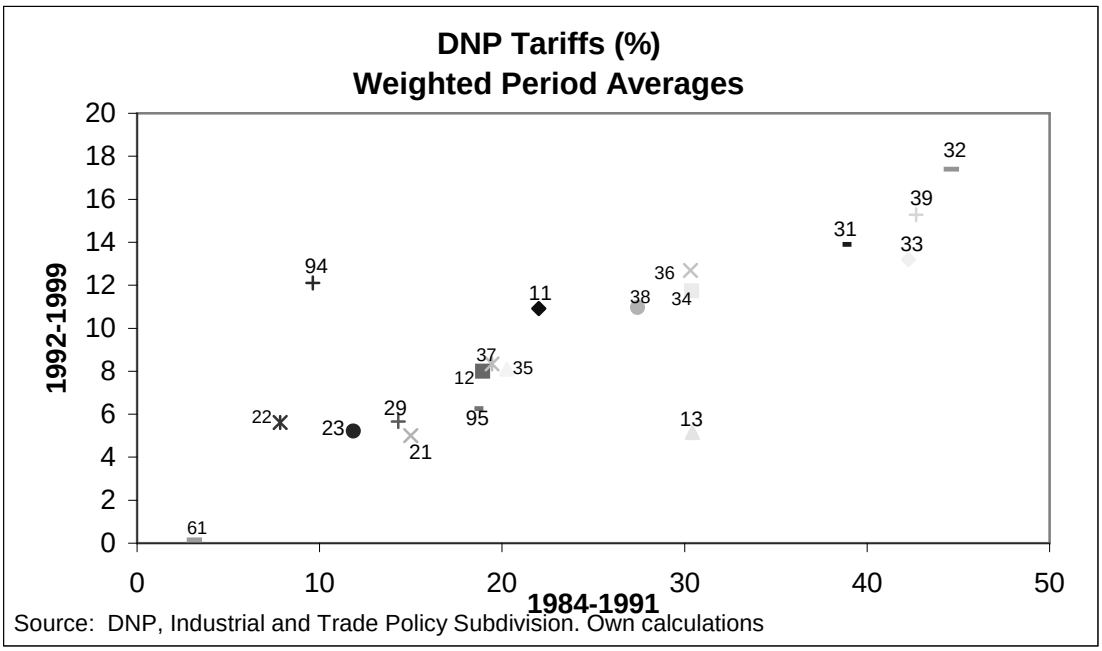



Figure 4: Comparison of tariff measures

*Notes: Panel (a) depicts the measure based on DNP data. Panel (b) is the authors' measure. The variable on the X-axis is year*

**Panel (a)**




**Panel (b)**

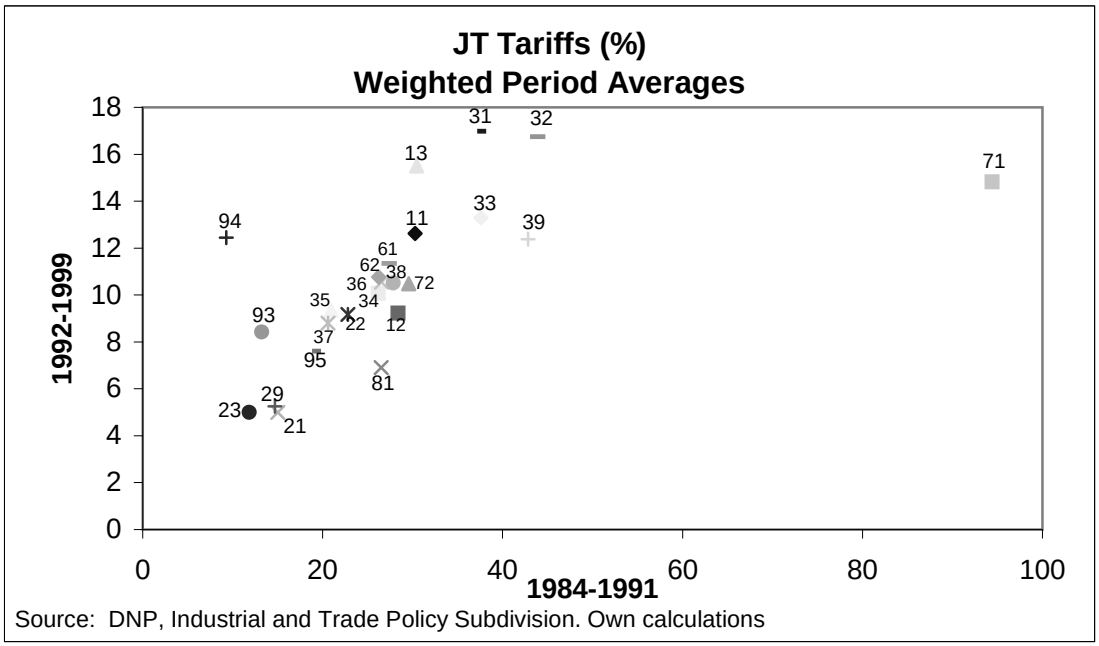



Figure 5: Average tariff levels before and after the trade liberalization

*Notes: Panel (a) depicts the measure based on DNP data. Panel (b) is the authors' measure. The variable on the X-axis is year*

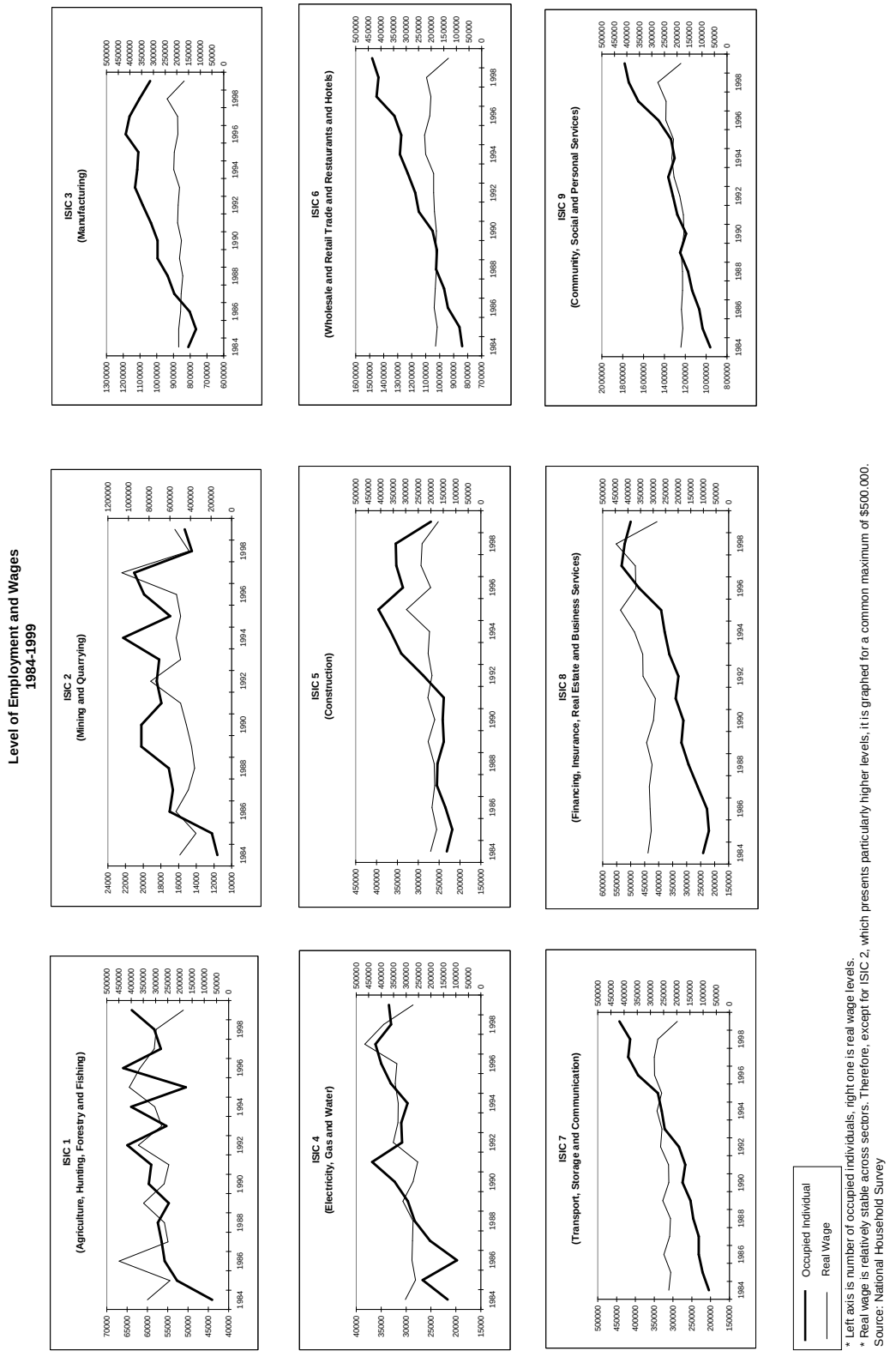
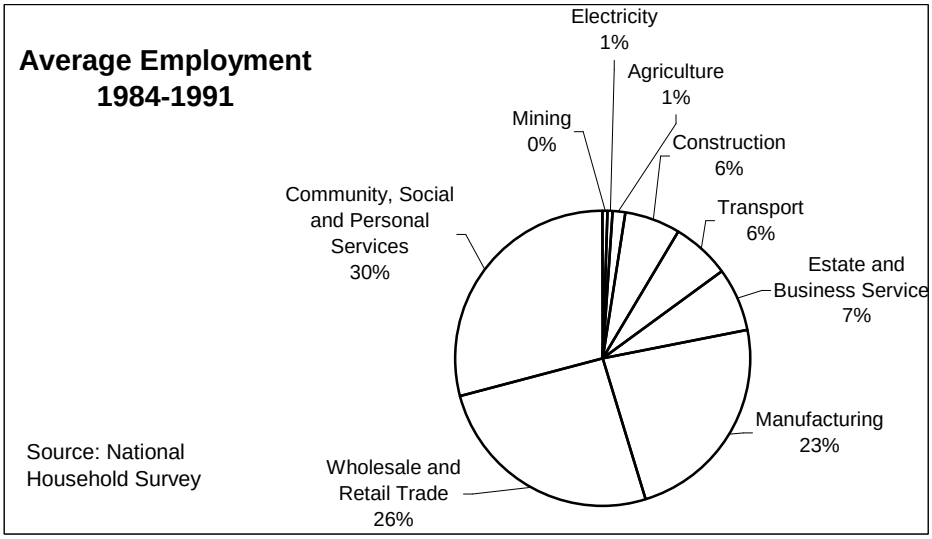



Figure 6: Level of employment and wages by ISIC 1-digit sector

*Notes: The variable on the X-axis is year*

**Panel (a)**




**Panel (b)**

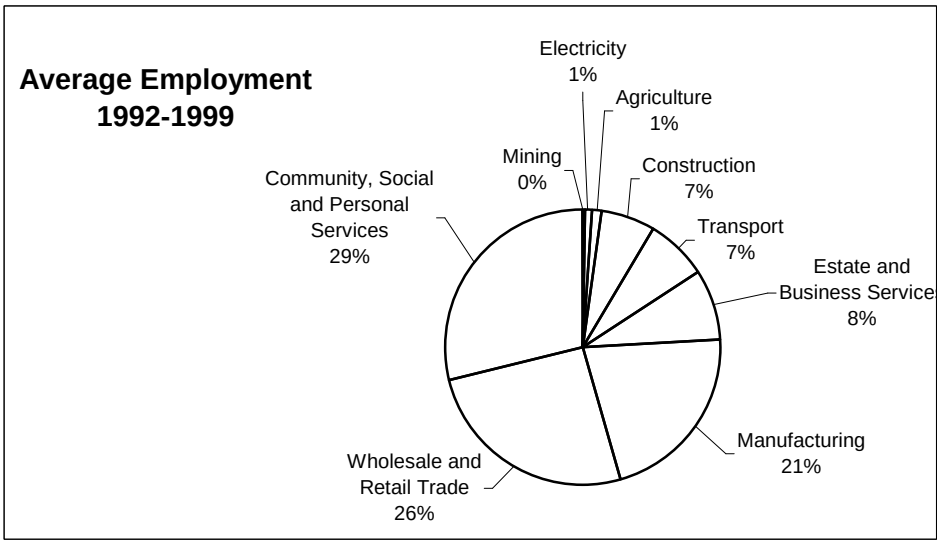



Figure 7: Average share of employment by ISIC 1-digit sector

DEPENDENT VARIABLE: LN of employment (logemploy)

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| logaltW | -0.417 | -0.448 | -0.444 | -0.536 | -0.615 | -0.673 |
| | (0.79) | (0.86) | (0.86) | (1.04) | (1.13) | (1.24) |
| logcpi | 1.623 | 1.481 | 1.473 | 1.650 | 2.478 | 1.851 |
| | (1.92)* | (1.77)* | (1.76)* | (1.98)** | (1.59) | (2.17)** |
| tariff_wnJT | 2.089 | 2.085 | 2.066 | 1.995 | 2.011 | 2.050 |
| | (5.39)*** | (5.52)*** | (5.27)*** | (5.04)*** | (5.10)*** | (5.20)*** |
| woman | | 1.603 | 1.631 | 1.625 | 1.633 | 1.606 |
| | | (2.89)*** | (2.90)*** | (2.85)*** | (2.87)*** | (2.82)*** |
| logeduc | | | -0.072 | -0.062 | -0.056 | -0.055 |
| | | | (0.25) | (0.21) | (0.19) | (0.19) |
| logage | | | | 1.792 | 1.808 | 1.801 |
| | | | | (1.56) | (1.59) | (1.58) |
| trend | -0.264 | -0.240 | -0.238 | -0.284 | -0.525 | -0.360 |
| | (1.52) | (1.40) | (1.39) | (1.66)* | (1.27) | (1.94)* |
| trend2 | | | | | 0.004 | |
| | | | | | (0.65) | |
| trendapert | | | | | | 0.027 |
| | | | | | | (1.01) |
| Constant | 18.669 | 18.263 | 18.352 | 13.562 | 16.662 | 15.808 |
| | (2.50)** | (2.47)** | (2.46)** | (1.63) | (1.64) | (1.81)* |
| Observations | 363 | 363 | 363 | 363 | 363 | 363 |
| R-squared | 0.67 | 0.69 | 0.69 | 0.69 | 0.69 | 0.69 |
| Fixed effects | ISIC 1-digit | ISIC 1-digit | ISIC 1-digit | ISIC 1-digit | ISIC 1-digit | ISIC 1-digit |

Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

logaltW is a simple average of all wages within 1-digit ISIC sector

Figure 8: Effect of the control variables on the coefficients

*Notes:*

DEPENDENT VARIABLE: LN of employment (logemploy)

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| logaltW | -0.536 | -0.505 | -0.551 | -0.514 | -0.530 | -0.678 |
| | (1.04) | (0.90) | (1.22) | (1.09) | (0.95) | (1.17) |
| logcpi | 1.650 | 1.149 | 2.027 | 1.478 | 1.220 | 1.885 |
| | (1.98)** | (1.11) | (2.47)** | (1.66)* | (1.27) | (2.07)** |
| tariff_wnJT | 1.995 | | | | | |
| | (5.04)*** | | | | | |
| tariff_wnDNP | | 1.382 | | | | |
| | | (1.51) | | | | |
| tariff_nCEDE | | | 3.355 | | | |
| | | | (5.16)*** | | | |
| tariff_nDNP | | | | 2.273 | | |
| | | | | (2.88)*** | | |
| tariff_eff | | | | | 0.884 | |
| | | | | | (3.25)*** | |
| tariff_long | | | | | | 0.022 |
| | | | | | | (4.89)*** |
| woman | 1.625 | 1.875 | 1.302 | 1.671 | 1.783 | 1.661 |
| | (2.85)*** | (2.69)*** | (2.29)** | (2.45)** | (2.62)*** | (2.97)*** |
| logeduc | -0.062 | 0.368 | 0.080 | 0.515 | 0.420 | -0.411 |
| | (0.21) | (1.15) | (0.29) | (1.68)* | (1.32) | (0.95) |
| logage | 1.792 | 0.687 | 1.616 | 0.617 | 0.717 | 1.562 |
| | (1.56) | (0.53) | (1.42) | (0.49) | (0.55) | (1.33) |
| trend | -0.284 | -0.201 | -0.338 | -0.255 | -0.213 | -0.313 |
| | (1.66)* | (0.96) | (2.05)** | (1.44) | (1.08) | (1.70)* |
| Constant | 13.562 | 14.912 | 14.572 | 15.487 | 15.148 | 17.211 |
| | (1.63) | (1.67)* | (1.93)* | (1.97)** | (1.71)* | (1.83)* |
| Observations | 363 | 289 | 391 | 322 | 289 | 297 |
| R-squared | 0.69 | 0.69 | 0.70 | 0.71 | 0.69 | 0.69 |
| Fixed effects | ISIC 1-digit | ISIC 1-digit | ISIC 1-digit | ISIC 1-digit | ISIC 1-digit | ISIC 1-digit |

Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

logaltW is a simple average of all wages within 1-digit ISIC sector

Figure 9: Alternative measures of tariff levels

*Notes:*

DEPENDENT VARIABLE: LN of employment (logemploy)

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| logaltW | -0.536 | -0.212 | -0.244 | -0.381 | -2.794 | -2.299 | -2.895 |
| | (1.04) | (1.25) | (1.47) | (2.14)** | (9.21)*** | (7.52)*** | (8.24)*** |
| logcpi | 1.650 | 0.549 | 0.644 | 0.728 | 2.390 | 1.939 | 2.584 |
| | (1.98)** | (1.79)* | (1.94)* | (2.34)** | (2.50)** | (1.90)* | (2.47)** |
| tariff_wnJT | 1.995 | 0.044 | | | 2.264 | | |
| | (5.04)*** | (0.41) | | | (5.66)*** | | |
| tariff_nDNP | | | -0.058 | | | 1.358 | |
| | | | (0.21) | | | (1.87)* | |
| tariff_long | | | | -0.000 | | | 0.024 |
| | | | | (0.03) | | | (4.86)*** |
| woman | 1.625 | 0.191 | 0.106 | 0.248 | 3.212 | 3.083 | 3.049 |
| | (2.85)*** | (0.27) | (0.16) | (0.32) | (5.12)*** | (4.00)*** | (4.44)*** |
| logeduc | -0.062 | 0.252 | 0.275 | 0.463 | 0.932 | 1.089 | 0.783 |
| | (0.21) | (1.19) | (1.28) | (1.51) | (2.56)** | (2.91)*** | (1.54) |
| logage | 1.792 | -1.088 | -1.009 | -0.840 | -0.902 | -2.294 | -1.181 |
| | (1.56) | (1.68)* | (1.54) | (1.36) | (0.70) | (1.50) | (0.84) |
| trend | -0.284 | -0.076 | -0.102 | -0.115 | -0.422 | -0.331 | -0.441 |
| | (1.66)* | (1.20) | (1.50) | (1.79)* | (2.09)** | (1.56) | (2.04)** |
| Constant | 13.562 | 17.542 | 17.549 | 18.698 | 50.051 | 47.565 | 52.817 |
| | (1.63) | (5.62)*** | (5.87)*** | (5.53)*** | (9.51)*** | (9.02)*** | (9.00)*** |
| Observations | 363 | 363 | 322 | 297 | 363 | 322 | 297 |
| R-squared | 0.69 | 0.97 | 0.97 | 0.97 | 0.53 | 0.54 | 0.51 |
| Fixed effects | ISIC 1-digit | ISIC 2-digit | ISIC 2-digit | ISIC 2-digit | NO | NO | NO |

Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

logaltW is a simple average of all wages within 1-digit ISIC sector

Figure 10: Alternative specifications of fixed effects

*Notes:*

DEPENDENT VARIABLE: LN of employment (logemploy)

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| logaltW | -0.536 | | | |
| | (1.04) | | | |
| logaltW_agg | | 0.129 | 0.005 | 0.213 |
| | | (0.23) | (0.01) | (0.33) |
| logcpi | 1.650 | 1.294 | 1.674 | 1.449 |
| | (1.98)** | (1.63) | (2.12)** | (1.64) |
| tariff_wnJT | 1.995 | 1.951 | | |
| | (5.04)*** | (4.97)*** | | |
| tariff_nCEDE | | | 3.206 | |
| | | | (4.96)*** | |
| tariff_long | | | | 0.023 |
| | | | | (4.90)*** |
| woman | 1.625 | 1.620 | 1.318 | 1.640 |
| | (2.85)*** | (2.80)*** | (2.29)** | (2.89)*** |
| logeduc | -0.062 | -0.075 | 0.054 | -0.399 |
| | (0.21) | (0.25) | (0.19) | (0.92) |
| logage | 1.792 | 1.660 | 1.499 | 1.420 |
| | (1.56) | (1.41) | (1.28) | (1.16) |
| trend | -0.284 | -0.217 | -0.271 | -0.232 |
| | (1.66)* | (1.32) | (1.70)* | (1.31) |
| Constant | 13.562 | 5.027 | 7.392 | 5.702 |
| | (1.63) | (0.60) | (0.95) | (0.60) |
| Observations | 363 | 363 | 391 | 297 |
| R-squared | 0.69 | 0.69 | 0.70 | 0.68 |
| Fixed effects | ISIC 1-digit | ISIC 1-digit | ISIC 1-digit | ISIC 1-digit |

Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

logaltW is a simple average of all wages within 1-digit ISIC sector
logaltW_agg is a simple average of all wages in the economy

Figure 11: Economy-wide average wage as the alternative wage

*Notes:*

DEPENDENT VARIABLE: LN of sector wage (logWi)

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| logaltW | 0.664 | 0.662 | 0.608 | 0.555 | 0.512 | 0.505 |
| | (2.52)** | (2.52)** | (3.32)*** | (3.18)*** | (2.81)*** | (2.81)*** |
| logcpi | -0.014 | -0.024 | 0.087 | 0.190 | 0.632 | 0.263 |
| | (0.04) | (0.07) | (0.35) | (0.79) | (1.36) | (1.06) |
| tariff_wnJT | -0.256 | -0.256 | 0.017 | -0.025 | -0.016 | -0.005 |
| | (2.86)*** | (2.80)*** | (0.25) | (0.35) | (0.23) | (0.07) |
| woman | | 0.116 | -0.273 | -0.276 | -0.272 | -0.283 |
| | | (0.92) | (2.21)** | (2.29)** | (2.26)** | (2.31)** |
| logeduc | | | 1.020 | 1.025 | 1.029 | 1.028 |
| | | | (5.46)*** | (5.83)*** | (5.63)*** | (5.75)*** |
| logage | | | | 1.037 | 1.045 | 1.040 |
| | | | | (2.24)** | (2.27)** | (2.25)** |
| trend | 0.001 | 0.003 | -0.027 | -0.054 | -0.182 | -0.081 |
| | (0.02) | (0.05) | (0.53) | (1.09) | (1.42) | (1.50) |
| trend2 | | | | | 0.002 | |
| | | | | | (1.09) | |
| trendapert | | | | | | 0.010 |
| | | | | | | (1.58) |
| Constant | 4.143 | 4.114 | 2.840 | 0.068 | 1.724 | 0.883 |
| | (1.13) | (1.13) | (1.09) | (0.03) | (0.60) | (0.36) |
| Observations | 363 | 363 | 363 | 363 | 363 | 363 |
| R-squared | 0.31 | 0.31 | 0.58 | 0.61 | 0.61 | 0.61 |
| Fixed effects | ISIC 1-digit | ISIC 1-digit | ISIC 1-digit | ISIC 1-digit | ISIC 1-digit | ISIC 1-digit |

Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

logaltW is a simple average of all wages within 1-digit ISIC sector

Figure 12: Effect of the control variables on the coefficients

*Notes:*

DEPENDENT VARIABLE: LN of sector wage (logWi)

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| logaltW | 0.555 | 0.521 | 0.561 | 0.548 | 0.509 | 0.512 |
| | (3.18)*** | (2.68)*** | (3.71)*** | (3.28)*** | (2.64)*** | (2.70)*** |
| logcpi | 0.190 | 0.112 | 0.162 | 0.072 | 0.201 | 0.253 |
| | (0.79) | (0.37) | (0.72) | (0.26) | (0.69) | (0.99) |
| tariff_wnJT | -0.025 | | | | | |
| | (0.35) | | | | | |
| tariff_wnDNP | | -0.400 | | | | |
| | | (1.79)* | | | | |
| tariff_nCEDE | | | -0.036 | | | |
| | | | (0.26) | | | |
| tariff_nDNP | | | | -0.259 | | |
| | | | | (1.19) | | |
| tariff_eff | | | | | -0.098 | |
| | | | | | (1.35) | |
| tariff_long | | | | | | -0.001 |
| | | | | | | (1.33) |
| woman | -0.276 | -0.235 | -0.284 | -0.242 | -0.250 | -0.303 |
| | (2.29)** | (1.80)* | (2.33)** | (1.87)* | (1.95)* | (2.55)** |
| logeduc | 1.025 | 0.931 | 1.048 | 0.970 | 0.942 | 1.159 |
| | (5.83)*** | (4.91)*** | (6.13)*** | (5.16)*** | (5.00)*** | (10.39)*** |
| logage | 1.037 | 1.158 | 1.023 | 1.106 | 1.151 | 1.007 |
| | (2.24)** | (2.29)** | (2.34)** | (2.28)** | (2.26)** | (2.13)** |
| trend | -0.054 | -0.044 | -0.048 | -0.033 | -0.059 | -0.067 |
| | (1.09) | (0.70) | (1.06) | (0.59) | (0.97) | (1.29) |
| Constant | 0.068 | 0.178 | -0.072 | -0.192 | 0.480 | 0.571 |
| | (0.03) | (0.07) | (0.03) | (0.09) | (0.19) | (0.22) |
| Observations | 363 | 289 | 391 | 322 | 289 | 297 |
| R-squared | 0.61 | 0.61 | 0.65 | 0.67 | 0.61 | 0.60 |
| Fixed effects | ISIC 1-digit | ISIC 1-digit | ISIC 1-digit | ISIC 1-digit | ISIC 1-digit | ISIC 1-digit |

Robust t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

logaltW is a simple average of all wages within 1-digit ISIC sector

Figure 13: Alternative measures of tariff levels

*Notes:*