Trade Protection and Industry Wage Structure in Poland

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Abstract

This study examines the impact of Poland's trade liberalization 1994-2001 on the industry wage structure. The data suggest that a worker's industry affiliation explains a substantial amount of variation in a worker's wages, ranging from 5 to 14 percent depending on the years considered. The results indicate that industry affiliation is an important channel through which trade liberalization affects worker earnings—a decrease in industry tariffs is associated with a higher industry wage premium. This result is robust to including year and industry fixed effects, controlling for exports, imports, real effective exchange rates, industry concentration, FDI stock and capital accumulation. This finding is consistent with liberalization increasing competitive pressures, forcing firms to restructure and improve their productivity, which in turn translates into higher profits being shared with workers. In addition, we find that industries more exposed to import competition are also those with higher shares of unskilled labor. However, there is no significant effect of tariff reduction on industry-specific skill premium. Thus, the increased productivity from greater import competition appears to be applicable to all workers, regardless of their skill levels. In sum, we find no evidence of an erosion of wages of the unskilled (i.e., "race to the bottom") from trade liberalization. Given that the poor in Poland are predominantly the unskilled (i.e., those with little education), trade liberalization should be beneficial for the poor.

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Introduction

Rapid trade liberalizations undertaken by many developing and transition countries during the past decade have inspired heated public discussions. Proponents of trade liberalization posit that for developing countries, many of which are small economies with abundant labor, opening would lead to rising wages. They point to the substantial increases in average real wages taking place in open economies in the developing world over the last several decades as evidence that trade does indeed increase demand for the abundant factor – labor in this case – much like the trade theory would predict. Opponents of trade liberalization, on the other hand, speak about the uneven distribution of gains from openness to trade and resulting increases in wage inequality. They also claim that liberalization will lead to a "race to the bottom" in wages, and as a consequence, to impoverishment of workers.

To date there is still little conclusive evidence about the effects of trade liberalization on wages. One shortcoming of the early literature has been the use of average industry wage data, which are assumed to be independent of characteristics of workers in the industry, and the focus on outcomes (e.g., exports, imports, prices) instead of policy measures (e.g., tariffs). Only recently researchers have begun to utilize policy variables (i.e., tariffs) to examine the impact of liberalization on industry wage premiums which measure the portion of wages that cannot be explained by worker's or firm's characteristics but can be explained by a worker's industry affiliation. However, the conclusions of such studies have been mixed. On the one hand, Revenga (1997) and Goldberg and Pavcnik (2004) provide evidence suggesting that trade liberalization erodes wages of workers in previously protected sectors. On the other hand, Pavcnik et al. (2004) find no significant relationship between liberalization and industry wage premium, while Gaston and Trefler (1994) show that liberalization is associated with a higher industry wage premium.

In this paper, we investigate the relationship between trade liberalization and industry wage premium and the association between trade liberalization and industry-specific skill premium to understand how trade liberalization might have affected wages of the unskilled. Since the poor are predominantly unskilled, understanding the channel through which trade liberalization affects wage structures can shed light on trade's linkage to poverty. Unlike existing studies, which are based on the U.S. or Latin American data, this paper focuses on Poland, a Central European country undergoing transition from planned to market economy.

Factor endowments in Poland differ from those in the countries previously examined. The share of population aged 15-75 with college education at 9.2 percent in 1999 is lower than that in the United States, yet unlike many Latin American countries Poland attained universal literacy among the population due to its socialist legacy.

We are interested in the impact of trade liberalization on industry wage premiums and industry-specific skill premium in Poland because they have important implications for income inequality and poverty. Industries have different worker composition, some with higher proportion of skilled labor than others. If trade liberalization erodes industry wage premium, and if tariff reduction is greater in sectors with disproportionate percentage of unskilled labor, then the unskilled could be affected by these two forces leading a greater decline in income. The effect of changes in industry premium on income distribution and poverty is likely to be larger in Poland than in other countries due to the rigidity of its labor market and the slow change in the regional distribution of economic activities (see Table A1 in Appendix III). Thus, they are likely to exacerbate the existing regional disparities in incomes and poverty incidence illustrated in Figure 1. Focus on the return to skill is also very appropriate given the fact that educational attainment is a powerful predictor of poverty status. For instance, while fewer that 0.6 percent of household headed by a person with college education were subject to hard poverty in 2001, the same was true of 12 percent of households headed by an individual with a secondary vocational degree and 18 percent of households whose head had only primary education. As evident from Table 1, the figures for medium poverty were equally striking. Moreover, this pattern persisted throughout the whole period of our study 1994-2001 (Topinska and Kuhl, 2003).

The rigidity of Poland's labor regulations is an advantage in our analysis: with the limited labor mobility across sectors in the short- and medium-term, a worker's industry affiliation is the immediate channel through which trade affects wages. As illustrated in Figure 2, employers in Poland are more restricted in their hiring and firing decisions relative to their counterparts in the United Kingdom, Turkey, Russia, Brazil, Colombia or Mexico, just to name a few. Figure 2 presents the index of hiring and firing flexibility compiled by the Global *Competitiveness Report* (GCR), published jointly by the Geneva-based World Economic Forum and the Center for International Development at Harvard University. It is a country specific measure that quantifies the average response to the survey question: "Is hiring and firing of workers flexible enough?" It takes on the value of 6 for a very flexible labor market and 1 in the case of the most rigid ones.

Since it is based on the views of "business practitioners" in each country, it captures not only laws on the books but also their enforcement. According to this index, Singapore and Hong Kong had the most flexible labor markets while Poland ranked 25th out of 49 countries. In comparison, Singapore and Hong Kong have an index of over 5; United Kingdom, Brazil, Czech Republic, and Russia (among other countries) have an index above 4; the index for Poland is 3.6. A similar picture emerges from Figure 3, which presents the Index on the Flexibility of Individual Dismissal compiled by Djankov et al. (2003). Unlike the GCR Index in the previous Figure, this index is based on the existing regulations rather than their enforcement. In addition to rigid labor markets which hinder worker reallocation across sectors, labor mobility across regions is limited in Poland due to housing shortage and prohibitive rent costs (for evidence see Deichmann and Henderson, 2004, Przybyla and Rutkowski, 2004).

The second advantage of choosing Poland as the subject of our analysis is the fact that the changes in its tariffs can be treated as exogenous, as they were stipulated by the Association Agreement between the European Community and Poland signed in 1991. This agreement predetermined schedule of tariff reductions, which took place during the period of interest 1994-2001. Moreover, as the goal of the agreement was free movement of goods between the two entities and Poland's accession to what is now called the European Union, all tariffs on manufactured products (with the exception of processed food) were brought down to zero by 2001. Poland's trade liberalization was rapid and encompassed a drastic reduction in tariff from over 20 percent in leather manufacturing; and over 15 percent in wood; non-metallic; rubber and plastic products in 1991 to zero within a decade.

Following Goldberg and Pavcnik (2004), we investigate the question of interest in two steps. First, we use the labor force surveys containing detailed workers' and firms' characteristics to construct industry wage premiums for each year during the period 1994-2001. We find that industry wage premiums vary across industries and within industries over time. Industry affiliations also play a significant role in determining the worker's wages—after controlling for worker's and firm's characteristics; they account for between 5 and 14 percent of the explained variation in hourly wages. In the second stage, we form a panel of industries and examine the relationship between industry wage premium and tariff reduction using a specification in first differences. We do so for 23 sectors encompassing manufacturing and services as well as for the subsample of 14 manufacturing sectors.

We find that industries with a greater tariff reduction have higher industry wage premium. This result is robust to including year and industry fixed effects, controlling for exports, imports, real effective exchange rates, industry concentration and capital accumulation. In addition, we find that greater import volume is associated with higher industry wage premium. This result reinforces our finding that a reduction in tariff increases competitive pressures in the liberalizing industry and forcing companies to restructure and improve productivity, which in turn results in the gains being shared with employees. This interpretation is in line with the findings of many studies that established a positive association between trade liberalization and productivity.[1] To further support this interpretation we employ firm level data for the period 1994-2000 to demonstrate that trade liberalization resulted in increased productivity in liberalizing sectors. The robust and significant relationship between a reduction in tariff and an increase in industry wage premium is also consistent with the stylized fact that there is much inefficiency in a planned economy; a sector that is exposed to greater foreign competition during the transition becomes more efficient and productive.

Finally, to shed some light on whether the decline in trade protection affects industry-specific returns to skill, we repeat the exercise outlined earlier but focus on industry-specific returns to college education. Compared to unskilled workers in the same sector, skilled workers do not appear to enjoy additional skill premium over and above the industry wage premium from trade liberalization. Thus, the increase in efficiency in liberalized sectors seems to arise from workers of all skill levels, and we find no evidence of an erosion of wages of the unskilled (i.e., "race to the bottom" in wages) from trade liberalization. Given that the poor in Poland are predominantly the unskilled (i.e., those with little education), trade liberalization should be beneficial for the unskilled.

This study outline is organized as follows. The next section presents some facts on Poland's trade liberalization. It is followed by a description of the empirical strategy and the data employed in the analysis. Then we present the estimation results. The last section concludes.

[1] See Harrison (1994) for Cote d'Ivoire, Krishna and Mitra (1998) for India, Kim (2000) for Korea, Fernandes (2001) for Colombia and Pavcnik (2002) for Chile.

Trade Liberalization in Poland

In September 1989 Poland's first non-communist government since the end of World II assumed power, taking over the economy with a large budget deficit and a triple-digit inflation. On January 1, 1990 the government implemented a bold reform program ("Balcerowicz plan") aimed at stabilizing the economy, beginning the process of economic liberalization and privatization. During the initial period of transition (1990-91) Poland experienced a deep recession, followed by a strong recovery with the average annual growth rate of GDP equal to almost 5 percent during the 1992-2000 period.

Transition to a market economy completely revolutionized Poland's international trade. The country moved from a centrally-planned system of exports and imports conducted by state trading agencies under the arrangements of the Council for Mutual Economic Assistance to a free market where local producers suddenly become subject to the forces of competition. In 1991 trading under the Council for Mutual Economic Assistance collapsed and in December of the same year Poland signed an Association Agreement with the European Community, which was a prelude to its future membership in the European Union (EU). In July of 1995 Poland joined the World Trade Organization. Severe recessions in Poland's traditional export markets coupled with lowering of tariffs in Western European countries resulted in massive reorientation of Polish international trade from East to West.

The Association Agreement signed by Poland (and other Central and Eastern European countries) stipulated asymmetric phase-out of import tariffs with the goal of free trade in industrial goods by the end of 1999. As a result, in 1999 the average Polish tariff on imports from the EU, the European Free Trade Association (EFTA) and Central European Free Trade Agreement (CEFTA) countries was brought down to 6.5 percent, as compared to the Most-Favored-Nation (MFN) rate of 15.6 percent and the 34.6 percent rate applied to non-WTO members. The rapid liberalization of trade in manufacturing products was not, however, accompanied by similar changes in agricultural goods. While in 1999, the simple average applied MFN rate on manufacturing products was equal to 11.1 percent, the corresponding figure for agriculture was 34.2 percent. The differences largely reflect the tariffication of variable levies agree by Poland during the Uruguay Round. Because Poland was a non-market economy for the base years of 1986-88, selected in the Uruguay Round for estimating tariff equivalents of non-tariff barriers prohibited on agricultural products, Poland applied the generally much higher

EU tariff rates as the basis for tariffication, and thus considerably increased its protection of the agricultural sector (WTO 2000).

Figure 4 shows the reduction in sectoral tariffs applied to imports from the European Union and from the world, respectively, between 1994 and 2001. The largest reduction of 23 percentage points was observed in leather and leather products, followed by a 15-percent-point or higher reductions in other non-metallic products; rubber and plastic products; wood and wood products; and other manufacturing. The smallest change was registered in tariffs on electricity and natural gas, which were low to begin with. By 1999 all industrial products from the EU with the exception of food, beverage and tobacco products, motor vehicles and petroleum were entering Poland duty free; however, imports from the world were still subject to positive tariffs. As of 1999, about three-quarters of Poland's exports and imports were conducted under preferential trading arrangements and thus subject to preferential tariffs.

As detailed in Appendix I, the Association Agreement predetermined the speed and extent of trade liberalization which allows us to treat tariff changes as exogenous. Since many agricultural products and processed foods, beverages and tobacco were excluded from the liberalization specified in the agreement and/or remained subject to quantitative restrictions, we will not include them in the analysis.

Related Literature

The theoretical context for our analysis is provided by the specific factors model. The model focuses on the short-run and assumes that factors of production are immobile across sectors. Given the rigidities present in Poland's labor market, this model constitutes a suitable basis for thinking about the relationship between trade and wages in the Polish context. The model predicts a positive association between protection and industry wages. Protection reduces imports and reduced imports increase labor demand, which in turn increases wages. This mechanism raises wages in the protected industry relative to the economy-wide average wage. A second channel through which trade and protection affect wages is imperfectly competitive factor markets. For example, unions may extract part of the rents from protection in the form of more jobs rather than higher wages. Unionization is not a material issue in our analysis because it has become very weak during the transition. Trade union density in Poland has dropped from

80 percent of the workforce in the 1980s to 14 percent in 2002. The highest trade union density can be observed in mining (43.8 percent), and non-tradable sectors such as transport (27.3 percent), and education (27.5 percent) (Boeri and Garibaldi, 2003).

A third channel through which trade and protection affect wages is imperfectly competitive product markets. Trade and protection affect the strategic interaction between firms that will affect firm performance and wages. For example, if trade protection promotes entry into an industry by enhancing the profitability of existing firms, and if new entrants face setup costs, then protection promotes inefficient entry and raises average production costs (Horstmann and Markusen, 1986).

The second strand of literature particularly relevant to a transition economy, like Poland, which until 1990 was heavily protected and not subject to market forces and competition, is the literature on trade liberalization and productivity. The increase in trade protection and its associated inefficiency and lower productivity can be found in the literature using the computable general equilibrium models (for example, Cox and Harris, 1985; Brown et al. 1992). There is also strong evidence from findings of firm-level studies that reduction in trade protection is associated with productivity improvement. The competition effect from imports has been documented by many empirical studies (Roberts and Tybout, 1997). For instance, Pavcnik (2002) finds that the productivity of plants in the import-competing sectors grew 3-10 percent more than in the non-traded goods sector during trade liberalization in Chile, suggesting that exposure to international competition forces previously shielded plants to improve their performance. Fernandes (2003) demonstrated that trade liberalization in Colombia has increased plant-level productivity, primarily through gains in within-plant productivity. Other studies include Harrison (1994) for Cote d'Ivoire, Krishna and Mitra (1998) for India, Kim (2000) for Korea, and Hay (2001) for Brazil.

Data and Methodology

Labor Force Survey (LFS)

The analysis is based on the data collected through the Polish Labor Force Survey (LFS). The survey has been conducted four times each year since the fall of 1992, and we have access to selected quarters of the surveys during the period 1992-2001. Unfortunately, it is not possible to

employ all eleven years in the analysis as in the 1992 and 1993 surveys, there was no distinction among various manufacturing sub-sectors. Thus, our analysis covers the period of 1994 through 2001. We use the second quarter of years 1993 through 2001, except in years 1999 and 2001, for which only information for the first quarter was available.

The survey sample is representative of the country's population. Sampling for the LFS follows the two-stage household sampling. First, the stratification is based on voivodships (administrative districts), and primary sampling units are sampled from each strata with diversified sampling probability, proportional to the number of households in a primary sampling unit. Second, a determined number of households are selected randomly from each primary sampling unit, depending on the size of primary sampling units. For example, 8 households are sampled from primary sampling units from rural municipalities, and 5 households are sampled from primary sampling units from large cities.

Between 1993 and 1998, the sample was interviewed only in the middle month of the quarter whereas since 1999, a uniform number of randomly selected households was interviewed in every week of the 13 weeks throughout the quarter. In each quarter about 24 thousand households are interviewed, amounting to about 40 thousand individuals sampled. Members of households above aged 15 are asked questions on their employment status, type of employers, sector of employment, monthly earnings, weekly hours worked, and personal characteristics. Unfortunately, wage information on self-employed is not available as questions about earnings are not asked to the self-employed. Employees make up about 70 percent of the sample in the Survey, and self-employed, another 25 percent, and the remaining 5 percent are unpaid family workers. Employment sectors are classified according to a variant of the European NACE classification system, which includes 34 sectors, 14 of which pertain to manufacturing activities.

Empirical Framework

The analysis proceeds in two stages. The first stage consists of estimating a wage equation with the real hourly wages being the dependent variable. The real hourly wage is calculated by deflating the reported monthly wage to 1992 zlotys using the Consumer Price Index from the IMF's *International Financial Statistics* and dividing it by the number of hours worked in the reporting week multiplied by the number of weeks (4.2). Our sample is restricted

to employed individuals of ages 15-75 inclusive, and we estimate the wage equation (1) separately for each year,

$$\ln w_{ijt} = X_{ijt}\beta_t + I_{ijt} * wp_{jt} + \varepsilon_{ijt} \quad (1)$$

where $\ln w_{ijt}$ is the log of real wages of worker i, in industry j, of year t. X_{ijt} is the vector of worker characteristics that include, age, age squared, marital status, sex, education attainment, occupation; geographic variables such as region dummies, city size; and industry affiliation (I_{ijt}). The coefficients of the vector of industry indicators are the industry wage premium which capture the variation in wages that cannot be explained by worker's characteristics.

As suggested by Haiskel-DeNew and Schmidt (1997), we normalize the wage premiums as deviations from the employment-weighted average wage premium using their two-step restricted least squared procedure. This normalized wage premium will be the proportional difference in wages for a worker in a given industry relative to an average worker in all industries with the same observable characteristics. This normalized wage differentials and their exact standard errors are calculated. In the second stage, we pool the vectors of industry wage premiums and tariffs for all years, and estimate a model relating first differences in industry wage premium to annual change in tariffs and control variables such as year and industry fixed effects as well as other industry-specific variables:

$$\Delta premium_{jt} = \delta \Delta tariff_{jt} + \gamma D_{jt} + \nu_{jt} \quad (2)$$

Since the industry wage premium is estimated, it is measured with error. It does not affect the consistency of the second-stage coefficients as long as the measurement error is uncorrelated with the independent variables. Nevertheless, we can improve the efficiency of the second-stage estimates by running a weighted least-squares using the inverse of the standard error of the wage premium estimates from the first stage (computed using the Haiskel-DeNew-Schmidt procedure) as weights. We will also take into account of general forms of heretoskedasticity and serial correlation in the error terms of equation (2) by computing robust (Huber-White) standard errors clustered by industry.

For each industry and time period, we use the simple average tariff vis-à-vis the European Union and also the simple average tariff vis-à-vis the world. We experiment with trade-weighted average tariffs and the results are similar to those of the simple averages. Thus, we present only the results pertaining to the simple averages of tariff rates applied to imports from the European Union and from the world.

Our approach allows us to control for individual worker's characteristics in estimating the industry wage premium, which is the variation of wages due strictly to a worker's industry affiliation. Moreover, this permits us to take into consideration changes of worker composition in the industry and returns to any worker characteristics overtime. On the other hand, unobserved worker's characteristics (e.g., motivation, ability, good work ethics etc) can still affect both wages and industry selection. As long as these unobserved characteristics are uncorrelated with trade policy, they will be eliminated in our first-differences.

We also control for additional variables in our second stage regressions in an attempt to eliminate potential omitted variable bias. We include such controls as the Herfindahl Index that measures concentration in the industry, lagged capital accumulation in the industry, lagged stock of foreign direct investment into the sector, lagged sector imports and exports, and real effective exchange rate. We introduce lagged variables instead of contemporaneous ones to avoid potential simultaneity bias.

Descriptive Statistics

Before proceeding to the empirical results, we briefly discuss the summary statistics. As presented in Table 2, the average age of workers in our sample was 56 in 1994 and increased steadily to 59 years in 2000. However, there was a sharp drop in 2001, with the average age equal to only 39 years. Average hours of work remained quite steady at about 41 hours throughout the period, with the exception of 2001 when a slight decline to 39 was registered. About three quarters of workers in our sample are married, and females constitute less than half (45-47 percent) of the sample throughout the period. In 1994, only 24 percent of workers were employed in the private sector but increased to 49 percent by 2001. Throughout the second half of the 1990s, almost all employed (97 percent) considered their jobs permanent, but in 2001 this figure dropped to 88 percent. The real average hourly wage increased by about 50 percent between 1994 and 2001.

As for the educational attainments, they have increased during the period considered. The proportion of workers with primary school education or less fell from 13.7 percent to 10.5 percent. The shares of workers with general secondary education or vocational education have remained constant at 7 percent and 35 percent, respectively. The percentage of workers with

tertiary education rose—the share of those with university degrees increased from 12 to 15 percent.

Table 3 presents the distribution of labor across industries in each year during the 1994-2001 period. The figures reflect structural changes taking place in the economy during this period, namely a fall in the agricultural and mining employment and a rise of services sectors which until 1990 had been underdeveloped. As for the latter, a particularly strong expansion was observed in wholesale and retail trade (43 percent growth), hotel services (71 percent growth); financial, banking and real estate services (at 43 percent). Employment in manufacturing industries remained relatively stable with the exception of plastic and rubber products which registered a 89 percent growth whereas machinery has contracted, halving its share.

The changes in the economic structure have also affected the role of unions in Polish economy. Mining and machinery sectors used to be industries with strong union presence, but the large fall in employment in these industries contributed to erosion of unions in Poland, as was the case in many other European countries where sectors with highest number of union members had contracted (Boeri and Garibaldi (2003)). Unionization has also become weaker because of privatization and the increase in the number of smaller enterprises. Historically, 100 percent of large state-owned enterprises (250+ employees), and 75 percent of medium-sized state-owned enterprises (50-250 employees) had two or more unions. But after privatization, only 5 percent of large private companies have unions. Unions are virtually absent in newly created small private companies (Gardawski et al., 1998). Thus, unionization is not a significant force in Poland during the period of our analysis.

Within each industry, we observe changes in the composition of labor force. As illustrated in Table 4, which presents the share of unskilled workers in each industry, with the exception of the paper and pulp manufacturing and social and communal services sector where there have been increases in the shares of unskilled workers, the other industries registered declines of different magnitudes. Sectors such as construction, agriculture, wood product manufacturing and textile manufacturing experienced a limited fall (3-5 percent) in the shares of unskilled workers whereas industries such as banking and financial services; rubber and plastic product manufacturing observed larger declines (44 percent, and 57 percent, respectively) overtime.

Figure 5 shows that sectors with higher proportion of unskilled workers experienced a greater reduction in import tariffs between 1994 and 2001. The correlation between unskilled labor share and the change in tariff is –0.644. The sector with the greatest decrease (23 percent) in average tariff vis-a-vis the European Union is the leather manufacturing in which the shares of unskilled labor were 22 percent and 17 percent in 1994 and 2001, respectively. In contrast, machinery and equipment industries had the smallest decrease (8 percent) in tariff and the shares of unskilled labor were 11 percent and 5 percent in 1994 and 2001, respectively.

Table 5 presents the skill premium, defined by the ratio of wages of workers with tertiary education relative to wages of workers with primary or less schooling, for each industry. Between 1994 and 2001, some industries observed increases in the skill premium whereas others have experienced decline. The correlation between the evolution of the unskilled labor share in the industry and the skill premium is low (0.25). While banking and financial services experienced a significant fall (of 22 percent) in the share of unskilled labor and an increase of 67 percent in the skill premium, in the rubber and plastic product manufacturing which also observed a fall of 30 percent in the share of unskilled labor the skill premium went up (by 31 percent).

Empirical Results

As mentioned earlier, our analysis proceeds in two steps. In the first step, we estimate a wage equation for each year separately and present the results in Table 6. We find that returns to education increase with successively higher attainment (note that the omitted category is a 5-year university degree or higher). As expected, the data indicate that older workers, married individuals and males earn more. Wages also increase with the size of the city (the omitted category is city with population above one million). A worker's industry affiliation explains a substantial amount of variation in a worker's wages, ranging from 14 percent in 1995; 10 percent in 1994 and 1997; 12 percent in 1996; over 7 percent in 1998-2000 to 5 percent in 2001. As reflected in Table 7, there is a significant variation across and within industries in terms of the industry wage premium. For example in 1994, the industry wage premiums ranged from -0.103 to 0.223. Over time some industries registered a decline (e.g., wood products) while other saw an increase in the premium (e.g., machinery).

Tariffs and industry wage premium

Moving on to the second stage regressions, Table 8 presents the estimates of the effect trade protection has on industry wage premium. The estimates come from the weighted least squares regressions on first differences. The standard errors are adjusted for clustering on industries. We begin with the sample encompassing all sectors, i.e., manufacturing (except for the food, beverage, tobacco sector excluded because of the concerns regarding non-tariff barriers and tariffs not being predetermined), electricity and services. In the case of services, all tariffs have been set to zero. In the top panel, we present the results using the simple average of import tariffs in a given industry vis-à-vis the European Union. We find that a reduction in tariffs increases the industry wage premium and the effect is significant at the 5 percent level. The result is robust to controlling for year and industry fixed effects. Year fixed effects will absorb economy wide shocks that may affect wages. Industry dummies will control for other factors that influencing growth or decline in the premium of a given industry, such as for instance, technological progress, taxation policy, decline in union power, etc. In the last specification, we include the lagged value of Herfindahl index, which captures industry concentration. The index is calculated based on firm level data from the Amadeus database, described in Appendix II. It is worth noting that the inclusion of additional controls increases the size of the tariff coefficient. In the bottom panel, we present results employing tariffs vis-à-vis the world. The results are very similar to those found in the top panel in terms of sign, magnitude and significance level.

As a robustness check, we also estimate the industry wage premiums with additional control related to workplace, i.e., dummies for firm size categories and firm ownership types (public, private, cooperative) in the first stage. The second stage results based on these alternative estimates are presented in Table 9. Given the similarity to the estimates presented in Table 8, in subsequent tables we only present the results from the more parsimonious specification.

Since one may be concerned about including services sectors in the analysis, next we estimate the second stage based on a restricted sample of only manufacturing sectors and electricity production. The results presented in the first three columns of Table 10 confirm our earlier findings. Column (1) shows that higher trade protection is associated with lower industry wage premium, controlling for the concentration in the industry. When we put in additional year

dummies, the relationship between tariff and industry wage premium is still significantly negative (Column (2)). However, once we include both the year and industry fixed effects, the negative relationship between tariff and industry wage premium is no longer significant for the tariff vis-à-vis the European Union but is still significantly negative for the tariff vis-à-vis the world (Column (3)).

As yet another robustness check, we add to the specification the lagged value of imports and exports as well the real effective exchange rate. In the regressions using tariffs on imports from the EU we employ trade figures pertaining to the EU. When the tariff data pertain to the world is used, we employ the trade measures vis-a-vis the world. Trade data come from the UN COMTRADE database and the real effect exchange rates are taken from the IMF's *International Financial Statistics.* In column (4), we control for industry concentration and imports in the sector. As before tariffs are negatively associated the with industry wage premium. Moreover, imports also have a significantly positive effect on industry wage premium which reinforces the relationship between trade protection and industry wage premium. In other words, lower barriers to trade, as captured by lower tariffs or higher imports, are associated with higher industry premiums. In columns (5) and (6), we include exports volume in the sector and the real effective exchange rates. While the additional controls are not statistically significant, the relationship between tariff, imports and industry wage premium still holds. Thus, in Poland, lower trade protection and therefore, greater import competition brings about *higher* industry wage premium and in parallel, greater import volume is associated with *higher* industry wage premium. These findings are consistent with those of Gaston and Trefler (1994) based on cross sectional data for the U.S.

So far our specifications have controlled for unobserved time-invariant industry characteristics (through first differencing) and time trend in industry wage premiums (through inclusion of industry fixed effects in the first differenced specification). To address the concern that there may be other time-varying factors affecting industry premiums, we experiment with additional controls, such as, capital accumulation, stock of foreign direct investment (FDI) and the share of unskilled labor. All three controls vary by time and are industry specific. The figures on capital accumulation come from various issues of the Polish Statistical Yearbooks, FDI data from Foreign Trade Research Institute (various issues) and the shares of unskilled labor are calculated based on the Labor Force Survey. All three controls are entered as first lags.

Additionally, in all specifications we include the lagged value of industry concentration (Herfindahl) index. Results using tariffs vis-à-vis the European Union are presented in the top panel of Table 11 and those using tariffs vis-à-vis the world are in the bottom panel. In column (1), controlling for capital accumulation and industry's concentration, we find that a greater reduction in tariffs is associated with a higher industry wage premium. Also, higher capital accumulation is associated with higher industry wage premium. In column (2), we control for industry's concentration and FDI stock in the sector, and similarly we find a negative and significant relationship between tariffs and industry wage premium. However, FDI stock does not appear to have a significant effect on industry wage premium. In column (3), we control for capital accumulation, foreign direct investment, industry's concentration, and the share of unskilled labor. The effect of tariff on industry wage premium is still negative, although significant only at the 10 percent level. Columns (4) through (6) show that the results still hold in addition to controlling for industry dummies.

In Table 12, we repeat the last exercise on the restricted sample (manufacturing sectors plus electricity). Similar to results for all sectors, we find that trade protection is negatively associated with industry wage premium. In this case, the greater the share of unskilled labor is in a sector, the higher the industry wage premium. When we include the industry indicators in addition to the year dummies, the effect of tariff on industry wage premium is still negative but only significant at the 10 percent level. The lower significance is not surprising, given the fact that since the additional control are not available for all industry-year combination, these regressions are based on a lower number of observations than those in the earlier tables.

Tariffs and industry specific skill premium

We now turn to the results on trade liberalization and industry-specific skill premium. There are several reasons to expect that industry wage premiums may differ across workers with different educational attainments. For instance, mobility of workers across sectors most likely depends on their education, skill and sector specific human capital. Worker's mobility will in turn affect the ability to bargain over wages or the share of the industry rents. It's also very likely that monitoring of workers also differs by workers' tasks, and different industries face different monitoring costs.

We follow Pavcnik et al. (2004) and modify equation (1) above to include the industry-specific skill premium that captures the additional returns to university education, on top of the industry wage premium enjoyed by all workers in the industry and the economy wide returns to education:[2]

(1') $$\ln w_{ijt} = X_{ijt}\beta_t + I_{ijt} * wp_{ijt} + I_{ijt} * S_{ijt} wp_{Sjt} + \varepsilon_{ijt}$$

S_{ijt} is a dummy for worker *i* in industry *j* with university education at time *t*. The coefficient wp_{Sjt} captures the additional industry wage premium that accrues to workers with university education over and above the industry wage premium for all workers represented by wp_{jt}. As in the case of industry wage premiums, we use the Haisken-DeNew and Schmidt (1997) procedure so that the industry-specific skill premium can be interpreted as the proportional differences in wages for a university educated worker in a given industry relative to an average university educated worker in all industries with the same observable characteristics.

Table 13 presents the relationship between trade protection and industry-specific skill premiums estimated using weighted least squares and first-difference specification on the subsample of manufacturing sectors. Including year dummies, we find that a reduction in tariffs is associated with a positive and significant increase in industry specific skill premium, with controls for industry concentration, trade exposure measures and the real effective exchange rate (columns (1) through (3)). However, once we also include industry dummies, we no longer find a significant relationship between tariff reduction and industry specific skill premium (columns (4) through (6)) .

In summary, our results suggest that contrary to the fears about 'race to the bottom' in wages, tariff reductions can be associated with increases in industry premiums in the liberalizing sectors. This is consistent with liberalization increasing competitive pressures in the industry and thus forcing firms to restructure and improve their productivity. This argument is in line with results of many firm-level studies, cited earlier, which find that trade liberalization leads to higher productivity. This channel is even more plausible in the context of a transition economy, like Poland, where local firms were sheltered from any kind of competition until 1990. To provide further evidence on the plausibility of this channel, we use firm level data for the same period to demonstrate that trade liberalization led to higher total factor productivity in Polish firms. To make this exercise as comparable as possible to the industry premium results we use

[2] Unlike Pavcnik et al. (2004) we allow the economy wide returns to education to differ across years.

the same aggregation of industries and a comparable time period (1994-2000). Full details are provided in Appendix II.

Conclusions

Our results indicate that industry affiliation plays quite a substantial part in explaining variation in a worker's wages. Even after controlling for worker's and firm's characteristics, a worker's industry affiliation still accounts for between 5 and 14 percent of the explained variation in log hourly wages. We also find that the returns to a worker's industry affiliation or the industry wage premia are negatively correlated with trade protection. This result is consistent with the argument that reduction in trade protection brings about higher competition from imports, which can enhance worker productivity and industry performance. The increase in efficiency seems to arise from workers of all skill levels, and in particular, those with less education in the manufacturing sector. Reinforcing the results of higher trade protection and lower wages, we find that increases in imports in the sector also increase industry wage premium, holding constant the level of trade protection, exports, industry concentration, and real effective exchange rate. The robust and significant relationship between a reduction in tariff and an increase in industry wage premium is also consistent with the stylized fact that there is much inefficiency in a planned economy; a sector that is exposed to greater foreign competition during the transition becomes more efficient and productive.

In addition, we find that industries that are more exposed to import competition are also those with higher shares of unskilled labor. Compared to their unskilled colleagues in the same sector, we do not find that skilled workers enjoy additional wage premium over and above their industry wage premium from trade liberalization. In another words, reduction in trade protection does not have a significant effect on industry-specific skill premium. Since increases in industry wage premium accrue to all workers regardless of their skill levels in a particular industry, we find no evidence of an erosion of wages of the unskilled (i.e., "race to the bottom") from trade liberalization. Given that the poor in Poland are predominantly the unskilled (i.e., those with little education), trade liberalization should be beneficial for the poor.

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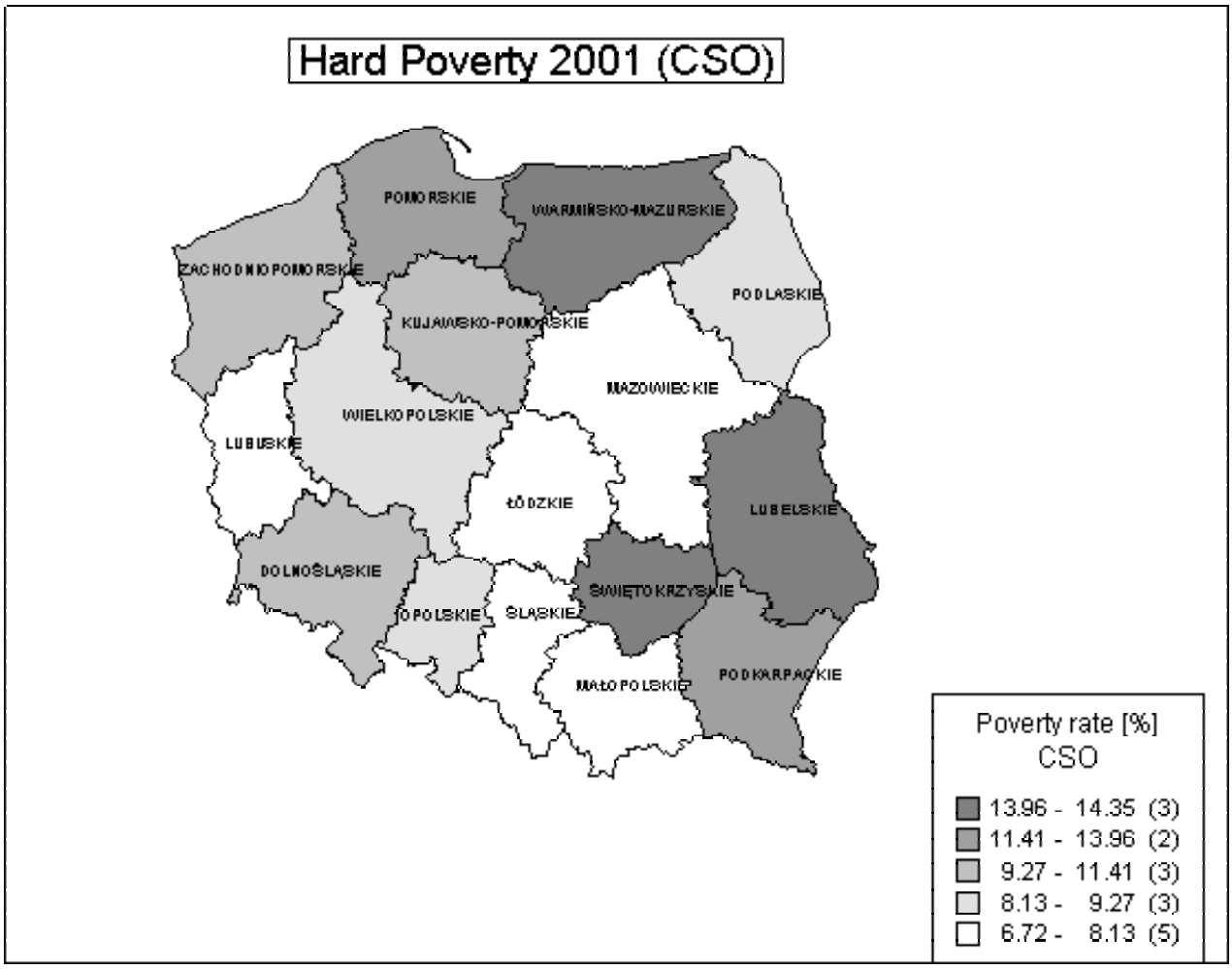
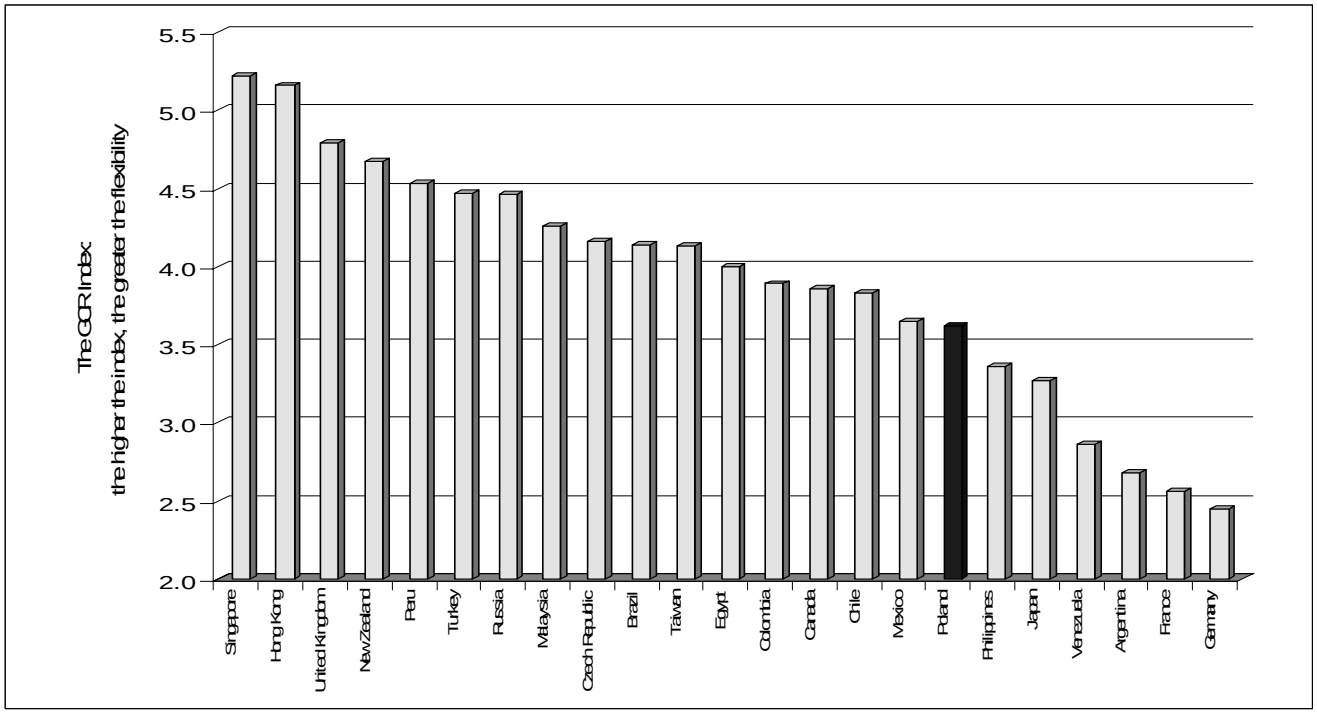
Figure 1. Regional incidence of poverty in Poland in 2001



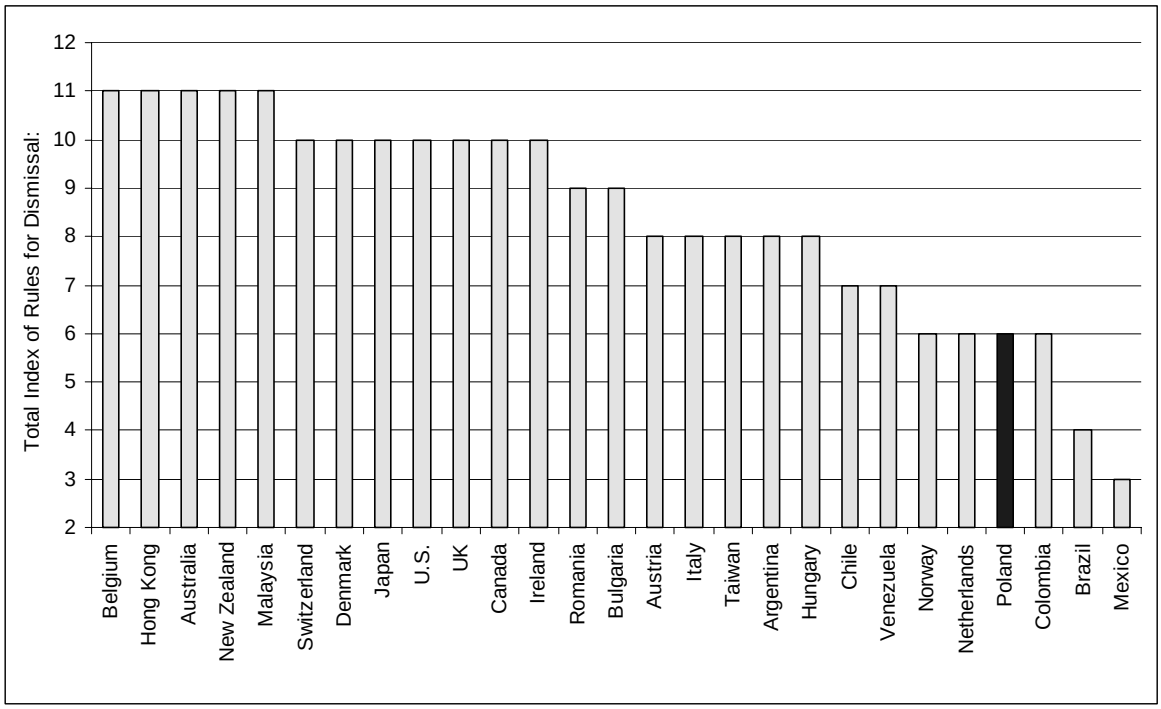
Source: Topinska and Kuhl (2003)

Figure 2. Rigidity of Poland's labor market in international comparison -Index I



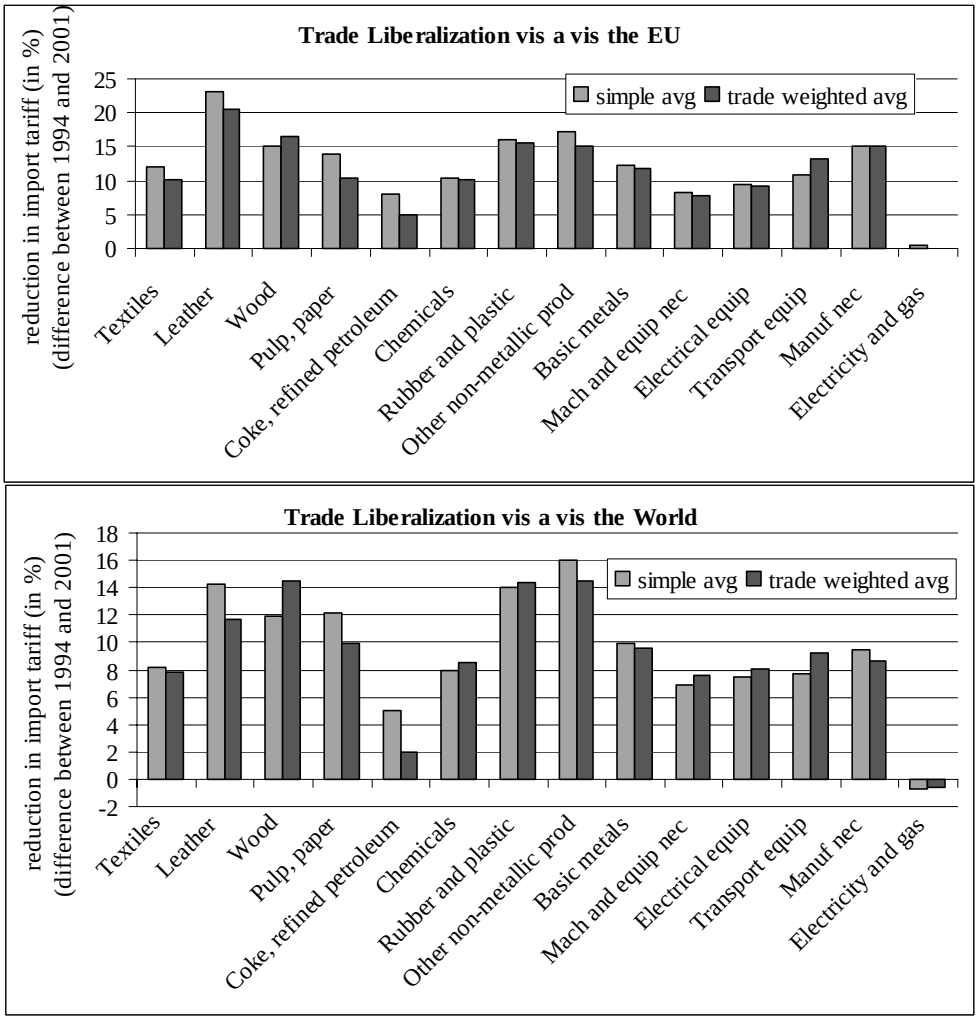
Source: World Economic Forum (1996)

Figure 3. Rigidity of Poland's labor market in international comparison -Index II



Source: Djankov et al. (2003)

Figure 4. Reduction in Poland's import tariffs between 2001 and 1994



Source: World Bank's WITS database

Figure 5. Share of unskilled labor and tariff reduction (1994-2001)

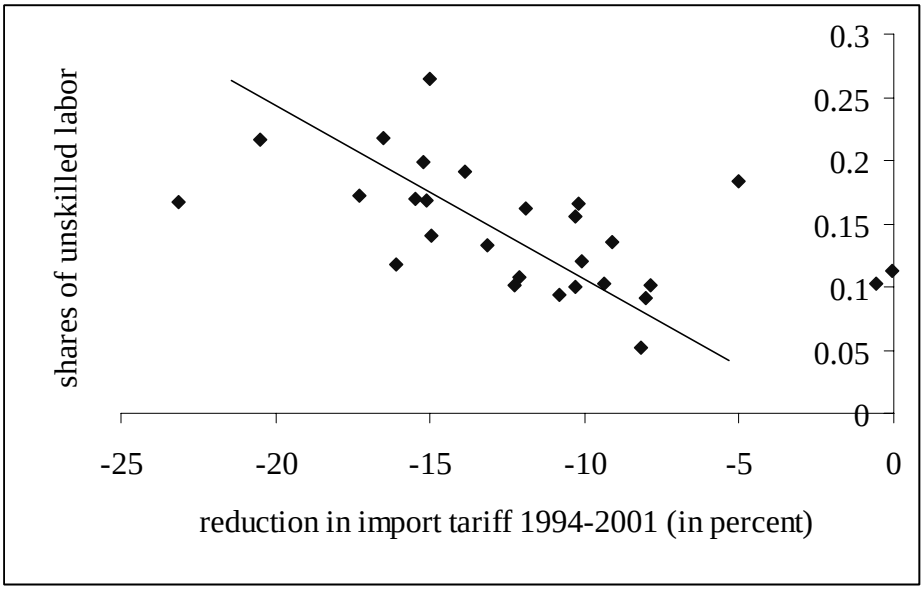


Table 1. Hard and medium poverty in Poland in 2001

	Poverty Headcount (%)	
Education of the hh head	**Hard poverty**	**Medium poverty**
Tertiary	0.57	1.29
Secondary general	3.75	6.96
Secondary vocational	12.16	19.01
Primary	**17.72**	**26.76**
TOTAL	9.60	15.17

Source: Topinska and Kuhl (2003).

Table 2. Summary Statistics

	1994	1995	1996	1997	1998	1999	2000	2001
real hourly wage (in PLN)	1.03	1.05	1.14	1.25	1.32	1.35	1.47	1.49
	[.56]	[.57]	[.64]	[.74]	[.72]	[.79]	[1.0]	[1.1]
age	55.9	56.6	57.2	58.1	58.7	58.9	59.5	39.2
	[9.6]	[9.6]	[9.57]	[9.5]	[9.3]	[9.2]	[8.9]	[10.6]
weekly hours worked	41.6	41.9	41.9	41.9	41.6	41.1	40.5	39.4
	[7.8]	[7.6]	[7.4]	[7.3]	[7.3]	[6.9]	[8.2]	[9.3]
married	77%	77%	77%	78%	79%	80%	81%	74%
female	45%	46%	46%	45%	46%	46%	46%	47%
working in private sector	24%	27%	30%	34%	37%	38%	41%	49%
current job is non-temporary	97%	97%	97%	97%	98%	97%	97%	88%
Highest level attained (% by categories)								
primary or less	13.73	13.62	12.94	11.94	11.1	11.24	10.46	10.53
general secondary	7.51	7.34	6.81	6.48	6.45	6.30	6.22	7.18
basic vocational	35.62	35.30	35.37	35.96	35.66	34.94	34.92	35.15
2-yr-college or secondary vocational	30.93	31.41	31.68	32.37	32.67	32.83	32.07	32.28
University	12.22	12.34	13.20	13.25	14.11	14.71	16.33	14.86
Size of City (% by categories)								
100,000 or more people	33.28	32.03	31.4	30.16	29.16	29.04	27.72	28.73
less than 100,000 people	35.78	37.19	38.66	38.96	38.11	38.41	40.14	38.54
village	30.94	30.78	29.95	30.88	32.73	32.56	32.14	32.72
Num of observations	15,509	15,798	15,056	14,623	14,312	12,594	9,206	10,650

Notes:
[..] denotes standard errors. The sample is restricted to those between 15-75 year-old, employees only.

Table 3. Distribution of employment by industries, 1994-2001

	1994	1995	1996	1997	1998	1999	2000	2001
Agriculture, fishery	0.044	0.037	0.033	0.032	0.033	0.032	0.029	0.024
mining	0.047	0.044	0.039	0.036	0.036	0.032	0.025	0.021
manufacturing *of which*								
food, beverage, tobacco	0.053	0.054	0.055	0.053	0.052	0.054	0.051	0.052
textile	0.041	0.046	0.042	0.042	0.042	0.040	0.039	0.037
leather	0.008	0.008	0.007	0.008	0.008	0.006	0.006	0.006
Wood	0.019	0.017	0.017	0.020	0.018	0.018	0.018	0.025
paper products	0.009	0.010	0.010	0.010	0.011	0.010	0.010	0.012
petroleum	0.004	0.004	0.003	0.003	0.003	0.004	0.002	0.003
chemical	0.014	0.013	0.017	0.014	0.012	0.013	0.014	0.012
rubber/plastic	0.007	0.007	0.008	0.009	0.010	0.011	0.011	0.014
non-metallic	0.016	0.017	0.018	0.018	0.014	0.013	0.016	0.015
metal	0.038	0.040	0.039	0.035	0.035	0.036	0.034	0.034
machinery	0.027	0.028	0.024	0.025	0.022	0.023	0.023	0.017
electrical appliances	0.014	0.012	0.014	0.014	0.013	0.013	0.014	0.017
transport equipment	0.019	0.018	0.019	0.021	0.020	0.018	0.016	0.016
other manufacturing	0.018	0.015	0.017	0.017	0.017	0.015	0.014	0.020
Services *of which*								
Utilities	0.025	0.028	0.029	0.027	0.025	0.023	0.027	0.026
Construction	0.077	0.072	0.068	0.074	0.077	0.076	0.079	0.072
Wholesale and retail trade;	0.094	0.101	0.101	0.100	0.108	0.109	0.108	0.134
Hotels and restaurants	0.012	0.013	0.013	0.013	0.012	0.012	0.012	0.020
Transport, and communication	0.073	0.078	0.074	0.080	0.080	0.074	0.076	0.072
Financial, real estate and business activities	0.045	0.051	0.057	0.052	0.055	0.062	0.058	0.064
Public administration;	0.066	0.066	0.072	0.073	0.072	0.068	0.074	0.070
Education, health and social work	0.188	0.183	0.194	0.194	0.192	0.207	0.209	0.185
Other community, social and personal service activities	0.044	0.038	0.030	0.032	0.032	0.033	0.033	0.032
All sectors	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 4. Share of unskilled labor (workers with primary or less schooling), by industries 1994-2001

	1994	1995	1996	1997	1998	1999	2000	2001
Agriculture, fishery	0.335	0.357	0.346	0.309	0.336	0.323	0.313	0.283
mining	0.140	0.141	0.121	0.105	0.114	0.094	0.113	0.104
manufacturing *of which*								
food, beverage, tobacco	0.191	0.182	0.194	0.169	0.159	0.154	0.130	0.158
textile	0.166	0.138	0.147	0.143	0.129	0.129	0.161	0.108
leather	0.217	0.200	0.190	0.179	0.129	0.135	0.180	0.167
Wood	0.218	0.204	0.223	0.174	0.156	0.230	0.211	0.199
paper products	0.156	0.154	0.142	0.149	0.116	0.096	0.228	0.191
petroleum	0.183	0.197	0.137	0.128	0.146	0.125	---	0.091
chemical	0.120	0.162	0.191	0.159	0.124	0.120	0.113	0.100
rubber/plastic	0.169	0.168	0.258	0.234	0.134	0.183	0.073	0.118
non-metallic	0.265	0.237	0.199	0.230	0.209	0.199	0.185	0.172
metal	0.162	0.152	0.150	0.132	0.120	0.132	0.096	0.101
machinery	0.101	0.107	0.076	0.059	0.060	0.086	0.074	0.052
electrical appliances	0.135	0.127	0.108	0.081	0.090	0.125	0.114	0.103
transport equipment	0.133	0.122	0.102	0.098	0.105	0.092	0.083	0.094
other manufacturing	0.168	0.148	0.174	0.156	0.133	0.104	0.109	0.140
Services *of which*								
Utilities	0.113	0.143	0.125	0.109	0.097	0.086	0.096	0.102
Construction	0.163	0.171	0.153	0.167	0.151	0.153	0.153	0.149
Wholesale and retail trade;	0.088	0.090	0.092	0.075	0.083	0.078	0.068	0.080
Hotels and restaurants	0.147	0.212	0.158	0.119	0.066	0.097	0.125	0.109
Transport, and communication	0.140	0.147	0.135	0.123	0.117	0.122	0.102	0.105
Financial, real estate and business activities	0.086	0.064	0.079	0.075	0.067	0.070	0.048	0.067
Public administration;	0.069	0.054	0.041	0.045	0.042	0.032	0.036	0.036
Education, health and social work	0.106	0.108	0.105	0.100	0.091	0.091	0.079	0.075
Other community, social and personal service activities	0.123	0.139	0.134	0.118	0.116	0.132	0.165	0.173

Table 5. Skill premium (ratio of wages of workers with university education to wages of workers with primary or less schooling) by industries, 1994-2001

	1994	1995	1996	1997	1998	1999	2000	2001
Agriculture, fishery	2.12	1.70	1.96	2.39	2.09	2.04	2.17	2.61
mining	1.66	1.59	1.66	1.71	1.62	1.58	1.40	1.94
manufacturing *of which*								
food, beverage, tobacco	2.22	1.91	2.08	2.58	3.79	2.77	1.76	2.46
textile	2.35	2.29	1.96	1.97	2.11	1.82	1.89	4.68
leather	3.06	1.76	1.35	1.43	0.84	1.99	2.61	1.98
Wood	2.15	1.82	2.43	2.89	1.98	2.31	1.62	2.96
paper products	2.32	1.63	2.11	2.68	3.13	2.07	2.56	2.79
petroleum	1.86	1.23	1.90	2.14	1.95	2.37	---	1.33
chemical	1.99	1.99	2.18	2.26	2.03	1.85	2.40	1.93
rubber/plastic	2.62	2.16	1.95	2.12	2.04	1.61	1.84	1.80
non-metallic	2.77	2.09	2.11	1.51	3.93	2.86	2.20	1.87
metal	1.93	1.89	1.87	2.14	2.00	1.94	1.91	1.88
machinery	2.11	1.93	1.88	2.07	1.93	2.42	2.22	1.84
electrical appliances	1.89	1.89	1.96	2.06	1.70	1.78	1.86	1.98
transport equipment	2.24	1.87	2.11	1.85	1.53	2.23	2.01	2.27
other manufacturing	1.85	1.99	2.44	3.02	1.96	2.15	2.20	3.35
Services *of which*								
Utilities	1.57	1.69	2.23	2.28	1.82	2.13	2.13	2.74
Construction	1.96	1.83	1.82	2.29	2.37	2.18	2.40	2.13
Wholesale and retail trade;	2.07	2.24	2.35	2.66	2.89	2.42	2.12	2.74
Hotels and restaurants	1.66	2.64	1.89	2.21	2.60	1.39	2.85	2.41
Transport, and communication	1.77	1.79	1.91	2.58	2.23	1.96	2.08	2.07
Financial, real estate and business activities	2.00	2.23	2.33	2.61	2.52	2.55	2.86	3.34
Public administration;	2.72	2.30	2.62	2.74	2.65	2.37	2.15	2.35
Education, health and social work	1.82	1.77	1.72	1.77	1.72	1.69	1.91	1.89
Other community, social and personal service activities	2.38	1.72	2.02	2.11	1.97	2.23	1.99	2.61

Table 6. First-stage wage regression, 1994-2001

Dependent variable: log hourly real wage	1994	1995	1996	1997	1998	1999	2000	2001
age	0.0102***	0.0094***	0.0066**	0.0090***	0.0095***	0.0127***	0.0084*	0.0312***
	[0.0029]	[0.0029]	[0.0029]	[0.0032]	[0.0034]	[0.0036]	[0.0048]	[0.0027]
age squared	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0001***	-0.0003***
	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]	[0.0000]
married dummy	0.0678***	0.0565***	0.0507***	0.0397***	0.0428***	0.0401***	0.0363***	0.0460***
	[0.0071]	[0.0071]	[0.0068]	[0.0072]	[0.0072]	[0.0077]	[0.0098]	[0.0101]
female dummy	-0.1218***	-0.1299***	-0.1434***	-0.1478***	-0.1411***	-0.1321***	-0.1344***	-0.1158***
	[0.0068]	[0.0069]	[0.0066]	[0.0070]	[0.0068]	[0.0072]	[0.0092]	[0.0096]
city size [50K – 1million population]	-0.0174	-0.0188*	-0.0387***	-0.0578***	-0.0294***	-0.0431***	-0.0490***	-0.0425***
	[0.0106]	[0.0103]	[0.0097]	[0.0104]	[0.0103]	[0.0113]	[0.0134]	[0.0145]
city [20-50K population]	-0.0323***	-0.0470***	-0.0482***	-0.0560***	-0.0365***	-0.0560***	-0.0702***	-0.0692***
	[0.0094]	[0.0097]	[0.0093]	[0.0099]	[0.0098]	[0.0105]	[0.0125]	[0.0134]
city [10-20K population]	-0.0464***	-0.0740***	-0.0668***	-0.0708***	-0.0489***	-0.0843***	-0.1236***	-0.1021***
	[0.0119]	[0.0115]	[0.0108]	[0.0114]	[0.0115]	[0.0122]	[0.0144]	[0.0151]
city [5-10K population]	-0.0461***	-0.0703***	-0.0573***	-0.0540***	-0.0553***	-0.0558***	-0.0342*	-0.1044***
	[0.0144]	[0.0148]	[0.0140]	[0.0151]	[0.0151]	[0.0161]	[0.0207]	[0.0217]
city [2-5K population]	-0.0680***	-0.0642***	-0.0540***	-0.0392*	-0.0703***	-0.1062***	-0.0889***	-0.028
	[0.0198]	[0.0184]	[0.0185]	[0.0212]	[0.0190]	[0.0195]	[0.0225]	[0.0235]
city (<2K population]	-0.0076	-0.1762***	-0.1352	-0.0169	-0.0861	-0.1032**	-0.0721	0.0698
	[0.0678]	[0.0538]	[0.0945]	[0.1376]	[0.0667]	[0.0483]	[0.0560]	[0.0644]
village dummy	-0.0628***	-0.0739***	-0.0751***	-0.0770***	-0.0663***	-0.0657***	-0.0925***	-0.0794***
	[0.0079]	[0.0080]	[0.0077]	[0.0082]	[0.0080]	[0.0086]	[0.0103]	[0.0108]
dummy: 2 year college	-0.1537***	-0.1251***	-0.1524***	-0.1813***	-0.2100***	-0.2155***	-0.2064***	-0.2397***
	[0.0158]	[0.0162]	[0.0154]	[0.0166]	[0.0161]	[0.0175]	[0.0227]	[0.0233]
dummy: secondary technical	-0.2683***	-0.2049***	-0.2365***	-0.2572***	-0.2800***	-0.2559***	-0.2511***	-0.2542***
	[0.0121]	[0.0128]	[0.0123]	[0.0131]	[0.0128]	[0.0139]	[0.0176]	[0.0182]
dummy: secondary general educ	-0.2702***	-0.1926***	-0.2302***	-0.2482***	-0.2639***	-0.2448***	-0.2471***	-0.2543***
	[0.0147]	[0.0154]	[0.0151]	[0.0162]	[0.0157]	[0.0173]	[0.0221]	[0.0221]
dummy: vocational education	-0.3436***	-0.2759***	-0.3174***	-0.3490***	-0.3650***	-0.3296***	-0.3066***	-0.3431***
	[0.0137]	[0.0146]	[0.0141]	[0.0148]	[0.0144]	[0.0158]	[0.0201]	[0.0205]
dummy: primary educated	-0.4197***	-0.3485***	-0.3754***	-0.4251***	-0.4243***	-0.3746***	-0.3767***	-0.4573***
	[0.0153]	[0.0162]	[0.0157]	[0.0168]	[0.0164]	[0.0179]	[0.0229]	[0.0233]
dummy: less than primary	-0.3004***	-0.4448***	-0.2658***	-0.3476***	-0.5776***	-0.3751***	-0.2649	-0.4001**
	[0.0779]	[0.0812]	[0.0933]	[0.1122]	[0.1028]	[0.1331]	[0.2026]	[0.1998]
Observations	15,486	15,773	15,050	14,616	14,309	12,592	9,202	10,641
R-squared	0.43	0.40	0.46	0.43	0.44	0.43	0.43	0.42
R-squared without industry indicators	0.39	0.35	0.41	0.39	0.41	0.40	0.40	0.40
Variation attributed to industry indicators (%)	10.3	14.3	12.2	10.3	7.3	7.5	7.5	5.0

Notes: * denotes significance at the 10-percent level; ** denotes significance at the 5-percent level; and *** denotes significance at the 1-percent level. The sample is restricted to those between 15-75 year-old, employees only.

Table 7. Industry wage premiums, 1994-2001

	1994	1995	1996	1997	1998	1999	2000	2001
Agriculture, fishery	-0.103	-0.093	-0.118	-0.081	-0.083	-0.055	-0.097	-0.047
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
mining	0.381	0.416	0.412	0.361	0.339	0.353	0.355	0.319
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
manufacturing *of which*								
food, beverage, tobacco	0.017	-0.012	0.024	0.019	0.031	0.044	-0.009	-0.053
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
textile	-0.030	0.005	-0.047	-0.060	-0.060	-0.058	-0.101	-0.080
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
leather	-0.035	-0.022	-0.032	-0.017	-0.028	-0.040	-0.115	-0.052
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
wood	0.014	0.022	0.039	0.008	-0.004	-0.031	-0.002	-0.050
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
paper products	0.122	0.036	0.101	0.202	0.147	0.104	0.104	0.094
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
petroleum	0.371	0.363	0.392	0.360	0.382	0.392	0.328	0.404
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
chemical	0.126	0.134	0.249	0.248	0.232	0.144	0.232	0.154
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
rubber/plastic	0.114	0.015	0.076	0.122	0.094	0.052	0.088	0.069
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
non-metallic	0.043	0.073	0.077	0.058	0.045	0.077	0.059	0.045
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
metal	0.089	0.098	0.110	0.071	0.080	0.075	0.076	0.061
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
machinery	0.011	0.061	0.039	0.032	0.001	0.060	0.047	0.042
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
electrical appliances	0.040	0.090	0.068	0.013	0.058	0.080	0.059	0.068
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
transport equipment	0.068	0.114	0.108	0.107	0.155	0.109	0.170	0.179
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
other manufacturing	0.014	0.026	0.006	0.034	0.012	-0.008	-0.028	0.012
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
Services *of which*								
Utilities	0.223	0.233	0.217	0.220	0.183	0.191	0.182	0.154
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
Construction	0.014	0.010	0.001	0.004	0.019	0.059	0.044	0.004
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
Wholesale and retail trade;	-0.036	-0.048	-0.042	-0.045	-0.034	-0.048	-0.031	-0.056
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
Hotels and restaurants	-0.064	-0.018	-0.043	-0.061	-0.038	-0.008	0.018	0.023
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
Transport, and communication	0.057	0.036	0.027	0.032	0.054	0.031	0.097	0.082
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
Financial, real estate and business activities	0.074	0.052	0.053	0.042	0.063	0.037	0.057	0.065
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
Public administration;	0.101	0.100	0.136	0.096	0.068	0.058	0.086	0.074
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
Education, health and social work	-0.014	-0.029	0.000	-0.031	-0.049	-0.076	-0.043	-0.042
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]
Other community, social and personal service activities	0.008	-0.055	-0.044	-0.043	-0.058	-0.022	-0.016	-0.052
	[0.011]	[0.012]	[0.013]	[0.014]	[0.014]	[0.015]	[0.019]	[0.023]

note: standard error in []

Table 8. Weighted Least Squares estimation on first differences: industry wage premiums and tariffs, all sectors

Dependent variable: Industry wage premium	[1]	[2]	[3]	[4]
Simple Average Tariff vis-à-vis the European Union	**-0.192** **[0.077]**	**-0.2695*** **[0.0915]**	**-0.3237**** **[0.1160]**	**-0.3228**** **[0.1261]**
Lagged Herfindahl Index (i.e., concentration within an industry)				-0.054 [0.0475]
Year dummies	No	Yes	Yes	Yes
Industry dummies	No	No	Yes	Yes
Simple Average Tariff vis-à-vis the World	**-0.1808**** **[0.0816]**	**-0.2807*** **[0.0873]**	**-0.3055*** **[0.1022]**	**-0.2969**** **[0.1101]**
Lagged Herfindahl Index (i.e., concentration within an industry)				-0.0543 [0.0478]
Year dummies	No	Yes	Yes	Yes
Industry dummies	No	No	Yes	Yes

Notes: The number of observations is equal to 154 in columns (1) – (3) and 124 in column (4). The observations pertain to 22 industries for 8 years, 1994-2001. We lose 1 year because of first difference.
* denotes significance at the 10-percent level; ** denotes significance at the 5-percent level; and *** denotes significance at the 1-percent level.
[..] denotes robust standard errors. Robust standard errors are calculated by clustering the industries, thus taking into consideration the correlation of industries between years.

Table 9. Weighted Least Squares estimation on first differences: alternative measure of industry wage premiums, all sectors

Dependent variable: Alternative measure of # industry wage premium	[1]	[2]	[3]	[4]
Simple Average Tariff vis-à-vis the European Union	**-0.209****	**-0.2749****	**-0.3155****	**-0.3127****
	[0.082]	**[0.1005]**	**[0.1222]**	**[0.1304]**
Lagged Herfindahl Index (i.e., concentration within an industry)				-0.0485
				[0.0426]
Year dummies	No	Yes	Yes	Yes
Industry dummies	No	No	Yes	Yes
Simple Average Tariff vis-à-vis the World	**-0.1998****	**-0.2904*****	**-0.3078*****	**-0.2971****
	[0.0854]	**[0.0950]**	**[0.1078]**	**[0.1137]**
Lagged Herfindahl Index (i.e., concentration within an industry)				-0.0491
				[0.0424]
Year dummies	No	Yes	Yes	Yes
Industry dummies	No	No	Yes	Yes

Notes: The number of observations is equal to 154 in columns (1) – (3) and 124 in column (4). They pertain to 22 industries for 8 years, 1994-2001. We lose 1 year because of first difference.
the industry wage premium measured is estimated with more control variables (e.g., firm size, firm type) in the first stage.
* denotes significance at the 10-percent level; ** denotes significance at the 5-percent level; and *** denotes significance at the 1-percent level.
[..] denotes robust standard errors. Robust standard errors are calculated by clustering the industries, thus taking into consideration the correlation of industries between years.

Table 10. Weighted Least Squares estimation on first differences: industry wage premiums, tariffs, and other trade exposure variables, manufacturing sectors

Dependent variable: industry wage premium	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Simple Average Tariff vis-à-vis the European Union	**-0.2294****	**-0.2976***	-0.3107	**-0.3064***	**-0.3012***	**-0.3012***	-0.3036
	[0.1000]	**[0.1618]**	[0.1797]	**[0.1574]**	**[0.1627]**	**[0.1627]**	[0.1873]
Lagged Herfindahl Index (i.e., concentration within an industry)	**-0.0991***	-0.0802	-0.1012	-0.1609	-0.1718	-0.1718	-0.1717
	[0.0482]	[0.0816]	[0.0952]	[0.1120]	[0.1205]	[0.1205]	[0.1645]
Lagged imports				**0.0188****	**0.0198*****	**0.0198*****	0.0036
				[0.0066]	**[0.0063]**	**[0.0063]**	[0.0191]
Lagged exports					-0.008	-0.008	-0.0143
					[0.0153]	[0.0153]	[0.0253]
Lagged real effective exchange rate						0.0000	0.0001
						[0.0014]	[0.0016]
Year dummies	No	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	No	No	Yes	No	No	No	Yes
Simple Average Tariff vis-à-vis the World	**-0.2178****	**-0.2941***	**-0.3018***	**-0.3074***	**-0.3070***	**-0.3070***	**-0.3103***
	[0.0917]	**[0.1529]**	**[0.1690]**	**[0.1468]**	**[0.1486]**	**[0.1486]**	**[0.1699]**
Lagged Herfindahl Index (i.e., concentration within an industry)	**-0.1118****	-0.0879	-0.111	-0.169	-0.1722	-0.1722	-0.1901
	[0.0514]	[0.0848]	[0.0990]	[0.1029]	[0.1112]	[0.1112]	[0.1467]
Lagged imports				**0.0153*****	**0.0155*****	**0.0155*****	0.011
				[0.0044]	**[0.0045]**	**[0.0045]**	[0.0104]
Lagged exports					-0.0021	-0.0021	-0.0042
					[0.0123]	[0.0123]	[0.0210]
Lagged real effective exchange rate						-0.0008	-0.0006
						[0.0016]	[0.0020]
Year dummies	No	Yes	Yes	Yes	Yes	Yes	Yes
Industry dummies	No	No	Yes	No	No	No	Yes

Notes: The number of observations is equal to 95 in columns (1) - (3) and to 94 in the remaining specifications. They pertain to 14 industries for 8 years, 1994-2001. We lose 1 year because of first difference. Note that exports and imports data in the top and bottom panel pertain to trade with the EU and the world, respectively.
* denotes significance at the 10-percent level; ** denotes significance at the 5-percent level; and *** denotes significance at the 1-percent level.
[..] denotes robust standard errors. Robust standard errors are calculated by clustering the industries, thus taking into consideration the correlation of industries between years.

Table 11. Weighted Least Squares estimation on first differences: industry wage premiums, tariff, and other sector-specific variables (labor shares and investment), all sectors

Dependent variable: industry wage premium	[1]	[2]	[3]	[4]	[5]	[6]
Simple Average Tariff vis-à-vis the European Union	**-0.3110*** [0.0988]**	**-0.2894** [0.1208]**	**-0.2464* [0.1233]**	**-0.3189** [0.1261]**	**-0.3518** [0.1450]**	**-0.2356* [0.1291]**
Lagged Herfindahl Index (i.e., concentration within an industry)	-0.0563 [0.0402]	0.0049 [0.0490]	-0.0396 [0.1257]	-0.0635 [0.0457]	0.0077 [0.0672]	0.0447 [0.2506]
Lagged capital accumulation	**0.0130** [0.0055]**		0.003 [0.0095]	**0.0132* [0.0065]**		-0.0012 [0.0134]
Lagged foreign direct investment		0.0000 [0.0000]	0.0000 [0.0000]		0.0000 [0.0000]	0.0000 [0.0000]
Lagged unskilled labor shares			0.2357 [0.1888]			0.2178 [0.2054]
Year dummies	yes	yes	yes	yes	yes	yes
Industry dummies	no	no	no	yes	yes	yes
Simple Average Tariff vis-à-vis the World	**-0.2967*** [0.0914]**	**-0.2652** [0.1146]**	**-0.2463** [0.1042]**	**-0.2922** [0.1098]**	**-0.2924** [0.1281]**	**-0.2152* [0.1111]**
Lagged Herfindahl Index (i.e., concentration within an industry)	-0.0543 [0.0404]	0.01 [0.0493]	-0.0284 [0.1241]	-0.0636 [0.0460]	0.0098 [0.0686]	0.0491 [0.2510]
Lagged capital accumulation	**0.0117** [0.0049]**		0.0016 [0.0088]	**0.0129** [0.0061]**		-0.0011 [0.0134]
Lagged foreign direct investment		0.0000 [0.0000]	0.0000 [0.0000]		0.0000 [0.0000]	0.0000 [0.0000]
Lagged unskilled labor shares			0.2278 [0.1895]			0.2149 [0.2061]
Year dummies	yes	yes	yes	yes	yes	yes
Industry dummies	no	no	no	yes	yes	yes

Notes: The number of observations is equal to 141 in columns (1) and (4), 93 in columns (2) and (5) and 79 in columns (3) and (6). They pertain to 22 industries for 8 years, 1994-2001. We lose 1 year because of first difference.
* denotes significance at the 10-percent level; ** denotes significance at the 5-percent level; and *** denotes significance at the 1-percent level.
[..] denotes robust standard errors. Robust standard errors are calculated by clustering the industries, thus taking into consideration the correlation of industries between years.

Table 12. Weighted Least Squares estimation of first differences: industry wage premiums, tariff, and other sector-specific variables (labor shares and investment), manufacturing sectors

Dependent variable: industry wage premium	[1]	[2]	[3]
Simple Average Tariff vis-à-vis the European Union	**-0.3313****	**-0.3274****	**-0.2561***
	[0.1440]	**[0.1157]**	**[0.1255]**
Lagged capital accumulation	-0.0842	-0.0862	-0.0963
	[0.0706]	[0.0724]	[0.0767]
Lagged foreign direct investment	0.0000	0.0000	0.0000
	[0.0000]	[0.0000]	[0.0000]
Lagged unskilled labor shares	0.4624**	0.4679**	0.4674**
	[0.1547]	[0.1736]	[0.1878]
Lagged Herfindahl Index (i.e., concentration within an industry)		-0.4415	-0.5601
		[0.2929]	[0.5351]
Year dummies	Yes	Yes	Yes
Industry dummies	No	No	Yes
Simple Average Tariff vis-à-vis the World	**-0.3170****	**-0.3103*****	**-0.2455***
	[0.1250]	**[0.0972]**	**[0.1115]**
Lagged capital accumulation	-0.0866	-0.0885	-0.0983
	[0.0701]	[0.0721]	[0.0766]
Lagged foreign direct investment	0.0000	0.0000	0.0000
	[0.0000]	[0.0000]	[0.0000]
Lagged unskilled labor shares	0.4526**	0.4584**	0.4610**
	[0.1547]	[0.1723]	[0.1858]
Lagged Herfindahl Index (i.e., concentration within an industry)		-0.4342	-0.5498
		[0.2914]	[0.5328]
Year dummies	Yes	Yes	Yes
Industry dummies	No	No	Yes

Notes: The number of observations in column (1) is equal to 55 and 54 in the remaining columns. The observations pertain to 13 industries for 8 years, 1994-2001. We lose 1 year because of first difference.
* denotes significance at the 10-percent level; ** denotes significance at the 5-percent level; and *** denotes significance at the 1-percent level.
[..] denotes robust standard errors. Robust standard errors are calculated by clustering the industries, thus taking into consideration the correlation of industries between years.

Table 13. Weighted Least Squares estimation of first differences: industry specific skill premiums, tariffs, and other trade exposure variables, manufacturing sectors

Dependent variable: industry specific skill premium	[1]	[2]	[3]	[4]	[5]	[6]
Simple Average Tariff vis-à-vis the European Union	**-1.1909****	**-1.1569***	**-1.1569***	-0.8114	-0.7677	-0.7677
	[0.5418]	**[0.5388]**	**[0.5388]**	[0.6329]	[0.6246]	[0.6246]
Lagged Herfindahl Index (i.e., concentration within an industry)	0.049	-0.0427	-0.0427	0.1026	0.0646	0.0646
	[0.3057]	[0.3223]	[0.3223]	[0.4798]	[0.4956]	[0.4956]
Lagged imports	-0.0497	-0.0433	-0.0433	0.0317	0.0142	0.0142
	[0.0658]	[0.0659]	[0.0659]	[0.0870]	[0.0860]	[0.0860]
Lagged exports		-0.0575	-0.0575		-0.0672	-0.0672
		[0.0989]	[0.0989]		[0.1214]	[0.1214]
Lagged real effective exchange rate			**-0.0157****			**-0.0161***
			[0.0065]			**[0.0075]**
Year dummies	yes	yes	yes	yes	yes	yes
Industry dummies	no	no	no	yes	yes	yes
Simple Average Tariff vis-à-vis the World	**-1.0802****	**-1.0746****	**-1.0746****	-0.8222	-0.8222	-0.8222
	[0.4480]	**[0.4542]**	**[0.4542]**	[0.5095]	[0.5095]	[0.5095]
Lagged Herfindahl Index (i.e., concentration within an industry)	0.0217	-0.0334	-0.0334	0.1188	0.1188	0.1188
	[0.2859]	[0.2875]	[0.2875]	[0.4450]	[0.4450]	[0.4450]
Lagged imports	-0.0589	-0.0566	-0.0566	-0.042	-0.042	-0.042
	[0.0408]	[0.0429]	[0.0429]	[0.0676]	[0.0676]	[0.0676]
Lagged exports		-0.0307	-0.0307	-0.0441	-0.0441	-0.0441
		[0.0789]	[0.0789]	[0.0994]	[0.0994]	[0.0994]
Lagged real effective exchange rate			-0.0158**		-0.0156	-0.0156
			[0.0071]		[0.0089]	[0.0089]
Year dummies	yes	yes	yes	yes	yes	yes
Industry dummies	no	no	no	yes	yes	yes

Notes: The number of observations is equal to 94. They pertain to 13 industries for 8 years, 1994-2001. We lose 1 year because of first difference.
Note that exports and imports data in the top and bottom panel pertain to trade with the EU and the world, respectively.
* denotes significance at the 10-percent level; ** denotes significance at the 5-percent level; and *** denotes significance at the 1-percent level.
[..] denotes robust standard errors. Robust standard errors are calculated by clustering the industries, thus taking into consideration the correlation of industries between years.

Appendix I[3]

Association Agreement between the European Communities and the Republic of Poland

Article 10 of the Europe Agreement signed in 1991 between Poland and the European Community stipulated the schedule of liberalization with respect to manufacturing products (HS Chapters 25-97). This schedule **did not cover** HS Chapters 1 –24, which **agricultural products**, **processed foods, beverages and tobacco products.** The provisions of Article 10 were as follows:

1. Customs duties on imports applicable in Poland to products originating in the Community listed in Annex IVa shall be abolished **on the date of entry into force** of this Agreement.

Annex IVa covered selected non-agricultural products from the following headings of the Harmonized System: 25, 26, 27, 28, 29, 30, 38, 40, 44, 45, 47, 48, 49, 50, 51, 52, 53, 68, 71, 72, 74, 75, 78, 79, 80, 81, 84, 85, 86, 87, 88, 90, 97.

2. Customs duties on imports applicable in Poland to products originating in the Community which are listed in Annex IVb shall be **progressively** reduced as specified in that Annex.

Annex IVb covered selected tariff lines pertaining to motor vehicles (HS8703, 8704, 8706 and 8707). It specified that customs duties on imports applicable in Poland to these products originating in the Community shall be eliminated according to the following schedule:

- on 1 January 1994 they will be reduced to six-seventh of the basic duty,
- on 1 January 1996 they will be reduced to five-seventh,
- on 1 January 1998 they will be reduced to four-seventh,
- on 1 January 1999 they will be reduced to three-seventh,
- on 1 January 2000 they will be reduced to two-seventh,
- on 1 January 2001 they will be reduced to one-seventh,
- on 1 January 2002 they will be reduced to zero,

It also specified a suspension of customs duties within the limit of an annual preferential tariff quota for a certain number of cars starting from 1 January 1993.

3. Customs duties on imports applicable in Poland to products originating in the Community other than those listed in Annexes IVa and IVb shall be **progressively reduced**, and abolished by the end of the seventh year at the latest from the entry into force of this Agreement according to the following timetable:
   - **three years after** the date of entry into force of this Agreement each duty shall be **reduced to 80%** of the basic duty,
   - **four years after** the date of entry into force of this Agreement each duty shall be **reduced to 60%** of the basic duty,

[3] The authors would like to thank Federica Saliola for preparing the information for this appendix.

- **five years after** the date of entry into force of this Agreement each duty shall be **reduced to 40%** of the basic duty,
- **six years after** the date of entry into force of this Agreement each duty shall be **reduced to 20%** of the basic duty,
- **seven years after** the date of entry into force of this Agreement the remaining duties **shall be eliminated**.

Provisions of the Europe Agreement with respect to **agricultural products** (HS Chapters 1 to 24) were coved in Chapter II which specified that

- Customs duties on imports applicable in Poland to products originating in the Community listed in the annex XI shall be reduced on the date of entry into force of the Agreement by 10 percentage points.

  Annex XI pertained to selected products from HS Chapters: **01** Live Animals, **04** Dairy Produce, Birds' Eggs, Natural Honey, Edible Products of Animal Origin, not Elsewhere Specified or Included, **06** Live Trees and Other Plants, Bulbs, Roots and the Like, cut Flowers and Ornamental Foliage, **07** Edible Vegetables and Certain Roots and Tubers, **08** Edible Fruit and Nuts, Peel of Citrus Fruits or Melons, **10** Cereals, **12** Oil Seeds and Oleaginous Fruits, Miscellaneous Grains, Seeds and Fruit, Industrial or Medicinal Plants, Straw and Fodder **15** Animal or Vegetable Fats and Oils and Their Cleavage Products, Prepared Edible Fats, Animal or Vegetable Waxes, **18** Cocoa and Cocoa Preparations, **19** Preparations of Cereals, Flour, Starch or Milk, Pastrycooks' Products, **20** Preparations of Vegetables, Fruit, Nuts or Other Parts of Plants, **22** Beverages, Spirits and Vinegar, **23** Residues and Waste From the Food Industries, Prepared Animal Fodder

- The Community and Poland shall grant each other the concessions referred to in Annexes Xa (imports of bovine animal), Xb (some products of chapters 01, 02 - Meat and Edible Meat Offal, 04), Xc (some products of chapters 07, 08, 20) and XI on a harmonious and reciprocal basis, in accordance with the conditions laid down therein.

  Annex Xa specified that “In case the number of animals fixed in the framework of the balance sheet arrangements foreseen in Regulation (EEC) No 805/68 are lower than a reference quantity, a **global tariff quota** equal to the difference between that reference quantity and the number of animals fixed under the balance sheet arrangements will be opened to imports from Hungary, Poland and Czechoslovakia.”

- Trade in agricultural goods was to remain subject to **quantitative restrictions**, which according to Article 20 were to be gradually abolished.

  Poland shall abolish at the latest by the end of the fifth year from the entry into force of the Agreement the quantitative restrictions on imports originating in the Community listed in Annex IX in accordance with the conditions established in that Annex.
  Annex IX covered: Beverages, Spirits and Vinegar (HS Chapter 22).

Appendix II

Evidence of Trade Liberalization and Changes in Firm Productivity

In order to shed some light on the channel through which trade liberalization may influence industry premiums, we examine the impact of tariff reductions on the productivity of Polish firms. This exercise is based on an unbalanced panel dataset of 5,090 firms operating in Poland during the period 1994-2000.[4] The information comes from a commercial database Amadeus, compiled by Bureau van Dijk, which contains comprehensive information on companies operating in thirty-five European countries, including Poland.

The analysis proceeds in two stages. First, we estimate a production function separately for each sector to get measures of the total factor productivity (TFP):[5]

$$ln\ Y_{it} = \alpha + \beta_1\ ln\ L_{it} + \beta_2\ ln\ K_{it} + \beta_2\ ln\ M_{it} + \mu_t + \varepsilon_{it}$$

where Y_{it} represents sales of firm i in year t, deflated by the sectoral deflator taken from the Poland's *Statistical Yearbooks*, L_{it} is the number of employees, K_{it} the value of fixed assets and M_{it} the value of materials used. K_{it} and M_{it} are deflated by the GDP deflator. The equation also contains year dummies.

Then we relate the annual changes in TFP to the changes in industry import tariffs:

$$\Delta\ ln\ TFP_{ijt} = \phi\ \Delta\ tariff_{jt} + \mu_j + u_{it}$$

where TFP_{ijt} is the total factor productivity estimated in the first stage for firm i operating in sector j in year t and $tariff_{jt}$ is the tariff on imports of industry j's products in year t. Estimating the equation in first differences allows us to eliminate unobserved time-invariant characteristics of industry j. Since some industries may be experiencing faster TFP growth due to, for instance, faster technological progress we also include industry fixed effects in the estimation. To take into account the fact that while the variable of interest (tariffs) is industry-specific, a firm is the unit of observation, we report robust standard errors corrected for clustering by industry. To make the analysis as comparable as possible to the industry premium exercise, we employ exactly the same industry classification and use the same tariff figures.

The estimation results, presented below, give support to our hypothesis that trade liberalization is associated with higher productivity at the firm level. We find a negative and statistically significant coefficient on the tariff variable both in the sample encompassing all sectors as well as in the manufacturing subsample. The results hold for both trade liberalization vis a vis the European Union as well as for tariffs vis a vis the world. The results are also robust to including in the regression a lagged measure of industry concentration (Hefindahl index).

[4] Unfortunately, the version of Amadeus to which we have access does not include the 2001 figures.

[5] Due to a small number of observations we combine textiles and leather products into one sector when estimating the production function. We also combine coke and petroleum manufacturing with chemicals.

Total factor productivity and trade liberalization: estimation on first differences

Dependent variable: Total factor productivity	All sectors		Manufacturing only	
Simple Average Tariff vis-à-vis the European Union	**-2.073** **[0.989]**	**-1.7611*** **[1.0075]**	**-2.0733*** **[1.0026]**	**-2.0987*** **[0.9898]**
Lagged Herfindahl Index (i.e., concentration within an industry)		-1.1178 [0.7906]		0.0908 [1.2733]
Industry dummies	Yes	Yes	Yes	Yes
Simple Average Tariff vis-à-vis the World	**-1.9361**** **[0.8329]**	**-1.7026*** **[0.8448]**	**-1.8098**** **[0.8307]**	**-1.7552**** **[0.8065]**
Lagged Herfindahl Index (i.e., concentration within an industry)		-1.24 [0.7724]		-0.2852 [1.1204]
Industry dummies	Yes	Yes	Yes	Yes

Notes: The number of observations is equal to 6,039 in columns (1) and (2) and 2,420 in columns (3) and (4). The observations pertain to the period 1994-2000.
* denotes significance at the 10-percent level; ** denotes significance at the 5-percent level; and *** denotes significance at the 1-percent level.
[..] denotes robust standard errors. Robust standard errors are calculated by clustering the industries, thus taking into consideration the correlation of industries between years.

Appendix III

Table A1. Distribution of male employment by industries and by broad regions, 1994-2001

1994	Poland	Districts along the western border	Interior/center districts	Capital city (ie., Warsaw)	Districts along the eastern border	Northern coastal districts
Agriculture,mining,fishery	31.39	28.87	33.05	4.6	44.15	20.49
services sector	45.86	45.63	42.44	77.89	38.12	57.94
manufacturing	22.75	25.5	24.51	17.51	17.73	21.57
of which						
food, beverage, tobacco	17	10	20	13	23	18
textile	7	5	11	1	3	4
leather	2	2	2	1	3	2
wood	11	10	10	6	12	12
paper products	3	2	4	11	2	4
petroleum	2	3	1	0	1	1
chemical	5	7	4	8	4	3
rubber/plastic	3	2	3	2	4	1
non-metallic	6	6	6	6	9	3
metal	16	21	15	9	10	8
machinery	11	14	9	9	9	11
electrical appliances	5	5	5	12	3	4
transport equipment	8	5	4	10	12	19
Other manufacturing	7	7	6	11	6	7

2001	Poland	Districts along the western border	Interior/center districts	Capital city (ie., Warsaw)	Districts along the eastern border	Northern coastal districts
Agriculture,mining,fishery	24.92	20.61	27.28	4.02	37.52	13.31
services sector	51.98	54.52	48.12	76.84	44.39	60.92
manufacturing	23.1	24.87	24.6	19.14	18.09	25.77
of which						
food, beverage, tobacco	19	13	22	13	27	20
textile	5	4	9	4	3	1
leather	2	1	2	0	2	1
wood	10	11	8	5	11	12
paper products	4	3	5	9	3	6
petroleum	1	2	1	1	1	1
chemical	5	6	4	6	3	5
rubber/plastic	4	4	5	6	6	3
non-metallic	6	6	6	2	6	2
metal	16	23	14	15	11	12
machinery	9	12	8	12	9	7
electrical appliances	5	5	4	12	3	4
transport equipment	7	6	4	9	9	19
Other manufacturing	7	4	10	7	6	7

Source: Labor Force Surveys