DISCUSSION PAPER SERIES

IZA DP No. 5597

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March 2011

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zur Zukunft der Arbeit
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Discussion Paper No. 5597
March 2011

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IZA Discussion Paper No. 5597
March 2011

ABSTRACT

Wage Structure Effects of International Trade: Evidence from a Small Open Economy

In the last decades, international trade has increased between industrialised countries and between high- and low-wage countries. This important change has raised questions on how international trade affects the labour market. In this spirit, this paper aims to investigate the impact of international trade on wage dispersion in a small open economy. It is one of the few to: i) use detailed matched employer-employee data to compute industry wage premia and disaggregated industry level panel data to examine the impact of changes in international trade on changes in wage differentials, ii) simultaneously analyse both imports and exports, and iii) examine the impact of imports according to the country of origin. Looking at the export side, we find (on the basis of the system GMM estimator) a positive effect of exports on industry wage premia. The results also show that import penetration has a significant and negative impact on industry wage differentials whatever the country of origin. However, the country of origin appears to matter quite a lot. Indeed, the detrimental effect of imports on wages is found to be significantly bigger when the latter come from low-income countries than from high-income countries.

JEL Classification: F16, J31

Keywords: wage structure, inter-industry wage differentials, international trade, matched employer-employee data

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1. Introduction

In the last decades, international trade has increased between industrialised countries and between high- and low-wage countries. As an example, the trade-to-GDP ratio in OECD countries increased from 13% in 1970 to more than 28% in 2007. In the EU27, the trade openness ratio was 40% in 2007, while it was above 50% for small countries (OECD, 2009). Globalisation is also reflected in the increased dispersion of geographical partners of OECD countries.

These important changes have raised questions on how international trade affects the labour market. Hence, a vast literature scrutinizes trade mechanisms to better understand both labour demand and wage structure changes (Slaughter, 1999). The impact of globalisation on labour-market outcomes is tackled through different trade and labour market models (e.g. Heckscher-Ohlin trade or specific-factor models). Moreover, a wide range of aspects and potential outcomes of globalisation is considered, i.e. impact of changes in trade protection, import penetration or export shares on employment, wage inequalities or the return to workers' characteristics, such as education (e.g. Freeman, 1995; Kugler and Verhoogen, 2009; Melitz, 2003; Verhoogen, 2008; Wood, 1994).

In the case of developed countries, an important part of the literature concentrates on the role of imports from low-wage countries to explain the increasing pressure on unskilled labour markets (Freeman, 1995). Particular attention is devoted to the effects of trade on low-skilled employment and on the evolution of the skilled/unskilled wage ratio. Studies on the wage consequences of international trade generally examine the latter's impact on the return to workers' characteristics (Pavcnik *et al.*, 2004). However, a growing number of papers focus on the sectoral affiliation of the workers to analyse trade effects on wages (Hoekman and Winters, 2005). In this case, the wage differential attributed to the workers' industry affiliation is examined to understand the effects of globalisation on earnings. Given that the existence of sectoral effects on workers' wages is a stylised fact in the economic literature (Krueger and Summers, 1988; Vainiomäki *et al.*, 1995; Hartog *et al.*, 2000; Du Caju *et al.*, 2010), some authors argue that studies that do not take into account the industry affiliation may neglect an important channel through which trade affects wages (Pavcnik *et al.*, 2004).

Trade effects on inter-industry wage differentials can pass through several channels. First, strong import growth or trade liberalisation reforms may involve pro-competitive effects in the product market that may influence industry rents and therefore the industry wage structure (Kramarz, 2008). Secondly, trade changes may have an impact on industry- or firm-level productivity, thereby changing industry-relative wages (Martins and Opromolla, 2009). Thirdly, growth in the import penetration level may be considered as a shock to labour demand that affects the industry wage structure in the presence of imperfect labour mobility across sectors (Dutta, 2007).

Regarding the export side, Schank *et al.* (2007) suggest that high-export sectors offer high wages as the result of relatively favourable foreign demand shocks. They also state that the wage premium in exporting sectors is compatible with the turnover version of the efficiency wage theory. For Lundin and Yun (2009), exporting industries pay higher wages since exports increase profits and stimulate expansion.

The empirical literature regarding the impact of trade openness on industry wage premia is still relatively scarce (Gaston and Trefer, 1994; Borjas and Ramey, 1995; Jean and Nicoletti, 2002; Lundin and Yun, 2009).[1] However, the results are quite compelling. For example, Grey

[1] Another strand of the literature investigates how trade reforms affect inter-industry wage differentials primarily in developing countries (Robertson, 2000; Feliciano, 2001; Hasan and Chen, 2003; Pavcnik *et al.*, 2004;

(1993) and Katz *et al.* (1989) show for Canada and the US, respectively, that workers in import-intensive industries have lower wage premia, while workers in export-intensive industries receive higher wage premia. Using US data, Borjas and Ramey (1995) report a negative impact of import penetration on wages of low-skilled workers in concentrated industries. For Norway, Salvanes *et al.* (1998) find a positive relationship between the degree of openness and wage premia. Lundin and Yun (2009) examined the situation in the Swedish manufacturing sector. Their results indicate that industries that face intensive import competition from low wage countries have lower wage premia. In contrast, export intensities are not found to have a significant impact on workers' wages.[2]

In this paper, we investigate the impact of international trade on wage premia in a small open economy, i.e. Belgium. More precisely, our objective is to examine the following questions:

1. Do workers in export-intensive sectors earn higher wages?
2. Do workers in import-intensive sectors earn lower wages?
3. Does the country of origin of imports matter? Are the size of wage differentials in import-intensive sectors different when imports are principally coming from low-income countries or middle- to high-income countries?

Our paper significantly contributes to the existing literature as it is one of the few to: i) use detailed matched employer-employee data to compute industry wage premia and disaggregated industry level panel data to examine the impact of changes in international trade on changes in wage differentials, ii) simultaneously analyse both imports and exports, and iii) examine the impact of imports according to the country of origin.

To address these questions, we rely on detailed matched employer-employee data (SES-SBS) covering all years from 1999 to 2006. These data contain detailed information on firm characteristics and on individual workers. SES-SBS is merged with data on international trade (at the NACE three-digit level) coming from the NBB International Trade dataset. The richness of our data allows us to control for important econometric issues that are not systematically addressed in other studies, such as the potential endogeneity of trade variables and the existence of industry unobserved fixed effects.

The remainder of this paper is organised as follows. In the next section a review of the literature on the magnitude and sources of inter-industry wage differentials is presented. Section 3 describes the data and the methodology. Section 4 examines the size, dispersion and stability of inter-industry wage differentials in the Belgian private sector over the period 1999-2006. The contribution of international trade to observed inter-industry wage differentials is analysed in section 5. The last section concludes.

2. Background

2.1. Inter-Industry Wage Differentials: What Do We Know?

Questions on the impact of trade on the industry wage premium fit into a larger empirical debate reopened in the late eighties about the causes of wage inequalities. Several papers

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Goldberg and Pavcnik, 2005; Dutta, 2007). For example, Dutta (2007) examines the link between tariff reduction and industry wage premia in India. He finds that high-tariff industries offer higher wage premia. A similar result is found for Colombia by Goldberg and Pavcnik (2005), when industry fixed effects are included in the analysis. Jean and Nicoletti (2002) also report a positive impact of tariffs on wages using panel data for 12 OECD countries. In contrast, Pavcnik *et al.* (2004) obtain no significant effect between changes in trade policy and changes in industry wage premia in Brazil.

[2] However, Lundin and Yun (2009) results only refer to OLS estimates that are likely to be biased.

emphasised that pay differentials existed in the US between workers with the same observable individual characteristics and working conditions but employed in different sectors (Dickens and Katz, 1987; Krueger and Summers, 1988; Katz and Summers, 1989). In recent years, comparable results have been obtained for a large number of countries (Araï *et al.*, 1996; Hartog *et al.*, 1997, 2000; Vainiomäki and Laaksonen, 1995). In parallel, it has been shown that the structure of inter-industry wage differentials is quite consistent and strongly correlated between countries, but that its scale varies considerably between industrialised countries (Barth and Zweimüller, 1992; Edin and Zetterberg, 1992; Helwege, 1992; Zanchi, 1992; Kahn, 1998; Teulings and Hartog, 1998; Björklund *et al.*, 2007; Gannon *et al.*, 2007; Du Caju *et al.*, 2010).

Overall, these different results suggest that individual wages are not solely determined by personal productive characteristics and task descriptions, but also by employer features. They might nevertheless also derive from the fact that the unobserved qualities of the labour force are not randomly distributed across industries. Gibbons and Katz (1992) test this hypothesis and find for the US that the magnitude of the industry wage differentials is almost undiminished when estimating wage equations in first differences rather than in levels. Their findings thus indicate that the workers' sectoral affiliation does matter. The unobserved quality explanation has also been tested for Portugal by Martins (2004) and for eight European countries by Du Caju *et al.* (2010). These results also suggest that non-competitive forces may play an important role in the wage determination process. In contrast, findings of Goux and Maurin (1999) and Abowd *et al.* (1999) show that individual fixed effects explain a large fraction of the estimated inter-industry wage differentials in France. A similar result has been found for the UK (Benito, 2000; Carruth *et al.*, 2004), the US (Björklund *et al.*, 2007) and Scandinavian countries (Björklund *et al.*, 2007).

All in all, there is no consensus regarding the exact scale of industry wage premia. Moreover, while studies on industry wage differentials offer some evidence against the perfectly competitive model, they hardly allow one to discriminate between alternative models supporting the existence of an effect of employer characteristics on wages (Krueger and Summers, 1988; Lindbeck and Snower, 1990; Thaler, 1989; Walsh, 1999; Benito, 2000). *Prima facie*, wage disparities observed between sectors support the efficiency wage theory. Indeed, this theory shows that if the incentive conditions for effort vary between sectors, then two workers with identical productive characteristics and working conditions are likely to earn different wages. For instance, according to the effort version of the efficiency wage theory, large companies would find it in their interest to offer relatively higher wages to their employees because they face higher costs to monitor effort.

However, this theory does not explain why the scale of inter-industry wage differentials varies between countries and appears to be more compressed in corporatist countries. The motives for companies to pay efficiency wages, i.e. wages above the competitive level, actually appear to be similar among industrialised countries. Therefore, some authors (e.g. Teulings and Hartog, 1998) believe that the explanation put forward by Holmlund and Zetterberg (1991), based upon the rent sharing theory, is more compelling.

Holmlund and Zetterberg (1991) showed that the influence of sectoral conditions (variations in prices and productivity) on wages is strong in the US, moderate in Germany and low in the Scandinavian countries. The elasticity between the sectoral environment and wages thus appears to be more pronounced in non-corporatist countries. Put differently, the determination of wages would depend more on the general macro-economic conditions in corporatist countries. This may be due to the fact that explicit or implicit coordination of wage bargaining in corporatist countries restricts workers' insider power, or, in other words, their ability to obtain a portion of the sectoral rents. It is also argued that the policy of 'wage solidarity' pursued by unions in most corporatist countries reinforces this phenomenon (Vainiomäki and Laaksonen, 1995). In sum, this strand of the literature suggests that rent sharing is partly responsible for observed sectoral wage premia and for their apparently higher dispersion in non-corporatist countries.

Additional evidence on the existence and magnitude of rent sharing is provided by studies that directly estimate the elasticity between wages and profits (or value-added) with firm-level or matched worker-firm data (Araï, 2003; Blanchflower *et al.*, 1996; Christophides and Oswald, 1992; Fakhfakh and FitzRoy, 2004; Goos and Konings, 2001; Hildreth and Oswald, 1997; Margolis and Salvanes, 2001; Martins, 2009; Rycx and Tojerow, 2004; Van Reenen, 1996). Findings from this literature show that profitable firms pay higher wages even after detailed personal and firm characteristics are controlled for.

In the case of Belgium, Du Caju *et al*. (2010) have shown how rent sharing contributes to the explanation of inter-industry wage differentials. In their paper, the rent sharing phenomenon accounts for a significant fraction of the inter-industry wage differentials. They find that the magnitude, dispersion and significance of inter-industry wage differentials decrease sharply when controlling for profits.

2.2. Inter-Industry Wage Differentials and International Trade: How Does it Work?

Interestingly, several papers finding a positive elasticity of salaries to firms' quasi-rents overcome endogeneity problems by instrumenting profits with shocks to foreign competition (Abowd and Lemieux, 1993; Abowd and Allain, 1996).[3] They indeed consider foreign competition as exogenously modifying rents and, hence, collective-bargaining conditions and rent sharing. Hence, an imperfectly competitive labor model like rent sharing provides channels through which international trade may affect inter-industry wage differentials (Pavcnik *et al*., 2004).

Borjas and Ramey (1995) suggest that foreign competition has a greater impact on rents and hence on wages in more concentrated industries. They show, for example, that wages are sensitive to net imports in an open economy version of Abowd and Lemieux's rent sharing model in which market structures vary across sectors.[4] Because trade induces more competition, it may impact on rents that workers are extracting and reduce sectoral wage premia. As a result, industries with more foreign competition pay lower wages on average. This effect differs from the potential impact of an increase in competition on returns to skills. Even if more competition at the sectoral level leads to higher returns to skill, wages for both

[3] Indeed, at least two econometric problems arise when current profits are used to estimate the wage-profit elasticity. First, there is an accounting relationship between wages and current profits: if wages increase, profits (i.e. value-added minus remuneration of labour) automatically decrease. Therefore, OLS estimates of rent sharing are likely to be downward biased. Second, a positive relationship between wages and current profits may arise because higher wages can provide employees with incentives to step up their effort (cf. efficiency wage theories). This would lead to an upward biased estimation of rent sharing. To sum up, OLS estimates of wage-profit elasticity might be biased and inconsistent due to simultaneity problems between wages and current profits. To account for this issue, two-stage least squares (2SLS) is generally applied using instruments for contemporaneous profits. Instruments used in the literature to control for the endogeneity of profits include: lagged profits, the degree of market competition, prices of imports and exports, exchange rate variations, past technological innovations and sales.

[4] However, it should be noted that more competitive arguments can also be put forward. Lawrence (2000), for instance, argues that trade may change the wage structure through its impact on technology and TFP. Moreover, Lovely and Richardson (1998) emphasize that trade can influence the return to skills and therefore also the wage structure.

high-skilled and low-skilled workers may be lower as a result of the drop in rents. This implies that the overall effect on wages may be ambiguous and hence raise an empirical question (Guadalupe, 2007).

Kramarz (2008) put forward that imports can affect not only overall profits, but also the result of the wage bargaining between workers and employers. For example, importers may pay more to their workers to neutralize hold-up opportunities when they purchase imported intermediate inputs in advance (Martins and Opromolla, 2009). On the other hand, imports of finished goods may have a negative impact on wages by decreasing workers' outside opportunities and hence their bargaining position. Several papers have focused on the impact of deregulation on wages and found significant effects (Rose, 1987; Hirsch, 1993; Card, 1996). In the presence of rent-sharing and trade unions, an increase in product market competition may lead to wage compression through the weakening of union bargaining power and a decrease in rents (Guadalupe, 2007). In other words, through the product market, international trade increases competition between labor markets and hence, the substitutability of employees (Rodrik, 1997).

Using a production function approach as Hall (1988) and Crépon *et al.* (2007), Abraham *et al*. (2009) try to focus simultaneously on imperfections in product and labor markets. They find that imports decrease both markups and union bargaining power. They also show that import competition from low-income countries has a stronger negative impact on union bargaining power in the Belgian manufacturing sector. Bernard *et al.* (2006) reach similar results for the US. Finally, Cuñat and Guadalupe (2009) focus on the effects of imports competition on US executive pay. They find that increases in import competition tend to make pay more sensitive to performance.

Overall, it seems that the rent-sharing model can explain both wage differentials across sectors and how foreign competition leads to lower wages. Hence, the empirical section herein focuses on the role of international trade in determining the structure of observed inter-industry wage differentials through rent-sharing mechanisms.[5] In this framework, imports increase product-market competition in import-oriented industries and, hence, decrease rents and wages that follow. Furthermore, this negative effect will be stronger the lower the prices are of import goods, which is the case for imports from low-income countries.[6]

A similar result could be explained with the specific-factor model. However, this model is more restrictive. It assumes that workers are immobile in the short- and medium- run and that skills are industry-specific. These are two assumptions that are not necessary to explain the impact of trade on sectoral wage premia within the rent sharing model.[7]

[5] The Belgian labor market is characterized by a relatively high trade union density, a large collective bargaining coverage rate, industry bargaining (essentially) and a national minimum wage. Given these features, we believe that non-competitive mechanisms have a strong potential in explaining the impact of international trade on the wage structure. This intuition is also supported by the fact that Goos and Konings (2001) and Rycx and Tojerow (2004) provide empirical evidence for the existence of rent-sharing in the Belgian private sector and that Du Caju *et al.* (2010) show that this rent-sharing phenomenon accounts for a significant part of inter-industry wage differentials.

[6] Dutta (2007) and Martins and Opromolla (2009) put forward another mechanism that can take place in a labor market with non-competitive features. In this case, rent sharing follows the impact of trade changes on industry- or firm- level productivity, thereby changing industry-relative wages. This explanation concerns precisely more imports of inputs than overall imports of any kind of goods. Access to higher-quality or cheaper intermediate inputs results in higher profits and, hence, in higher wages.

[7] In the case of the standard Hecksher-Ohlin-Samuelson model, inter-industry wage differentials are difficult to explain since factors are mobile and their prices equalize across industries.

Regarding the export side, Lundin and Yun (2009) suggest that exports increase profits and stimulate expansion. In the short run, this situation brings firms to compete more for the same workforce and as a result, wages increase across the whole industry. Martins and Opromolla (2009) refer to hold-up opportunities for employees working in the case of export firms having to make export-related investments. Moreover, in a rent sharing framework, the fact that exporters are more productive translates into higher wages (De Locker, 2007; Martins and Opromolla, 2010; Van Biesebrock, 2005).

Schank *et al.* (2007) propose another argument to explain why exporting industries pay higher wages. They suggest that high-export sectors offer high wages as the result of relatively favorable foreign demand shocks. They also put forward that the wage premium in exporting sectors is compatible with the turnover version of the efficiency wage theory. The point is that high-export industries succeed thanks to their product quality advantage and the associated highly qualified workforce. Since this kind of workforce is relatively rare and involves higher turnover costs, it is argued that firms in these sectors offer wages above the market level to secure their competitive advantage in the global market.

3. Data and Methodology

3.1. Data

The present study is based upon the SES-SBS, the Belgian linked employer-employee dataset and the NBB International Trade dataset. While the former contains detailed information on both workers and firms, the latter gathers import and export flows by industry and country of origin.

Our linked employer-employee data (SES-SBS) is obtained through the combining of the *Structure of Earnings Survey* (SES) and the *Structure of Business Survey* (SBS) for all years from 1999 to 2006.[8] SES-SBS covers Belgian establishments employing at least ten workers and with economic activities within sections C to K of the NACE Rev. 1 classification. The survey contains a wealth of information, provided by establishments' management, both on firms (e.g. sector of activity, size of the establishment, and level of wage bargaining) and individual workers (e.g. education, age, seniority, number of working hours paid, gender, occupation, gross hourly wages, annual bonuses).[9] Gross hourly wages – *excluding* bonuses[10] – are calculated by dividing total gross earnings (including earnings for overtime hours and premiums for shift work, night work and/or weekend work) in the reference period (October) by the corresponding number of total paid hours (including paid overtime hours). Gross hourly wages – *including* bonuses – are obtained by adding to the gross hourly wages (excluding bonuses) the annual bonuses divided by: i) the number of months to which the bonuses correspond and ii) the total number of paid hours in the reference period, respectively. After the exclusion of individuals for whom one of the variables used entailed an

[8] Due to its cross-sectional nature, workers cannot be followed across time within or between firms.

[9] The SES is conducted on the basis of a two-stage random sampling approach of enterprises or local units (first stage) and employees (second stage). The establishments, randomly chosen from the population, report data on a random sample of their workforce. The SES is thus a stratified sample. The stratification criteria refer to the region where the local unit is located (NUTS categories), the principal economic activity (NACE groups) and the size of the local unit (this size is determined by data collected from the Social Security Organisation). Sampling percentages of local units depend positively on the size of the unit. Within a local unit, the number of workers to be considered also depends on size, but negatively. Because of this sampling strategy, weights have to be used to extrapolate employees and local units in the sample to the entire stratum. For more details see Demunter (2000).

[10] Annual bonuses include irregular payments which do not occur during each pay period, such as pay for holidays, 13th month or profit-sharing.

incorrect or missing observation, the final samples contain between 94,476 (in 1999) and 105,596 (in 2006) individuals.[11]

Data on international trade (at the NACE three-digit level) are coming from the NBB International Trade dataset. They include data on exports and imports by industry and trading origin. Information on domestic competition (i.e. the Herfindahl index), to be included as a control variable in the regressions (see below), is extracted from the *Structure of Business Survey*.

Table 1 presents domestic competition, import and export exposure, over time. While exports are measured by the ratio of export to total turnover, imports are expressed by the ratio of import to output and imports minus exports.[12] Import penetration is measured overall and by country groups. These groups are based on the World Bank Analytical Classification presented in World Development Indicators (GNI per capita in US$ Atlas method: gross national income divided by mid-year population). Countries are classified according to 2000 GNI per capita. The groups are: low income (L), $755 or less; lower middle income (LM), $756 to $2995; upper middle income (UM), $2996 to $9265; and high income (H), $9265 or more. The Herfindahl index corresponds to the sum of squared market shares at the three-digit sector level.

[Insert Table 1 about here]

As shown in Table 1, the export ratio varies between 0.327 in 1999 and 0.331 in 2006. Rather stable over time, it shows the importance of exports for Belgian firms. For imports, we observe that Belgian firms are highly exposed to competition from abroad. Around 40 percent of consumption comes from abroad. While most of the imports are coming from high income countries, the share from middle and low income countries has increased over time.

[Insert Figure 1 about here]

Figure 1 shows the means of top 15 and bottom 15 of gross hourly wages for Nace 3-digit industries for the years 1999 and 2006. We note that on average, the gross hourly wage including bonuses has been increasing from 14.5 EUR in 1999 to 17.2 EUR in 2006. Figure 1 reveals, in addition, that mean gross hourly wages fluctuate considerably across sectors. In 1999, the best paying industry is the manufacture of refined petroleum products (Nace 232). The average worker there earns around 24.6 EUR per hour (26.4 EUR per hour in 2006). This sector is followed by Real estate activities with own property (Nace 701), Manufacture of basic chemicals (Nace 241), Research and experimental development on natural sciences and engineering (Nace 731) and Other computer related activities (Nace 726).

The Bars sector is at the very bottom of the wage scale. The average worker's hourly wage here is 7.8 EUR (11.5 EUR per hour in 2006), approximately 2 to 3 times less than that of the average worker in the best paying industry. At the bottom of the scale, we likewise find Restaurants (Nace 553), Camping sites and other provision of short-stay accommodation (Nace 552), Industrial cleaning (Nace 747) and Canteens and catering (Nace 555).

Where do these substantial gross wage differentials come from? Can they solely be accounted for by sectoral heterogeneity in workers' productive characteristics, working conditions and specific features of the employers in each firm? Or do they also derive from changes in

[11] Descriptive statistics relative to the merged SES-SBS samples are reported in Appendix 1.

[12] Total turnover and output are extracted from the firms' annual accounts.

international trade? These questions, among others, are analysed in the remainder of this paper.

3.2. Methodology

To measure the effects of trade on the industry wage structure, we adopt a two-step estimation procedure. First, we estimate industry wage differentials at the NACE three-digit level for every year from 1999 to 2006. The methodology adopted to estimate inter-industry wage differentials and their dispersion is consistent with that of Krueger and Summers (1988). However, the standard errors of these differentials have been corrected according to Haisken-DeNew and Schmidt (1997). This strategy rests upon the estimation, for all the years from 1999 to 2006, of the following semi-logarithmic wage equation:

$$\ln w_{ij} = X_{ij}\beta + \psi_k + Z_j\delta + \varepsilon_{ij} \qquad (1)$$

with w_{ij} the gross hourly wage (including bonuses) of worker i in firm j; X_{ij} the individual characteristics of worker i in firm j (a dummy for sex, 6 dummies for the highest completed level of education, 8 dummies for the age of the worker, 3 dummies for the number of years of tenure, 2 dummies for the type of employment contract, a dummy indicating if the worker is part-time, a variable showing whether the individual received a bonus for shift, night and/or weekend work, a dummy for paid overtime and 22 occupational dummies); ψ_k the sector effect (dummy variables relating to individuals' sectoral affiliation, nomenclature available at the NACE three-digit level); Z_j the characteristics of firm j (7 dummies for the size of the establishment, a dummy for the type of financial and economic control and a dummy for the level of collective wage bargaining).

Next, inter-industry wage differentials, estimated at the NACE three-digit level for the years 1999 to 2006, are pooled together and used as a dependent variable in a regression aiming to examine the impact of international trade on wage premia. More precisely, following Lundin and Yun (2009), we regress industry wage differentials on import penetrations and export ratios, controlling for domestic competition (i.e. the Herfindahl index). Since the dependent variable in this stage is the estimate from equation (1), it is weighted using the inverse of the standard errors of the industry wage premium. The point is that we want to give more weight to industry wage premia that are more precisely estimated (i.e. with least variance). The model is therefore estimated with weighted least squares (WLS) and specified as follows:

$$IWD_{kt} = \beta_{im}Import_{k,t} + \beta_{ex}Export_{k,t} + \beta_{h}HIndex_{k,t} + DY_t + v_{kt} \qquad (2)$$

where $Import_{kt}$ and $Export_{kt}$ are import penetrations and export ratios, respectively, at the NACE three-digit level. $HIndex_{k,t}$ is the Herfindahl index, i.e. a proxy for domestic competition. Finally, DY_t is a vector of year dummies. Sensitivity tests are also performed to examine whether the impact of imports on industry wage premia depends on the country of origin.

The most straightforward approach to estimating equation (2) is to run pooled OLS with year fixed effects. This approach might however lead to biased and inconsistent estimates due to a simultaneity problem between wages and export and/or import flows. Indeed, technical changes or adverse shocks to labor costs could bring reverse causation and, hence, biased and inconsistent estimates (Feliciano, 2001; Bertrand, 2004). In this case, the OLS-estimate of import penetration is upward biased and the estimate for export orientation is downward biased.

To account for this issue, we applied two-stage least squares (2SLS), using lagged variables as instruments for contemporaneous export ratio and import penetration. We believe that our instrumenting strategy is of potential interest since we expect lagged variables to be uncorrelated (or at least less correlated) with the error term and highly correlated with the endogenous variable (i.e. contemporaneous export ratio and import penetration).[13] However, caution is still required given that import and export ratios are relatively persistent over time.[14]

Besides endogeneity problems, running pooled OLS does not allow us to take into account industry fixed unobserved heterogeneity. For this reason, we are also estimating our model in a more complete specification with a set of industry dummies that allows to focus on the within-industry variations of wage premiums over time.

Although fixed-effect estimators control for the unobserved sectoral heterogeneity, they might suffer, like OLS estimates, from potential endogeneity problems. Hence, the last specification is based respectively on the static and dynamic system Generalized Method of Moments (GMM) estimators proposed by Arellano and Bover (1995) and Blundell and Bond (1998). This methodology implies that variables in the differenced equation are instrumented by their lagged levels and that variables in the level equation are instrumented by their lagged differences.[15] It thus addresses simultaneity issues and controls for industry fixed unobserved heterogeneity. The dynamic version of the system GMM estimator also considers the potential state dependence of the dependent variable using one year lagged inter-industry wage differentials as an additional explanatory variable.

4. Empirical Results

4.1. Inter-Industry Wage Differentials

Inter-industry wage differentials are estimated on the basis of equation (1) using as a dependent variable the (log of) individual gross hourly wages including annual bonuses.[16] Table 2 reports best- and worst- paying industries at the Nace three-digit level over the period 1999-2006.[17] These are shown as deviations from the employment-weighted mean. As a summary statistic, we present the employment-weighted and adjusted standard deviation of the inter-industry wage differentials. Results show, for all the years from 1999 to 2006, the existence of wage differentials between workers employed in different sectors, even after controlling for a large number of individual and establishment characteristics. Between 74 and 83 percent of these differentials are statistically significant at the 10 percent level.

[Insert Table 2 about here]

The best-paying industry over the period 1999-2006 is, *ceteris paribus*, Manufacture of refined petroleum products (232). Depending on the period under investigation, the average worker earns there between 24 percent in 2003 and 35 percent in 2001 more than the average

[13] Other instruments used in the literature to control for the endogeneity include exchange rate variations, past technological innovations and sales (Bertrand, 2004; Revenga, 1992).

[14] Therefore, we also use the system GMM estimator (see below).

[15] Time dummies are considered as exogenous and we use respectively first and second lags and second and third lags of other explanatory variables as instruments.

[16] Results from the wage regressions are reported in Appendix 2.

[17] The complete set of results, i.e. the 139 inter-industry wage differentials by year at the NACE three-digit level, are available upon request.

worker in the whole economy.[18] At the top of the conditional wage distribution, we also find the Manufacture of basic chemicals (241), Manufacture of other chemical products (246), Other financial intermediation (652) and Real estate activities with own property (701). At the bottom of the scale, we find, amongst others, Manufacture of other wearing apparel and accessories (182), Manufacture of jewelry and related articles (362), Hotels (551), Camping sites (552), Restaurants (553), Bars (554) and Canteens and catering (555).[19]

Results in Table 2 also show that the dispersion of inter-industry wage differentials, measured by the weighted adjusted standard deviation (WASD) of inter-industry wage premia, varies between 0.075 in 2006 and 0.109 in 2005.

[Insert Table 3 about here]

Table 3 shows how the hierarchy of sectors in terms of wages is correlated over time. Correlation coefficients between the wage differentials estimated for all years from 1999 to 2006 vary between approximately 0.75 and 0.89 percent. These correlations suggest that the estimated wage differentials between industrial sectors do not derive from transitory differences in demand or supply across industries.[20] Hence, the next section focuses on how inter-industry wage differentials may be related to international trade and domestic product market competition.

4.2. Inter-Industry Wage Differentials and International Trade

In this section, we present evidence on how, *ceteris paribus*, sectoral wage premia are modified in industries facing changes in export ratio or/and import penetration. We first discuss results for wage premia and trade intensity from the different models described in the methodology section (OLS, 2SLS, FE and SYS-GMM). In order to test more precisely how import penetration affects the sectoral wage structure, we focus in the second part of this section on the differential impact of changes in import competition from high- versus low-income countries, controlling for export ratio and domestic market competition. These different specifications are estimated with the more complete model i.e. Generalized Method of Moments.

Table 4 shows the effect of international trade on the wage premium. In a first stage, we estimate this equation by ordinary least squares (OLS) with year-fixed effects and standard errors that are robust to heteroscedasticity and serial autocorrelation. Our benchmark regression clearly supports the hypothesis that inter-industry wage differentials are significantly related to trade flows. First, we find that the coefficient on total import

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[18] In order to get the difference in percentage terms between the wage (in EUR) of the average worker in sector k and the employment-share weighted mean wage (in EUR) in the economy, the following expressions have been computed : $V_k = [(\exp(\hat{\psi}_k) - 1) - G]$ for $k = 1,\dots, K$ and $V_{K+1} = -G$; where $G = \sum_{k=1}^{K} \overline{p}_k [\exp(\hat{\psi}_k) - 1]$ and $\overline{p}_k$'s are sectoral employment shares. This transformation is necessary because the estimated wage equation has a semi-logarithmic form, so that inter-industry wage differentials, calculated from equation (1), are initially expressed in log point form (for a discussion see Araï *et al.*, 1996 or Reilly and Zanchi, 2003).

[19] See Du Caju *et al.* (2010) for detailed analysis of inter-industry wage differentials in Belgium.

[20] Yet, it could be argued that the unobserved quality of the labour force is not randomly distributed across sectors. In other words, high-paying industries might simply be those in which the non-observed quality of the labour force is the highest. To examine this issue, we applied Martins' (2004) methodology to all the waves of the SES-SBS from 1999 to 2006. Empirical results (available on request) suggest that the contribution of unobserved ability to inter-industry wage differentials in Belgium is limited and hence that other explanations deserve to be investigated.

penetration is negative and significant. This result is consistent with previous work (Revenga, 1992; Bertrand, 2004; Cunat and Guadalupe, 2009). Looking at the export side, we find a positive effect of exports on the industry wage structure. This result is compatible with the hypothesis that the increase in profits generated by achieving a competitive position in export markets does generate higher wages. These findings put into perspective contrasting results obtained by Lundin and Yun (2009) for Sweden on the basis of a between-industry approach. Our results, nevertheless, are in line with Schank *et al.* (2007) who list correlation between exports and wages in 22 countries.

Overall, results for both exports and imports seem, at least partially, in line with Budd and Slaughter's (2004) previous finding that profits are shared across borders. Moreover, these results are particularly interesting since they are amongst the few to include both dimensions of international trade, i.e. export and imports flows (Martins and Opromolla, 2009).

[Insert Table 4 about here]

Although these results seem accurate, they should be interpreted with caution. Indeed, OLS estimates reported in Table 4 might be biased and inconsistent due to a simultaneity problem between industry wage premium and current export ratio and/or import penetration. We, therefore, estimate equation (2) by two-stage least squares (2SLS). We use the lagged values of trade variables as instruments. Results of our 2SLS regressions are presented in column 3 of Table 4. We still find a significant impact of trade on industry wage differentials.[21] A comparison of columns 2 and 3 in Table 4 seems to validate the relevance of the instrumentation strategy. While the impact of the export ratio increases from 0.129 to 0.137, indicating that our previous estimate was downward biased, the negative influence of import penetration changes from -0.115 to -0.131, revealing that the OLS result was upward biased. Overall, 2SLS results seem to deal with the endogeneity problem and, hence, support the causality effects from trade flows on industry wage differentials.

Both OLS and 2SLS may still suffer from the omission of industry fixed effects. Fixed-effect estimators precisely deal with time-invariant unobserved heterogeneity across industries (such as production technology or other omitted characteristics at the industry level). They are presented in column 4 of Table 4. The inclusion of fixed effects has a clear influence on the magnitude of the impact of export ratio and import penetration. Both coefficients drop sharply, but are still significant and have the expected sign. In other words, when we rely solely on within-industry variation, import penetration still has a negative impact on sectoral wage premia. The export ratio still has a positive impact.

In addition to the OLS, 2SLS and FE results, Table 4 also presents static and dynamic GMM-SYS estimates, respectively (see columns 5 and 7). To examine their reliability, we first apply the Hansen (1982) test of overidentification restrictions and Arellano-Bond's (1991) test for second-order autocorrelation in the first-differenced errors. Results for the static specification do not reject the null hypothesis of valid instruments and of no autocorrelation. In contrast, the dynamic specification leads to inconsistent results given that first-differenced errors are autocorrelated (whatever the instrumenting strategy adopted). Be that as it may, GMM estimates (both static and dynamic) still support the hypothesis that industry wage premia are significantly and positively (negatively) influenced by the export (import penetration) ratio.

[21] Note that: a) all coefficients in the first-stage regressions are jointly significant at the 1 percent level, b) regression coefficients associated to our main instruments (i.e. lagged export and import ratios) are highly significant and equal to 0.976 and 0.836 respectively, c) the R^2 of the first-stage regression stands at 0.97.

Finally, we extend our model to control for internal market competition by including a variable that measures domestic market concentration by industry and year, i.e. the Herfindahl index. If the industry wage differential hypothesis is accurate, the more concentrated sectors should pay higher wages (Guadalupe, 2007). Yet, this prediction does not seem to be valid for sectors that are exposed to international competition in a small open economy like Belgium. Indeed, the regression coefficient associated to the Herfindahl index is never statistically significant (see columns 6 and 8). This result is not surprising as it simply highlights that the Herfindahl index is not an important determinant of wage setting in sectors that are facing strong competition from abroad. Be that as it may, findings still support the conclusions that high export exposure is correlated with higher industry wage differentials, while imports have a negative impact on them.

4.3. Inter-Industry Wage Differentials and International Trade: Does the Country of Origin Matter?

In this section, we test the robustness of our results with alternative specifications. We divide imports into categories by country to assess the differentials effects of imports from different origins on industry wage differentials. This allows us to test more accurately the rent-sharing hypotheses presented above. Indeed, results consistent with the mechanisms outlined in section 2 should show that sectors that face higher import competition from low-income countries have lower wage premia. This should occur through the downward pressure of the lower prices of import goods on firm domestic revenue and, hence, on their profits. The lower profits should in turn lead to lower wages in the presence of rent sharing.

Countries are classified according to 2000 GNI per capita. The groups are: low income (L), $755 or less; lower middle income (LM), $756 to $2995; upper middle income (UM), $2996 to $9265; and high income (H), $9265 or more.[22] Two different specifications are tested: one with two categories (H and all the others) and another one with all four categories.

[Insert Table 5 about here]

Table 5 presents the results of this exercise obtained with the static GMM-SYS estimator.[23] Columns 2 and 3 analyze the model with two groups of countries and columns 4 and 5 the one with four categories. In both cases, Hansen J-statistics (1982) for overidentifying restrictions and Arellano-Bond's (1991) tests for second order autocorrelation in the first differenced errors attest the reliability of the GMM estimates. Both specifications clearly confirm that exports have a significant and positive influence on inter-industry wage differentials. They also indicate that import penetration has a significant negative effect on the wage premium whatever the country of origin.[24] However, the country of origin matters. Indeed, the negative effect of imports on wages is bigger when they originate from a low-wage country. These results suggest the existence of a price effect for imports from both low- and high-income countries. However, the size of this effect appears to decrease as the income level of the country from which goods are imported increases. Finally, our results again show that the

[22] These groups are based on the World Bank Analytical Classification presented in World Development Indicators (GNI per capita in US$ Atlas method: gross national income divided by mid-year population).

[23] Results based on the dynamic GMM-SYS estimator cannot be interpreted as they never pass the Arellano-Bond's (1991) test for second order autocorrelation in the first differenced errors (whatever the instrumenting strategy adopted). To put it differently, we systematically have to reject the null hypothesis of no autocorrelation (see Appendix 3).

[24] Except for upper-middle income countries. The explanation for this is unclear. However, it could be related to the fact that countries classified in this category are more likely to belong to another category over time.

Herfindahl index is not statistically significant (see columns 3 and 5). They thus confirm that domestic competition is not a crucial variable for explaining wage differentials across sectors that are widely open to international competition.

5. Conclusion

In the last decades, international trade has increased between industrialised countries and between high- and low-wage countries. This important change has raised questions on how international trade affects the labour market. In this spirit, this paper investigates the impact of international trade on wage dispersion in a small open economy. More precisely, it examines the following questions:

1. Do workers in export-intensive sectors earn higher wages?
2. Do workers in import-intensive sectors earn lower wages?
3. Does the country of origin of imports matter? Are the size of wage differentials in import-intensive sectors different when imports are principally coming from low-income countries or middle- to high-income countries?

This paper significantly contributes to the existing literature as it is one of the few few to: i) use detailed matched employer-employee data to compute industry wage premia and disaggregated industry level panel data to examine the impact of changes in international trade on changes in wage differentials, ii) simultaneously analyse both imports and exports, and iii) examine the impact of imports according to the country of origin.

The empirical analysis is based on the SES-SBS, the Belgian linked employer-employee dataset and the NBB International Trade dataset. While the former contains detailed information on both workers and firms, the latter gathers import and export flows by industry and country of origin. The richness of these data (covering all years from 1999 to 2006) allows to control for important econometric issues that are not systematically addressed in other studies, such as the potential endogeneity of trade variables and the existence of industry unobserved fixed effects.

Empirical results (based on the system GMM estimator) show the existence of a significant positive effect of exports on industry wage premia. They also indicate that import penetration has a significant and negative impact on industry wage differentials whatever the country of origin. However, the country of origin appears to matter quite a lot. Indeed, the detrimental effect of imports on wages is found to be significantly bigger when the latter come from low-income countries than from high-income countries. Overall, these results fit quite well with the predications of the rent-sharing model. The latter states that imports increase product-market competition in import-oriented industries and, hence, decrease rents and wages. Furthermore, this model suggests (in line with empirical results) that the negative effect on wages will be stronger the lower the prices of imported goods, i.e. the lower the income level of the country from which the goods are imported. Results regarding exports are compatible with the idea that the increase in profits generated by the achievement a competitive position in export markets does generate higher wages. Results presented in this paper can be easily compared with those of Lundin and Yun (2009). The latter examined the impact of international trade variables on inter-industry wage differentials in the Swedish manufacturing sector over the period 1996-2000. Their estimates suggest, in line with the present paper, that industries facing intensive import competition from low-wage countries have lower wage premiums. In contrast, they find no significant effect of export intensities on industry wage differentials. Yet, their study differs from present one in several ways. Firstly, they do not control for unobserved time-invariant industry specific effects. Secondly, they use one-year lagged international trade variables to address the potential endogeneity issue. However, the accurateness of this approach can be discussed as trade variables are relatively persistent over time and no over-identification test could be performed given the use of a single instrument. Finally, the potential state dependence of inter-industry wage differentials is not taken into account their study. These methodological differences (with respect to the present paper) may contribute to explain why results are not exactly the same in both studies. In another closely related paper, Abraham et al. (2009) analyze how increased economic integration has affected labor and product markets. Their results, based on a panel of Belgian manufacturing firms, show that important competition (particularly from low wage countries) has a negative effect on both markups and union bargaining power. Along the lines of the present paper, they thus suggest that increased import penetration is associated with a moderation of wage claims in unionized countries.

Acknowledgment

Some of the work for this paper was conducted while Ilan Tojerow was visiting the Center of Labor Economics at UC Berkeley. This paper is produced as part of the Wage Dynamics Network (WDN) coordinated by the European Central Bank (ECB). Financial support from the National Bank of Belgium (NBB) is gratefully acknowledged. This paper has benefited from presentations at 2010 All-California Labor Economic Conference and at UC Berkeley Labor Lunch. We also would like to thank Statistics Belgium for giving access to the data. Opinions expressed in this article do not necessarily reflect the views of the institutes the authors are affiliated with. Any remaining errors are those of the authors.

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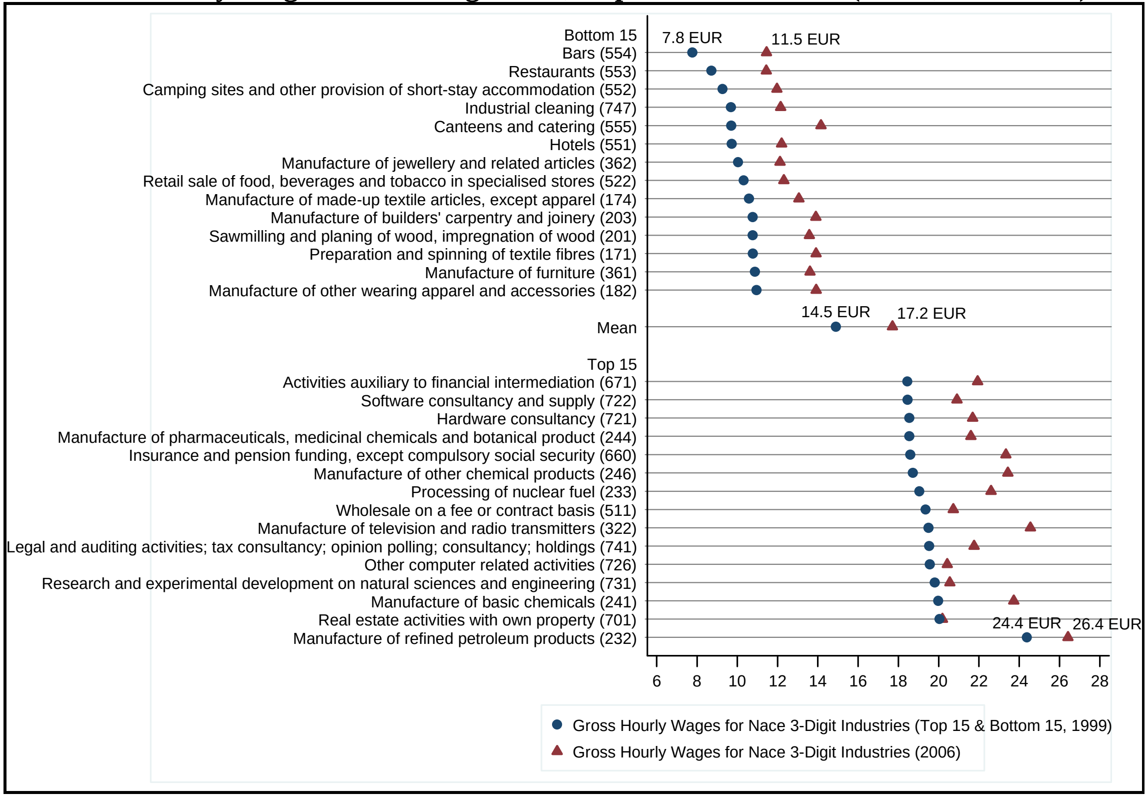
FUGURE 1

Gross Hourly Wages, Nace 3-Digit level, Top 15 & Bottom 15 (Mean, 1999-2006)



Source: SES-SBS.

TABLE 1

Industry Characteristics: Trade Exposure[#] and Herfindahl Index[+]

Variables / Years:	1999	2000	2001	2002	2003	2004	2005	2006
Export Ratio: [a]	0.327	0.335	0.340	0.339	0.330	0.333	0.330	0.331
	(0.275)	(0.326)	(0.336)	(0.394)	(0.382)	(0.389)	(0.397)	(0.425)
Import Penetration: [b]								
All countries	0.414	0.379	0.388	0.402	0.376	0.378	0.384	0.384
	(921)	(0.420)	(0.426)	(0.583)	(0.531)	(0.544)	(0.622)	(0.646)
High income countries (H)	0.375	0.335	0.338	0.346	0.325	0.324	0.324	0.320
	(0.873)	(0.372)	(0.361)	(0.471)	(0.447)	(0.441)	(0.494)	(0.525)
Middle & low income countries (UM, LM, L)	0.042	0.047	0.053	0.059	0.054	0.057	0.063	0.067
	(0.086)	(0.085)	(0.101)	(0.158)	(0.115)	(0.126)	(0.153)	(0.149)
Upper-middle income countries (UM)	0.021	0.022	0.025	0.027	0.026	0.027	0.028	0.030
	(0.043)	(0.036)	(0.041)	(0.054)	(0.046)	(0.054)	(0.062)	(0.062)
Low-middle income countries (LM)	0.015	0.018	0.021	0.026	0.022	0.023	0.028	0.029
	(0.039)	(0.046)	(0.059)	(0.099)	(0.66)	(0.063)	(0.084)	(0.078)
Low income countries (L)	0.006	0.007	0.007	0.007	0.006	0.007	0.007	0.008
	(0.018)	(0.020)	(0.019)	(0.019)	(0.017)	(0.019)	(0.018)	(0.020)
Herfindahl Index: [c]	0.137	0.135	0.133	0.132	0.140	0.137	0.139	0.148
	(0.145)	(0.136)	(0.128)	(0.127)	(0.142)	(0.131)	(0.134)	(0.153)

Source:[#] NBB International trade dataset, [+]Structure of Business Survey.
Note: Standard deviation in parentheses. [a] Ratio of export to total turnover. [b] Ratio of import to consumption i.e. output plus imports minus exports. [c] Sum of squared market share at the three-digit sector level. Country groups are based on the World Bank Analytical Classification presented in World Development Indicators (GNI per capita in US$ Atlas method: gross national income divided by midyear population). Countries are classified according to 2000 GNI per capita. The groups are: low income (L), $755 or less; lower middle income (LM), $756 to $2995; upper middle income (UM), $2996 to $9265; and high income (H), $9265 or more.

TABLE 2

Inter-industry wage differentials, 1999-2006: Top & Bottom of the Wage Scale

Industries (NACE 3-digit) / Years:	1999	2000	2001	2002	2003	2004	2005	2006
Top of the wage scale:								
Quarrying of sand and clay (142)	0.116**	0.078**	0.143**	0.104**	0.145**	0.113**	0.088**	0.064**
Manufacture of vegetable and animal oils and fats (154)	0.124**	0.050*	0.113**	0.102**	0.088**	0.092**	0.135**	0.104**
Manufacture of grain mill products, starches and starch products (156)	0.098**	0.113**	0.066**	0.108**	0.084**	0.075**	0.085**	0.123**
Manufacture of pulp, paper and paperboard (211)	0.088**	0.101**	0.094**	0.132**	0.134**	0.130**	0.147**	0.108**
Printing and service activities related to printing (222)	0.082**	0.081**	0.091**	0.129**	0.107**	0.079**	0.120**	0.055**
Manufacture of refined petroleum products (232)	0.328**	0.327**	0.341**	0.277**	0.252**	0.284**	0.288**	0.265**
Processing of nuclear fuel (233)	0.096**	0.091**	0.073**	0.071**	0.036°	0.129**	0.138**	0.129**
Manufacture of basic chemicals (241)	0.179**	0.188**	0.212**	0.176**	0.198**	0.185**	0.236**	0.183**
Manufacture of pharmaceuticals, medicinal chemicals and botanical product (244)	0.076**	0.068**	0.117**	0.090**	0.121**	0.119**	0.147**	0.099**
Manufacture of other chemical products (246)	0.199**	0.246**	0.218**	0.153**	0.167**	0.209**	0.174**	0.155**
Manufacture of basic precious and non-ferrous metals (274)	0.124**	0.080**	0.138**	0.078**	0.083**	0.111**	0.073**	0.059**
Manufacture of insulated wire and cable (313)	0.097**	0.128**	0.035**	0.020	0.082**	0.054**	0.087**	0.067**
Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy (322)	0.152**	0.133**	0.132**	0.153**	0.094**	0.081**	0.111**	0.132**
Wholesale on a fee or contract basis (511)	0.157**	0.135**	0.115**	0.110**	0.158**	0.156**	0.116**	0.064**
Other financial intermediation (652)	0.097**	0.199**	0.136**	0.106**	0.137**	0.098**	0.173**	0.057**
660	0.056**	0.075**	0.082**	0.090**	0.085**	0.108**	0.129**	0.119**
Activities auxiliary to financial intermediation, except insurance and pension funding (671)	0.103**	0.105**	0.140**	0.120**	0.228**	0.058**	0.178**	0.069**
Real estate activities with own property (701)	0.187**	0.166**	0.243**	0.217**	0.218**	0.212**	0.21**	0.143**
Other computer related activities (726)	0.058°	0.170**	0.107**	0.016	0.167**	0.128**	0.190**	0.057*
Bottom of the wage scale:								
Finishing of textiles (173)	-0.102**	-0.129**	-0.125**	-0.086**	-0.110**	-0.096**	-0.052*	-0.091**
Manufacture of made-up textile articles, except apparel (174)	-0.138**	-0.123**	-0.125**	-0.107**	-0.199**	-0.121**	-0.142**	-0.139**
Manufacture of other wearing apparel and accessories (182)	-0.155**	-0.174**	-0.16**	-0.143**	-0.199**	-0.120**	-0.096**	-0.110**
Sawmilling and planing of wood, impregnation of wood (201)	-0.099**	-0.146**	-0.109**	-0.132**	-0.126**	-0.121**	-0.148**	-0.107**
Manufacture of builders' carpentry and joinery (203)	-0.126**	-0.073**	-0.083**	-0.105**	-0.116**	-0.092**	-0.161**	-0.060**
Manufacture of furniture (361)	-0.150**	-0.124**	-0.13**	-0.111**	-0.144**	-0.128**	-0.117**	-0.131**
Manufacture of jewellery and related articles (362)	-0.222**	-0.095**	-0.208**	-0.233**	-0.177**	-0.24**	-0.237***	-0.199**
Recycling of non-metal waste and scrap (372)	-0.084**	-0.034	-0.073**	-0.042**	-0.146**	-0.074**	-0.018	-0.137**
Retail sale in non-specialised stores (521)	-0.051**	-0.060**	-0.048**	-0.065**	-0.039**	-0.138**	-0.090**	-0.022**
Other retail sale of new goods in specialised store (524)	-0.055**	-0.098**	-0.041**	-0.078**	-0.102**	-0.165**	-0.129**	-0.104**
Retail sale not in stores (526)	-0.197**	-0.078**	-0.089**	-0.125**	-0.116**	-0.198**	-0.092**	-0.128**
Hotels (551)	-0.208**	-0.184**	-0.201**	-0.224**	-0.184**	-0.183**	-0.265**	-0.153**

Camping sites and other provision of short-stay accommodation (552)	-0.220**	-0.251**	-0.197**	-0.168**	-0.205**	-0.193**	-0.194**	-0.192**
Restaurants (553)	-0.208**	-0.206**	-0.185**	-0.228**	-0.177**	-0.199**	-0.249**	-0.139**
Bars (554)	-0.269**	-0.244**	-0.246**	-0.241**	-0.239**	-0.180**	-0.094**	-0.104**
Canteens and catering (555)	-0.220**	-0.189**	-0.187**	-0.148**	-0.184**	-0.211**	-0.209**	-0.136**
Scheduled air transport (621)	0.0637**	-0.155**	0.0048	-0.003	0.097**	0.083**	0.019	-0.045*
Post and courier activities (641)	-0.076**	-0.205**	-0.237**	-0.226**	-0.150**	-0.145**	-0.213**	-0.067**
Renting of personal and household goods n.e.c. (714)	-0.080*	-0.068**	-0.089**	-0.139**	-0.085**	-0.127**	-0.208**	-0.170**
Maintenance and repair of office, accounting and computing machinery (725)	-0.135**	-0.094**	-0.096**	-0.076**	-0.132**	-0.114**	-0.020	-0.180**
Advertising (744)	-0.014	-0.070**	-0.165**	-0.071**	0.008	0.007	-0.015	-0.060**
Labour recruitment and provision of personnel (745)	-0.118**	-0.094**	-0.200**	0.068**	0.002	0.050**	-0.001	0.012
Investigation and security activities (746)	-0.193**	-0.086**	-0.146**	-0.045**	-0.144**	-0.118**	-0.136**	-0.260**
Industrial cleaning (747)	-0.050**	-0.060**	-0.106**	-0.064**	-0.087**	-0.065**	-0.196**	-0.034**
Per cent significant industry wage differentials at the 10% level	79.1 (110/139)	78.4 (109/139)	74.8 (104139)	79.9 (111 /139)	77.0 (107/139)	83.5 (116/139)	79.9 (111/139)	80.6 (112/139)
Weighted adjusted standard deviation (WASD)	0.084	0.089	0.102	0.081	0.086	0.096	0.109	0.075
Number of industries	139	139	139	139	139	139	139	139

Notes: Top 10 and bottom 10 for all the years. Standard errors of the industry wage differentials are computed according to Haisken-DeNew and Schmidt (1997). All the inter-industry wage differentials at the Nace three-digit level are available upon request. **/*/°: significance at the 1, 5 and 10 per cent level, respectively.

TABLE 3

Pearson / Spearman Correlation Coefficients Between Inter-Industry Wage Differentials, NACE three-digit (n=139) (SES-SBS data)

Years:	1999	2000	2001	2002	2003	2004	2005
2000	0.85** / 0.81**						
2001	0.88** / 0.84**	0.89** / 0.84**					
2002	0.85** / 0.77**	0.85** / 0.80**	0.88** / 0.84**				
2003	0.87** / 0.82**	0.85** / 0.80**	0.88** / 0.84**	0.89** / 0.84**			
2004	0.87** / 0.82**	0.83** / 0.77**	0.84** / 0.78**	0.88** / 0.82**	0.85** / 0.79**		
2005	0.79** / 0.75**	0.82** / 0.78**	0.85** / 0.80**	0.87** / 0.82**	0.86** / 0.81**	0.86** / 0.81**	
2006	0.81** / 0.75**	0.77** / 0.75**	0.81** / 0.76**	0.81** / 0.79**	0.80** / 0.74**	0.85** / 0.81**	0.84**/ 0.83**

Notes: Computation based on the inter-industry wage differentials estimated at the Nace 3 digit level. n stands for the number of sectors. **/*/°: coefficient significant at the 1, 5 and 10 per cent, respectively.

TABLE 4

International Trade and Inter-Industry Wage Premiums

(Dependent Variable: adjusted industry wage premium, robust s.e.)

Variables / Models:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	OLS	2SLS	FE	GMM-SYS (static)		GMM-SYS (dynamic)	
IWD $_{t-1}$ [a]						0.356**	0.346**
						(0.067)	(0.070)
Export ratio	0.129**	0.137**	0.069**	0.071*	0.085*	0.076*	0.078*
	(0.016)	(0.019)	(0.018)	(0.032)	(0.042)	(0.038)	(0.038)
Import penetration	-0.115**	-0.131**	-0.044**	-0.096**	-0.093**	-0.058**	-0.060**
	(0.013)	(0.019)	(0.004)	(0.017)	(0.020)	(0.016)	(0.016)
Herfindahl Index					-0.065		0.045
					(0.114)		(0.070)
Year dummies	yes (8 y.)	yes (8 y.)	yes (8 y.)	yes (8 y.)	yes (8 y.)	yes (7 y.)	yes (7 y.)
Adjusted R^2	0.098	0.097	0.090				
AR(2) (*p-value)*				0.555	0.414	0.033	0.036
Hansen test (*p-value*)				0.332	0.324	0.115	0.092
Number of observations	984	984	984	984	984	861	861

Notes: [a] IWD $_{t-1}$ stands for one year lagged industry wage differentials. Inter-industry wage differentials are estimated on the basis of equation (1). The inverse of adjusted and weighted variances of the inter-industry wage differentials are used as weight. Robust standard errors are reported in brackets. The instruments used in the 2SLS regressions (besides the exogenous variables in equation (1)) are lagged value of trade variables. AR(2) displays the test for second-order autocorrelation in the first-differenced errors. In the GMM models, first and second lags of explanatory variables, excluding time dummies, are used as instruments. **/*/°: coefficient significant at the 1, 5 and 10 per cent, respectively.

TABLE 5

International Trade and Inter-Industry Wage Premiums

(GMM-SYS (static), Dependent Variable: adjusted industry wage premium, robust s.e.)

Variables / Models:	(1)	(2)	(3)	(4)
Export ratio	0.112**	0.074**	0.065**	0.061**
	(0.024)	(0.008)	(0.014)	(0.015)
Import Penetration				
All countries				
High income countries (H)	-0.057°	-0.016**	-0.021**	-0.021**
	(0.032)	(0.005)	(0.008)	(0.008)
Middle & low income countries (UM, LM, L)	-0.146*	-0.201**		
	(0.067)	(0.036)		
Upper-middle income countries (UM)			0.000	0.004
			(0.000)	(0.165)
Low-middle income countries (LM)			-0.189°	-0.187°
			(0.099)	0.102
Low income countries (L)			-0.680*	-0.626*
			(0.335)	(0.316)
Herfindahl Index		-0.105		0.040
		(0.071)		(0.067)
Year dummies	yes (8 y.)	yes (8 y.)	yes (8 y.)	yes (8 y.)
AR(2) (*p-value)*	0.848	0.759	0.904	0.982
Hansen test (*p-value)*	0.174	0.175	0.516	0.447
Number of observations	984	984	984	984

Notes: Inter-industry wage differentials are estimated on the basis of equation (1). Robust standard errors are reported in brackets. AR(2) displays the test for second-order autocorrelation in the first-differenced errors. In models (1) and (2) second and third lags of explanatory variables, excluding time dummies, are used as instruments. In models (3) and (4) first and second lags of explanatory variables, excluding time dummies, are used as instruments. **/*/°: coefficient significant at the 1, 5 and 10 per cent, respectively.

APPENDIX 1

Means (standard deviations) of selected variables, 1999-2006 (SES-SBS data)

Variables / Years:	1999	2000	2001	2002	2003	2004	2005	2006
Gross hourly wage : (in EUR) includes overtime paid, premiums for shift work, night work and/or weekend work and bonuses (i.e. irregular payments that do not occur during each pay period, i.e. pay for holiday, 13th month, profits sharing, etc.).	14.5 (6.5)	14.7 (6.7)	14.8 (6.8)	15.2 (6.6)	15.3 (6.4)	16.5 (7.1)	17.0 (7.4)	17.2 (7.0)
Education:								
Primary or no degree	11.2	9.2	8.5	8.0	7.3	7.5	7.7	9.3
Lower secondary	27.9	28.6	29.3	28.2	27.1	26.8	20.9	20.0
Technical/Artistic/Prof. upper secondary	20.2	20.4	20.7	19.3	19.7	22.6	27.1	25.0
General upper secondary	16.2	17.7	16.0	19.2	19.0	16.4	16.8	19.0
Higher non-university short type	15.6	15.1	16.9	15.6	17.0	16.7	17.3	15.3
University and non-university education, long type	8.4	8.5	8.2	9.0	9.4	9.4	9.8	10.7
Post graduate or PhD	0.5	0.5	0.4	0.7	0.5	0.6	0.5	0.6
Age of the worker:								
20-24 years	8.8	9.4	9.7	8.7	7.9	7.6	7.7	7.6
25-29 years	16.2	15.8	15.6	14.8	14.9	13.9	14.3	13.1
30-34 years	17.8	17.1	16.8	16.8	16.8	16.4	15.7	14.2
35-39 years	16.7	17.1	16.7	17.2	16.9	16.6	16.5	16.0
40-44 years	14.1	14.1	14.3	15.0	14.9	15.4	15.6	16.2
45-49 years	12.4	12.2	12.0	12.3	12.7	13.3	13.2	13.7
50-54 years	9.4	9.6	9.6	9.6	9.9	10.6	10.5	11.3
55-59 years	3.8	3.9	4.5	4.7	5.0	5.2	5.4	6.5
60 years or more	0.8	0.9	1.0	0.9	1.0	1.0	1.1	1.5
Seniority in the company:								
0-1 year	24.0	26.6	27.5	23.1	20.4	20.0	18.3	22.7
2-4 years	18.8	19.9	21.3	24.7	25.3	23.5	21.0	17.7
5-9 years	18.5	16.0	14.7	16.1	17.8	19.6	23.4	21.3
10 years or more	38.7	37.5	36.5	36.1	36.5	36.8	37.4	38.4
Female (yes)	30.0	30.4	33.2	31.7	33.3	31.4	32.7	30.8
Paid overtime (yes)	4.2	3.5	2.5	2.2	3.2	4.3	5.4	5.2
Part time (yes)	9.1	8.8	9.5	10.3	10.0	10.4	11.9	10.8
Bonuses for shift, night and/or weekend work (yes)	15.6	14.9	14.2	14.7	15.1	14.3	15.0	15.7
Type of employment contract:								
Permanent	95.2	94.6	94.5	96.2	95.5	95.7	95.2	94.9
Fixed-term	3.7	4.3	4.7	3.1	3.7	3.6	4.2	4.4
Other	1.1	1.0	0.8	0.6	0.8	0.7	0.5	0.7
Private firm (yes): >50 per cent privately owned firm	96.4	97.1	95.5	96.1	94.3	93.9	95.7	97.9
Size of the establishment:								
1-4 employees	0.9	1.0	1.0	1.0	3.0	1.2	1.6	1.0
5-9 employees	3.0	2.7	2.3	2.7	4.4	3.5	3.7	3.0
10-19 employees	10.6	10.9	10.2	12.0	10.1	10.3	10.2	10.1
20-49 employees	20.4	20.8	19.3	20.7	18.2	21.1	19.5	18.3
50-99 employees	12.6	12.2	12.1	12.1	11.6	12.7	11.9	12.4
100-199 employees	12.9	12.9	13.7	14.3	12.8	12.8	13.7	13.4
200-499 employees	15.0	16.7	16.1	16.1	17.0	17.0	17.1	17.8
500 employees or more	24.6	22.8	25.4	21.0	22.9	21.3	22.2	24.0
Firm-level collective agreement (yes): collective wage agreement at the firm level for blue- and/or white collars workers	28.5	28.9	26.9	27.9	28.7	30.1	30.5	29.9
Number of observations	97,476	101,551	102,687	100,586	96,724	93,326	94,423	105,596

Notes: The descriptive statistics refer to the weighted sample. Descriptive statistics relative to the occupation and the sectoral affiliation of the workers are available upon request.

APPENDIX 2

Log wage equation, OLS, 1999-2006 (SES-SBS data)

Variables / Years:	1999	2000	2001	2002	2003	2004	2005	2006
Intercept	2.406**	2.359**	2.372**	2.292**	2.219**	2.407**	2.454**	2.496**
	(0.015)	(0.022)	(0.017)	(0.016)	(0.016)	(0.019)	(0.019)	(0.017)
Individual characteristics: [a]								
Education:								
Primary or no degree	Reference category							
Lower secondary	-0.010**	0.036**	0.026**	0.015**	0.012**	0.019**	0.011**	-0.003
	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Technical/Artistic/Prof. upper secondary	0.023**	0.077**	0.073**	0.048**	0.058**	0.068**	0.044**	0.033**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
General upper secondary	0.038**	0.079**	0.067**	0.051**	0.059**	0.080**	0.051**	0.041**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
Higher non-university short type	0.093**	0.153**	0.124**	0.113**	0.113**	0.147**	0.125**	0.106**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
University and non-university education, long type	0.218**	0.254**	0.268**	0.226**	0.236**	0.264**	0.246**	0.213**
	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.006)
Post graduate or PhD	0.331**	0.386**	0.391**	0.298**	0.327**	0.317**	0.295**	0.295**
	(0.018)	(0.017)	(0.020)	(0.018)	(0.020)	(0.018)	(0.018)	(0.015)
Age of the worker:								
20-24 years	Reference category							
25-29 years	0.039**	0.039**	0.044**	0.035**	0.014*	0.029**	0.010*	0.025**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
30-34 years	0.098**	0.104**	0.114**	0.104**	0.092**	0.108**	0.081**	0.098**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
35-39 years	0.140**	0.140**	0.156**	0.144**	0.135**	0.144**	0.128**	0.142**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
40-44 years	0.154**	0.166**	0.171**	0.168**	0.160**	0.168**	0.150**	0.156**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
45-49 years	0.182**	0.183**	0.191**	0.179**	0.176**	0.187**	0.164**	0.177**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)
50-54 years	0.208**	0.214**	0.216**	0.200**	0.196**	0.207**	0.184**	0.183**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)
55-59 years	0.234**	0.241**	0.232**	0.219**	0.213**	0.222**	0.206**	0.209**
	(0.007)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.006)
60 years or more	0.237**	0.209**	0.191**	0.204**	0.186**	0.205**	0.187**	0.187**
	(0.014)	(0.013)	(0.014)	(0.012)	(0.011)	(0.010)	(0.012)	(0.011)
Seniority in the company:								
0-1 year	Reference category							
2-4 years	0.069**	0.066**	0.062**	0.058**	0.050**	0.038**	0.034**	0.055**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
5-9 years	0.091**	0.088**	0.084**	0.090**	0.089**	0.066**	0.065**	0.078**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
10 years or more	0.131**	0.128**	0.127**	0.134**	0.126**	0.118**	0.110**	0.123**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)
Female (yes)	-0.118**	-0.112**	-0.113**	-0.115**	-0.115**	-0.117**	-0.102**	-0.118**
	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)
Paid overtime (yes)	0.021**	0.009*	0.019**	0.009°	0.019**	0.016**	0.008*	0.015**
	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.005)	(0.004)	(0.004)
Part time (yes)	-0.038**	-0.029**	-0.023**	-0.027**	-0.018	-0.026	0.016**	-0.025**
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Bonuses for shift, night and/or weekend work (yes)	0.047**	0.044**	0.053**	0.041**	0.051**	0.059**	0.041**	0.065**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Type of employment contract:								
Permanent	Reference category							

Fixed-term	-0.092**	-0.064**	-0.060**	-0.071**	-0.079**	-0.091**	-0.050**	-0.102**
	(0.005)	(0.005)	(0.005)	(0.008)	(0.006)	(0.005)	(0.007)	(0.005)
Other	-0.044**	-0.079**	-0.058**	-0.038**	-0.008	-0.112**	0.009	-0.059**
	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)	(0.012)	(0.015)	(0.010)
Occupation (n=23):	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm characteristics: [b]								
Private firm (yes): >50 per cent privately owned firm	0.005	0.016°	0.029**	0.085**	0.097**	0.079**	0.063**	-0.008
	(0.008)	(0.010)	(0.007)	(0.007)	(0.006)	(0.007)	(0.008)	(0.007)
Size of the establishment:								
1-4 employees	Reference category							
5-9 employees	0.029**	-0.018	-0.025°	0.041**	0.044**	0.017	-0.021	0.014
	(0.011)	(0.018)	(0.014)	(0.012)	(0.012)	(0.016)	(0.014)	(0.014)
10-19 employees	0.016°	-0.028°	-0.034**	0.039**	0.054**	-0.001	-0.016	0.019
	(0.010)	(0.017)	(0.012)	(0.011)	(0.011)	(0.015)	(0.013)	(0.013)
20-49 employees	0.040**	0.000	-0.007	0.060**	0.094**	0.026°	0.015	0.041**
	(0.010)	(0.017)	(0.012)	(0.011)	(0.011)	(0.015)	(0.013)	(0.013)
50-99 employees	0.071**	0.024	0.024*	0.090**	0.108**	0.048**	0.043**	0.058**
	(0.010)	(0.017)	(0.013)	(0.011)	(0.020)	(0.015)	(0.013)	(0.013)
100-199 employees	0.091**	0.041*	0.029*	0.108**	0.134**	0.076**	0.069**	0.076**
	(0.010)	(0.017)	(0.012)	(0.012)	(0.011)	(0.016)	(0.013)	(0.013)
200-499 employees	0.108**	0.062**	0.054**	0.137**	0.154**	0.095**	0.086**	0.108**
	(0.010)	(0.017)	(0.012)	(0.011)	(0.011)	(0.015)	(0.013)	(0.013)
500-1500 employees	0.136**	0.092**	0.061**	0.169**	0.197**	0.120**	0.130**	0.145**
	(0.010)	(0.017)	(0.013)	(0.012)	(0.012)	(0.016)	(0.014)	(0.013)
Firm-level collective agreement (yes): collective wage agreement at the firm level for blue- and/or white collars workers	0.033**	0.044**	0.041**	0.045**	0.043**	0.054**	0.039**	0.030**
	(0.002)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.002)
Industry effects (Nace 3-digit, n=142) [c]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.65	0.64	0.62	0.64	0.62	0.65	0.61	0.58
F-test	557.8**	541.9**	554.2**	526.0**	508.4**	539.5**	466.4**	441.2**
Number of observations	97,476	101,551	102,687	100,586	96,724	93,326	94,423	105,596

Notes : The dependent variable is the individual gross hourly wage, including bonuses (ln). White (1980) heteroscedasticity-consistent standard errors are reported between brackets. [a] Dummy for sex; 6 dummies for education; 8 dummies for age; 3 dummies for tenure; 2 dummies for the type of employment contract; a dummy indicating if the worker is part-time; a variable showing whether the individual received a bonus for shift work, night work and/or weekend work; a dummy for paid overtime; and 22 occupational dummies. [b] 7 dummies for the size of the establishment (i.e. number of workers); a dummy for the establishment's financial and economic control; and a dummy for the level of collective wage bargaining. [c] NACE three-digit industry classification; **/*/°: significance at the 1, 5 and 10 per cent, respectively.

APPENDIX 3

International Trade and Inter-Industry Wage Premiums

(GMM-SYS (dynamic), Dependent Variable: adjusted industry wage premium, robust s.e.)

Variables / Models:	(1)	(2)	(3)	(4)
IWD $_{t-1}$ [a]	0.353**	0.351**	0.440**	0.421**
	(0.068)	(0.072)	(0.073)	(0.083)
Export ratio	0.0.063**	0.063**	0.044°	0.041
	(0.017)	(0.017)	(0.023)	(0.026)
Import Penetration				
All countries				
High income countries (H)	-0.029	-0.029	-0.017	-0.012
	(0.019)	(0.019)	(0.021)	(0.025)
Middle & low income countries (UM, LM, L)	-0.097*	-0.097*		
	(0.041)	(0.042)		
Upper-middle income countries (UM)			0.001	-0.020
			(0.111)	(0.116)
Low-middle income countries (LM)			-0.108°	-0.118°
			(0.066)	0.068
Low income countries (L)			-0.361*	-0.286°
			(0.182)	(0.163)
Herfindahl Index		0.011		0.067
		(0.056)		(0.057)
Year dummies	yes (8 y.)	yes (8 y.)	yes (8 y.)	yes (8 y.)
AR(2) (*p-value)*	0.034	0.036	0.017	0.026
Hansen test (*p-value)*	0.229	0.213	0.373	0.257
Number of observations	861	861	861	861

Notes: [a] IWD $_{t-1}$ stands for one year lagged industry wage differentials. Inter-industry wage differentials are estimated on the basis of equation (1). Robust standard errors are reported in brackets. First and second lags of explanatory variables, excluding time dummies, are used as instruments. **/*/°: coefficient significant at the 1, 5 and 10 per cent, respectively.