

Trade and wages: Winning and losing sectors in the enlarged European Union

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Éva Katalin Polgár

eva-katalin.polgar@ecb.europa.eu

ECB - EU Neighbouring Regions Division

and

Julia Woerz

julia.woerz@oenb.at

OeNB - Foreign Research Division

Outline

Background and motivation

Wage and trade developments in the enlarged EU

Econometric analysis

Conclusions

Research question: is there a systematic relationship between trade and wages at the industry level in EU25?

Background

General perception:

trade \Rightarrow increased competition \Rightarrow wage pressure

Literature: diverse approaches

Theory: trade theory (Stolper-Samuelson etc.) rather than wage equations

Empirics: testing the theoretical predictions is not straightforward (Krugman, 2008)

Concerning the general perception: ambiguous results

Empirical literature

Trade and wages in general, mostly wage inequality:

Feenstra-Hanson: overview

Both positive and negative effects found

Transition countries: more limited evidence

Onaran-Stockhammer, 2006: negative long-term net effect of trade on wages

Other studies focusing rather on the relationship of FDI or skill-biased technical change and wages

Generally country-specific studies

Data sources and coverage

Coverage:

25 EU countries (excl. Bulgaria and Romania)

[two EU candidate countries separately considered]

11 years (1995-2005)

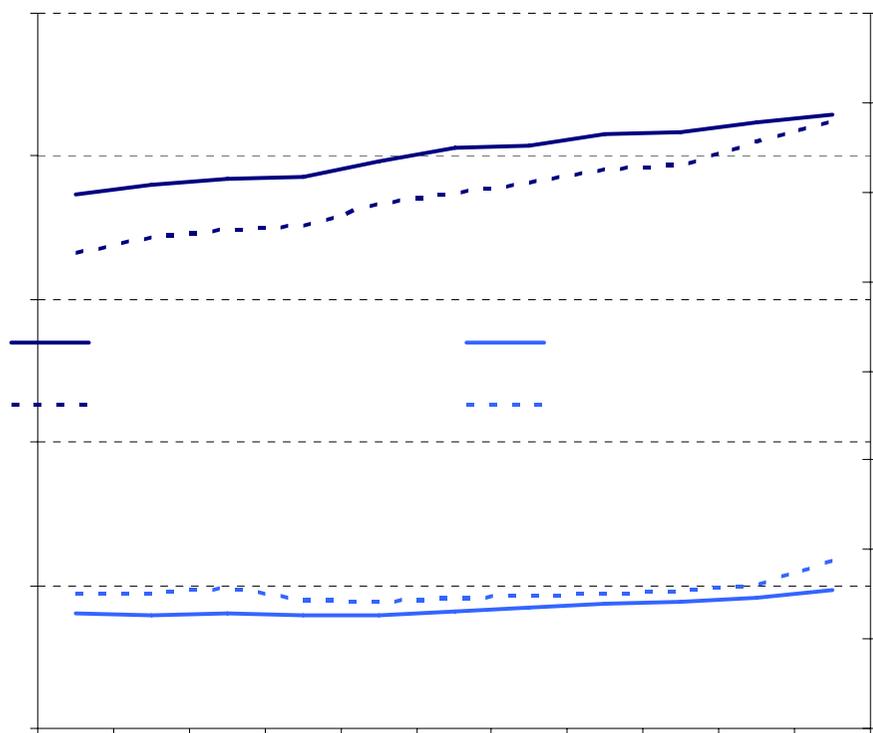
21 industrial activities (15 manufacturing + 6 service sectors)

Variables:

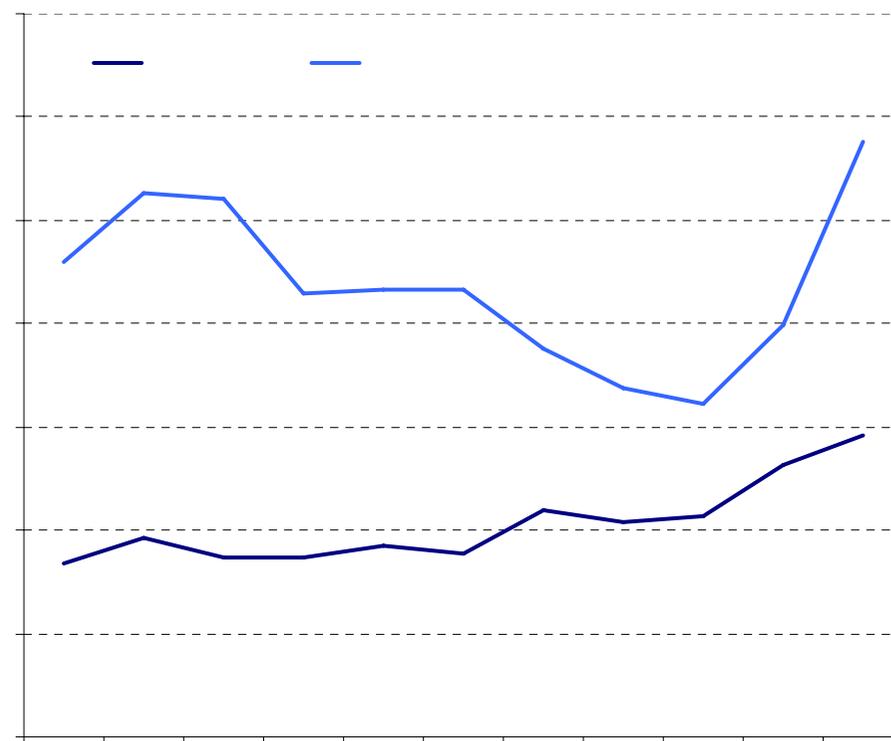
Labour compensation, gross output, value added, hours worked (EU KLEMS)

Trade flows (UN COMTRADE, Eurostat ITS)

Average real hourly wages of the economy



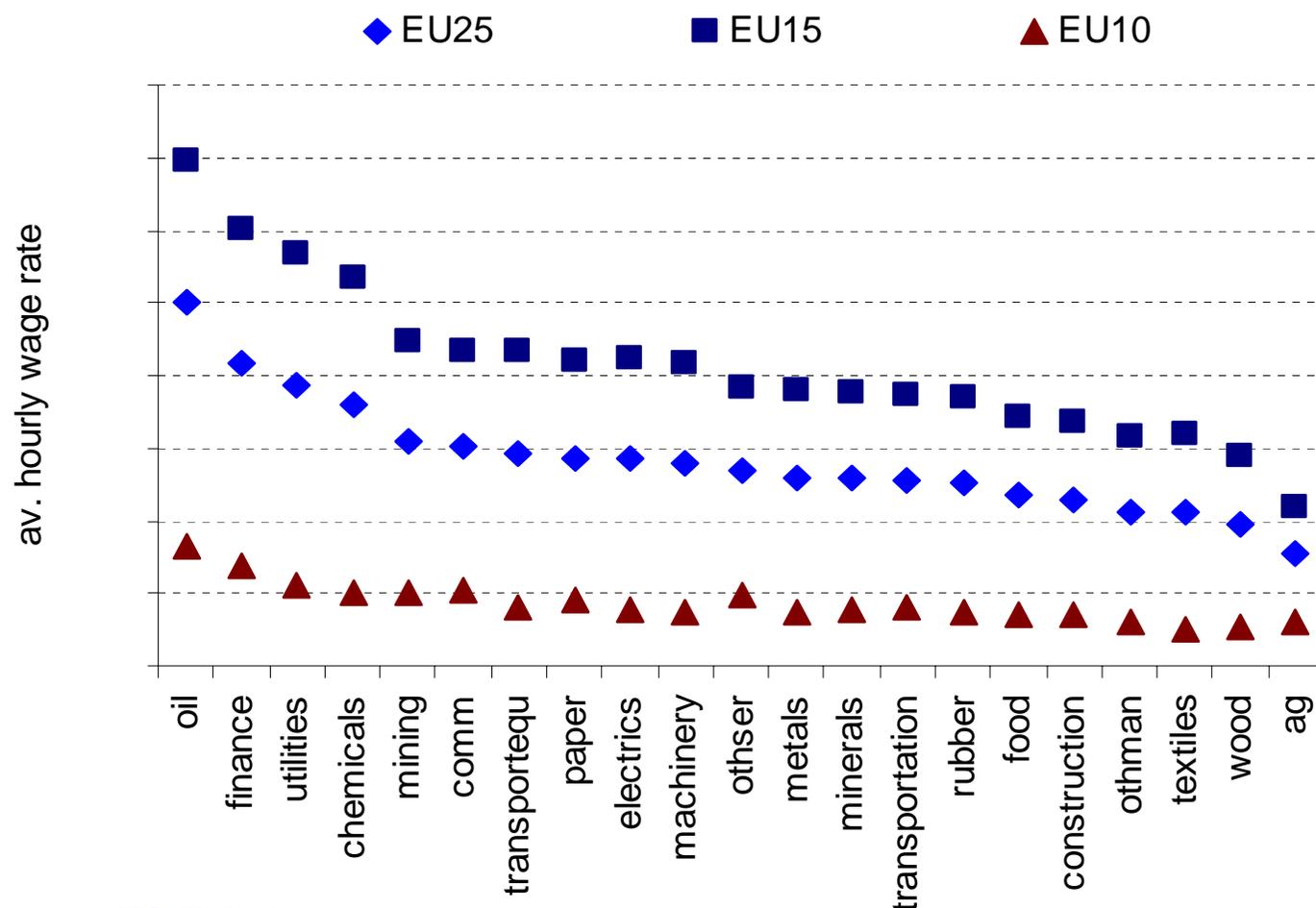
Coefficient of variation



Source: authors' calculations based on the EU KLEMS database

Relative wages by industry

1995-2005



Ranking of industries is remarkably similar for all country groups in terms of relative wages, but not in terms of trade performance

Grouping of industries

We define 3 industry groups according to their export performance (= cumulated real export growth) in 1995-2005:

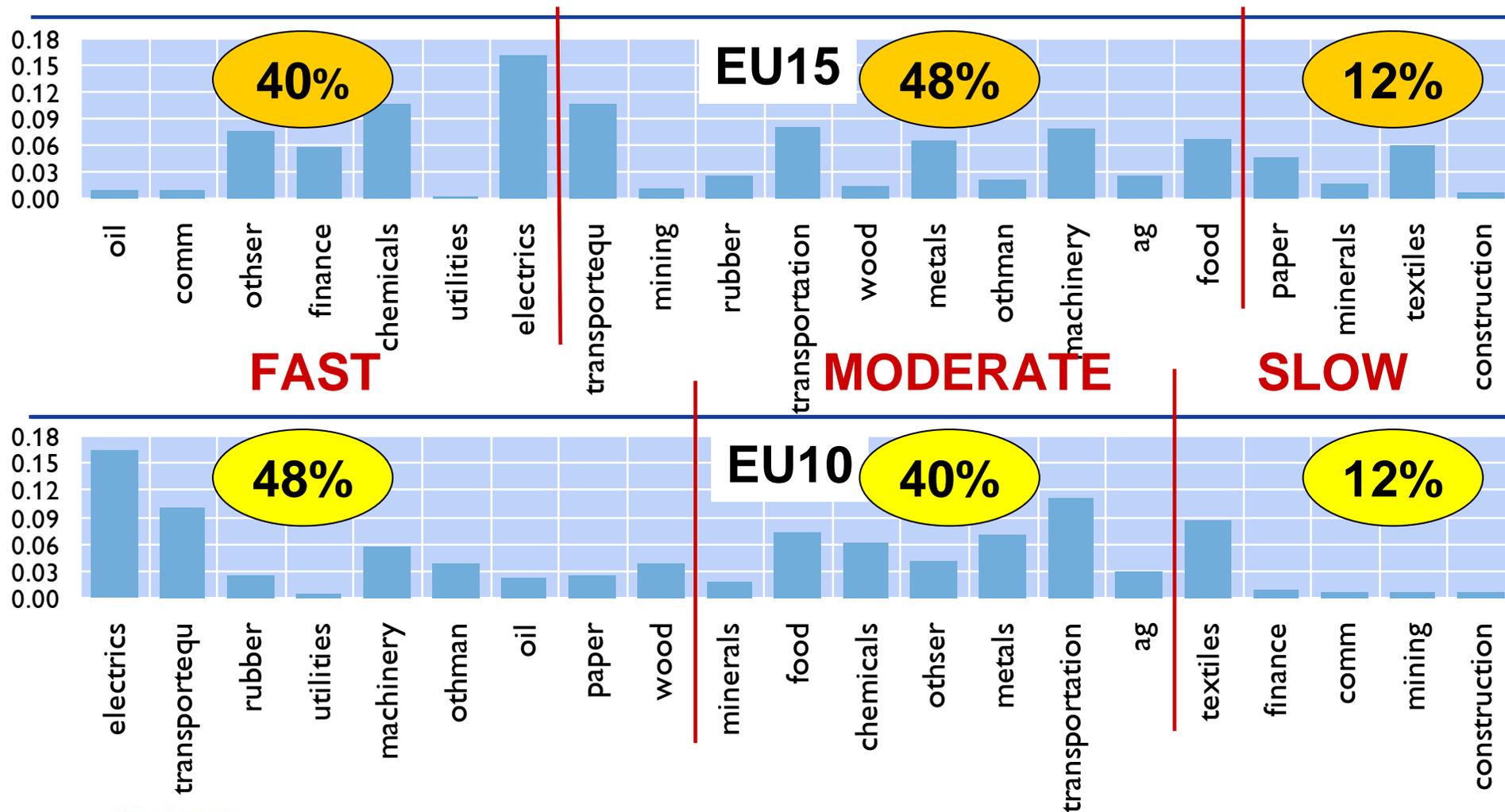
Fast growing industries > 100%

Moderately growing industries > 30% but < 100%

Slow growing industries < 30%

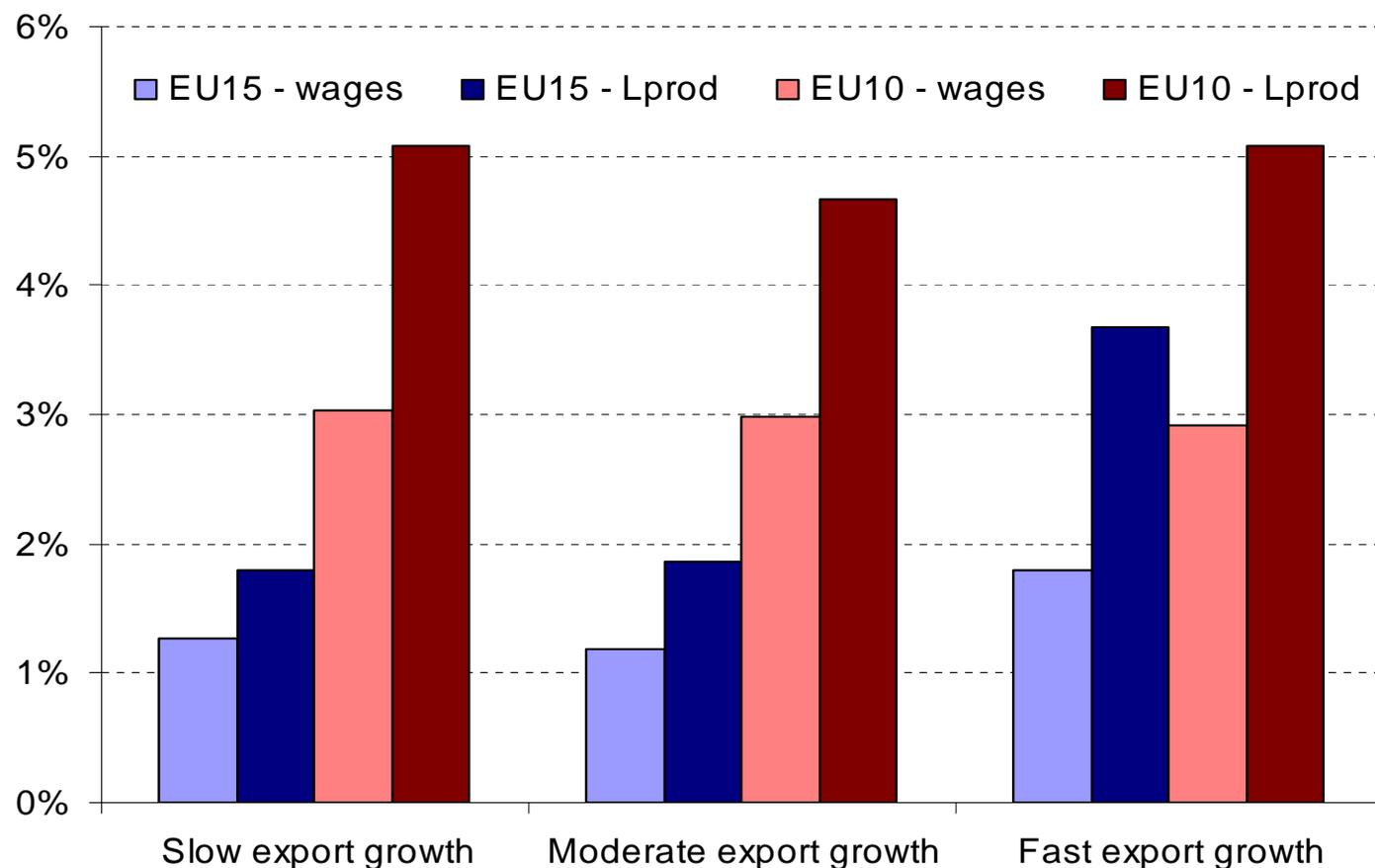
Pro memoria: cumulated global real export growth in 1995-2005: 30% (WTO)

Export performance by industry



Wage and productivity growth by industry groups

av. annual growth: 1995-2005



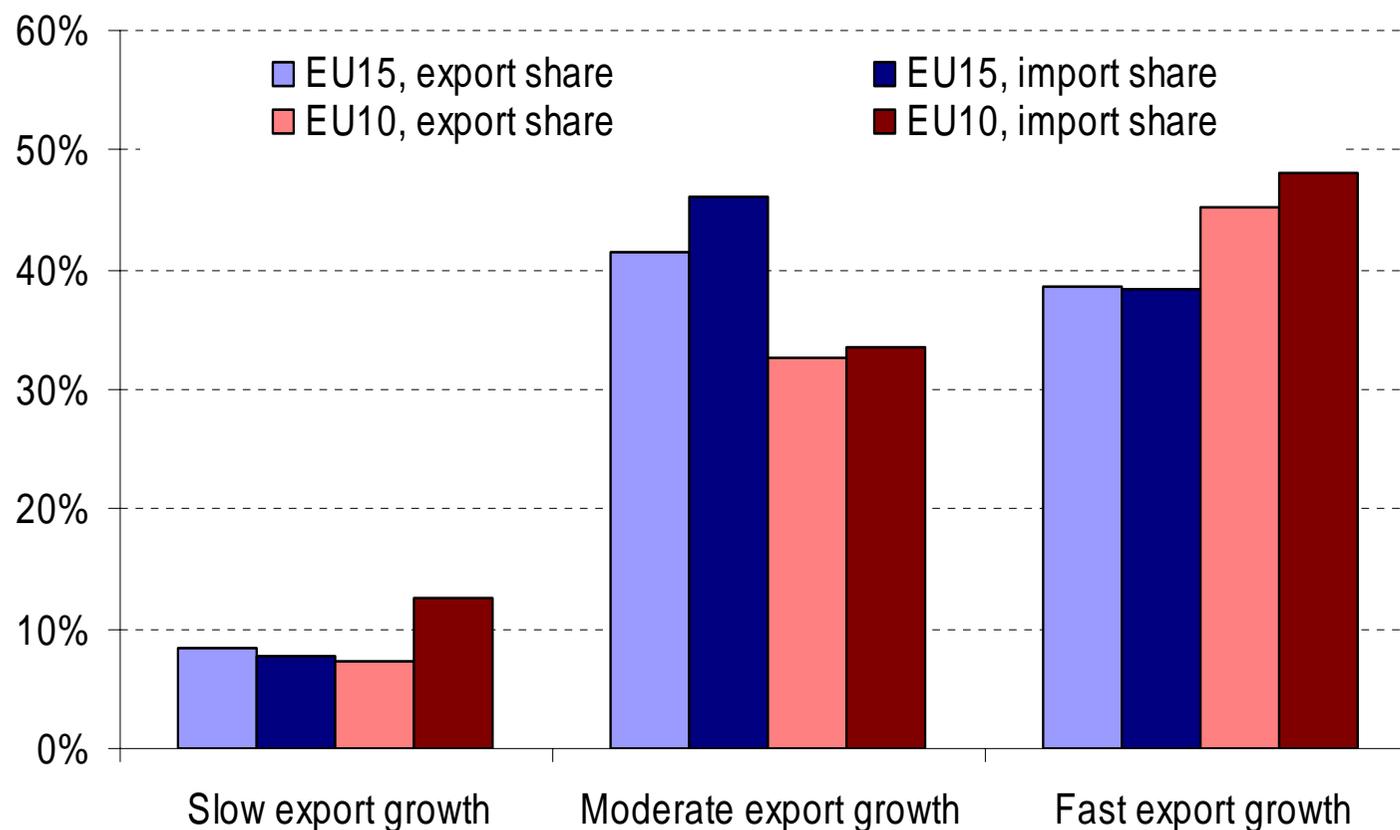
Wage and productivity dynamics much stronger in EU10.

Productivity growth exceeded wage increases in all industry groups.

Source: authors' calculations based on the EU KLEMS database

Trade shares

2005



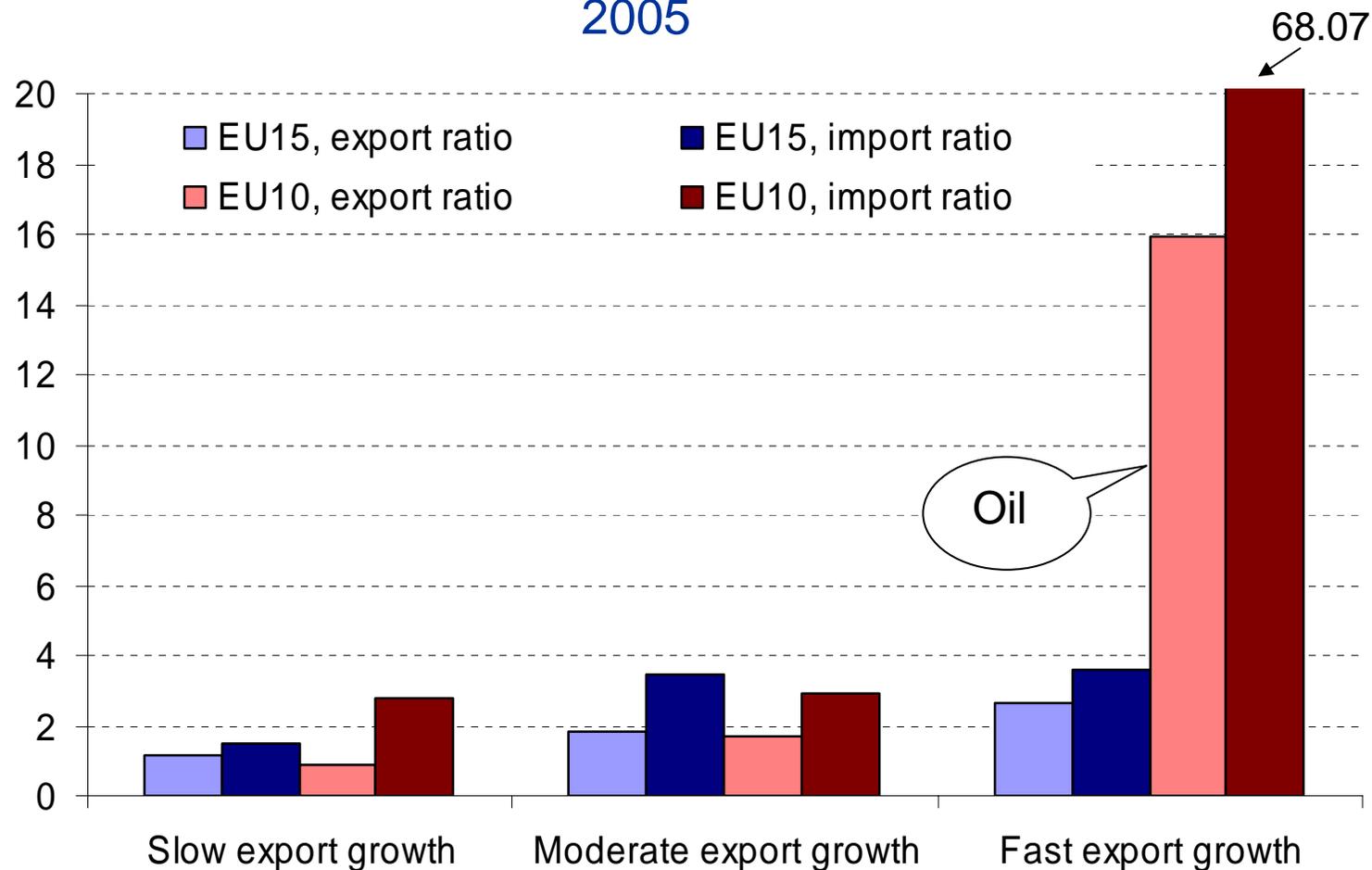
Source: authors' calculations based on the UN COMTRADE database

Industries with highest export growth account for most trade flows to/from EU10 in terms of *cumulated* trade shares ...

... and dominate in both EU10 and EU15 in terms of *average* shares.

Trade-to-value added ratios by industry groups

2005



EU10: the impact of trade highest in industries with fastest export growth.

EU15: the impact of trade very similar across industry groups.

Source: authors' calculations based on UN COMTRADE database

Econometric analysis

We explain real hourly wages by

- Real economy and labour market relevant variables

Labour productivity



Unemployment



- Trade variables



imports/value added (resp. exports)

imports (exports) in other sectors

general openness of the country

across countries and time for each industry.

Results I

		EU25	EU15	EU10
w_t-1	+	✓	✓	✓
Prod	+	✓	✓	✓
UR	-	✓	✓	✓
Imports	+	chem, metals, utilities, finance	ag, food, chem, rubber, min, metals, electr, man n.i.e.	chem, metals, utilities, finance
	-	wood, oil	comm, business ser	wood, oil
Imports other	+	mining, oil, electr, comm, business ser	oil, man n.i.e.	electr, comm, business ser
	-	metals	minerals	metals
Open general	+	business ser		comm, construction, business ser
	-	wood, paper, rubber, metals, transp.equ., man n.i.e., transp.ser	ag, wood, oil, man n.i.e., transp.ser	mining, wood, paper, rubber, metals, transp.equ., man n.i.e.

Results I

- **Elasticity of wages to trade depends on economic activity**
Cross-country differences matter less for the wage response to trade than industry-specific characteristics
- **Still, it is not adequate to treat EU15 and EU10 alike**
- **More open countries have lower wage levels**
- **But we find more industries with a positive direct impact from trade than a negative sign**
- **Results for exports similar**

Results I

EU25: 6 out of 21 industries show a statistically significant correlation between trade and wages, of which 4 show a positive sign

EU15: 10 industries (8 positive)

EU10: 8 industries (6 positive)

But the economic impact is very small!!!

EU15: elasticity around 0.01

EU10: elasticity around 0.003 – 0.085

Results I – Industries grouped by export performance

EU15	export growth performance		
	fast	moderate	slow
lagged wage	0.4518 ***	0.3518 ***	0.4078 ***
unemployment	-0.0100 ***	-0.0073 ***	-0.0067 ***
productivity	0.0926 **	0.2399 ***	0.274 ***
import ratio	0.0017 ***	0.0011	0.0106
import ratio - rest of ec.	0.0600 *	0.0310 *	-0.0167
country openness	-0.1018 ***	-0.1097 ***	-0.0527
Obs.	861	1233	495
Chi2	268.7419	270.5056	188.5845

Results I – Industries grouped by export performance

EU10	export growth performance		
	fast	moderate	slow
lagged wage	0.6786 ***	0.2337 **	0.0668
unemployment	-0.0052 *	-0.0079 **	-0.002
productivity	0.1555 **	0.577 ***	0.6024 ***
trade ratio	0	0.0131 ***	0.0082
trade ratio - rest of ec.	0.0289 ***	-0.0205 *	-0.0031
country openness	0.0624	-0.0934 *	-0.0573
Obs.	780	630	450
Chi2	164.6839	158.2713	215.3288

How does trade affect wage formation?

Does trade bring more wage-discipline?

In an integrated economic environment: will wages follow foreign wages or domestic factors (productivity)?

We add to our model foreign wages:

wages in the same sector in all other countries



wage_EU * open_sector



prod * open_sector



Results II

Confirmation of this wage-disciplining effect only for EU10

	EU15			EU10		
	fast	mod.	slow	fast	mod.	slow
Imports	+		+	+	+	+
M_other	+	+			-	
Open_gen	-	-	-			
Wage_EU	+	+	+	+		
Wage_EU*open	+			-		-
Prod * open	-					+

Results II

- **Controlling for the influence of foreign wages does not alter previous results**
- **EU15: foreign wages correlate positively and strongly with wages (elasticity: 0.15 – 0.17)**
- **Trade does not bring wages more in line with domestic productivity developments**
- **EU10: wages correlated with foreign wages only in fast growing export industries (elasticity: 0.28)**
- **But we find here evidence for more reaction of wages to changes in productivity**

Conclusions

Increased trade penetration can change the composition of tasks towards more productive, more skill-intensive activities by replacing low-wage jobs

At the same time, greater exposure to international competition (tougher economic environment) exerts downward pressure on wages, possibly also undermines the power of trade unions

These counter-acting effects materialise differently in individual industries

Industries with fast export growth react more strongly to trade

Conclusions

The effect of trade on wage levels is small and depends strongly on economic activity:

- +** manufacture of chemicals, metals (EU25)
- +** electrical machinery (EU15)
- provision of utilities, financial intermediation (EU10)

Very often: more open countries --> lower wage levels in resource

- intensive and low-skill activities (wood, paper, rubber, metals, man. n.i.e., transport. equ., transp. services)

Differences across countries matter less than across industries!

Conclusions

Economic policy must take account of substantial differences between individual economic activities when promoting trade

While the productivity enhancing effects of trade are more often positive, an increase in the return to labour is not always guaranteed

EU10: trade promotes the realignment of wages with productivity developments (EU15: foreign wages influence wages more strongly)

Further important issues to be considered: wage inequality and unemployment effects.

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ECB - EU Neighbouring Regions Division

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Éva Katalin Polgár

EU Neighbouring Regions Division

European Central Bank

and

Julia Woerz

Foreign Research Division

Oesterreichische Nationalbank

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Abstract

The paper contributes to the abundant but as yet inconclusive literature on the effect increased openness to trade has on wages, using industry-level data for 21 service and manufacturing industries in 25 EU countries over the period 1995-2005. The cross-country and industry-specific approach allows us to control for unobserved heterogeneity at both country and industry levels. While we are able to identify some, often resource-based industries as winners from increased trade integration, we find very few and small effects in general. The relationship between trade and wages tends to be weaker in western European countries (EU15) than in the EU Member States in central and eastern Europe (EU10). At the same time, higher openness appears to have led to an increasing influence of foreign wages on wage setting in the EU15. In contrast, wages in the EU10 have become less responsive to foreign wages and we find evidence for more realignment with productivity developments as a result of trade openness.

JEL codes: F14, F15, F16, J31

Keywords: trade, openness, wages, imports, European integration, wage discipline

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1. Introduction

Globalisation has gained unprecedented momentum in recent decades. Thus, it is no surprise that it also features prominently in theoretical and empirical papers, trying to investigate or predict its impacts. Some effects are welcome (e.g. lower consumer prices), while others generate resistance, given fears that cheap imports or offshoring production to areas with lower input prices will negatively affect employees, lowering wages and/or increasing unemployment.

The economic literature on whether such fears are grounded is vast, but has delivered mixed results. This is especially true for empirical models. It might well be the case that it is impossible to draw general conclusions, as individual countries and regions differ substantially in terms of trade and wage structures as well as, perhaps, the relationship between trade and wages. Therefore, given the unquestionable relevance of the topic, it makes sense to continue with careful analysis for different regions of interest. One such region is central and eastern Europe, where trade was liberalised generally in the early 1990s and subsequently redirected towards the EU15¹, as a result of which it increased in volume and importance.

For these reasons, we would like to explore the effects of central and eastern Europe's increased openness to trade on wages within the enlarged European Union (EU). The fact that trade and wages often evolve differently across industries would imply that the relationship between the two also depends on the type of economic activity. For example, increased import penetration may drive up average wages in more skill-intensive sectors but exert a downward pressure on wages for low-skill activities, which tend to be displaced by imports. Therefore, the analysis in this paper is carried out at the industry level. Another purpose of the paper is to identify the relevance of domestic versus international factors in determining sector-specific wage levels. While there is a strong persistence in wages over time in the EU15, wages appear to respond more strongly to changes in domestic determinants in the EU10. In this respect, we investigate the role that trade plays in bringing wages in line with domestic productivity developments.

The paper is structured as follows. Section II provides a review of the relevant literature, constituting the background and the motivation of the current study. Section III is a descriptive analysis of the data, depicting the variables relevant for the analysis. The econometric estimation follows in Section IV, and conclusions are drawn in Section V.

2. Existing findings and motivation

The wage rate, i.e. the factor price of labour, is a crucial economic variable as it influences the supply and demand of labour, and therefore affects output, unemployment, consumption and welfare. Accordingly, wage developments may be analyzed from many different angles, making the theory of wages rather complex. Taking an international perspective and including openness and trade in the considerations increases this complexity. While there is a general perception that trade could affect wages through enhancing competition and thus pressing for

¹ EU15 includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg Netherlands, Portugal, Spain, Sweden and the United Kingdom. EU25 includes all current Member States except for Bulgaria and Romania, i.e. also the EU10 (Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia), who joined the EU on 1 May 2004.

lower production costs, it is surprisingly difficult to find clear-cut results for the influence of trade on wages in economic theory.

Wage equations generally focus on the domestic determinants of wages (education, experience etc.).² Alternative determinants may be derived from wage-related trade theory, such as the theory of factor price equalisation or the Stolper-Samuelson theorem, which states a positive relationship between the relative prices of goods and the relative returns of the factors used more intensively in their production. The locally scarce factor, supposedly capital in developing and labour in developed countries, would thus suffer from trade liberalization (*ceteris paribus*). The problem in applying these theories empirically or as a basis for policy implications is that they rely on relatively restrictive assumptions³, and the results generally refer to the relative intensity of factors in the production of goods, which is rather difficult to establish based on available data. Therefore, theory is rather inconclusive for simple statements on the impact of trade openness or trade flows on overall wages or wages in certain sectors.⁴

The results are also rather mixed empirically, and often it is hard to establish the exact relationship to theoretical statements, like the Stolper-Samuelson theorem, given that available data do not allow to completely control for factor intensities in production. In a recent work Krugman considers past trends in trade and their effect on our understanding of the trade-wage nexus. He discusses in detail the consequences in aggregation at the sectoral level, and states that with vertical integration it became very complicated to judge which sectors are labour intensive and which are skill intensive, therefore it is not obvious to interpret such an analysis from the Stolper-Samuelson perspective. In particular, he states that “the changing nature of world trade has outpaced our ability to engage in secure quantitative analysis ... How can we quantify the actual effect of rising trade on wages? The answer, given the current set of data, is that we can't.”⁵

Nonetheless, more current theoretical papers on wages and trade (and many different models) appear to coincide in the relatively general conclusion that international trade increases wage inequality within an economy (across different activities as well as across different skill segments etc.). An earlier example, focusing on the effects of globalisation, is Manasse and Turrini (2001). In the trade model of Egger and Kreckemeier (2008) international trade also increases involuntary unemployment next to domestic wage inequality. In Amiti and Davis (2008) trade liberalisation (reduction in tariffs) results in increased inequality.

However, the picture is less clear again if one turns to empirical applications, which require firm-level data and often treat wage inequality as a rather abstract concept that is not easily adaptable to data. Indonesian data analyzed by Amiti and Davis (2008) point toward increased inequality. Using data on occupations in the US, Rabbani (2005) finds wage inequality to have increased with openness across countries, but less strongly in the case of a trade deficit.⁶

² See for example Mason (1994), Wolpin (2000) or Belzil (2006).

³ Relaxing some of the assumptions can change the results. Thompson (2007; p.12.) examining theoretical results concerning the influence of a fall in import prices of labour intensive imports on wages concludes: “With more than the minimal number of inputs, there is no simple theoretical prediction regarding the wage.”

⁴ In the specific context of offshoring Hijzen et al. (2007; p.3.) state that “In general, these studies conclude that almost anything can happen to wages depending on the configuration of sectoral factor-intensities, the relative factor-intensity of components relocated abroad and relative factor endowments.” See also Stehrer (2005).

⁵ Krugman (2008), p.27.

⁶ The question of causality naturally arises in this context. Trade may have an impact on wages, but large wage differentials may also promote trade. In this paper, we mainly start with the idea of trade having an influence on

In contrast, Galiani and Sanguinetti (2003) find that in the case of Argentina, trade deepening can only explain a relatively small proportion of the observed rise in wage inequality. Similarly, Attanasio et al. (2004) find that the overall effect of the trade reforms in Columbia on the wage distribution may have been small. Finally, Mishra and Kumar (2005) even find the opposite effect for India, suggesting that trade liberalisation has led to decreased wage inequality.

The inconclusiveness of the empirical evidence is not surprising, taking into account that also in this branch of the literature, theories rely on ad hoc assumptions and deliver conclusions for certain elaborate cases including characteristics not directly observable in the data. This points to a final shortcoming of the large theoretical and empirical literature on the relationship of trade and wages: in a quest to include the details present in the theory as much as possible, most empirical evidence is based on country-specific survey data on individuals or firms, while cross-country analyses are mostly missing. Our attempt is to fill this gap by exploring the effects of increased openness to trade on industry level-wages within the enlarged European Union. In the group of central and eastern European transition countries, trade liberalisation in the early 1990s boosted trade volumes with western Europe. This boom was reinforced by the process of EU accession. This is thus an interesting case for investigating the consequences of these increased trade flows. Is there any effect on wages, wage growth or wage inequality in this group of countries? Is there an impact in the western European countries? Does the impact differ at the sectoral level; are there winners and losers among the industries?

We attempt to answer these questions focusing on the transition countries and the group of incumbent EU states separately. While these two groups of countries share many common characteristics (especially in their labour markets) they also show a clear distinction in their trade patterns and dynamics therein. With regard to transition economies, the empirical evidence on the trade-wage nexus is rather limited. Most related papers investigate somewhat different questions, like the effect of foreign direct investment (FDI) on wages or the employment effects of trade.⁷ The trade-wage relationship in the region is explicitly considered in Onaran and Stockhammer (2006), focusing on the manufacturing sectors in five countries (the Visegrad countries and Slovenia) in 2000-2004. According to the findings, FDI had a positive effect on wages only in the capital- and skill-intensive sectors, while the long-term net effect of exports and imports was negative.⁸ In our contribution to the topic, we would like to check whether one can find an empirical relationship between wage developments and trade in the EU25, and whether it is the same across industries and country groups or not.

domestic wage developments. In order to estimate the latter effect consistently despite the likely reverse causality we employ dynamic panel data methods in the empirical part.

⁷ Bruno et al. (2005) focuses on six manufacturing sectors in three countries (Czech Republic, Hungary, Poland) in 1993-2000, and tries to relate FDI to the rising skill premium. The hypothesis is basically rejected. Esposito and Stehrer (2007) focus instead on the sector bias of skill-biased technical change and find that it is important in explaining the rising relative wage of skilled workers in the manufacturing sector in Hungary and Poland, but the effect cannot be confirmed in the Czech Republic. Grotkowska (2008) is investigating the impact of trade on employment in the Polish manufacturing sector, and finds that there is a significant, though small impact, which is negative in sectors competing with imports in developing countries, while positive in sectors exporting to developed countries.

⁸ In particular, exports had a negative and imports a positive effect on wages, but overall the impact of international trade was small and in net terms negative.

3. Wage and trade developments within the enlarged EU

For the analysis, three main data sources are used, and extended with a few series from different sources. The main dataset for all but trade variables is the EU KLEMS database. This contains measures among others on output, price developments, productivity, labour compensation and employment at the industry level for all EU25 countries up to 2005.⁹ As eight of the EU10 countries are transition economies, which had often lacking and incomparable data or untypical economic developments before 1995, we use data for 1995-2005 only. Nominal data are in national currency, which we convert to euro using annual exchange rates from the IMF WEO¹⁰ database. We have complemented this dataset by trade data at the industry level from the UN Comtrade database for the manufacturing sectors and from the Eurostat International Trade in Services (ITS) database for the services sectors.¹¹ All trade data were converted to euro using the annual ECU-euro/USD exchange rates from the Main Economic Indicators database of the OECD. Hence, we arrive at a comprehensive dataset, linking trade, output and wage data for the manufacturing and the services sector whereby we have 15 manufacturing roughly two-digit NACE sectors (including agriculture) and 6 service sectors at the one-digit NACE level. In total our dataset comprises information for 25 countries, 11 years and 21 economic activities.

Candidate countries of south-eastern Europe could not be included in the main analysis due to the incomparability or unavailability of data. Nevertheless, we did undertake a separate and smaller-scale examination of Croatia and the former Yugoslav Republic of Macedonia.¹² Sources for the trade data of these two countries are the same as above, while all other data series were kindly provided by the respective central banks.

3.1. Wages and productivity

The EU KLEMS database includes data on total employee compensation, the number of people employed and hours worked in the EU25 countries, which allows us to calculate wages per employed persons and hourly wages. Despite concerns about the comparability of the hours worked, we decided to use hourly wages for three reasons. First, in terms of the skill composition of labour, we only have information on the hours worked. Second, if reliable, hours worked give a clearer picture of labour used in the production process than the number of employees. Last, in our case the correlation of the two variables is very strong for all countries and industries, so there is no reason to assume that using the number of employed would produce a more reliable comparison. Therefore we calculate hourly wages (compensation of employees divided by hours worked) and hourly productivity (value added divided by hours worked) for each observation in our three dimensions (country, industry and year).

⁹ The EU KLEMS dataset was established by a consortium led by the Groningen Growth and Development Centre. The time series start in 1970 and have currently been updated to include 2006 (but 2006 data were not yet available for this study). See Timmer et al. (2008).

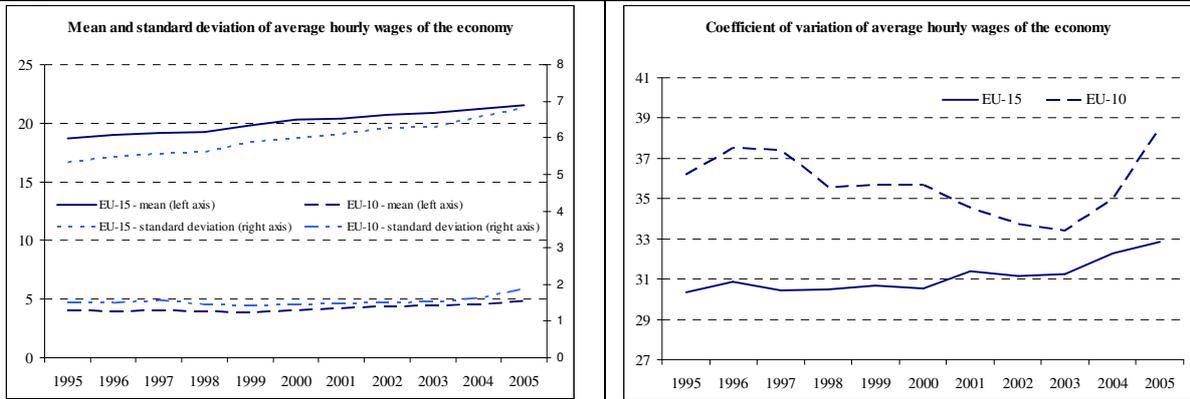
¹⁰ International Monetary Fund, World Economic Outlook. From this source we only take the exchange rates, the consumer price indices used for deflating some of the variables where the GDP deflators are not applicable, and the total exports and imports of goods and services of the countries.

¹¹ Merchandise trade data were converted from 5-digit SITC codes to 2-digit Nace Rev. 1 industries using the correspondence keys implemented in the World Bank and UNCTAD WITS software. Services trade data were converted to match closely NACE Rev. 1 1-digit codes following the UN Manual on Services recommendations.

¹² There are currently three EU candidate countries. However, wages at the industry level could not be calculated for Turkey, because only the compensation of employees, but not the number of employees (or hours worked) are available at this level. Therefore we could not include it in this analysis.

What do the data tell us? In terms of average hourly wages of the economy (that is, average across the industries), one can see a significant difference between the EU15 and EU10 countries. This is obvious from Figure 1, where we have taken simple averages of the mean hourly wages in the respective countries. Both the mean and the standard deviation show a steady, but moderate upward trend in both country groups.¹³ Since the standard deviation is not dimensionless, cross-country comparisons are often based on the coefficient of variation rather than a normalised measure of dispersion. Here we can see that the variability of average hourly wages (in per cent of the mean) is actually higher in the EU10 during the whole period.¹⁴ But while it continuously increased in the EU15, it actually declined in the EU10 until roughly EU entry and subsequently rose to its highest level in 2005.

Figure 1



Sources: Authors' calculations based on EU KLEMS.
 Notes: Hourly wages in euro, deflated by the consumer price index.

To take a different perspective, we calculated averages, standard deviations and coefficients of variation over time in all industries and for all countries. Since the EU15 and the EU10 retain distinct comparative advantages, the export performance of individual industries also differs greatly between the two country groups. To reflect this, we identified slow, moderately and fast growing industries separately for each group. Our upper limit for slow growth was 30%, the rate at which real world exports grew cumulatively between 1995 and 2005 according to WTO figures, while anything beyond 100% was defined as fast growth performance.¹⁵ For the EU15, we identified chemicals, electric equipment, communication and financial services and utilities as industries with fast export growth. Their joint share in total exports averaged around 40% for the region over the past decade. Their EU10 counterparts were, again, producers of electric equipment and utilities as exporters of mechanical machinery, other manufacturing, paper, rubber, wood and transport equipment. Between them, these industries accounted for nearly 50% of all exports on average.

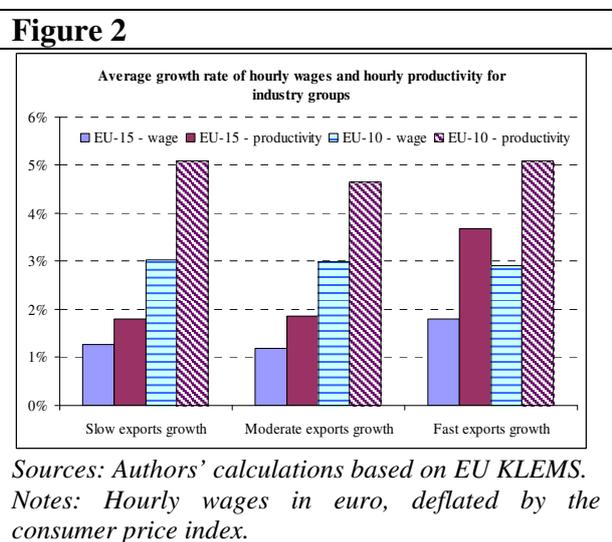
Across all industries, the EU15 average wages were higher than in the EU10 group; for the coefficient of variation this relationship was inverted. Moreover, we did not find much variability across the industry groups, except for the average real hourly wage in the EU15, which was substantially higher in the group with the fastest export growth than in the other

¹³ The only countries where the mean declined over time are Spain in EU15 and Hungary and Slovenia in EU10. It increased very significantly in the United Kingdom, the Baltic States and the Czech Republic. However, it is only the Czech Republic that made it to the upper half of the EU10 countries in terms of wages, while Slovenia still had the highest levels in 2005. It is also worth mentioning that hours worked remained remarkably stable over time in most countries, the increase is therefore due to the rising compensation of employees.

¹⁴ In the full sample is the highest in Portugal and Hungary, and the lowest in Sweden and Denmark.

¹⁵ The grouping of industries according to these criteria is available upon request.

industry groups. In order to get a clearer picture of the dynamics, we calculated the average annual growth rate of our main variables in all industries and countries over the entire period. Figure 2 shows the average annual growth rate of hourly wages together with that of hourly productivity. Both wages and productivity have generally increased at a higher rate in the EU10 than in the EU15. Productivity growth exceeded wage growth in all industry and country groups.



The correlation of average hourly wages and productivity was generally very high, except for the oil sector, and typically somewhat higher in the EU15 countries than in the other group. The opposite holds for the correlation of the growth rates of these variables, which was also generally lower. The two groups of countries differed substantially with regard to the distribution of wages and productivity. The distributions of both variables generally have a positive skew in both regions; in the EU10, they are very dense whereas the EU15 countries show a large range of higher values for both variables in the data at a low frequency,

reflecting much higher wages and much higher productivity values than in the EU10 group.

For Croatia and the former Yugoslav Republic of Macedonia, we do not have fully comparable data. Therefore, we cannot calculate hourly wages, but have – for a shorter time period – monthly gross wages. Average real wages across industries in Croatia are at a level comparable to average monthly wages in the EU10, while wages in the former Yugoslav Republic of Macedonia are approximately half as high. While the average monthly wage jumped by about 31% in Croatia between 1996 and 2006, it even declined slightly in the former Yugoslav Republic of Macedonia in this period. The dispersion of wages, as measured by the standard deviation, increased in both countries. This also holds for the coefficient of variation, but the increase was more pronounced in the former Yugoslav Republic of Macedonia, where wages vary more across industries than in Croatia.

3.2. Trade variables and the openness of the economy

Trade variables show lower dispersion during the period in general, and the respective export and import indicators are highly correlated. Total exports and imports of goods and services (taken from the IMF WEO, see footnote 10) have risen substantially over time, with France, Germany and the United Kingdom, as well as the Czech Republic, Hungary and Poland showing the highest rates of growth in the two country groups. Both the ratios of exports and imports to value added and openness increased moderately in the economies in general, as we would expect given the greater economic integration of these countries ten years on. Interestingly, we can observe very diverse developments at the industry level.

Given the focus at individual industries in this paper, let us highlight some main features of our industry groups with respect to trade. The share of an industry's exports/imports in total national exports/imports indicates its relevance for the overall trade performance of the economy. The industries with the highest (export as well as import) shares are electrical and optical equipment, chemicals and transport equipment. Among the sectors with somewhat

lower but still significant trade shares, export performance typically matches import performance, except for mining and quarrying (which reveals high import shares only) and transportation and storage services (which is characterised by significant export shares only). The two country groups differ substantially when it comes to exports of chemicals and real estate and business services (where the shares are higher in the EU15) and in electrical and optical equipment (which is more relevant in the EU10). This also holds for imports, except for chemicals where the difference is much smaller.

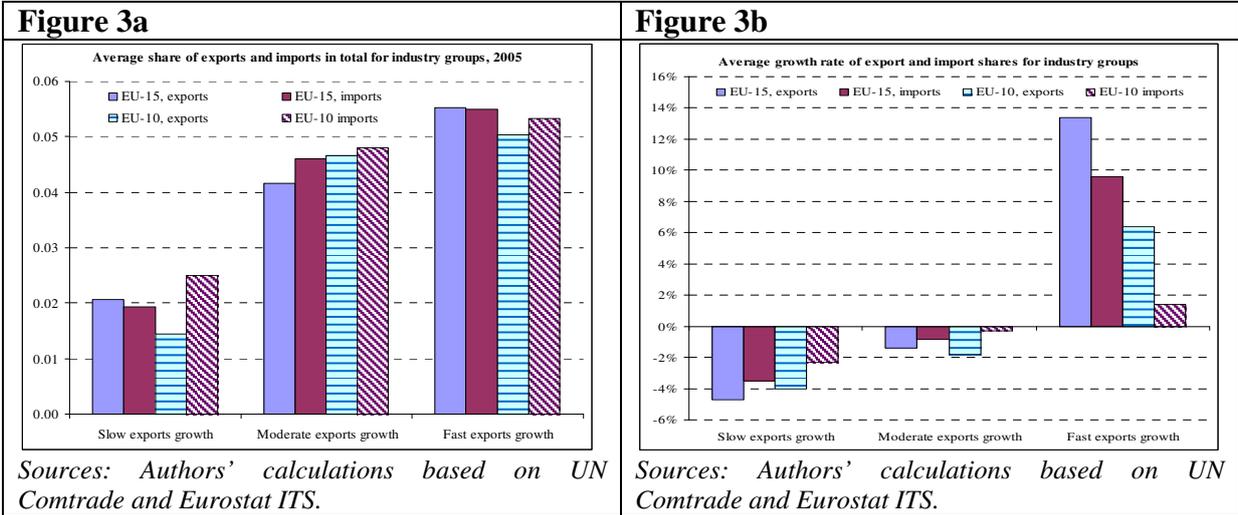
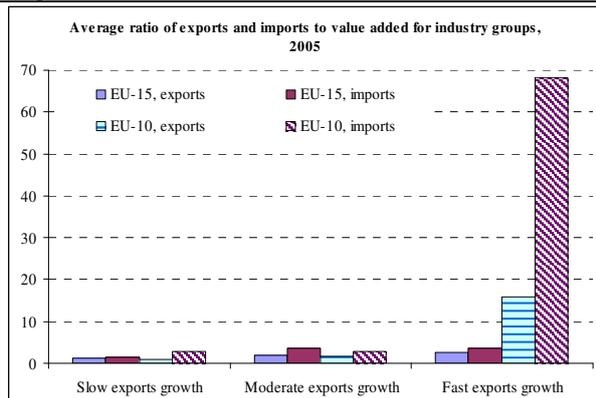
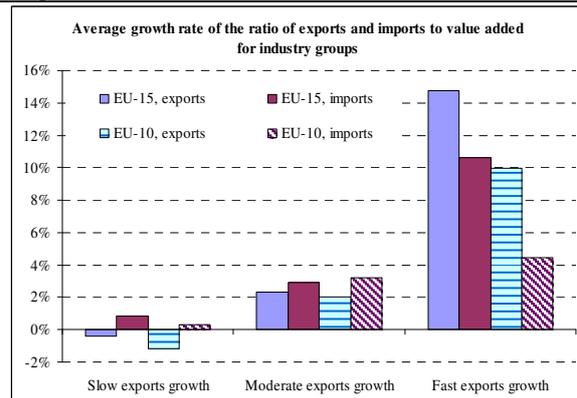


Figure 3a shows that on average the industries with more rapid export growth had grown to become the most important sectors in terms of both imports and exports by 2005. In the EU15, import shares are higher than export shares only in the sectors with moderate export growth, while the EU10 is a net importer in all industry groups.

The ratio of imports and exports to value added, as well as openness (measured as imports plus exports over gross output) reflect how important trade is for a sector, while the shares described above indicated the relevance of the sectors in trade. While the differences are minor in the EU15, where the sectors with slow export growth are generally the most open industries, in the EU10 trade ratios are by far the highest in the group with the most dynamic export growth (this is especially true for the import ratio, see Figure 4a), reflecting the high trade (particularly import) penetration of the oil sector in the EU10. Mining and quarrying is only sector where both ratios are substantially higher in the EU15, which means that only the group with the fastest export growth is more open in the EU10 than in the EU15. In the EU15 the ratio of oil imports does not seem to matter to this extent, and openness is on average lower in the fast growing sectors than in the moderately growing sectors.

Figure 4a

Sources: Authors' calculations based on UN Comtrade and Eurostat ITS.

Figure 4b

Sources: Authors' calculations based on UN Comtrade and Eurostat ITS.

In terms of growth rate of trade ratios, clearly the group with the most dynamic export growth leads in both country groups (Figure 4b). Export and import ratios in the EU10 generally increased at a more moderate pace than in the EU15. In terms of openness, this resulted in negative average growth rates in both country groups in the slowly expanding (or sometimes declining) sectors, and accelerating growth in the other groups – reaching 10% in the EU15 and 6% in the EU10 for the most dynamic group.

Turning to Croatia and the former Yugoslav Republic of Macedonia, trade ratios and openness have been increasing due to enhanced economic integration, but the export base is narrow. In absolute terms, total exports and imports of goods and services have risen substantially over time in Croatia and less strongly in the former Yugoslav Republic of Macedonia. Both the ratios of exports and imports to value added and openness increased in the economies in general, as we would expect given the increased economic integration of these countries with especially the EU economies. Interestingly, developments have been more diverse at the industry level. In terms of exports, the industries with the highest shares in total exports are hotels and restaurants in Croatia (over 30%) and textiles and metals in the former Yugoslav Republic of Macedonia (over 25% and 20%, respectively). The dominance of these sectors reflect that the export base is very narrow in these countries, especially in manufacturing, and performance is highly dependent on developments in tourism (Croatia) or metal prices (former Yugoslav Republic of Macedonia).¹⁶ Imports are more broadly based, with transportation (over 10%) and electrics, machinery and chemicals accounting for the highest shares in Croatia, and food (over 10%), chemicals and metals in the former Yugoslav Republic of Macedonia.

Trade seems to have been driven to a large extent by low production costs. The low-wage sectors have on average and cumulatively the highest share in both countries. Both in terms of export and import ratios, as well as openness, the high-wage sectors show negligible trade penetration in both countries. This is in stark contrast to both the EU10 and EU15 averages, where trade actually plays the greatest role in this industry group. Therefore, it seems that as expected, in these countries exports are driven more by low production costs than in the EU10 or EU15. Moreover, all industries are significantly more open in Croatia, where food leads in terms of imports, and hotels and restaurants in terms of exports. However, trade increased

¹⁶ For comparison, in the EU10 the highest export share is 14% (electrical machinery). This is also the sector with the highest import share (16%).

most in the medium-wage sectors, as a first sign for a changing composition of trade in the candidate countries.

4. Econometric estimation

We empirically test the relationship of wage developments and trade at the sectoral level in the EU25 in general, and in the transition countries in particular for the period 1995-2005. Using a panel approach, we take both the cross-sectional and the time series components of the dataset into account, whereas earlier studies generally analyse countries separately, utilising often much more detailed national information. Given the comparatory nature of our study, we lack these details, but the conclusions drawn from the analysis have a more general validity than those of individual country studies. Moreover, the variation of explanatory variables over time and over countries increases the explanatory power and the degrees of freedom for the regression.

We follow a very general approach, which can be grounded on both a labour market and a trade background. We test the following equation:

$$(1) \quad \ln(\text{wage}_{c,i,t}) = \alpha + \beta_1 * ur_{c,t} + \beta_2 lprod_{c,i,t} + \beta_3 * trade_{c,i,t} + \beta_4 trade_other_{c,i,t} + \beta_5 open_{c,t} + \gamma_c + \varepsilon_{c,i,t}$$

The dependent variable is the natural logarithm of the real hourly wage in country c , industry i and year t converted to euro using current exchange rates and deflated by the consumer price index. We regress hourly wages on the unemployment rate and hourly labour productivity of the respective sector. Since we do not have sector-specific unemployment data, we use the country-wide unemployment rate to reflect the relative scarcity of the factor labour. We are aware that this is a rather restricted set of real economy and labour market relevant variables. Yet other variables, such as sector-specific employment (a very crude proxy at the sector level for labour supply conditions), GDP growth as well as a time trend, were either insignificant or did not change the results. We expect a negative coefficient on unemployment, arguing that high unemployment – meaning an abundance of labour – should exert a downward pressure on wages. The advantage of using the economy-wide unemployment rate is that it already incorporates changes in sector-specific unemployment levels attributable to inter-sectoral mobility. This is a non-negligible factor in wage formation.¹⁷ As for labour productivity, we clearly expect a positive coefficient, since labour should be paid its marginal product. Working with data at the industry level, as we do here, also means that we cannot include variables reflecting worker’s characteristics (such as age, experience, education or gender), which is common to micro-based wage equations.

Next, we include a set of trade variables. Trade can influence domestic wages on both the import and the export side. Imports affect wages by displacing otherwise domestically produced goods and services. However, the relationship between imports and domestic wages depends on whether imports replace products involving low-productivity, low-wage activities or whether they compete with high-productivity, high-wage activities. In the former case, we should observe a positive effect on the average wage level of a sector while in the latter case we may well observe a negative relationship between imports and wages on average. Thus, our expectation on the sign of the import variable is in fact open. Yet as we expect the first effect to occur more often in more sophisticated activities, we rather expect a positive

¹⁷ We thank one of the referees for making this point. Of course, we are not able to capture inter-sectoral mobility explicitly in our approach which is based on separate estimation of individual industries.

relationship in more technology- and skill-intensive industries. Turning to the export channel, we argue that more exposure to the global market through exporting would introduce more competition in a sector and hence again work in two ways: the quality of the products produced has to rise, implying also higher productivity levels for surviving firms and hence a positive effect on wages. At the same time, more competition may exert stronger pressure on wages and reduce the power of worker unions, thus driving wages down. Which effect dominates, remains an empirical issue.

For the trade variables, we used the ratio of imports (and exports respectively) over value added, again converting all variables into euro equivalents using current exchange rates and then applying a sector-specific value-added deflator for value added and a gross output deflator for imports and exports. Using trade shares (i.e. imports as a share of economy-wide imports) would give a different flavour to the analysis, especially since a rise in one sector's trade share must imply a decline in another sector's trade share by definition. Wages in a specific industry are likely to be influenced by trade developments in other sectors within a country. Therefore we include two additional controls in the model: the trade ratio in the rest of the economy - that is in all sectors other than the one analysed - to account for an influence of trade on wages in a specific sector, which occurs through trade in upstream or downstream industries. Individual sectors of an economy are strongly linked through inputs from upstream industries and intermediate demand by downstream industries. Through this variable, we capture possible repercussions from increased import penetration in one sector in other sectors of the economy. For instance, in the case where imports in the same industry affect wages negatively due to higher competition pressures, higher imports by upstream industries could nevertheless boost wages to higher levels, since they increase productivity by enabling cheaper and possibly also higher-quality inputs into production. We further control for the general openness of the country by including the ratio of country-wide exports plus imports over GDP. Thus, we allow for a differential impact of trade in very open as opposed to rather closed markets. Since we never include sector-specific import and export ratios in a single specification in order to avoid a possible bias arising from the high correlation between the two series, controlling for the country's openness to trade seems adequate given that trade is always a two-way phenomenon. We have also experimented with other trade variables – net exports, openness and import penetration in each industry – but these had a low explanatory power and the results were mostly insignificant.

Our specification is similar to those often used in the empirical literature.¹⁸ However, we estimate the above model separately for each industry, thus allowing for a different reaction of wages on trade in each sector. First results, based on a fixed-effects estimation with clustered standard errors, showed that there was considerable autocorrelation left in the residuals (as evidenced by the Wooldridge test for panel data models). Therefore we chose to estimate our model in a dynamic setting, using the general method of moments (GMM) estimator proposed by Arellano and Bond (1991).

4.1. Results for individual industries

The coefficients on the domestic economy variables are highly robust across sectors and yield the expected signs. Unemployment correlates negatively with wages in all sectors, the coefficient is statistically significant in 10 out of the 21 sectors. An increase in the unemployment rate by 1 percentage point (ppt) translates into a decrease in average wage

¹⁸ For example Winter-Ebmer and Zimmermann (1998), Hofer-Huber (2003) or Onaran-Stockhammer (2006).

levels between 0.5% in communication services and 1.8% in construction services, with most sectors experiencing a decrease by roughly 1%. Also the productivity level exhibits the expected sign. Wages respond positively to higher labour productivity, the coefficient is almost always statistically significant. Increases in productivity are only partly reflected in higher wages. The elasticity is far below 1 and ranges between 0.14 (electrical machinery and equipment) and 0.6 (other business services).

Only few industries actually show a statistically significant association between wages and our trade variables. These are reported in Table 1 below.¹⁹ The relationship is negative in the case of wood and oil refining and positive in the remaining four activities (chemicals, metals, utilities and financial intermediation). However, the economic significance is on average small, although it varies greatly by each sector. For the oil industry, the effect is negligible, and it is also very small in chemicals and metals. In the wood industry, a 10 ppt increase in the import ratio is associated with a 0.7% lower wage level, while it corresponds to a 5% higher wage level in electricity, gas and water supply. In some industries (i.e. oil and metals), the effects from increased imports within the sector are overcompensated by contrary effects from increased trade in the remaining sectors of the economy. Results for exports, though not reported here, are highly similar. To summarise, we can identify only a handful of industries with a statistically significant relationship between trade and wages and even fewer sectors, where this relationship is also economically significant. Further, the industries presented in Table 1 do not appear to share many characteristics, except that they are mostly resource-based activities.

	wood	oil	chemicals	metals	utilities	finance
lagged wage	0.309 *** 3.21	0.653 *** 3.97	0.1877 *** 2.80	0.2416 *** 5.00	0.2855 *** 2.71	0.2034 0.92
unemployment	-0.0117 *** -2.59	-0.0086 -1.40	-0.0094 * -1.65	-0.0029 -0.47	0.0074 1.54	-0.012 *** -2.77
productivity	0.3689 *** 4.21	-0.0213 -0.69	0.4507 *** 4.26	0.5086 *** 5.57	0.2357 *** 3.35	0.4848 *** 4.75
import ratio	-0.0778 *** -11.88	-0.0001 *** -2.95	0.0113 ** 2.38	0.0227 *** 3.93	0.4965 * 1.66	0.1079 ** 2.52
import ratio - rest of ec. country	0.0024 0.16	0.0727 *** 2.74	-0.0587 -1.41	-0.0932 *** -3.93	0.0146 1.53	-0.0168 -1.23
openness	-0.1609 ** -2.34	-0.0529 -0.39	-0.1106 -1.07	-0.1335 * -1.69	0.0187 0.42	-0.0256 -0.45
constant	0.7588 *** 4.79	1.0621 * 1.77	0.7516 ** 2.21	0.5026 *** 2.80	0.9165 *** 3.96	0.7524 1.64
Obs.	213	190	213	213	197	216
No. of groups	24	22	24	24	24	24
Chi2	1500.00	54.98	37.96	226.96	117.04	240.25
z-value (AR-1)	-2.59	-2.35	-1.10	-1.98	-1.61	-0.51
z-value (AR-2)	-0.82	1.48	-0.81	-0.58	0.19	1.51

*Notes: Dependent variable is the log real hourly wage, deflated by CPI. t-ratios are reported below each coefficient, *(**)[***] indicate significance at 10% (5%)[1%] level or lower. z-values indicate the significance of a test on autocorrelation (ar) in the residuals, whereby the 1st-order z-value should exceed |1.96| and the 2nd-order z-value should be below this level in order to indicate that the dynamic estimation is appropriate.*

¹⁹ We present the results for selected industries in the paper, due to space limitations. The full set of results for all industries is available from the authors upon request.

Although we explicitly control for general openness, it still seems odd to impose the same model on all EU members. Therefore we separated the sample into two groups: the smaller and considerably more open economies which acceded the EU in 2004 (EU10) and the remaining EU15. Results for EU15 are displayed in Table 2, results for EU10 in Table 3. In each subsample, a larger number of sectors emerges with a statistically significant relationship between trade and wages. Let us briefly discuss the domestic variables first. The relationship between unemployment and wages remains negative; however, we see a stronger effect in the EU10 (between 1% and 2%) as compared to the EU15 (between 0.5% and 1%). Also productivity developments get translated more strongly into wage developments in the EU10 – where a productivity increase by 1% is often associated with a 0.5% rise in wages and as much as 0.8% in other business services. In the EU15 this elasticity is noticeably lower and lies between 0.1% and 0.45%.

Turning to our variables of main interest, we find again mixed results in many respects. First of all, we observe positive and negative correlations between imports and wages. Secondly, the magnitude of the coefficient varies greatly between individual sectors. What is most striking is that the results for EU25 were mostly driven by the group of EU10. In particular the large coefficient on imports in the electricity and gas sector arises from these countries. On the other hand, the variation is also much higher in the EU10 when referring to the economic impact of trade on wages in different industries with very low coefficients in some sectors. In the EU15, the coefficients are often around 0.1. This means that a 10 ppt increase in the import ratio in one sector (i.e. for the production of transport equipment - the second most open sector after the oil industry - this would imply a rise in the import ratio from 4.5% to roughly 14.5%) is associated with a roughly 1% rise in wages. In the EU10 this coefficient ranges between 0.03 and 0.85, meaning that a 10 ppt rise in the import ratio of the metal industry would *ceteris paribus* imply a 0.3% higher wage level while this effect would be 8.5% in the distribution of electricity, gas and water. Another interesting observation relates to the sector mix. The only service sectors yielding a significant coefficient in the EU15 are communication and other business services. In both cases, we observe a negative relationship, which is also economically meaningful in communication services. For the EU10, again communication, other business services, but also financial services appear in the table. However, here we observe a positive correlation between the three trade variables and wages. Overall country openness also shows a positive sign.

Nevertheless, the group of industries with a significant correlation between trade and wages still seems to be rather coincidental. In the next section we try to group industries by their export performance. Industries with higher export growth are more exposed to international markets and hence international competition. As a result, we would also expect to see more significant results emerging in these industries.

Table 2: Results for EU15, individual industries

	agriculture	food	chemicals	rubber	minerals
lagged wage	0.4211 * 1.67	0.3712 *** 2.88	0.404 *** 3.15	0.3994 *** 6.29	0.2022 *** 3.07
unemployment	-0.0103 *** -3.18	-0.0054 -1.64	-0.0111 *** -3.50	-0.0052 -1.62	-0.003 -1.02
productivity	0.4018 *** 2.69	0.1981 ** 2.26	0.1786 *** 2.73	0.271 ** 2.46	0.4559 *** 6.13
import ratio	0.1322 * 1.92	0.0927 ** 2.37	0.0175 * 1.73	0.0956 *** 2.59	0.1673 ** 2.26
import ratio - rest of ec.	0.0882 0.60	-0.0284 -0.29	-0.0603 -0.53	-0.0952 -0.68	-0.2018 ** -2.42
country openness	-0.235 *** -2.95	-0.0466 -0.77	-0.1063 -1.26	-0.049 -0.71	0.0461 0.74
constant	-0.1958 -0.40	1.0815 ** 2.47	1.3406 *** 4.08	0.8083 ** 2.37	0.8083 *** 3.91
Obs.	123	123	123	123	123
No. of groups	14	14	14	14	14
Chi2	364.87	135.29	146.23	207.56	211.17
z-value (AR-1)	-2.34	-1.82	-1.75	-1.82	-2.50
	metals	electrics	othman	comm	othser
lagged wage	0.0785 0.84	0.4394 *** 5.39	0.3881 *** 3.42	0.3618 *** 4.45	0.7388 *** 9.46
unemployment	-0.0081 *** -3.40	-0.0091 * -1.89	-0.0053 * -1.94	-0.0099 -1.59	-0.0132 *** -2.63
productivity	0.3918 *** 3.23	0.1314 *** 4.17	0.1547 *** 2.86	0.0928 ** 2.19	0.2456 1.55
import ratio	0.0505 * 1.78	0.0172 * 1.76	0.0452 *** 3.13	-0.2022 * -1.69	-0.0516 *** -2.66
import ratio - rest of ec.	-0.059 -0.67	-0.2224 -1.59	0.1326 ** 2.16	-0.0195 -0.25	0.051 1.26
country openness	-0.0303 -0.45	-0.0252 -0.30	-0.1778 *** -4.37	0.1433 1.11	-0.0471 -0.80
constant	1.4036 *** 5.64	1.3623 *** 6.06	1.1476 *** 4.51	1.6131 *** 10.10	-0.1124 -0.21
Obs.	123	123	123	126	126
No. of groups	14	14	14	14	14
Chi2	66.73	117.90	328.09	401.27	606.94
z-value (AR-1)	-0.61	-2.31	-2.55	-1.94	-1.61
z-value (AR-2)	1.78	1.83	-0.40	-0.73	0.81

*Notes: Dependent variable is the log real hourly wage, deflated by CPI. t-ratios are reported below each coefficient, *(**)[***] indicate significance at 10% (5%)[1%] level or lower, respectively. z-values indicate the significance of a test on autocorrelation (ar) in the residuals, whereby the 1st-order z-value should exceed |1.96| and the 2nd-order z-value should be below this level in order to indicate that the dynamic estimation is appropriate.*

Table 3: Results for EU10, individual industries				
	wood	chemicals	metals	electrics
lagged wage	0.2932 *** 3.13	0.1861 *** 3.09	0.2735 *** 4.50	0.4949 *** 3.17
unemployment	-0.0178 *** -3.71	-0.0185 ** -2.21	0.0031 0.26	-0.0049 -0.94
productivity	0.439 *** 3.88	0.5403 *** 4.85	0.5248 *** 4.73	0.2327 *** 4.76
import ratio	-0.0745 *** -8.65	0.0122 ** 2.47	0.03 *** 2.79	-0.0011 -0.84
import ratio - rest of ec.	-0.0012 -0.09	-0.053 -1.33	-0.1309 *** -3.09	0.0359 *** 2.81
country openess	-0.2365 *** -2.92	-0.0124 -0.08	-0.1873 * -1.69	-0.0381 -0.65
constant	0.6386 *** 4.36	0.2978 0.95	0.285 1.29	0.3302 1.58
Obs.	90	90	90	90
No. of groups	10	10	10	10
Chi2	1.80E+03	61.4164	211.3204	105.0135
z-value (AR-1)	-2.0349	-0.712	-2.2323	-1.3394
z-value (AR-2)	-1.0719	-1.0121	-0.545	0.2945
	utilities	comm	finance	othser
lagged wage	0.2363 1.41	0.436 *** 3.76	0.3806 1.43	0.3607 *** 3.18
unemployment	0.0111 *** 2.15	0.0042 1.06	-0.003 -0.63	-0.0045 -1.06
productivity	0.2655 ** 2.38	0.283 *** 3.68	0.5539 *** 4.33	0.7952 *** 9.86
import ratio	0.8499 ** 2.25	0.0509 0.71	0.2302 ** 2.21	-0.2945 -1.21
import ratio - rest of ec.	0.0135 0.91	0.0125 ** 2.38	-0.0024 -0.15	0.054 *** 4.00
country openess	0.0099 0.09	0.0931 *** 3.59	0.0842 0.92	0.4064 *** 4.04
constant	0.4283 * 1.82	0.1106 1.37	-0.1099 -0.28	-1.3796 *** -5.91
Obs.	74	90	90	90
No. of groups	10	10	10	10
Chi2	913.06	726.51	98.16	1100.00
z-value (AR-1)	-1.47	-1.70	-1.45	-2.20
z-value (AR-2)	0.53	-1.60	0.59	1.57

*Notes: Dependent variable is the log real hourly wage, deflated by CPI. t-ratios are reported below each coefficient, *(**)[***] indicate significance at 10% (5%)[1%] level or lower, respectively z-values indicate the significance of a test on autocorrelation (ar) in the residuals, whereby the 1st-order z-value should exceed |1.96| and the 2nd-order z-value should be below this level in order to indicate that the dynamic estimation is appropriate.*

4.2. Results by industry groups

Table 4 below reports the results which we obtain for the EU15 when we pool industries by their growth performance into fast, moderately and slow growing sectors. We now see very clearly that those industries which experienced fast export growth over the past decade (and hence are subject to the greatest trade exposure) also exhibit a positive correlation between trade and wages at the sector level. Both directly, through imports or exports within the same

industry, as well as indirectly, through imports or exports in other industries, we can observe a statistically significant, albeit weak positive correlation. At the same time, we observe a strong negative effect from the country's general openness. This latter effect is considerably stronger in absolute terms and shows up in all three industry groups. When interpreting the relative magnitude of the coefficients, it has to be kept in mind that the openness of the country as such is likely to change by a much smaller degree than import or export ratios of individual sectors. Nevertheless, we find that the marginal effect of being a more open country is negative and greater than the positive marginal effect of increased imports (or exports) at the sector level. A 10 ppt rise in the country's openness (a rare phenomenon over the time period considered) would translate into 1% lower wages, while a 10 ppt rise in the import ratio of a fast growing sector would correspond to an increase in average wages of the sector by 0.01%. Similar results are obtained for export ratios. How can we reconcile these contradicting results? In general, greater openness is clearly associated with a lower general wage level. This was also an outcome of the industry-specific results before, where we often obtained a negative and statistically significant coefficient on country openness, even if no other trade variables were significant. However, in those industries with a strong trade performance (and hence those industries that are able to compete successfully in international markets) this negative effect is partly offset by positive effects from trade.

Table 4: Results for EU15, industries grouped by export performance

	Import ratios			Export ratios		
	export growth performance			export growth performance		
	fast	moderate	slow	fast	moderate	slow
lagged wage	0.4518 *** 5.77	0.3518 *** 7.06	0.4078 *** 4.52	0.4322 *** 5.48	0.3444 *** 7.05	0.4377 *** 5.42
unemployment	-0.01 *** -4.62	-0.0073 *** -5.11	-0.0067 *** -3.03	-0.0102 *** -4.68	-0.0075 *** -5.41	-0.0067 *** -3.25
productivity	0.0926 ** 2.35	0.2399 *** 7.65	0.274 *** 5.94	0.0947 ** 2.4	0.2414 *** 7.41	0.2762 *** 5.72
trade ratio	0.0017 *** 3.17	0.0011 0.73	0.0106 1.12	0.0028 *** 2.72	0.0076 1.59	0.0012 0.22
trade ratio - rest of ec.	0.06 * 1.87	0.031 * 1.76	-0.0167 -0.53	0.0604 ** 2.1	0.0137 0.66	-0.014 -0.51
country openness	-0.1018 *** -2.79	-0.1097 *** -4.9	-0.0527 -1.48	-0.0969 *** -2.72	-0.1026 *** -4.48	-0.0558 -1.55
constant	1.4516 *** 8.37	1.0838 *** 8.45	0.8533 *** 4.26	1.5023 *** 8.55	1.1012 *** 8.16	0.7741 *** 4.42
Obs.	861	1233	495	861	1233	495
No. of groups	97	140	56	97	140	56
Chi2	268.7419	270.5056	188.5845	260.629	259.1584	198.791
z-value (AR-1)	-4.2673	-5.1235	-3.3057	-4.199	-4.8948	-3.4766
z-value (AR-2)	-0.8348	1.7459	2.1277	-0.8754	1.7077	2.0493

*Notes: Dependent variable is the log real hourly wage, deflated by CPI. t-ratios are reported below each coefficient, *(**)[***] indicate significance at 10% (5%)[1%] level or lower, respectively. z-values indicate the significance of a test on autocorrelation (ar) in the residuals, whereby the 1st-order z-value should exceed |1.96| and the 2nd-order z-value should be below this level in order to indicate that the dynamic estimation is appropriate.*

For the EU10 (see Table 5) we cannot identify this general negative relationship between country-openness and wages. This group of countries is characterised by higher openness levels on average and also stronger trade growth over the past decade. Thus, even though the countries are more exposed to trade, we cannot identify a negative relationship with wages. In particular fast growing industries, in terms of their export growth, show positive indirect

effects from trade (both through imports and exports in other sectors in the economy). The positive, even though economically small, coefficient on imports in the moderately growing industries is more than offset by a negative coefficient on both other trade variables.

Some interesting results can further be read from the table. In both country groups, wage persistence is higher in the strongest growing export industries. But while it is also higher in the EU10 than the EU15 in this industry group, the opposite holds true for the two other industry groups. This means that wages in moderately and slow growing export sectors in the EU10 are more strongly determined by other factors than their EU15 counterparts. One such factor is labour productivity. Productivity developments are more strongly reflected in wage developments in the EU10. In the next section we will look at the impact of trade on this mechanism, i.e. whether increased trade implies more decoupled developments of wages and labour productivity or whether trade is able to reinforce the link between productivity and the actual return on labour. If this is the case, we speak of a wage-disciplining effect of trade.

Table 5: Results for EU10, industries grouped by export performance

	Import ratios			Export ratios		
	export growth performance			export growth performance		
	fast	moderate	slow	fast	moderate	slow
lagged wage	0.6786 ***	0.2337 **	0.0668	0.7053 ***	0.2599 **	0.062
	5.67	2.19	0.54	5.68	2.42	0.5
unemployment	-0.0052 *	-0.0079 **	-0.002	-0.0065 **	-0.0073 **	-0.0024
	-1.87	-2.14	-0.55	-2.41	-2.02	-0.7
productivity	0.1555 **	0.577 ***	0.6024 ***	0.1478 **	0.564 ***	0.6052 ***
	2.34	9.01	14.31	2.17	8.67	13.42
trade ratio	0.0	0.0131 ***	0.0082	-0.0001 **	0.013	0.0168
	-0.3	3.19	1.21	-2.22	1.64	1.09
trade ratio - rest of ec.	0.0289 ***	-0.0205 *	-0.0031	0.0496 ***	-0.0189	-0.0068
	2.76	-1.91	-0.4	3.41	-1.07	-0.5
country	0.0624	-0.0934 *	-0.0573	0.0523	-0.0744	-0.0445
openness	1.45	-1.72	-1.08	1.28	-1.37	-0.87
constant	0.1278	0.0709	0.3193 *	0.1146	0.0471	0.3215 *
	0.94	0.37	1.65	0.88	0.26	1.72
Obs.	780	630	450	780	630	450
No. of groups	89	70	50	89	70	50
Chi2	164.6839	158.2713	215.3288	192.3972	195.6902	193.3466
z-value (AR-1)	-3.4345	-1.7768	-1.1206	-3.4409	-2.0861	-1.0794
z-value (AR-2)	-0.474	-0.0469	1.7874	-0.4252	0.0327	1.8942

*Notes: Dependent variable is the log real hourly wage, deflated by CPI. t-ratios are reported below each coefficient, *(**)[***] indicate significance at 10% (5%)[1%] level or lower, respectively. z-values indicate the significance of a test on autocorrelation (ar) in the residuals, whereby the 1st-order z-value should exceed |1.96| and the 2nd-order z-value should be below this level in order to indicate that the dynamic estimation is appropriate.*

4.3. Does trade bring more wage discipline?

In the previous subsection, we tested for a direct association of wages and imports, as well as more generally wages and openness. Trade could, however, also affect wages in a more indirect way. For instance, if trade aids the equalisation of factor prices, then wages in different countries will tend to move closer together when trade flows are higher. This can be investigated by simply examining the relationship between wages in different countries. Yet in a recent contribution Persyn (2008) argues that the results can be misleading, since wages can actually become less interrelated despite such a co-movement. He proposes a –

theoretically founded – framework where foreign wages and terms interacting openness with both foreign wages and productivity are added to a wage equation. In general, he finds that trade enhances wage discipline in the sense that the wage becomes more aligned with the marginal product of labour as expressed in the level of labour productivity. If this is the case and wages are set according to their domestic fundamentals, then we can speak of enhanced wage discipline. This corresponds to a lower impact of foreign wages on wage-setting while productivity becomes more important in this process when trade costs are lower.²⁰

$$(2) \quad \ln(\text{wage}_{c,i,t}) = \alpha + \beta_1 * ur_{c,t} + \beta_2 lprod_{c,i,t} + \beta_3 * trade_{c,i,t} + \beta_4 trade_other_{c,i,t} + \\ + \beta_5 open_{c,t} + \beta_6 * foreignwages_{i,c,t} + \beta_7 * forwage * open_{i,c,t} + \\ + \beta_8 * forwag * lprod_{i,c,t} + \gamma_c + \varepsilon_{c,i,t}$$

We tried to integrate this idea in our framework, by adding three variables to the model specified in Equation 2, namely foreign wages (i.e. the average hourly real wage in the respective sector in all other EU25 countries) and two terms interacting the openness of the industry with foreign wages and with productivity. The results (see Tables 6 and 7) are robust for the variables in the earlier specification – productivity is significant and positive, its economic influence is higher in moderately and slow growing export industries. Higher unemployment is associated with marginally lower wages (but the effect is again very small in economic terms).

For the EU15, we again find a non-negligible negative correlation between wages and openness, but import and export ratios within the same sector are more often associated with higher wage levels. There is also some evidence for positive effects through imports or export in all remaining sectors, at least in industries with reasonably strong export growth. For the EU10, we now find a positive but again economically small relationship between imports and wages. This correlation is stronger for slow growing export industries. More importantly, the negative coefficient on country openness cannot be confirmed for this region.

With respect to the wage-disciplining effect of trade on wages, there is no evidence of such an effect in the EU15. In the EU10, foreign wages are rarely significant, either, but in twice as many sectors in the EU15 – in all cases with a positive sign, confirming more co-movement of wages. This might reflect a greater alignment of business cycles in the EU15, which have shared a common market for much longer than the EU10. The two interaction terms have generally opposite signs in each country group. While wages seem to broadly reflect wage levels abroad in the EU15, at least in the most successful export industries, this is also the case of a number of EU10 industries, namely agriculture, mining, wood, mechanical machinery, transport equipment and financial intermediation. Here, wages are strongly aligned with labour productivity, a channel which is reinforced through increased openness. While many of these industries exhibit also strong export growth performance, the effect is also evident in the slow growing export industries. In summary, we find more evidence for the EU10 for wage-setting in line with domestic productivity levels rather than the wage level abroad. Finally, while foreign wages are rarely significant apart from the fast growing industries, the interaction terms often are, generally confirming the idea that productivity gains in relevance against foreign wages.²¹

²⁰ Persyn (2008) uses a sample of 13 EU countries (EU15 countries excluding Greece and Luxembourg) for the period of 1980-2001 to test this hypothesis. Lower trade costs are reflected in higher values for a trade freeness indicator as defined on page 10 in his paper.

²¹ Again, all individual sector results are available upon request.

Thus, our results confirm Persyn's (2008) hypothesis of trade acting as a disciplining force on wages in the EU10, but not for the EU15. In the western countries productivity seems to matter less for wage-setting, and foreign wages seem to matter more, when openness is higher. This is an interesting result, as we analysed broadly the same group of countries as Persyn, if for different periods (1980-2001 versus 1995-2005), but came up with opposite results.²² Also, the model in the full sample again resembles more closely the behaviour in the EU10, as in our previous trade-only model. This may be related to the generally greater openness of the EU10, making them more responsive to trade.

Table 6: Wage-disciplining effect of trade in EU15

	Import ratios			Export ratios		
	export growth performance			export growth performance		
	fast	moderate	slow	fast	moderate	slow
lagged wage	0.4334 *** 6.26	0.363 *** 7.41	0.4031 *** 4.66	0.4107 *** 5.74	0.3402 *** 7.1	0.4438 *** 5.57
unemployment	-0.0071 *** -3.12	-0.0056 *** -3.59	-0.0043 ** -2.13	-0.0073 *** -3.18	-0.0059 *** -3.89	-0.0045 ** -2.52
productivity	0.1079 *** 2.28	0.217 *** 7.06	0.2825 *** 5.65	0.1118 ** 2.31	0.2342 *** 7.3	0.2701 *** 4.98
trade ratio	0.0013 *** 2.57	0.0009 0.12	0.046 ** 2.34	0.0026 ** 2.32	0.0218 *** 2.86	-0.0062 -0.76
trade ratio - rest of ec.	0.0463 * 1.89	0.0414 ** 2.05	-0.0074 -0.3	0.0498 ** 2.16	0.0229 1.19	-0.0059 -0.26
country	-0.2533 *** -2.88	-0.238 *** -5.34	-0.1898 *** -3.16	-0.2442 *** -2.74	-0.2348 *** -5.28	-0.2014 *** -3.28
openness	wage_EU 0.1726 ** 2.48	0.1482 *** 3.97	0.1602 *** 3.11	0.1666 ** 2.36	0.1416 *** 3.81	0.158 *** 3.09
wage_EU *	0.0127 *** 3.68	-0.0005 -0.08	0.0124 0.43	0.0134 *** 3.64	0.0067 1.58	0.0317 0.98
open	prod * open -0.0148 *** -3.07	0 0.01	-0.0257 -1.13	-0.0153 *** -3.12	-0.0085 ** -2.39	-0.0181 -0.79
constant	0.9443 *** 3.78	0.7481 *** 4.42	0.4278 1.61	1.0127 *** 3.92	0.768 *** 4.24	0.3716 1.49
Obs.	861	1233	495	861	1233	495
No. of groups	97	140	56	97	140	56
Chi2	403.5781	289.227	231.1303	380.3538	275.1158	290.6724
z-value (AR-1)	-3.9228	-5.2014	-3.169	-3.8094	-4.937	-3.4469
z-value (AR-2)	-0.7138	1.7024	2.3401	-0.7769	1.5762	2.3761

*Notes: Dependent variable is the log real hourly wage, deflated by CPI. t-ratios are reported below each coefficient, *(**)[***] indicate significance at 10% (5%)[1%] level or lower, respectively. z-values indicate the significance of a test on autocorrelation (ar) in the residuals, whereby the 1st-order z-value should exceed |1.96| and the 2nd-order z-value should be below this level in order to indicate that the dynamic estimation is appropriate.*

²² This difference remains valid when we replicate his analysis using exactly the same variables as he does (i.e. building his measure of “freeness”), but applying a different estimation method (as for the longer sample he estimates an error correction model, while we use a dynamic panel estimation due to the smaller time dimension in our sample).

Table 7: Wage-disciplining effect of trade in EU10

	Import ratios			Export ratios		
	export growth performance			export growth performance		
	fast	moderate	slow	fast	moderate	slow
lagged wage	0.6613 *** 5.19	0.2574 ** 2.51	0.1291 1.1	0.7075 *** 5.56	0.2628 *** 2.58	0.1053 0.87
unemployment	-0.0098 *** -3.55	-0.0086 ** -2.14	-0.0024 -0.75	-0.0086 *** -3.18	-0.0084 ** -2.16	-0.0025 -0.8
productivity	0.1756 *** 2.77	0.5617 *** 6.48	0.5488 *** 12.42	0.1597 ** 2.5	0.5811 *** 6.64	0.552 *** 12.89
trade ratio	0.0003 *** 4.21	0.0122 ** 2.38	0.034 *** 2.7	0.0008 1.61	0.0086 1.18	0.0171 1.09
trade ratio - rest of ec.	0.0046 0.4	-0.0243 * -1.92	-0.0071 -0.55	0.0244 * 1.76	-0.0241 -1.3	0.0046 0.3
country openess	-0.0841 -1.41	-0.1437 * -1.83	-0.0011 -0.01	-0.048 -0.87	-0.1435 * -1.85	0.0109 0.14
wage_EU	0.2769 *** 2.98	0.1177 0.95	-0.0287 -0.26	0.221 ** 2.51	0.118 0.95	-0.0756 -0.69
wage_EU * open	-0.0002 *** -3.29	-0.0006 -0.05	-0.0367 *** -3.25	-0.0001 ** -2.32	0.0122 1.19	-0.0115 * -1.66
prod * open	-0.0001 -0.42	0.0024 0.11	0.0261 *** 3.03	-0.0007 -1.38	-0.0142 -0.73	0.0192 ** 2.22
constant	-0.5059 * -1.94	-0.2086 -0.81	0.392 * 1.8	-0.4313 -1.63	-0.2533 -0.97	0.5167 ** 2.11
Obs.	780	630	450	780	630	450
No. of groups	89	70	50	89	70	50
Chi2	434.2955	215.9168	361.4122	576.9414	270.8576	257.8177
z-value (AR-1)	-3.1626	-2.0837	-1.6883	-3.5052	-2.2047	-1.4837
z-value (AR-2)	-0.1269	-0.0146	1.362	-0.0833	0.1069	1.7072

Notes: Dependent variable is the log real hourly wage, deflated by CPI. t-ratios are reported below each coefficient, *(**)[***] indicate significance at 10% (5%)[1%] level or lower, respectively. z-values indicate the significance of a test on autocorrelation (ar) in the residuals, whereby the 1st-order z-value should exceed |1.96| and the 2nd-order z-value should be below this level in order to indicate that the dynamic estimation is appropriate.

To conclude, trade seems to strengthen wage discipline primarily in eastern Europe by forcing wages to be more aligned with productivity and less subject to previous or foreign wage developments in the main trading partners. In other words, we find little support for factor price equalisation. In fact, higher openness actually enhances wage discipline in these countries. In contrast, no such evidence found for EU15 where wages are strongly positively influenced by foreign wages, an effect which is reinforced by trade in the fastest growing industries.

5. Conclusions

In this paper we reconsidered the effects of increased economic integration on the labour market. More specifically we scrutinised the impact of increased import and export ratios on average wage levels in the EU25. Given that both the theoretical and the empirical literature have remained inconclusive on the topic, we take an agnostic view and use a simple model, which encompasses domestic wage determinants together with various measures of trade penetration at the industry level – unlike most of the empirical literature on the trade-wage nexus, which is based on firm-level or individual data. The latter approach covers many factors that are relevant from a labour market perspective but at the same time implies that the results of these studies cannot be generalised, and that they are not controlled for country-

specific characteristics of individual labour markets. Another literature strand focuses on macro-economic effects which may hide differential relationships within individual activities of an economy. This industry-specific heterogeneity seems to be very relevant in the context of international trade though. In this paper we investigate the relationship between trade and wages for a comprehensive sample of 25 EU countries, focusing explicitly on individual industries. We find considerable differences in the wage response to trade in individual economic activities which are not easy to generalize.

As a first result, trade cannot often be identified as a decisive factor in determining wage levels. What may sound as a non-result is actually quite a positive result, since in public opinion, trade and more general “globalization” is often associated with a negative influence on the labour market. Resource-based industries appear to exhibit more often a statistically significant correlation between trade and wages. However, the economic impact is rather small with few exceptions.

Considerable differences exist between EU15 and EU10. First, the central and eastern European Member States appear to have been dominating the average results for the EU25 – which is less surprising when we consider that these countries are in general smaller economies and therefore considerably more open to trade, this observation might be less surprising. Second, the aggregate net effect of trade on wages seems to be negative for the EU15, since higher openness (at the macro-economic level) is usually associated with lower wage levels in this group. On average, an increase in openness by 10 ppt would relate to 1% lower wages. A small effect, to be sure, but some effect compared with EU10 industries, where no such general negative relationship has been observed. Third, wages in fast growing industries, in terms of their export performance, seem to profit from increased imports and exports in other sectors of the economy. In this respect, no discernible effects from own-industry trade could be identified for the EU10, whereas the EU15 clearly show a positive, albeit very small, effect from both imports and exports in the respective industry in addition to positive cross-industry effects.

We also take up the idea of trade acting as a wage-disciplining device in the sense that through increased openness, wages reflect more strongly the marginal product of labour and become less strongly aligned with foreign or past wages. We observe little evidence of wage co-movement in the sense of a strong impact of foreign wages on domestic wages in the EU10, while in western Europe wages tend to move together in many sectors across countries. Thus, trade can enhance wage discipline, as with higher openness wages are set more in line with productivity rather than foreign wages. This nevertheless only holds for the EU10, while in EU15 we find opposite results.

Overall, we can identify both negative and positive effects from increased trade on wages. Yet most of these effects are extremely small, which is why trade cannot be seen as a decisive factor in wage formation. This is in line with the results of previous studies. Furthermore, we can identify certain sectors where the significant effects prevail even when using more sophisticated estimation techniques based on instrumental variables. In many studies, all trade effects vanish when instruments are used in the estimation. We would like to stress that even though the effects are small and specific to certain sectors only, more openness to trade can not generally be associated with lower wages. In particular for the EU10, but also in the results for EU25 and EU15, the number of sectors with positive direct effects exceeds the number of sectors with negative effects. In many sectors, especially in those where no direct relationship between trade in the respective industry and the wage level could be established, we note a general negative relationship between country-openness and wages, though.

Therefore economic policy has to be carefully designed when addressing questions of increased trade integration and its wage effects. In particular, resource-based and network industries often emerge as winners from increased trade. However, losers emerge as well, especially when calculating the net effect from general increased openness and sector-specific effects. Furthermore, wage inequality across activities within a country is likely to be reinforced. This is to be expected since in general booming and thus better paying sectors are more likely to win from increased trade integration, while stagnating and hence low-wage sectors are more likely to come under wage pressure.

Further research should also carefully investigate the issue of wage inequality in response to economic integration. Wage inequality has different dimensions, such as wage dispersion across industries or across individuals due to differences in human capital, etc. For instance, a useful distinction is often made between wages of low and high skilled workers. In our dataset, we could not identify systematic differences - possibly because the informative value of industry-level data is limited with regard to the human capital of the labour force - and therefore did not elaborate further on this issue, but this could be subject to further investigations. Overall, before drawing detailed policy conclusions, we see a need for continued careful research, as well as for improving available statistics to provide this research with meaningful input for comparative analyses.

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