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Contents

Skills and the competitiveness of EU manufacturing industries

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In this article we present evidence of the relationship of human capital (skills measured by educational attainment) on productivity growth and export performance as measures of competitiveness. Labour productivity is commonly seen as the most important measure of competitiveness at the country and industry level. In this approach productivity growth is a function of the stock of human capital (skills) available where the underlying assumption is that a better educated workforce is better in adopting, implementing and even creating new technologies. A second measure of international competitiveness is success in foreign markets, i.e. exports. Higher export growth – compared to other countries – can be looked at as gaining competitiveness in world markets, driven by the dynamics of comparative advantages, and thus is a measure of revealed comparative advantages.

Data

For the estimations we use data from the recently released EU KLEMS database (see www.euklems.net) which provides the most comprehensive set of data for this purpose. The period we look at is 1995-2004. This allows to include a number of Central and East European countries in the analysis. From this database we use data for labour productivity (i.e. value added at constant prices divided by hours worked). As the skill information in this database is provided only at a more aggregate level, we have to combine these data with information on educational attainment levels using Labour Force Survey (LFS) data (available for the period 1998-2004). We shall use averages of employment shares of different educational attainment groups (ISCED groups high, medium and low educated) over a longer time interval by sector to avoid data problems such as fluctuations in shares due to small sample sizes and outliers. This allows the inclusion of 24 of the current EU member states (not included are Bulgaria, Malta and Romania for reasons of data

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availability). The industry breakdown is presented in Table 1. Below we shall also present evidence for groupings of industries; the groupings are defined with respect to the share of workers into low-skill- (L), medium-skill- (M) and high-skill- (H) intensive branches.

Table 1

Industry classification

Code	Description	Industry group
15t16	Food, beverages and tobacco	M
17t19	Textiles, textile products, leather and footwear	L
20	Wood and products of wood and cork	L
21t22	Pulp, paper, printing and publishing	M
23t25	Chemical, rubber, plastics and fuel	M
26	Other non-metallic mineral	M
27t28	Basic metals and fabricated metal	M
29	Machinery nec.	H
30t33	Electrical and optical equipment	H
34t35	Transport equipment	H
36t37	Manufacturing nec., recycling	L

To provide a first overview, in Figure 1 we plot the growth rates of labour productivity by industry aggregates according to the groups shown in Table 1 (the average growth rates are weighted by the average value added shares). Similarly, Figure 2 plots the structure of the initial gaps (expressed in per cent of the leading industry-country pair).

The most striking fact is that in a number of countries growth rates of the more skill-intensive sectors are higher. This is especially the case for the cohesion countries Greece and Portugal, and for all new member states except Cyprus. Most of these countries also show higher growth rates on average. In the advanced economies this pattern of higher growth rates in the skill-intensive sectors is eminent mainly in Finland and Sweden. From Figure 2 it is also appears that the initial gaps seem to be lower in the medium- and mainly the high-skill-intensive sectors (i.e. the productivity level in per cent of the leading country is higher in these sectors). Further, the initial productivity gaps are higher for the cohesion countries and the East European countries; in the latter group the initial productivity level relative to the leading industry in 1995 was between less than 20% and up to 40%. From these descriptive statistics one might conclude that the high-skill-intensive sectors also show higher labour productivity growth rates in general and that labour productivity in catching-up countries seems to converge faster in these sectors. Further, the initial productivity gap is important as it provides a potential for faster productivity growth (‘advantage of backwardness’).

Figures 3 and 4 present the growth rates of exports (nominal at current euro rates; industries weighted by gross output shares) and growth rates of unit labour costs (compensation divided by gross output and weighted by gross output shares) for the three industry groups and each country.

Again one can find higher growth rates of exports in the high-skill-intensive sectors on average. This is especially the case for East European countries such as the Czech Republic, Hungary, Poland, the Slovak Republic, Estonia and Latvia. Finally, the pattern of growth rates of unit labour costs mainly reflects the differences in growth rates of labour productivity. Most importantly, these are in particular declining strongly in the medium- and high-skill-intensive sectors of the East European countries (e.g. Hungary, Poland, Slovak Republic, and Estonia).

Skills and productivity growth

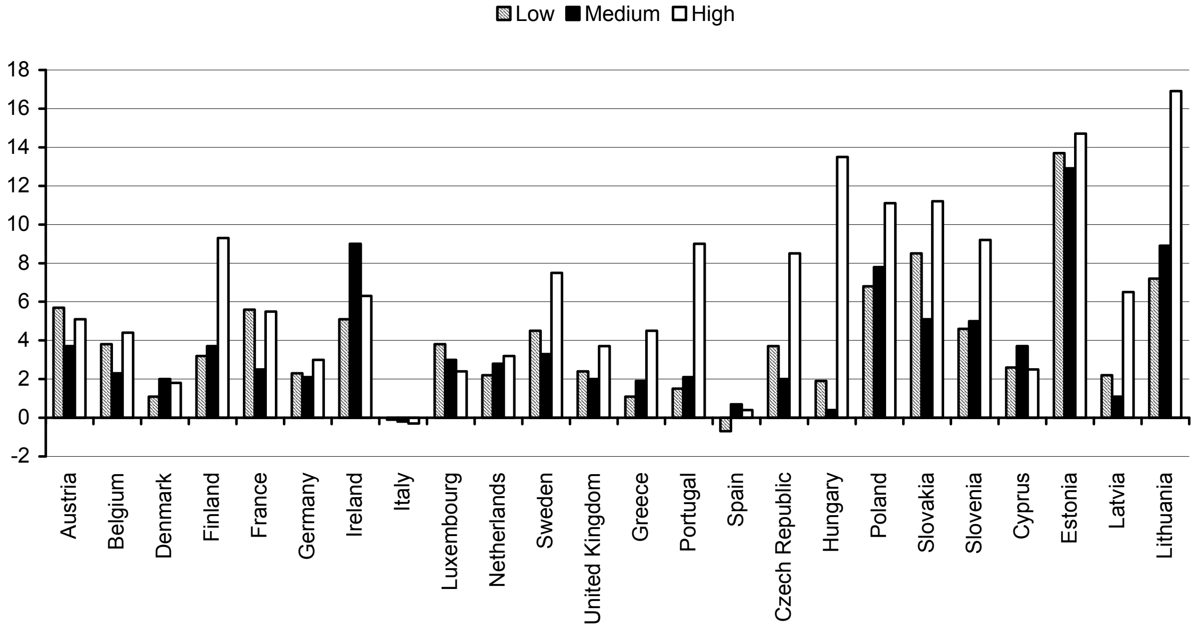
We start with studying the effects of the skill composition of the employed labour force on productivity growth by estimating the following specification (where we omitted country and industry subscripts)

$$\gamma = \beta_0 + \beta_1 S_k + \beta_2 G + Dummies + \varepsilon$$

The growth rate of labour productivity γ is regressed on the skill intensity variable S (expressed as the share of workers of skill type k = H, M, L in total employment of the particular

Figure 1

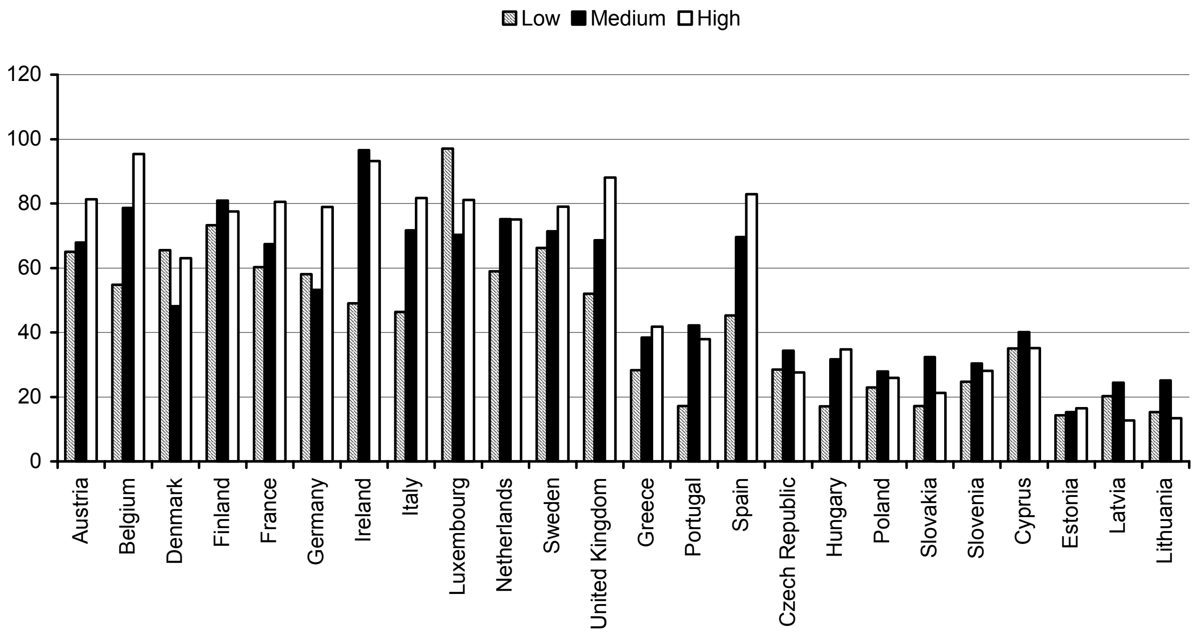
Growth rates of labour productivity (value added per hour worked) by industry groups, 1995-2004



Source: EU KLEMS database, March 2007; wiiw calculations.

Figure 2

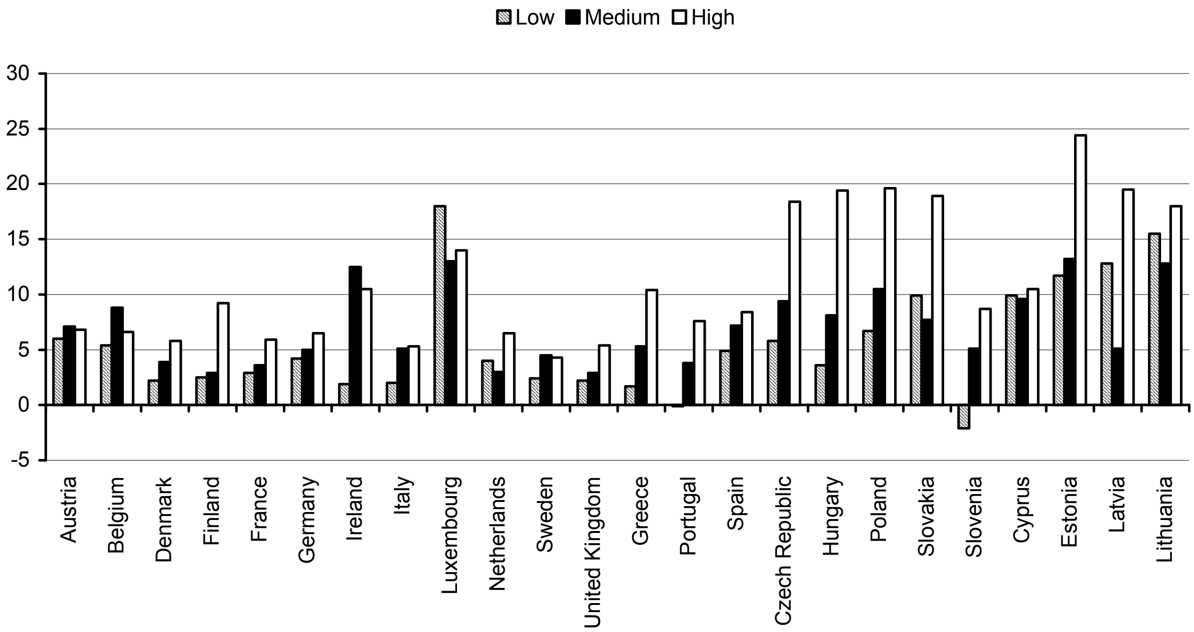
Initial level of labour productivity in per cent of leading country by industry (at PPP 1995)



Source: EU KLEMS database, March 2007; wiiw calculations.

Figure 3

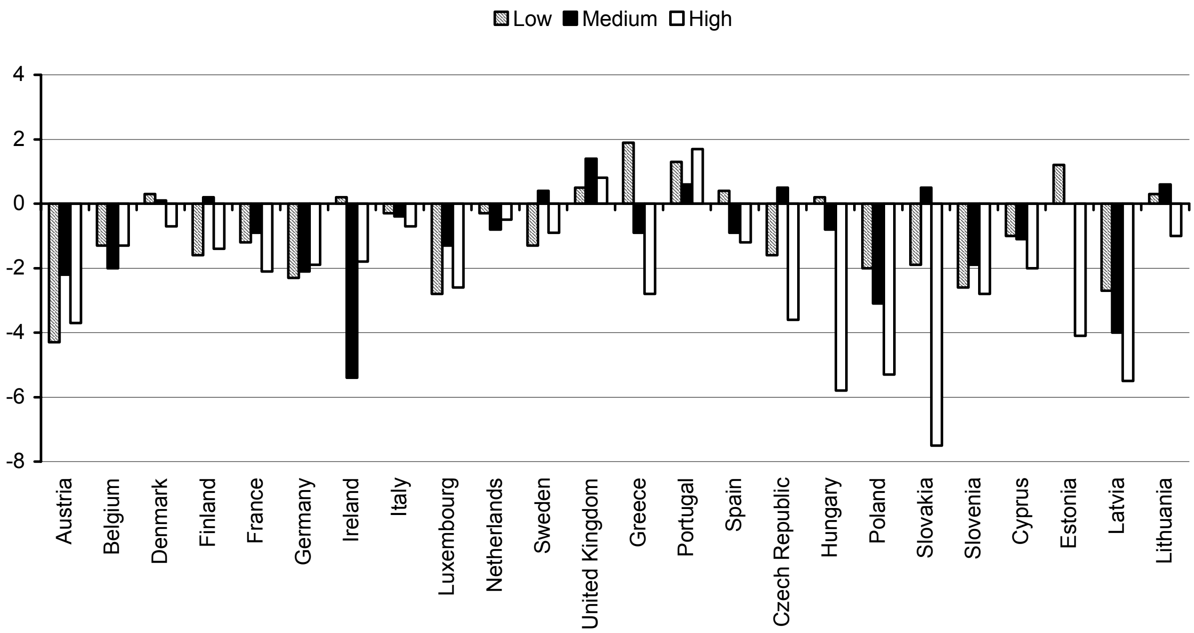
Average growth rates of exports (in per cent), 1995-2004



Source: UN COMTRADE database, wiiw calculations.

Figure 4

Growth rates of unit labour costs (in per cent), 1995-2004



Source: EU KLEMS database, March 2007, wiiw calculations.

industry and country), and the initial gap expressed as the log of the productivity level in a particular sector and country divided by the productivity level of the leading industry-country pair. The results from this regression are presented in Table 2. Here we included each of the skill types separately. (Specifications including the shares of two skill types simultaneously yield similar results.) The first three columns present results without industry dummies. In specification (2) we introduced industry dummies to account for industry-specific characteristics such as technology intensity, innovative potential, etc. In this case we performed LSDV regressions; the industry effects are not reported.

As expected we find a significant effect of the initial gap on productivity growth pointing towards a catching-up effect known as β-convergence. The implied half-time of closing the gap is between 25 and 35 years. More interesting are the results on the skill variables. We find significant positive effects of the share of high-skilled and medium-skilled on productivity growth, with the effect of the latter being smaller with around half of the effect of the share of high-skilled workers on productivity growth. These results suggest that a skilled labour force fosters productivity growth by increasing the capability of adopting, implementing or creating new technologies. The latter is mainly relevant for countries already being near the technology frontier. The parameter measuring the effect of the shares of low-skilled workers is significantly negative, suggesting that a skilling of the less educated workers would have a positive effect on productivity growth. The estimations are improved when including industry dummies capturing industry-specific effects. In this case the speed of convergence is higher and the implied half-time becomes even less than 20 years. Again, the results for the shares of the particular skill types hold, i.e. significantly positive for the high- and medium-skilled (for the latter the effect is again smaller) and significantly negative for the share of the low-skilled. The effects are however smaller, pointing towards the importance of the industry characteristics. We also tested a number of other specifications: First, when introducing industry group dummies (according to the skill intensities of industries as given in Table 1) these results are confirmed. Second, including country dummies additionally to the industry dummies provides no longer any significant results for the skill shares. This reflects the fact that the skill shares of the various skill types are relatively similar across industries for each country, reflecting supply-side factors. This thus causes multicollinearity of the skill variables and the country fixed effects resulting in higher standard errors and insignificant results. When including country dummies only, the effects of skill shares become significant with the expected signs, with the exception of the medium skill shares for which the coefficient becomes insignificant. Finally, we also tested the relationship with a limited country sample, i.e. excluding the East European catching-up countries. In this case the initial gap shows no longer a significant effect on productivity growth, as most of the countries and industries are close enough to the technology frontier. The results for the skill shares are, however, confirmed at the 10 % level, i.e. positive for high- and medium-skilled workers and negative for low-skilled workers (the only exception being the share of high-skilled when including industry dummies).

The descriptive overview above and also the previous results suggest that the effect of skills on productivity growth might vary across types of industries. Table 3 thus presents the results when allowing for different convergence rates and differences in the effects of skill shares across industry groupings (i.e. high-, medium- and low-skill intensive industries as indicated in Table 1 above).

The results from this specification show that convergence is taking place faster in the high-skill-intensive industries with a half-time of about 15 years as opposed to a half time of more than 25 years in the low-skill-intensive industries (depending on the skill measure). The share of high-skilled workers is only significant in the medium-skill-intensive industries. On the other hand, the share of medium-skilled workers is

Table 2

Labour productivity growth and skills

Dependent variable: Growth rates of labour productivity

	(1)			(2)		
Initial productivity gap	-0.027 ***	-0.021 ***	-0.020 ***	-0.041 ***	-0.035 ***	-0.033 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Share of high-skilled workers	0.105 ***			0.082 **		
	(0.001)			(0.020)		
Share of medium-skilled workers		0.061 ***			0.040 ***	
		(0.000)			(0.001)	
Share of low-skilled workers			-0.084 ***			-0.058 ***
			(0.000)			(0.000)
Industry dummies	No	No	No	Yes	Yes	Yes
F-value	25.29	27.25	36.55	9.49	12.77	13.08
R squared	0.21	0.22	0.28	0.40	0.40	0.42
Observations	264	264	264	264	264	264

Note: p-values from robust standard errors are reported in brackets.

Table 3

Labour productivity growth and skills by industry groups

Dependent variable: Labour productivity growth

	Share of high-skilled workers	Share of medium-skilled workers	Share of low-skilled workers
Initial productivity gap in low-skill-intensive industries	-0.027 ***	-0.016 *	-0.015 *
	(0.002)	(0.076)	(0.057)
Initial productivity gap in medium-skill-intensive industries	-0.028 ***	-0.039 ***	-0.033 ***
	(0.000)	(0.000)	(0.000)
Initial productivity gap in high-skill-intensive industries	-0.051 ***	-0.048 ***	-0.044 ***
	(0.000)	(0.000)	(0.000)
Skill share in low-skill-intensive industries	0.115	0.066 ***	-0.069 ***
	(0.165)	(0.000)	(0.000)
Skill share in medium-skill-intensive industries	0.164 ***	0.012	-0.049 ***
	(0.000)	(0.502)	(0.001)
Skill share in high-skill-intensive industries	0.004	0.057 **	-0.068 *
	(0.953)	(0.028)	(0.064)
Industry dummies	Yes	Yes	Yes
Industry group dummies	Yes	Yes	Yes
F-value	11.29	10.52	10.72
R squared	0.43	0.43	0.44
Observations	264	264	264

Notes: p-values from robust standard errors are reported in brackets.

significantly positive in the low- and high-skill-intensive industries but not so in the medium-skill-intensive industries. This result suggests that country-specific idiosyncrasies in the training and educational systems of different countries and in particular those of the Central and East European economies are important. The latter have a very high share of medium-educated workers and have also been the main catching-up economies. This is confirmed when looking at the specification using the share of low-skilled workers that is negatively significant in all industry groups (for high-skill-intensive industries at the 10% level only). As the shares sum up to one, this result also suggests that the share of high- and medium-skilled taken together is significantly positive.

Following the above-mentioned contributions at the total economy level, we also test the following specification, which is in line with the model suggested in Benhabib and Spiegel (2005) assuming a logistic form of technology diffusion. Following Vandenbussche et al. (2006) we use the share of workers with skill type k rather than the level of workers. Specifically we estimate the following specification

$$\gamma = \beta_0 + \beta_1 S_k + \beta_2 S_k (1 - G) + Dummies + \varepsilon$$

where the gap is now measured as the relative productivity level of the follower country's industry to the leading one. The results of this specification are presented in Table 4. Again we present two specifications: the first using simple OLS method whereas in the second we allow for industry-specific characteristics using industry dummies.

In the specification without industry dummies only the share of low-skilled is negatively significant, which conversely means that the share of high- and medium-skilled together would have a significantly positive effect on productivity growth. The interaction term between the skill share and gap (the gap is defined as 1-G) is positively significant, showing again the relevance of skill composition for convergence processes. It is important to note that the parameter is higher for the high-skilled in the interactive term, which shows the importance of this group for the catching-up process in technology, i.e. technology adoption and learning. Introducing industry dummies confirms these results with the exception that the share of high-skilled becomes negatively significant. This term was also negative but not significant in the previous specification without industry dummies. A closer look at the data shows that this result is

Table 4

Labour productivity growth, skills and technology diffusion

Results for total sample

Dependent variable: Labour productivity growth

	Share of high skilled workers	Share of medium skilled workers	Share of low skilled workers	Share of high and medium skilled workers	Share of high skilled workers	Share of medium skilled workers	Share of low skilled workers	Share of high and medium skilled workers
Skill share	-0.063	0.006	-0.150 ***	0.045 ***	-0.114 **	-0.019	-0.160 ***	0.018
	(0.153)	(0.717)	(0.000)	(0.006)	(0.021)	(0.324)	(0.000)	(0.275)
Share x (1-Gap)	0.332 ***	0.096 ***	0.096 ***	(0.069) ***	0.394 ***	0.122 ***	0.132 ***	0.090 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Industry dummies	No	No	No	No	Yes	Yes	Yes	Yes
F-value	20.68	28.70	5.85	38.5	5.85	12.05	10.67	12.16
R squared	0.19	0.22	0.32	0.28	0.32	0.36	0.34	0.39
Observations	264	264	264	264	264	264	264	264

Results for EU-15 subsample

Dependent variable: Labour productivity growth

	Share of high skilled workers	Share of medium skilled workers	Share of low skilled workers	Share of high and medium skilled workers	Share of high skilled workers	Share of medium skilled workers	Share of low skilled workers	Share of high and medium skilled workers
Skill share	0.082 *	0.027 *	-0.06 ***	0.037 **	0.046	0.035 *	-0.048 **	0.032 *
	(0.059)	(0.100)	(0.001)	(0.027)	(0.363)	(0.059)	(0.016)	(0.076)
Share x (1-Gap)	-0.049	-0.008	0.038 *	-0.006	-0.096	-0.025	0.033	-0.020
	(0.359)	(0.667)	(0.073)	(0.657)	(0.218)	(0.366)	(0.259)	0.355
Industry dummies	No	No	No	No	Yes	Yes	Yes	Yes
F-value	1.85	1.38	5.68	2.58	1.96	2.65	2.80	2.65
R squared	0.049	0.016	0.06	0.046	0.19	0.20	0.21	0.21
Observations	165	165	165	165	165	165	165	165

Notes: p-values from robust standard errors are reported.

mainly driven by the fact that the catching-up countries show particularly high growth rates in the higher-tech (skill-intensive) sectors – which might be driven by other factors such as foreign direct investment – and at the same time show relatively lower shares of high-skilled workers compared to the more advanced countries. This is confirmed when restricting the sample to the EU-15 countries. The results are reported in the second part of Table 4. In this restricted sample the parameters show the expected sign, i.e. positive for the high- and medium-skilled and negative for the low-skill share. These parameters are also significant in both specifications, with one exception. The interaction term becomes insignificant as the EU-15 countries are already operating near the technological frontier where the creation of knowledge and new technologies is relatively more important than their adoption. The generally positive effect of a skilled workforce is confirmed by the significance of the skill share when taking high- and medium-skilled together as reported in Table 4; however, this significance for the total sample is lost when introducing industry dummies. When including the share of high- and the share of low-skilled workers simultaneously and accordingly the interactions with the initial gap, we find a negative non-significant effect of the share of high-skilled workers and again a negative significant effect of the low-skilled workers. In this case only the interaction of the high-skill shares with the initial gap is significantly positive, which again emphasizes the role of the skilled workers in the catching-up process.

Again we test the same specification allowing for industry group-specific parameters, as reported in Table 5. The results are broadly confirmed in that the share of high- and medium-skilled is particularly important when interacted with the initial gaps. The share of low-skilled workers is negatively significant for all industry groups; the interaction with the initial gaps shows lower estimated values and less significance. The negative effect of the high-skilled workers share in high-skill-intensive industries and of medium-skilled workers in medium-skill-intensive industries again result from the peculiar catching-up process of the Central and East European economies. The second part of the table shows the results for a subsample comprising the EU-15 countries. For this subsample we find significantly positive effects of high and medium skills in the low- and medium-skill-intensive industry groups. The effect is, however, not significant for the high-skill-intensive industries.

Skills and international competitiveness

Another indicator for competitiveness is the export performance of the various countries as outlined above. This measures success in international markets. In the following we estimate whether a higher skill share has a positive effect on export growth, controlling for growth in unit labour costs. Specifically the estimated equation is given by (again omitting country and industry subscripts)

$$\gamma = \beta_0 + \beta_1 S_k + \beta_2 \mu + Dummies + \varepsilon$$

where γ is now the growth rate of exports and μ denotes growth rates of unit labour costs. Export data are taken from the UN COMTRADE database and are measured at current USD. Unit labour costs are calculated as labour compensation divided by gross output in local currency units. As above, we report the results for a specification first without including dummies and then including industry dummies capturing industry-specific characteristics. The results can be found in Table 6.

We find that a higher share of high- and medium-skilled workers spurs growth of exports in both specifications, i.e. also when including industry dummies. Furthermore, the coefficient of high-skilled workers is again higher compared to that for the medium-educated. The coefficient of the share of low-educated workers is negatively significant. The growth rate of unit labour costs relates negatively to export growth as higher unit labour costs decrease competitiveness. The results are confirmed when allowing for industry group-specific effects, as presented in Table 7.

Firstly, we find that the unit labour cost variable is particularly significant in the high- and low-skill-

Table 5

Labour productivity growth, skills and technology diffusion allowing for industry-group specific effects

Results for total sample

Dependent variable: Labour productivity growth

	Share of high-skilled workers	Share of medium-skilled workers	Share of low-skilled workers	Share of high- and medium-skilled workers
Skill share in low-skill-intensive industries	-0.159	0.038	-0.124 ***	0.040 *
	(0.135)	(0.214)	(0.000)	(0.094)
Skill share in medium-skill-intensive industries	0.017	-0.046 *	-0.131 ***	0.023
	(0.839)	(0.091)	(0.000)	(0.335)
Skill share in high-skill-intensive industries	-0.196 ***	-0.016	-0.280 ***	0.021
	(0.005)	(0.682)	(0.000)	(0.663)
Share x (1-Gap) in low-skill-intensive industries	0.475 ***	0.055	0.070 *	0.053 **
	(0.002)	(0.109)	(0.065)	(0.046)
Share x (1-Gap) in medium-skill-intensive industries	0.308 ***	0.130 ***	0.094 *	0.078 ***
	(0.004)	(0.000)	(0.061)	(0.005)
Share x (1-Gap) in high-skill-intensive industries	0.414 ***	0.157 ***	0.324 ***	0.117 ***
	(0.000)	(0.000)	(0.000)	(0.000)
Industry dummies	Yes	Yes	Yes	Yes
Industry group dummies	Yes	Yes	Yes	Yes
F value	7.20	9.86	10.18	10.27
R squared	0.34	0.38	0.38	0.41
Observations	264	264	264	264

Results for EU-15 subsample

Dependent variable: Labour productivity growth

	Share of high-skilled workers	Share of medium-skilled workers	Share of low-skilled workers	Share of high- and medium-skilled workers
Skill share in low-skill-intensive industries	0.014	0.069 **	-0.068 ***	0.051 **
	(0.910)	(0.025)	(0.009)	(0.035)
Skill share in medium-skill-intensive industries	0.128 **	0.046 **	-0.016	0.047 ***
	(0.019)	(0.012)	(0.577)	(0.006)
Skill share in high-skill-intensive industries	-0.016	-0.011	-0.111 **	-0.012
	(0.848)	(0.807)	(0.035)	(0.794)
Share x (1-Gap) in low-skill-intensive industries	-0.034	0.001	0.023	-0.001
	(0.808)	(0.983)	(0.512)	(0.981)
Share x (1-Gap) in medium-skill-intensive industries	-0.212 **	-0.077 *	-0.026	-0.060 *
	(0.046)	(0.099)	(0.581) ***	(0.083)
Share x (1-Gap) in high-skill-intensive industries	0.041	0.007	0.194	0.005
	(0.636)	(0.873)	(0.006)	(0.857)
Industry dummies	Yes	Yes	Yes	Yes
Industry group dummies	Yes	Yes	Yes	Yes
F value	1.95	2.44	3.18	2.58
R squared	0.22	0.23	0.27	0.23
Observations	165	165	165	165

Note: p-values from robust standard errors are reported in brackets.

Table 6

Skills and export performance

Dependent variable: Growth rates of exports

	Share of high-skilled workers	Share of medium-skilled workers	Share of low-skilled workers	Share of high-skilled workers	Share of medium-skilled workers	Share of low-skilled workers
Skill share	0.179 ***	0.059 ***	-0.103 ***	0.138 **	0.066 ***	-0.090 ***
	(0.000)	(0.005)	(0.000)	(0.018)	(0.000)	(0.000)
Growth rate of unit labour costs	-0.788 ***	-0.669 ***	-0.558 ***	-0.628 ***	-0.394 *	-0.370 *
	(0.000)	(0.002)	(0.008)	(0.001)	(0.056)	(0.076)
Industry dummies	No	No	No	Yes	Yes	Yes
F value	17.67	12.85	26.01	9.33	11.13	11.76
R squared	0.14	0.10	0.16	0.27	0.27	0.30
Observations	263	263	263	263	263	263

Note: p-values from robust standard errors are reported in brackets.

Table 7

Skills and export performance for industry groups

Dependent variable: Growth rate of exports

	Share of high-skilled workers	Share of medium-skilled workers	Share of low-skilled workers
Growth of unit labour costs in low-skill-intensive sectors	-0.746 **	-0.476	-0.480
	(0.035)	(0.292)	(0.288)
Growth of unit labour costs in medium-skill-intensive industries	-0.078	-0.058	-0.041
	(0.773)	(0.835)	(0.881)
Growth of unit labour costs in high-skill-intensive industries	-1.118 ***	-0.620	-0.454
	(0.000)	(0.104)	(0.254)
Skill share in low-skill-intensive industries	0.155	0.060 *	-0.065 *
	(0.320)	(0.093)	(0.095)
Skill share in medium-skill-intensive industries	0.119 *	0.052 ***	-0.071 ***
	(0.053)	(0.004)	(0.000)
Skill share in high-skill-intensive industries	0.185 *	0.082	-0.164 ***
	(0.084)	(0.125)	(0.001)
Industry dummies	Yes	Yes	Yes
Industry group dummies	Yes	Yes	Yes
F value	8.52	9.53	10.7
R squared	0.29	0.28	0.32
Observations	263	263	263

Note: p-values from robust standard errors are reported in brackets.

intensive groups of industries. These are the industry groups where a deterioration (improvement) in the unit labour cost position has the strongest negative (positive) effect. This could be interpreted as expressing a strong competitive pressure by lower-cost producers in the low-skill industries, but also in the lower-cost segment of the higher-skill industries. Secondly, we see that a high share of low-skilled workers is particularly detrimental for export competitiveness in the high- and then the medium-skill industries, which is again compatible with a strong competitive pressure in the low-quality segments by lower-cost producers of such industries. These are the segments that need to be vacated by the higher-cost producers which in our sample (i.e. European producers) are strongly represented.

Conclusions

This analysis has attempted to find evidence for skill compositional effects on two types of competitiveness variables, (labour) productivity growth and export growth. For this we used a disaggregated industry-level data set to capture the impact of skills on competitiveness for total manufacturing and three industry groups.

Given the data restrictions and the fact that two types of data sources had to be used (EU-KLEMS database and LFS statistics) we were restricted to analyse time series for the period 1995 to 2004 and for eleven manufacturing industries, but for a relatively full EU country sample including 24 countries of the European Union. Furthermore, we grouped industries into three groups depending upon whether these were industries with a high, medium or low (EU-wide) share of highly skilled workers and we supplied estimates for different effects of skill composition on competitiveness in these three industry groupings.

Overall, the results are promising in that the share of high-skilled turned out to be a significant factor over the entire country and industry sample in explaining relative productivity and export growth, followed by the share of medium-skilled; the share of low-skilled have a significant negative impact on the two competitiveness variables. Furthermore, when differentiating between the general effect of skill composition on the trend productivity growth rates and the impact which skills might have on the speed of catching-up, we found that the share of high-skilled is particularly important for the speed of catching-up. For a subset of advanced countries we still find evidence for the importance of a higher share of skilled workers. Finally, as regards export growth, we found particularly detrimental effects of a high share of low-skilled in the high- and then medium-skill industries which would indicate that in such industries it is particularly important to vacate low-skill niches which have come strongly under pressure from (both European and non-European) catching-up economies.

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Selected economic impacts of higher oil prices*

BY EDWARD CHRISTIE, MARIO HOLZNER AND GÁBOR PELLÉNYI**

Empirical findings on growth and inflation

Empirical research efforts covering the effects of oil price shocks on growth and inflation are of two main types: backward-looking econometric estimates and forward-looking projections or simulations from calibrated models. Given that high oil prices are a recent development after a long period of low real oil prices, it is preferable to use the latter. However, as dynamic simulations always assume a baseline scenario (the trajectory without an oil price shock), there are additional complexities stemming from the uncertainties surrounding the baseline scenario itself. In any case, recent estimates for the US economy (e.g. Jones et al., 2004) yield a relatively stable elasticity parameter between GDP growth and oil price shocks: approximately -0.05 for one quarter, assuming that the oil price shock lasts for two years. In other words, a 10% rise in oil prices shaves 0.5% off GDP for two years but the effect gradually wears off.

For European countries the effects of oil price shocks on GDP are thought to be lower. For the purposes of the current article we choose to refer to simulations made by Barrell and Pomerantz (2004), as it provides dynamic simulation results for several EU member states as well as for the euro area. However we will also discuss more recent contributions and data trends. The simulations of Barrell and Pomerantz (2004) are based on the NiGEM model, a global macroeconomic model based on a 'New Keynesian' framework with forward-looking agents and nominal rigidities. Each OECD country is modelled separately, as are China, Russia and a few other countries. The rest of the world is modelled as a set of regional blocks. In their simulations, the authors assume that the monetary authorities of OECD countries target inflation both in the short run and in the long run. Crucially, the authors conduct separate simulations for temporary and permanent oil price shocks. According to their simulations, the effect of a permanent oil price increase on economic growth is relatively short-lived. The bulk of the negative impact on output occurs in the first two years and wears off rapidly thereafter. Output effects from temporary price shocks are similar initially but of very small magnitude in the longer run. These results are in keeping with the results of other types of dynamic models. A review of several simulation results for the US economy can be found in EIA (2006).

The magnitude of the impact on output of a permanent oil price shock depends on the oil intensity of the economy. Simulation results for a permanent USD 10 increase in the oil price suggest a *cumulative loss over the first two years* of 0.38% of GDP for the euro area and of 0.47% for the United States, though certain new EU member states may experience higher losses due to higher oil intensities. In particular, the simulations suggest that the losses in the first year of the shock would amount to 0.21% for the euro area. These estimated responses should, however, be interpreted as an upper-bound concerning the most recent oil price increases for two main reasons: first, the starting level of the oil price for the increase that occurred between 2007 and 2008 was higher, leading to a smaller percentage change; and second, exchange rate developments dampen the shock in euro terms.

The effect on inflation is less clear and strongly depends on monetary policy responses. Assuming that monetary policy seeks a compromise between short-run and long-run price stability, simulations suggest that the impact on overall inflation peaks in

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the second year at around 0.3 percentage points for the euro area and at around 0.5 percentage points for the United States, while stronger effects are possible for more oil-intensive countries.

Given that recent oil price increases have been quite dramatic, these simulation results seem relatively high. Strongly negative growth impacts had not been observed until mid- to late-2007, leading some analysts and economists to conclude that 'oil shocks no longer shock', as evidenced for example in Segal (2007), or at least that their impacts are much smaller for certain key reasons, as expounded in Blanchard and Gali (2007). In order to offer a balance of views on the issue we briefly review their arguments. The explanations given for the absence of serious drops in growth until 2007 break down into three main categories. First and foremost, past oil shocks have been critically re-evaluated, and the conclusion which is currently gaining ground is that one of the main reasons for recessions after oil shocks in earlier days was because of inappropriate monetary policy responses, i.e. with too much focus on fighting short-run inflation and not enough focus on upholding growth. If one pictures a Taylor Rule, this is akin to saying that the weight given to reducing the (short-run) inflation gap was too high in the past, while the weight given to reducing the output gap was too low. Accordingly, authors such as Segal (2007) believe that monetary authorities have learnt from past mistakes, so that they would now not worsen shocks which, in most cases, are much less potent than generally believed. Another argument, developed in Blanchard and Gali (2007), is that nominal wage rigidity has decreased in OECD countries. In other terms, real wages can adjust downwards more rapidly and more strongly today after an oil shock than they could in the 1970s. As a result, wage inflation remains more subdued, reducing the likelihood and extent of restrictive monetary policy responses. Finally, both Blanchard and Gali (2007) and Segal (2007) argue that the substantial lowering of the oil intensity of GDP since the 1970s has reduced both the direct output effect and the direct inflationary effect of oil price shocks. This latter argument is supported by oil and energy intensity indicators.

Asymmetries across EU economies in terms of energy intensity

The impact of high oil prices also depends on the energy intensity of the economy. In this respect there are large differences among the EU member states: Bulgaria needs three times as much energy as Ireland to produce the same amount of value added (Figure 1). The economies of new member states in Central and Eastern Europe are particularly energy-intensive; this is due to their lower development levels and less efficient use of energy. On the other hand, countries with indigenous resources are less dependent on (mostly imported) hydrocarbons. The amount of oil required for producing a unit of value added is fairly similar across member states; only Cyprus and Malta are extremely reliant on oil. If all hydrocarbons are also taken into account, differences are more pronounced. Some new member states[1] rely heavily on Russian gas, and can be particularly exposed to high hydrocarbon prices.

Trade balance effects

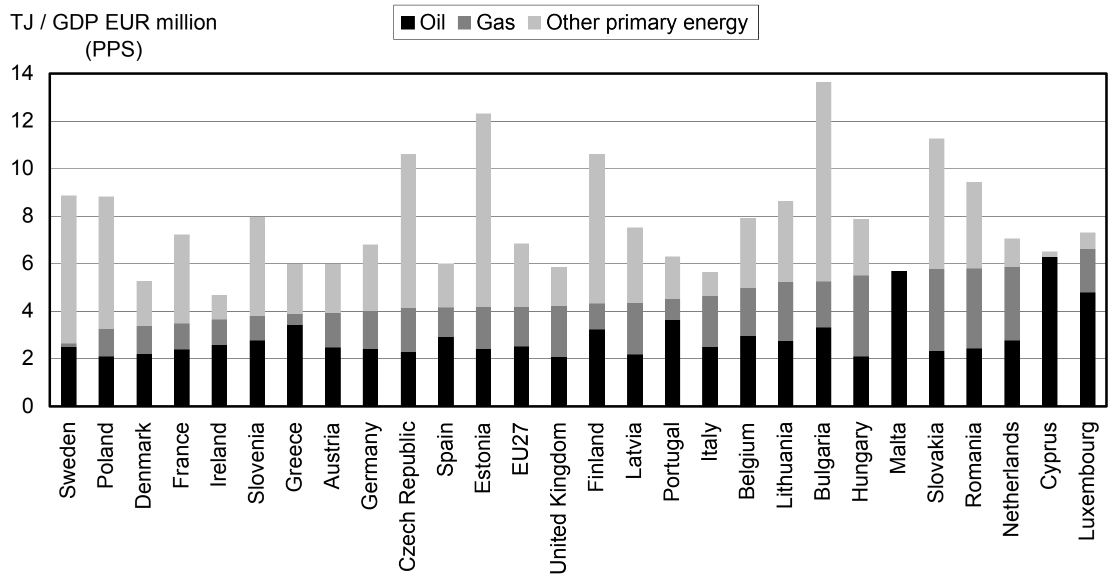
The trade balance of the European Union (EU-27) is significantly affected by high oil prices (Figure 2). Between 1999 and 2007 the total trade deficit widened from EUR 60 billion to EUR 186 billion. This was entirely driven by the deficit on energy products that quintupled by 2007 to reach almost EUR 270 billion (it peaked in 2006 with EUR 282 billion); meanwhile the non-energy trade balance even improved. Price changes accounted for 86% of the rise in the energy trade deficit; changing volumes caused the remaining 14%.

However, the same factors that mitigate the growth-reducing effect of high oil prices in Europe also act against the deterioration of the trade balance. According to our simple, static

[1] In particular Bulgaria, Hungary, Lithuania, Romania and Slovakia

Figure 1

Energy intensities of EU member states (2005)

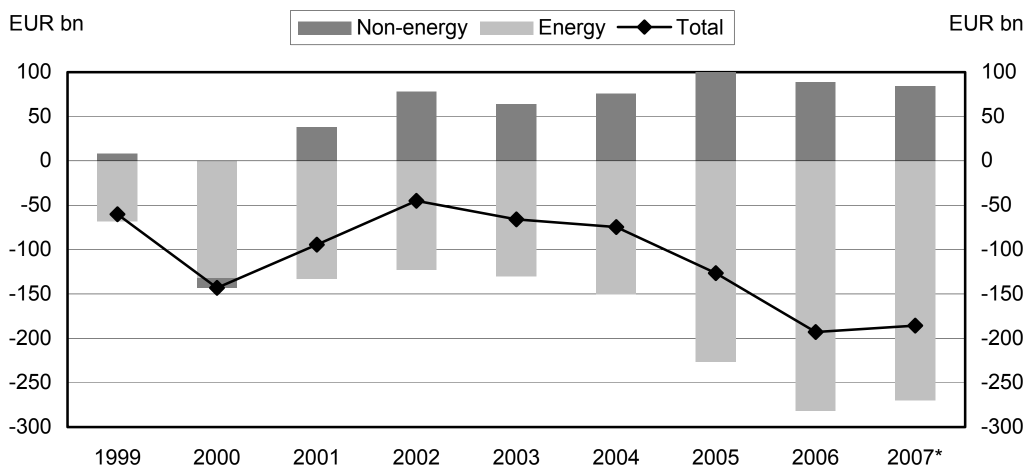


Note: Countries are ordered by their hydrocarbon intensity.

Source: Eurostat.

Figure 2

The evolution of energy and non-energy trade balances of the European Union (EU-27)



Note: Energy = SITC 3 commodity group.

* Preliminary data.

Source: Eurostat.

projections[2] a USD 10 rise in oil prices adds EUR 43 billion to the energy import bill while it increases non-energy exports by EUR 23 billion; the net effect is a EUR 20 billion rise in the trade

[2] We estimated the oil price elasticity of EU non-energy exports to OPEC countries, Norway and Russia and the oil price elasticity of EU energy exports and imports. Non-energy exports to other countries and non-energy imports were assumed to be independent of the oil price. We then simulated the evolution of the EU trade balance with various oil price levels.

deficit. A recent econometric study[3] also investigates the dynamic effects of oil price shocks on the trade balance of the euro area. It finds that the net effect of an oil price increase on the trade balance is negative in the first two years but later turns positive as non-energy exports expand.

Simulating shifts in trade patterns among oil importing countries

This part of our research is devoted to simulating shifts in international trade patterns due to a higher oil price. For this purpose we employ the global simulation model (GSIM), which is designed for the analysis of global, regional and unilateral trade policy changes by Francis and Hall (2003). The model is a multi-region, imperfect substitutes model of world trade employing a partial equilibrium approach. Each country produces only one composite good, in other words sectoral effects are not considered. The results of the GSIM allow the assessment of importer and exporter effects related to tariff revenues, exporter (producer) surplus, and importer (consumer) surplus, changes in trade turnover, domestic output and prices.

Our simulation is based on the fact that there exists a specific set of changes to import tariffs which is equivalent, in its effects on trade flows, to a change in the price of oil. We therefore introduce equivalent ad valorem tariff rate changes which simulate the effects of an assumed increase in the oil price. The additional simulated tariffs are computed using the different oil intensities of national production of the selected countries. These simulated new tariffs come in addition to existing official tariff rates for each single trade flow. Our simulation focuses on the EU, the USA, China, Japan and the rest of the world. The data we used were taken from the Global Trade Analysis Project (GTAP), the Energy Information Agency and the International Energy Agency. We do not take into consideration trade flows with countries that are net exporters of oil such as Russia or OPEC countries. The latter have an opportunity to benefit in terms of both output and non-oil exports under certain conditions. However, the goal here is to focus on the world's most important non-oil trade flows and on those of the EU in particular.

We decided to conduct a simulation of the past increase in the oil price, with the price of the barrel shifting from EUR 25 to EUR 60 per barrel, assuming an average past exchange rate of 1.3 USD/EUR. We assume 2004 levels of oil intensities, constant throughout the simulation period. As a result of the price shock, we estimate that EU exporters face the equivalent of an additional import tariff rate of 1.6% in ad valorem terms; an equivalent intra-EU barrier to trade is also assumed by the model. Similarly, given the different levels of oil use in production, US exporters will face an additional equivalent rate of 2.9%, the Japanese 1.7%, the Chinese 6.6% and the rest of the world 3.2%. Adding these rates to the base year tariff rates provides us with the following simulation results.

Table 1

Bilateral trade and output quantities: per cent change

Oil price shifts from EUR 25 to EUR 60 per barrel

		Destination				
		EU	**USA**	**Japan**	**China**	**ROW**
Origin	**EU**	***-1.1***	0.9	-0.8	6.4	1.1
	USA	-3.6	***-1.9***	-2.9	4.3	-1.6
	Japan	-0.9	0.9	***-1.1***	6.5	1.1
	China	-10.4	-8.4	-9.9	***-4.5***	-6.5
	ROW	-4.4	-2.6	-4.1	3.5	***-2.0***

Note: ROW = Rest of world.
Source: Own calculations.

Given the increase in the oil price and the subsequent, short-run rise in consumer prices, demand declines and overall production is estimated to fall slightly, as compared to the base year. Table 1 shows our results. The numbers on the diagonal represent the estimated changes in domestic output, while the numbers off the

[3] Kilian, Rebucci and Spatafora (2007).

diagonal represent the estimated changes in bilateral trade flows.

As is shown, this substantial oil price shock (EUR 35 per barrel, equivalent to USD 45 per barrel under our assumptions) leads to one-off static drops in output of 1.1% for the EU and Japan, of 1.9% for the USA, and of 4.5% for China. These results should however be interpreted with caution, as the model used is suitable for trade simulation rather than for output effects.

The changes in trade quantities in the aftermath of an oil price increase are expected to be mixed. In terms of exports we expect the two least oil-intensive players, the EU and Japan, to profit from a rising oil price, as compared to their oil-intensive trading partners in the US, China and the rest of the world. The EU could expect to increase its exports to the US by about 1% and to China by more than 6%. If the technological level of 2004 was assumed not to change, China would be a net loser of a higher oil price. Its highest rate of export drop (-10%) would be vis-à-vis the EU. In general the EU would face reduced import penetration from all the trading partners considered here (notwithstanding oil exporting countries).

These simulation results confirm the idea that those countries that use oil more efficiently in their production, such as the EU, can expect an improvement in their trade balances with respect to more oil-intensive net oil importers. This effect of course does not contradict the negative trade balance developments with respect to oil exporting countries, but it is interesting to see that not all net oil importing countries are likely to fare equally in a global environment of higher oil prices. Of course, the results shown must be put in context, as we did not assume any changes in exchange rates. The recent fall in the USD/EUR exchange rate may more than compensate the EU's energy intensity advantage with respect to EU-US trade. On the other hand, that very development reduces the size of the oil shock for the EU.

Effects on commodity prices

We conclude this preview with a look at selected results concerning commodity prices. Commodity prices may respond to changes in energy prices for two main reasons. First, the production process of many commodities requires the use of energy products, in the form of feedstock as well as in the form of energy. Second, energy prices affect the cost of transportation of the commodities to their consumers. Nevertheless, the prices of commodities crucially depend on a number of other factors, in particular market structures and the evolution of supply and demand. It is therefore not always easy to identify the size of the impact of energy prices on commodity prices, as that effect can be more than compensated by the effect of excess supply capacity or of excess demand.

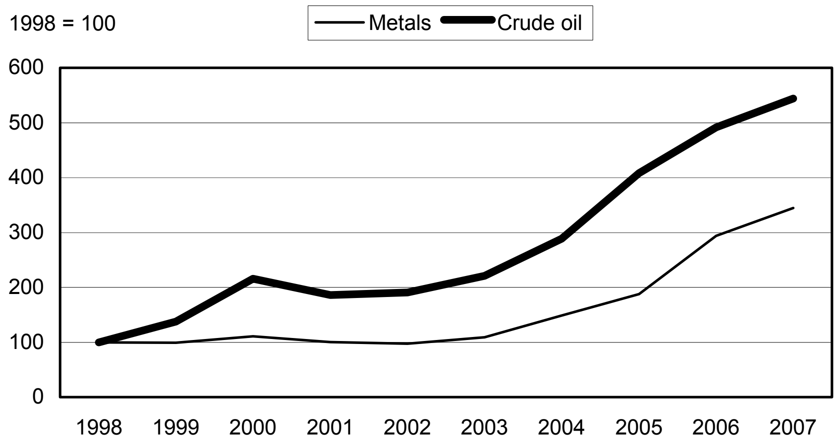
Industrial commodity prices

After a relatively stable period between 1998 and 2003, metal prices almost tripled between 2003 and 2006-2007 (Figure 3). However, the IMF (2007) forecasts that there should be a 14% fall in prices by 2008. There are several explanations for these changes:

- China has emerged as an economic giant in material terms. Its very strong economic growth, which includes very rapid industrialization as well as enormous investments in infrastructure and construction, has led to strong excess demand for metals.
- Major global and Chinese producers have been reacting to this growth in demand by investing in new supply capacity. These investments came with a lag and in some instances under-estimated the extent of demand growth, thus leading to upward pressure on prices. This phenomenon seems to be coming to a close as the new supply capacity comes online, leading to the fall in prices forecast for 2008.
- Higher crude oil prices played a part in driving up metal prices, given the energy-intensive nature of metals production and given increased transport costs.

Figure 3

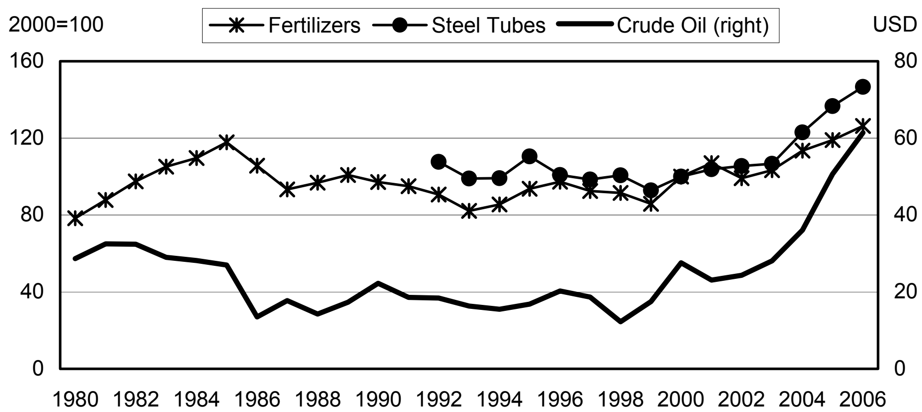
Global evolution of commodity prices



Source: IMF.

Figure 4

Selected domestic producer price indices, France, 1980-2006



Source: Eurostat, OPEC.

We now turn to the evolution of selected domestic commodity prices in the European Union. We focus our analysis on selected commodities which are internationally tradable and may be influenced by the price of oil, namely fertilizers, primary plastics and steel tubes (Figure 4).[4] We performed an econometric analysis to identify the impact of oil prices on these commodity prices.[5]

Our results were as follows: there are positive and significant level and first-difference effects of the oil price onto the price of fertilizers. Furthermore the

4 We extracted nominal price indices data from Eurostat covering these commodities. Owing to missing data for several countries for many of the earlier years, we used domestic prices for these commodities in France as an example. The data cover 1980-2006 for fertilizers, plastics in primary form, and 1992-2006 for steel tubes.

5 We ran vector autoregressions and subsequently performed Granger causality tests to check whether the level or lagged level of the nominal oil price was driving the prices of the selected commodities, and how strong that effect may be. We also tested for the effect of year-on-year changes in the oil price.

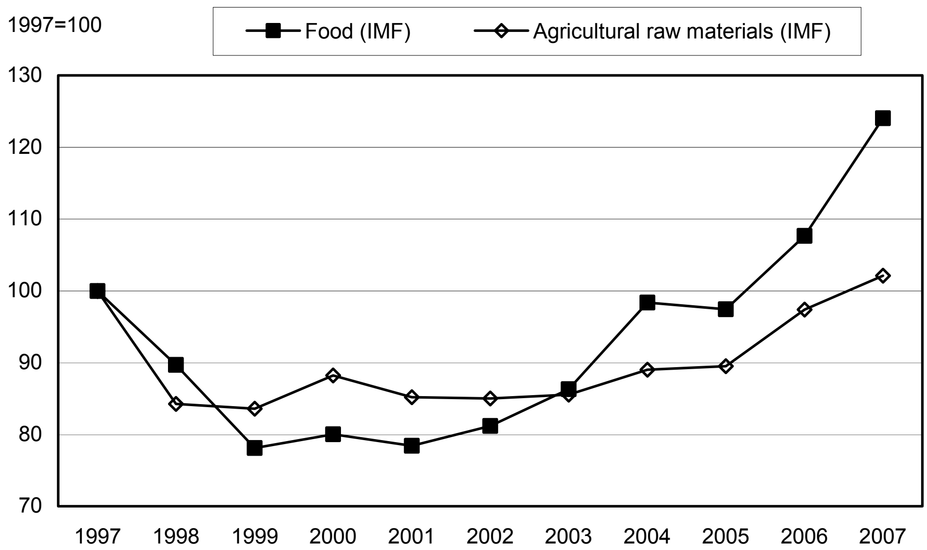
first-difference effect passes the Granger causality test. The regression results suggest a knock-on effect of 0.19 percentage points on the price increases of fertilizers for every percentage point acceleration in the price increase of crude oil. Prices of plastics in primary form do not appear to be significantly affected by the price of crude oil. Prices of steel tubes were significantly driven by the price of crude oil, with a significant, positive impact from year-on-year changes in the price of oil. This result is plausible, but must be seen in the context of the global evolution of demand and supply of steel, as discussed earlier.

Commodity prices in agriculture

Agricultural commodity prices have followed a similar tendency to crude oil prices (Figure 5). However, the magnitude of recent increases was much more limited: 38% for food and 21% for raw materials between 1998 and 2007 compared with 470% for crude oil. We performed the same econometric tests as for industrial commodities over the period 1980-2006. Neither the level of the oil price nor its growth rate was found to Granger-cause agricultural commodity prices, and the relationships were statistically insignificant. Based on these results we can conclude that the recent co-movement of oil and agricultural commodity prices is driven by a common third factor, namely the strong growth of the global economy. This situation is changing in the case of sugar and vegetable oils, whose potential use as biofuel make their price responsive to oil prices. For example, the free market price of sugar more than doubled between 2002 and 2006 as rising crude oil prices boosted biofuel consumption.

Figure 5

Global evolution of agricultural commodity prices



Note: Food = cereals, vegetable oils, meat, seafood, sugar, bananas, oranges. Agricultural raw materials = timber, cotton, wool, rubber, hides.
Source: IMF.

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Conventional signs and abbreviations

used in monthly statistical data

.	data not available
%	per cent
CMPY	change in % against corresponding month of previous year
CCPY	change in % against cumulated corresponding period of previous year (e.g., under the heading 'March': January-March of the current year against January-March of the preceding year)
3MMA	3-month moving average, change in % against previous year.
CPI	consumer price index
PM	change in % against previous month
PPI	producer price index
p.a.	per annum
mn	million
bn	billion
BGN	Bulgarian lev
CZK	Czech koruna
EUR	euro, from 1 January 1999
EUR-SIT	Slovenia has introduced the euro from 1 January 2007
HRK	Croatian kuna
HUF	Hungarian forint
PLN	Polish zloty
RON	Romanian leu
RUB	Russian rouble
SKK	Slovak koruna
UAH	Ukrainian hryvnia
USD	US dollar
M0	currency outside banks / currency in circulation (ECB definition)
M1	M0 + demand deposits / narrow money (ECB definition)
M2	M1 + quasi-money / intermediate money (ECB defintion)
M3	broad money

Sources of statistical data:
National statistical offices and central banks; wiiw estimates.

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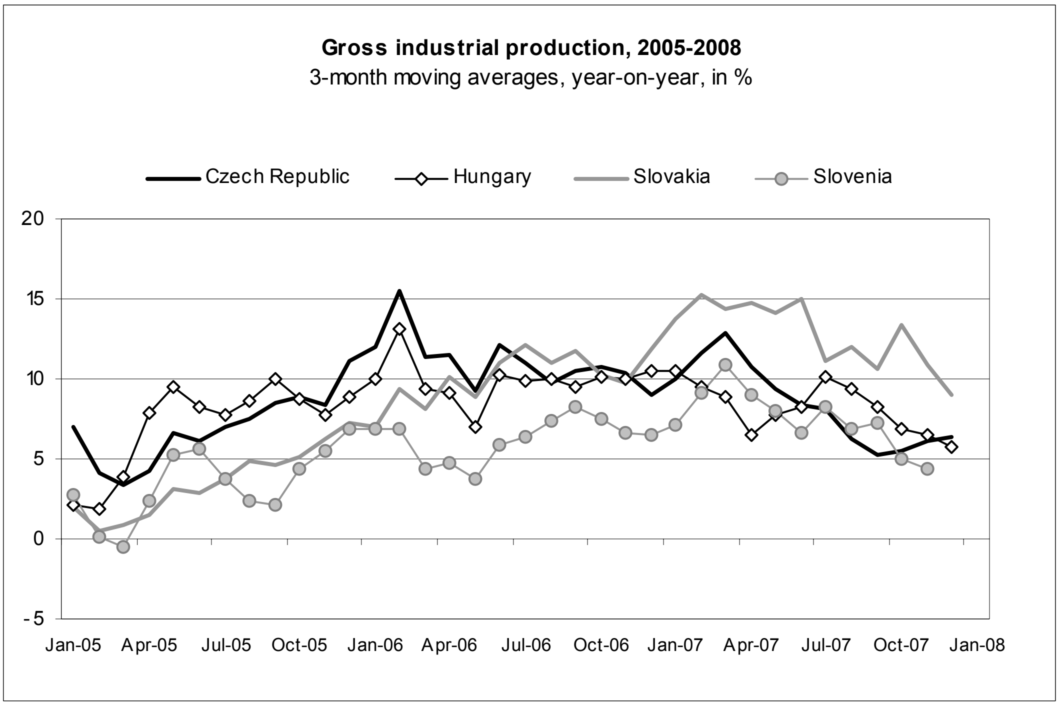

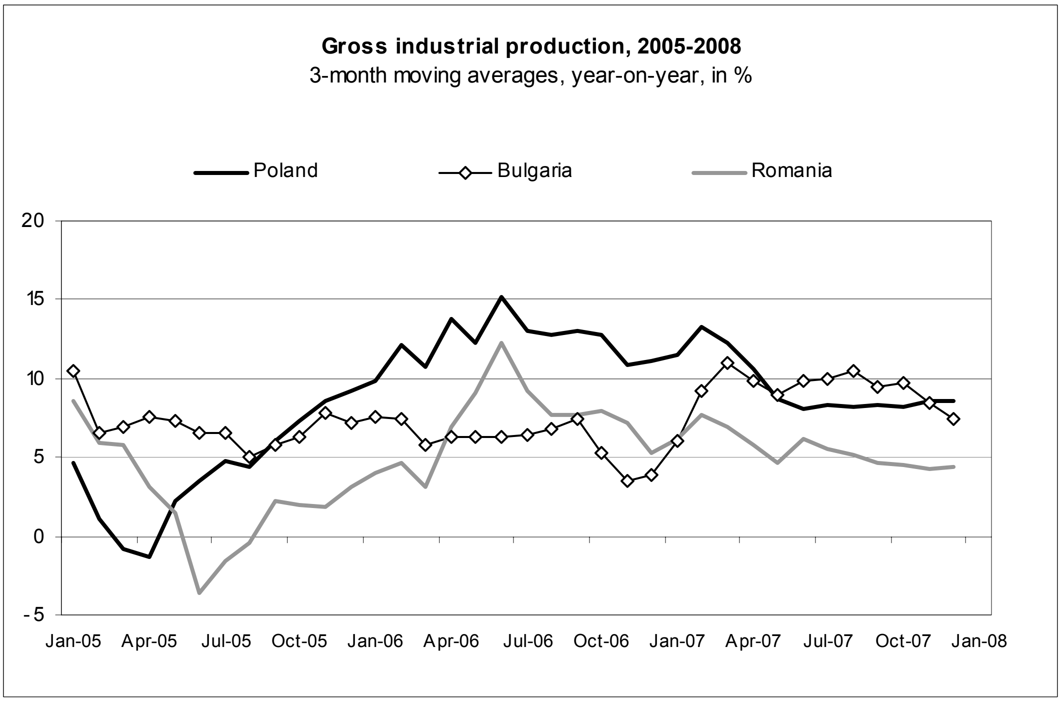

Source: wiiw Monthly Database incorporating national statistics.

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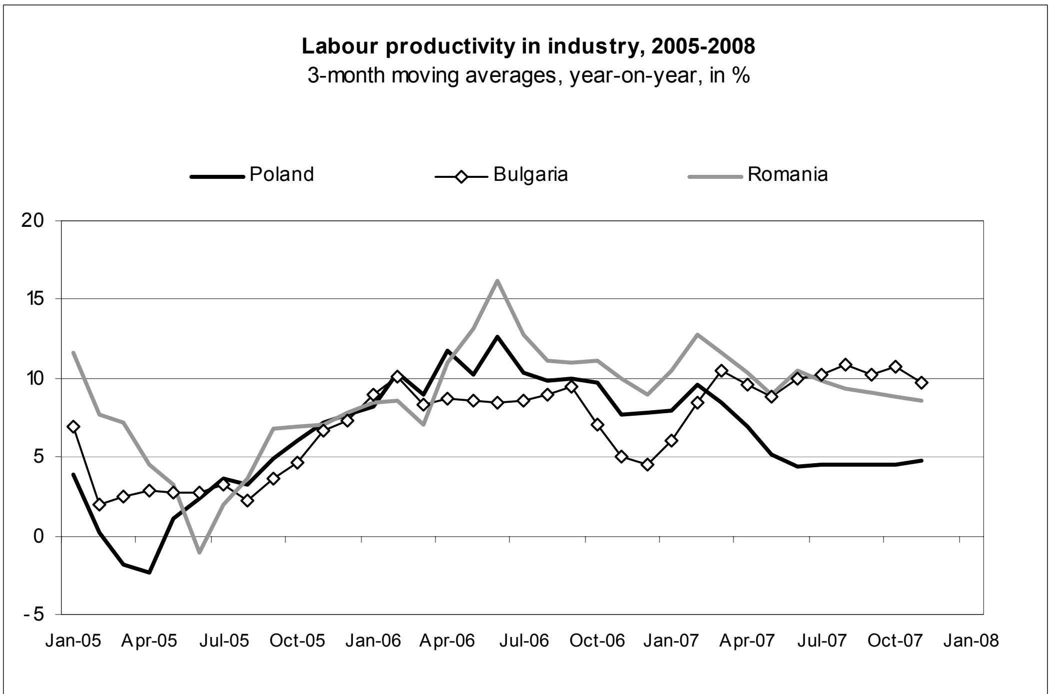

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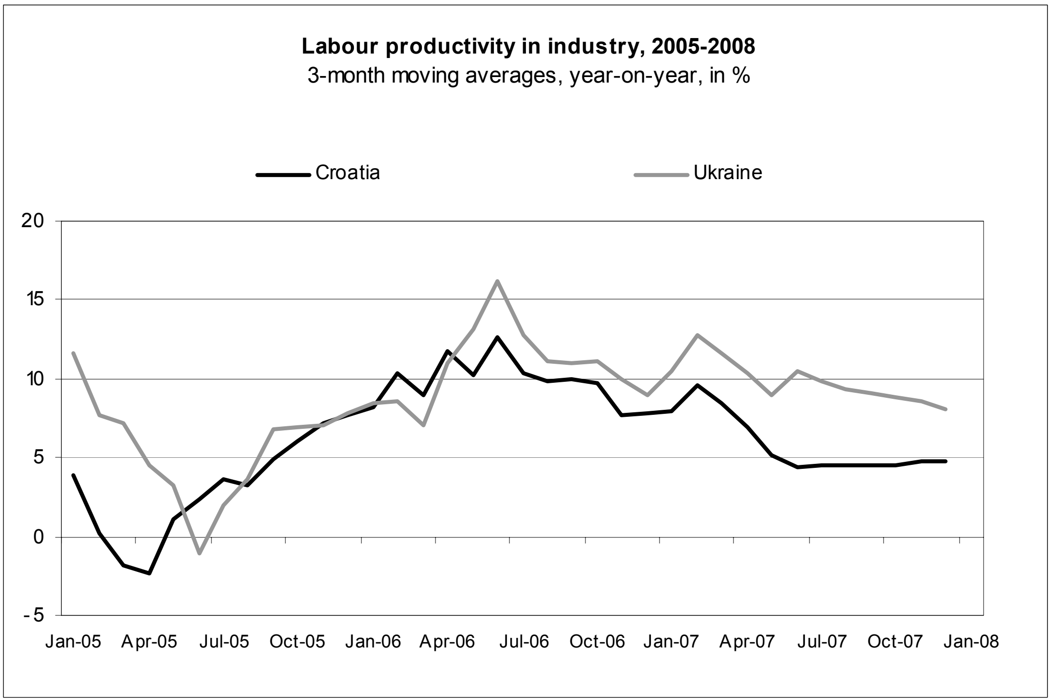

Source: wiiw Monthly Database incorporating national statistics.

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