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Can Trade Explain the Sector Bias of Skill-biased Technical Change?

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Robert Stehrer

Can Trade Explain the Sector Bias of Skill-biased Technical Change?

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Abstract

There is evidence that the skilled to unskilled wage rates were rising in the 1980s and at the beginning of the 1990s. This can potentially be explained by a Heckscher-Ohlin framework where economic integration implies that the advanced countries specialize in skilled-labour-intensive industries and developing countries in unskilled-labour-intensive industries. However, actual trade figures show that import penetration was particularly high in the skill-intensive industry segments also for trade integration with developing economies, which would imply a falling relative wage rate of skilled workers in the advanced countries in the Heckscher-Ohlin framework. If, however, these trade patterns induce relatively stronger skill-biased technical progress in the skill-intensive sectors, then the effect of trade would again be a potential reason for the widening of the wage differential between skilled and unskilled workers in the advanced countries. This paper presents some evidence that (negative) employment effects or positive productivity effects due to trade integration are particularly strong in the skill-intensive industries which supports the hypothesis above.

Keywords: skill-biased technical change, technology, trade and labour markets

JEL classification: F1, J3, O3

Robert Stehrer

Can trade explain the sector bias of skill-biased technical change?

1 Introduction

Over the past decade international economic integration has received a great deal of attention by economists and politicians. One of the main concerns has been the effects of trade liberalization on labour markets especially in the advanced countries and to a lesser extent in the developing countries (see e.g. Wood, 1994, and Feenstra and Hanson, 2001, for a recent overview). The recent debate has focused on the effects of trade versus the effects of technology to explain the rising wage differentials in the advanced countries in the 1980s and 1990s. In this there seems to be now a consensus that skill-biased technical change (SBTC) was more important than trade integration.[1] However, to explain the rising wage differential in the 1980s an acceleration of the SBTC rate should be observed which is not supported by the empirical evidence. Further there is a disagreement in the theoretical literature on the effects of SBTC on relative factor prices in multisectoral models. In a recent paper Haskel and Slaughter (2002) argue that it is the *sector bias of SBTC* which is important for explaining the rising skill premia; i.e. SBTC must be stronger in the skill-intensive sectors. They further provide empirical evidence that the sector bias was different in the 1980s compared to the 1970s (when SBTC was stronger in the low-skill-intensive sectors).

In this paper it is argued that trade did play an important role by using the idea of 'defensive innovation' (see Wood, 1995) at the sectoral level. The relevant hypothesis is that there is a set of countries having rapidly advanced in the high-tech and/or skill-intensive sectors. These were the sectors in which relatively larger initial gaps are observed (see Landesmann and Stehrer, 2001, and Stehrer and Wörz, 2003, for empirical evidence). These catching-up economies have now become important trading partners at least for some of the OECD countries and have gained market shares especially in the higher-tech sectors. This pattern of trade integration should, however, lead to falling skill premia in the advanced OECD countries. But, if this pattern leads to stronger SBTC in the sectors with larger growth rates of trade integration (i.e. the skill-intensive sectors) one can, first, explain the shift of the sector bias between the 1970s and 1980s and, second, argue that trade was an important cause of the rising wage differential in the advanced OECD economies.

The paper first provides an overview of the existing literature (section 2). In section 3 the arguments discussed above are analysed descriptively and we investigate why this particular pattern of trade integration was observed. In section 4 we provide employment and productivity regressions. Section 5 concludes.

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[1] Skill-biased technical change is defined as a higher skilled to unskilled ratio at given relative wage rates.

2 Trade versus technology

Let us briefly summarize the literature on technology, trade and labour market effects. We focus here mainly on the trade versus technology debate leaving out other important issues. Such issues include e.g. the effects of foreign direct investment (see e.g. Feenstra and Hanson, 1996 and 1997), of outsourcing (see e.g. Arndt, 1997 and 1999, Arndt and Kierzkowski, 2001, Feenstra and Hanson, 1999, Deardorff, 2001 and Kohler, 2001). Further there is some literature on the role of labour market institutions (see Davies, 1996, Davies and Reeve, 1997, and Acemoglu, 2002). These issues, though also important for this debate, will not be summarized here as the main point for this paper arises from the trade versus technology debate.

At the beginning of the 1990s, a debate started on the effects of rising internationalization and trade liberalization and their potential or actual effects on labour markets. The starting point was that the US economy experienced an increasing wage differential between skilled and unskilled workers (as well as between male and female, black and white, etc. as documented in Katz et al., 1993). At the same time the idea of creating a free trade zone between the US, Canada and Mexico was taking shape and materialized in 1994. These two facts started a discussion concerning the effects of trade liberalization on US labour markets amongst and between trade and labour market economists in the US and to a lesser extent in other advanced economies (see e.g. Dewatripont et al., 1999, for research on European economies).

A number of studies describe the changes in the labour markets that developed in the 1980s and 1990s. The majority of the papers in this category give more or less comprehensive descriptive overviews of the changes in wage and employment structures since the 1970s, mostly in the United States (evaluating the effects of increasing North-South trade including the impact of the NAFTA agreement). Only a few of the available papers deal with the evolution of wage and employment patterns in other OECD countries. For example, Katz et al. (1993) examine similarities and differences in patterns of change in the wage structures in the United States, Great Britain, Japan and France over the past twenty years. Educational and occupational wage differentials narrowed in all four countries in the 1970s. This pattern reversed with the increases in skill differentials in the United States, Great Britain and Japan in the early 1980s, and a muted but somewhat similar pattern appears to have emerged in France starting in 1984 (on this see e.g. Katz et al., 1993).

Other empirically motivated studies tried to examine the changes in the structure of wages in the United States using time series methods (e.g. Borjas and Ramey, 1994, and Bound and Johnson, 1992). The studies emphasized as explanatory factors mainly technological progress and not globalization, basing the argument on evidence which showed that shifts within sectors were far larger than shifts between sectors. Berman, Bound and Griliches (1994) distinguished two effects: relative demand for skilled workers may rise because skill-intensive industries are gaining shares whereas low-skill-intensive ones are losing shares (between industry shifts) or that relative demand for skilled workers is rising within the industries (within industry shifts). The first effect would be expected if trade specialization in a Heckscher-Ohlin framework matters, the second would be expected in the case of skill-biased technical progress. Using data on manual and non-manual workers, Berman, Bound and Grilliches (1994) showed that within-industry shifts are much more important than between-industry shifts. From this it was concluded that technology mattered far more than trade. This result was confirmed in more recent studies as well (see e.g. Berman et al., 1998, and Berman and Machin, 2000).

In a third strand, an explicit trade theoretical framework was used. All these papers are motivated more or less by neo-classical trade theory, especially the Heckscher-Ohlin model. The theoretical debate, which focused mainly on the factor bias versus the sector bias of technical change (which is interesting in itself), is mainly covered in Leamer (1994, 1996), Lawrence and Slaughter (1993), Lawrence (1996), Krugman (1995) and Wood (1994). The difficulty with this framework in the trade versus technology debate is to disentangle the effects of technological changes from the effects of globalization, which is up to now a theoretically as well as empirically unsolved problem (see e.g. the debate between Leamer, 1996 and Krugman, 1995). In the related empirical studies most authors tried to extract first the globalization effect and then attribute the residual to technological progress. Using this approach, Lawrence and Slaughter (1993) found that technological change is the main reason for the widening wage differential between skilled and unskilled workers. On the other hand, Leamer (1996) reverses the procedure mentioned above and first extracts the technological effect. He argues that one can find a close relationship between rising trade integration and declining prices of labour-intensive products for the 1970s which results in lower relative wages of unskilled workers. Similarly, Wood (1994, 1995) – using a factor content method which is itself heavily criticized by Leamer (2000) – maintains that trade had a major impact on labour markets in advanced economies causing the relative wage decline of unskilled workers. In this respect Wood also argues that defensive technological progress in the advanced countries (and especially unskilled-labour-saving innovation) is important for the explanation of the worsened position of the unskilled workers. This latter argument becomes important with respect to the hypothesis presented in this paper.

From a theoretical perspective there is also wide disagreement on the effects of technical change on relative factor prices. Much of the relevant literature is based on simplified assumptions (e.g. concerning technology, where often the Leontief production technology is assumed, or demand structures, where mainly homothetic or even Cobb-Douglas preferences are assumed). Results also depend on assumptions regarding the bias of technical change (factor or sector biased) and if technical change is local or global (and identical). In a recent paper Xu (2001) works through several cases in a 2x2x2-Heckscher-

Ohlin model with CES production and demand functions (i.e. assuming different substitution elasticities in factor and goods demand) and various forms of technical progress. For small open economies (i.e. with prices given exogenously) the effects are rather straightforward; however, the theoretical results are inconclusive for large open economies or the integrated world.

Summarizing, although there is now a vast theoretical and empirical literature on the relationships between trade, technology and labour markets, there seems to be no consensus on the effects of globalization, neither theoretically nor empirically, as argued above.

3 Structural trends, import penetration and export orientation

In a recent paper Haskel and Slaughter (2002) argue that it is the sector bias of skill-biased technical change (SBTC) which matters for explaining the movements in the wage differentials in the 1970s and 1980s. In their model, the sector bias of any technical change matters for the explanation of changes in relative factor prices, i.e. technical change must be concentrated in the skill-intensive sectors to explain rising skill premia. This result also holds in a flexible-price framework if the indirect effects on prices are sufficiently small. A number of empirical studies have shown that technical change is factor-biased in all sectors (i.e. sector-pervasive SBTC). Given this fact Haskel and Slaughter show that sector-pervasive SBTC must be concentrated in the skill-intensive sectors to explain the rising wage differential. The evidence provided by Haskel and Slaughter (2002) shows a strong correlation between the sector bias of SBTC and the changes in the skill premia for ten OECD countries: when SBTC is concentrated in the unskilled labour-intensive sectors, wage inequality is falling, as occurred mainly in the 1970s; when SBTC is concentrated in the skilled labour-intensive sectors, as in the 1980s, wage inequality is rising.

The questions arising from this evidence are, first, why the sector bias of SBTC has changed in the 1980s and 1990s as compared to the 1970s and, second, which role trade and international integration may have played in this respect. In this paper we look at the latter point and present some evidence that import penetration in the advanced countries has occurred mainly in the skilled labour-intensive sectors. If this pattern of trade integration has fostered SBTC in these sectors, then trade would be a potential explanation for the widening skill differential in the advanced countries.

Let us first discuss some broad patterns of the ongoing integration from which our hypotheses with regard to the sectoral employment and productivity effects are derived. We start with the data used in this study.

3.1 Data

From the STAN database we get data for production, employment and labour compensation. Data are reported for 22 countries at the ISIC rev. 2, 3- and 4-digit level from 1970 onwards. From this database we singled out six countries (France, Germany, Netherlands, Sweden, United Kingdom, USA).[2] These data were merged with the OECD bilateral trade database (BTD), which contains bilateral trade flows for each of the reporting OECD economies at the 4-digit ISIC industries. These two datasets have been matched, which resulted in a dataset for 23 manufacturing industries (see Appendix Table A1 for a list of industries).[3] The variables used in the study were employment levels (EMPN), labour costs per employee (LCPE), output at constant prices 1990 (PROD90), value added at constant prices 1990 (VAL90), and output and value added productivity (i.e. output and value added per employee) at constant prices 1990 (OPR90 and VPR90). For trade measures we used export orientation (exports over production, EXPSH) and import penetration (imports over production, IMPSH) at current exchange rates.

The main limitation of this database is that there is no information for skilled vs. unskilled workers available at the industrial level. Thus the impact of international integration, specialization, the skill bias of productivity upgrading, etc. on skill composition and wage structures cannot be analysed directly at the industry level. Instead, we use industry classifications, which reflect skill intensities. In this study we have ranked industries according to the skill intensities given in OECD (1998).[4] Industries are ranked according to skill intensities in the US which was applied for all countries. This ranking is fairly consistent with measuring skill intensities by wage structure. Using this information we aggregated the 22 industries into three segments (low-skill-, medium-skill- and skill-intensive) denoted by 1, 2, and 3 respectively (see Appendix Table A2 for the ranking of industries with regard to skill intensities).

Finally, to test the hypothesis that trade integration with different types of catching-up countries may have different effects on employment, we aggregated the group of trading partners into six groups (advanced OECD countries, catching-up OECD countries, Japan, East Asian Tigers, less successful catching-up countries, and Eastern European countries); see Appendix Table A3 for a detailed list of countries and groupings.

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2 The sample thus includes large and small economies as well as economies characterized by different labour market characteristics. In a recent project all OECD countries are included in the analysis.

3 Industry 384D (Discrepancy and scrap metals) was skipped from further analysis.

4 Most of the recent studies are using the UN industrial data. This database provides data on manual and non-manual workers at the disaggregated level. Unfortunately, however, this database ends in 1992 and thus only the development in the 1980s and beginning 1990s can be researched. For a recent contribution using this database see Haskel and Slaughter (2002).

3.2 Employment and productivity effects of trade integration

Tables 1a and 1b report the changes of these variables for the three industry aggregates and for each of the six countries. Table 1a emphasizes the structural component (with total manufacturing equal to 1) whereas Table 1b shows the evolution of each of the aggregates over time (1980 = 1).

Let us summarize the broad trends in the six economies. Trends in employment shares are rather diverse across countries, with the share in the less skill-intensive industries falling or constant (the exception being the UK with a sharp rise from 1990 to 1995). In the medium-skill industry segment, shares are falling (only rising in the UK) and finally, employment shares in the skill-intensive segment are rising in France and Germany, constant in the Netherlands and Sweden, and falling in the UK and the US. These trends themselves depend in a simple accounting on relative output vs. productivity growth. As one can see from Table 1b, employment was declining in all countries and industry segments, implying that output was growing more slowly than labour productivity (which has been a general trend in advanced economies over the past decades). In all countries output growth was more pronounced in the skill-intensive segments; only for the Netherlands and the UK one can see a less distinct pattern. This pattern is also found in the productivity measures; productivity in the skill-intensive segments more than doubled in this period; for Germany the increase was only about 90%.

Looking at labour costs, there is a general tendency for labour costs per employee to rise relatively faster in the skill-intensive segments; exceptions to this being the Netherlands and Sweden, where this pattern is less strong, and the UK, where labour costs per employee have risen faster in the medium-skill segment. In terms of structure this means that relative labour costs per employee have increased in the skill-intensive industries (with the exceptions of the Netherlands and the UK). These trends are in line with the hypothesis that in the 1980s there was a sector bias of SBTC towards the skill-intensive industries, which implies that relative wages of skilled workers in these industries are rising relatively faster than in the economy as a whole.

Let us now turn to the patterns of trade integration. As one can see from Table 1b, export orientation is increasing for all industry segments and in all countries. These increases in export orientation have been relatively stronger in the skill-intensive segments, which shifted the export composition towards the skill-intensive sectors (see Table 1a). Looking at particular country groups as trading partners, one can see that the bulk of exports is going to the advanced OECD countries. But for all groups of trading partners that export orientation was increasing relatively faster in the skill-intensive segments.

Table 1a

Descriptive statistics (Total manufacturing = 1)

	France			Germany			Netherlands			Sweden			United Kingdom			USA		
	1	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
Employment																		
1980	0.42	0.42	0.16	0.40	0.42	0.18	0.38	0.42	0.19	0.34	0.50	0.16	0.38	0.43	0.19	0.37	0.41	0.22
1985	0.41	0.41	0.18	0.37	0.44	0.19	0.37	0.44	0.20	0.31	0.53	0.16	0.38	0.41	0.21	0.35	0.41	0.24
1990	0.40	0.42	0.18	0.34	0.45	0.20	0.37	0.45	0.18	0.29	0.56	0.15	0.38	0.41	0.21	0.35	0.42	0.23
1995	0.39	0.42	0.19	0.35	0.45	0.20	0.37	0.45	0.18	0.27	0.57	0.16	0.44	0.40	0.16	0.37	0.44	0.20
Labour costs per employee																		
1980	0.87	1.06	1.19	0.84	1.11	1.09	0.91	1.01	1.16	0.91	1.05	1.02	0.90	1.08	1.02	0.85	1.10	1.08
1985	0.86	1.04	1.24	0.81	1.11	1.12	0.91	1.02	1.13	0.92	1.04	1.03	0.88	1.09	1.05	0.80	1.09	1.14
1990	0.85	1.04	1.24	0.80	1.10	1.11	0.90	1.04	1.10	0.92	1.03	1.05	0.91	1.07	1.03	0.80	1.08	1.17
1995	0.84	1.06	1.21	1.13	0.64	1.58	0.93	1.03	1.06	0.94	1.00	1.11	0.87	1.21	0.82	0.77	1.09	1.22
Output (at constant prices 1990)																		
1980	0.39	0.49	0.12	0.36	0.52	0.12	0.41	0.49	0.10	0.36	0.55	0.09	0.43	0.46	0.12	0.37	0.48	0.15
1985	0.38	0.47	0.15	0.34	0.53	0.13	0.42	0.47	0.12	0.36	0.54	0.11	0.40	0.46	0.14	0.33	0.50	0.18
1990	0.37	0.46	0.17	0.32	0.52	0.16	0.38	0.48	0.13	0.32	0.55	0.13	0.36	0.46	0.18	0.32	0.48	0.20
1995	0.35	0.45	0.20	0.32	0.50	0.18	0.37	0.49	0.14	0.26	0.50	0.23	0.37	0.51	0.12	0.31	0.46	0.22
Value added (at constant prices 1990)																		
1980	0.37	0.48	0.15	0.35	0.50	0.15	0.35	0.48	0.17	0.33	0.54	0.13	0.38	0.48	0.15	0.35	0.46	0.19
1985	0.36	0.46	0.19	0.32	0.50	0.18	0.33	0.49	0.18	0.31	0.55	0.14	0.37	0.45	0.18	0.31	0.47	0.22
1990	0.34	0.47	0.19	0.31	0.49	0.20	0.32	0.51	0.17	0.29	0.56	0.14	0.34	0.45	0.21	0.29	0.46	0.25
1995	0.33	0.46	0.21	0.31	0.49	0.20	0.32	0.51	0.17	0.26	0.55	0.19	0.33	0.51	0.16	0.28	0.46	0.26
Output productivity (at constant prices 1990)																		
1980	0.93	1.18	0.73	0.91	1.24	0.64	1.05	1.17	0.53	1.06	1.10	0.56	1.11	1.08	0.60	0.99	1.16	0.71
1985	0.93	1.14	0.84	0.93	1.20	0.68	1.13	1.07	0.60	1.16	1.01	0.65	1.06	1.12	0.66	0.93	1.20	0.74
1990	0.92	1.10	0.94	0.93	1.14	0.80	1.04	1.08	0.73	1.09	0.99	0.88	0.97	1.11	0.85	0.91	1.14	0.88
1995	0.89	1.08	1.04	0.92	1.10	0.92	1.00	1.07	0.81	0.98	0.88	1.48	0.84	1.27	0.74	0.86	1.07	1.11
Value added productivity (at constant prices 1990)																		
1980	0.88	1.15	0.92	0.88	0.91	0.98	0.99	0.94	1.18	1.14	1.08	1.11	1.11	0.85	0.88	0.79	0.77	0.90
1985	0.87	1.12	1.04	0.88	0.90	1.01	0.97	0.87	1.14	1.13	1.04	1.10	1.14	0.92	0.92	0.86	0.85	0.94
1990	0.86	1.12	1.04	0.90	0.88	1.00	0.91	0.81	1.09	1.13	1.01	1.08	1.10	0.97	0.92	0.96	1.00	1.10
1995	0.84	1.09	1.12	0.90	0.86	0.96	0.76	0.77	1.08	1.12	0.96	1.26	1.05	0.98	0.99	1.22	1.00	1.31
Exports																		
1980	0.32	0.52	0.15	0.23	0.60	0.17	0.31	0.54	0.15	0.22	0.62	0.16	0.20	0.58	0.22	0.18	0.54	0.28
1985	0.31	0.49	0.20	0.21	0.60	0.19	0.30	0.54	0.15	0.21	0.60	0.19	0.19	0.53	0.28	0.15	0.50	0.36
1990	0.30	0.49	0.22	0.20	0.60	0.20	0.32	0.48	0.20	0.18	0.61	0.21	0.20	0.50	0.31	0.16	0.46	0.38
1995	0.28	0.46	0.26	0.19	0.58	0.23	0.31	0.44	0.26	0.19	0.55	0.26	0.19	0.46	0.34	0.16	0.47	0.36
Imports																		
1980	0.32	0.53	0.15	0.37	0.47	0.16	0.36	0.48	0.16	0.28	0.55	0.17	0.30	0.51	0.19	0.29	0.54	0.17
1985	0.31	0.51	0.19	0.32	0.47	0.21	0.31	0.49	0.20	0.25	0.52	0.23	0.28	0.48	0.24	0.26	0.51	0.22
1990	0.29	0.50	0.22	0.32	0.45	0.22	0.30	0.46	0.24	0.26	0.48	0.26	0.27	0.48	0.26	0.25	0.49	0.26
1995	0.28	0.48	0.24	0.32	0.44	0.25	0.29	0.43	0.28	0.24	0.46	0.30	0.24	0.46	0.30	0.23	0.44	0.33

Table 1b

Descriptive statistics, 1980 = 1

	France			Germany			Netherlands			Sweden			United Kingdom			USA		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Employment																		
1985	0.86	0.87	0.97	0.86	0.97	0.98	0.85	0.92	0.90	0.84	1.01	0.94	0.78	0.76	0.85	0.89	0.95	1.04
1990	0.80	0.84	0.96	0.85	1.05	1.10	0.90	1.01	0.90	0.83	1.07	0.88	0.76	0.75	0.85	0.90	0.96	0.99
1995	0.69	0.75	0.87	0.75	0.92	0.93	0.83	0.92	0.78	0.63	0.92	0.78	0.67	0.56	0.49	0.90	0.98	0.86
Labour costs per employee																		
1985	1.66	1.64	1.73	1.21	1.26	1.29	1.23	1.24	1.20	1.57	1.54	1.58	1.60	1.66	1.69	1.30	1.38	1.46
1990	2.04	2.05	2.18	1.46	1.53	1.56	1.35	1.40	1.29	2.29	2.21	2.33	2.38	2.33	2.39	1.57	1.65	1.83
1995	2.44	2.54	2.57	1.47	0.64	1.59	1.67	1.66	1.48	3.17	2.93	3.37	2.92	3.40	2.45	1.84	2.01	2.28
Output (at constant prices 1990)																		
1985	0.97	0.94	1.26	0.99	1.06	1.19	1.16	1.07	1.31	1.05	1.05	1.23	0.98	1.02	1.22	0.96	1.12	1.25
1990	0.98	0.97	1.54	0.99	1.10	1.58	1.04	1.08	1.44	0.95	1.08	1.55	0.98	1.14	1.77	1.01	1.15	1.51
1995	0.94	0.98	1.78	0.96	1.06	1.74	1.04	1.11	1.57	0.96	1.22	3.38	0.91	1.18	1.08	1.12	1.29	1.94
Value added (at constant prices 1990)																		
1985	0.94	0.94	1.22	0.96	1.04	1.18	1.03	1.12	1.15	1.05	1.16	1.24	1.01	0.98	1.23	1.04	1.23	1.36
1990	1.01	1.08	1.40	1.03	1.15	1.48	1.16	1.34	1.26	1.06	1.27	1.35	1.11	1.15	1.74	1.10	1.34	1.72
1995	0.99	1.07	1.59	0.98	1.09	1.39	1.25	1.45	1.39	1.07	1.42	2.09	1.10	1.34	1.34	1.24	1.55	2.09
Output productivity (at constant prices 1990)																		
1985	1.12	1.08	1.30	1.14	1.09	1.21	1.37	1.17	1.46	1.24	1.04	1.30	1.25	1.36	1.43	1.08	1.18	1.20
1990	1.22	1.15	1.60	1.16	1.05	1.43	1.16	1.07	1.61	1.16	1.01	1.77	1.28	1.52	2.08	1.12	1.20	1.52
1995	1.37	1.32	2.06	1.29	1.15	1.86	1.25	1.20	2.02	1.53	1.32	4.35	1.36	2.12	2.19	1.24	1.32	2.26
Value added productivity (at constant prices 1990)																		
1985	1.09	1.09	1.25	1.11	1.08	1.20	1.21	1.22	1.28	1.24	1.15	1.31	1.29	1.30	1.45	1.16	1.29	1.31
1990	1.27	1.28	1.47	1.21	1.10	1.35	1.28	1.33	1.40	1.28	1.19	1.55	1.46	1.52	2.04	1.22	1.40	1.73
1995	1.44	1.44	1.84	1.31	1.18	1.49	1.50	1.57	1.79	1.70	1.53	2.69	1.63	2.39	2.73	1.37	1.59	2.44
Export orientation																		
1985	1.18	1.16	1.26	1.30	1.20	1.26	1.20	1.23	1.16	1.21	1.16	1.29	1.09	1.00	1.16	0.69	0.76	0.84
1990	1.25	1.20	1.32	1.26	1.20	1.21	1.31	1.09	1.40	1.01	1.10	1.28	1.22	1.00	1.26	1.11	1.09	1.33
1995	1.46	1.33	1.77	1.29	1.20	1.49	1.32	1.09	1.87	1.52	1.22	1.59	1.58	1.25	3.42	1.40	1.34	1.54
Import penetration																		
1985	1.18	1.19	1.21	1.13	1.14	1.36	1.01	1.17	1.31	1.01	0.99	1.33	1.23	1.27	1.38	1.42	1.44	1.55
1990	1.39	1.39	1.52	1.28	1.21	1.45	1.15	1.29	1.67	1.09	0.93	1.48	1.37	1.38	1.53	1.50	1.62	2.10
1995	1.48	1.36	1.68	1.42	1.24	1.82	1.05	1.18	1.87	1.23	0.94	1.43	1.50	1.62	3.90	1.78	1.82	3.24

With regard to imports, we can see from Table 1b that import penetration was rising in all cases (with the exception of Sweden in the medium-skill industry aggregate). In all countries import penetration was rising fastest in the skill-intensive aggregate and markedly in the UK and the US (where import penetration rates in 1995 were more than three times higher than in 1980). This can also be seen in Table 1a, which shows that in all countries the import composition shifted towards the skill-intensive segment. Tables 2b and 3b present the import penetration rates and the trends, respectively. Table 2b reveals that import penetration rates were always higher in the skill-intensive segment and that this pattern became even more pronounced over time. Further, the US is a relatively closed economy (compared to the European economies) but becomes relatively more open especially in the skill-intensive segment. Whereas the European economies face competition mainly from the group of the northern OECD countries, the US (and partly the UK) faces competition from Japan, the East Asian Tigers and the less successful catching-up economies. Importantly, US import penetration rates from these countries were rising especially in the skill-intensive segment.

There are some potential reasons for this pattern of trade integration to occur. Looking at the interaction between the processes of international economic integration, development and catching-up at the industrial level, Landesmann and Stehrer (2001) and Stehrer and Wörz (2003) pointed to the rather diverse patterns of technological catching-up based on the advantage-of-backwardness idea at the sectoral level. Higher initial gaps in the skill-intensive industries can be closed relatively faster in a simple catching-up model which explains the patterns of trade integration summarized above. From an endowment-based position one may also argue that the (successful) catching-up economies have built up their human capital (skilled workers), which enables them to succeed in exporting skill-intensive products.

This shows that the advanced countries face increasing competition from the newly developing and successful catching-up countries in the skill-intensive industries as compared to the less skill-intensive industries, which is opposite to the pattern one would expect from a simple Heckscher-Ohlin model. This is also the case for the US, where the main debate focused on the effects on employment from trade integration with Mexico.

From a theoretic perspective, the simple Heckscher-Ohlin interpretation of rising import penetration in the skill-intensive sectors would however imply that relative wage rates of skilled workers should fall rather than rise. But as argued above, if the increased competitive pressure in the skill-intensive industries leads to defensive innovation in these sectors, then SBTC can be biased towards the skill-intensive industries. Using the argument by Haskel and Slaughter (2002) this then implies that relative wage rates of skilled workers are rising if this effect is strong enough. In this way trade becomes again a potential reason for rising skill premia.

Table 2a

Export orientation

	France			Germany			Netherlands			Sweden			United Kingdom			USA		
	1	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
Total																		
1980	0.18	0.25	0.27	0.15	0.30	0.31	0.43	0.61	0.72	0.22	0.40	0.48	0.12	0.29	0.36	0.05	0.10	0.16
1985	0.22	0.29	0.33	0.20	0.36	0.39	0.52	0.75	0.83	0.27	0.46	0.62	0.13	0.29	0.42	0.03	0.08	0.14
1990	0.23	0.30	0.35	0.19	0.35	0.38	0.57	0.67	1.01	0.23	0.44	0.61	0.14	0.29	0.46	0.06	0.11	0.21
1995	0.27	0.33	0.47	0.20	0.36	0.47	0.57	0.66	1.35	0.34	0.49	0.76	0.19	0.36	1.25	0.07	0.13	0.25
Group A																		
1980	0.12	0.16	0.14	0.11	0.21	0.21	0.35	0.48	0.40	0.19	0.31	0.31	0.06	0.18	0.19	0.02	0.05	0.08
1985	0.15	0.19	0.20	0.15	0.26	0.29	0.41	0.61	0.52	0.23	0.38	0.45	0.09	0.20	0.28	0.01	0.04	0.07
1990	0.16	0.20	0.22	0.15	0.25	0.28	0.46	0.55	0.72	0.19	0.34	0.46	0.10	0.19	0.27	0.02	0.06	0.11
1995	0.18	0.22	0.27	0.14	0.23	0.31	0.45	0.52	0.89	0.28	0.36	0.50	0.13	0.24	0.81	0.03	0.07	0.11
Group B																		
1980	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00
1985	0.01	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00
1990	0.02	0.03	0.02	0.01	0.02	0.03	0.03	0.03	0.05	0.01	0.01	0.04	0.01	0.02	0.02	0.00	0.00	0.01
1995	0.03	0.04	0.03	0.01	0.02	0.03	0.03	0.03	0.07	0.01	0.01	0.04	0.02	0.02	0.05	0.00	0.00	0.00
Group C																		
1980	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.01
1985	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01
1990	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.02	0.00	0.01	0.01	0.01	0.01	0.02
1995	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.05	0.00	0.01	0.04	0.01	0.01	0.03
Group D																		
1980	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.01	0.01	0.00	0.01	0.01
1985	0.00	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.02	0.00	0.01	0.01	0.00	0.00	0.01
1990	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.02	0.00	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.02
1995	0.01	0.01	0.03	0.00	0.01	0.02	0.01	0.02	0.04	0.01	0.01	0.03	0.01	0.02	0.05	0.01	0.02	0.04
Group E																		
1980	0.05	0.07	0.10	0.03	0.06	0.06	0.07	0.07	0.13	0.02	0.06	0.13	0.02	0.08	0.09	0.02	0.04	0.05
1985	0.05	0.07	0.10	0.03	0.06	0.06	0.07	0.07	0.08	0.03	0.05	0.12	0.03	0.07	0.09	0.01	0.02	0.03
1990	0.03	0.05	0.09	0.02	0.04	0.05	0.06	0.04	0.07	0.02	0.03	0.08	0.02	0.04	0.05	0.02	0.03	0.05
1995	0.04	0.05	0.13	0.03	0.05	0.08	0.06	0.06	0.11	0.03	0.04	0.13	0.03	0.06	0.15	0.02	0.04	0.07
Group F																		
1980	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1985	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1995	0.00	0.00	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.00

Table 2b

Import penetration

	France			Germany			Netherlands			Sweden			United Kingdom			USA		
	1	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
Total																		
1980	0.17	0.23	0.24	0.18	0.17	0.22	0.46	0.49	0.72	0.26	0.33	0.47	0.17	0.25	0.31	0.08	0.09	0.09
1985	0.20	0.28	0.30	0.21	0.19	0.30	0.46	0.58	0.94	0.27	0.32	0.63	0.21	0.31	0.43	0.11	0.14	0.15
1990	0.24	0.32	0.37	0.24	0.21	0.32	0.53	0.63	1.19	0.29	0.31	0.69	0.24	0.34	0.47	0.11	0.15	0.20
1995	0.25	0.32	0.41	0.26	0.21	0.40	0.48	0.58	1.34	0.32	0.31	0.68	0.26	0.40	1.21	0.14	0.17	0.30
Group A																		
1980	0.12	0.19	0.20	0.12	0.14	0.16	0.37	0.40	0.60	0.20	0.28	0.41	0.12	0.18	0.20	0.03	0.05	0.03
1985	0.14	0.22	0.23	0.14	0.15	0.21	0.37	0.45	0.74	0.20	0.28	0.51	0.15	0.25	0.30	0.04	0.07	0.04
1990	0.16	0.26	0.28	0.15	0.16	0.22	0.40	0.51	0.93	0.21	0.27	0.55	0.16	0.26	0.29	0.04	0.08	0.06
1995	0.16	0.25	0.29	0.15	0.16	0.24	0.34	0.47	0.93	0.24	0.28	0.58	0.16	0.30	0.77	0.04	0.09	0.07
Group B																		
1980	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
1985	0.01	0.02	0.01	0.02	0.00	0.01	0.02	0.01	0.01	0.02	0.00	0.01	0.01	0.01	0.01	0.00	0.00	0.00
1990	0.02	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.02	0.02	0.00	0.01	0.02	0.01	0.01	0.00	0.00	0.00
1995	0.03	0.03	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.00	0.01	0.02	0.02	0.02	0.00	0.00	0.00
Group C																		
1980	0.00	0.01	0.02	0.00	0.01	0.02	0.00	0.01	0.04	0.00	0.01	0.04	0.00	0.01	0.02	0.01	0.02	0.03
1985	0.00	0.01	0.03	0.00	0.01	0.04	0.00	0.02	0.06	0.00	0.01	0.09	0.00	0.02	0.05	0.01	0.03	0.06
1990	0.00	0.01	0.04	0.00	0.01	0.05	0.00	0.03	0.11	0.00	0.02	0.07	0.00	0.02	0.05	0.01	0.04	0.06
1995	0.00	0.01	0.04	0.00	0.01	0.05	0.00	0.02	0.10	0.00	0.01	0.04	0.00	0.02	0.12	0.01	0.04	0.08
Group D																		
1980	0.00	0.00	0.01	0.01	0.00	0.01	0.02	0.00	0.02	0.01	0.00	0.01	0.01	0.00	0.01	0.02	0.00	0.02
1985	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.02	0.01	0.00	0.02	0.01	0.00	0.02	0.03	0.01	0.03
1990	0.01	0.00	0.02	0.01	0.00	0.03	0.01	0.01	0.08	0.01	0.00	0.04	0.01	0.01	0.03	0.03	0.01	0.04
1995	0.00	0.00	0.03	0.01	0.00	0.04	0.02	0.01	0.13	0.02	0.00	0.03	0.01	0.01	0.09	0.02	0.01	0.07
Group E																		
1980	0.03	0.03	0.00	0.03	0.02	0.01	0.05	0.06	0.01	0.02	0.03	0.00	0.03	0.02	0.01	0.02	0.02	0.01
1985	0.03	0.03	0.01	0.04	0.02	0.01	0.06	0.09	0.02	0.02	0.02	0.01	0.04	0.02	0.02	0.03	0.02	0.02
1990	0.04	0.02	0.01	0.04	0.01	0.01	0.07	0.06	0.03	0.03	0.01	0.01	0.04	0.02	0.02	0.04	0.03	0.04
1995	0.05	0.02	0.03	0.05	0.02	0.04	0.08	0.04	0.08	0.03	0.01	0.01	0.06	0.03	0.12	0.07	0.03	0.09
Group F																		
1980	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1985	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1990	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1995	0.00	0.00	0.00	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 3a

Export orientation (1980 = 1)

	France			Germany			Netherlands			Sweden			United Kingdom			USA		
	1	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
Total																		
1985	1.18	1.16	1.26	1.30	1.20	1.26	1.20	1.23	1.16	1.21	1.16	1.29	1.09	1.00	1.16	0.69	0.76	0.84
1990	1.25	1.20	1.32	1.26	1.20	1.21	1.31	1.09	1.40	1.01	1.10	1.28	1.22	1.00	1.26	1.11	1.09	1.33
1995	1.46	1.33	1.77	1.29	1.20	1.49	1.32	1.09	1.87	1.52	1.22	1.59	1.58	1.25	3.42	1.40	1.34	1.54
Group A																		
1985	1.21	1.22	1.41	1.33	1.26	1.35	1.19	1.27	1.31	1.23	1.24	1.44	1.48	1.09	1.44	0.68	0.87	0.82
1990	1.32	1.30	1.56	1.28	1.21	1.30	1.33	1.14	1.80	1.04	1.10	1.48	1.68	1.07	1.41	1.15	1.24	1.36
1995	1.47	1.40	1.88	1.19	1.11	1.45	1.30	1.08	2.23	1.51	1.16	1.62	2.20	1.35	4.19	1.31	1.39	1.33
Group B																		
1985	1.30	1.28	1.14	1.45	1.40	1.40	1.86	1.11	0.82	1.32	1.00	1.10	1.05	1.18	1.42	0.77	0.79	0.64
1990	2.81	2.12	1.60	2.01	2.21	1.91	2.69	1.72	2.17	1.60	1.17	2.92	2.43	1.73	1.95	1.37	1.02	1.79
1995	4.08	2.51	2.17	1.92	2.11	2.17	2.75	1.79	3.01	1.72	1.19	3.28	3.36	2.40	5.61	1.54	1.07	1.44
Group C																		
1985	1.66	1.57	1.11	1.53	1.64	1.38	1.27	1.87	1.26	1.20	1.47	1.29	1.58	1.39	1.12	0.99	0.94	1.02
1990	3.25	2.39	1.06	2.16	3.15	1.96	1.78	2.63	1.95	1.07	2.22	2.31	2.59	2.21	1.48	2.05	1.68	1.95
1995	3.98	2.72	1.84	2.31	2.87	2.45	2.27	2.98	4.06	2.31	2.28	6.55	2.72	2.92	7.02	2.32	1.91	2.15
Group D																		
1985	1.90	2.93	2.63	1.94	1.55	1.16	2.30	1.90	1.10	2.38	1.70	1.30	1.06	1.27	1.38	0.85	0.74	1.05
1990	3.27	3.95	3.25	2.52	2.39	1.54	2.57	2.16	1.45	2.48	2.19	0.96	1.47	1.28	1.48	1.58	1.76	1.91
1995	5.48	5.74	6.94	4.80	3.73	2.73	4.87	3.79	3.82	7.43	3.26	1.67	1.97	2.28	5.22	1.91	2.49	3.11
Group E																		
1985	1.02	1.00	1.01	1.15	0.97	0.99	1.04	0.98	0.59	1.06	0.79	0.98	1.18	0.87	0.98	0.60	0.58	0.72
1990	0.71	0.70	0.87	0.86	0.67	0.79	0.82	0.63	0.53	0.64	0.49	0.63	0.86	0.58	0.53	0.76	0.76	1.01
1995	0.80	0.77	1.31	1.03	0.85	1.27	0.88	0.87	0.82	1.11	0.68	1.03	1.13	0.80	1.65	1.19	1.08	1.45
Group F																		
1985	0.73	0.73	0.83	1.16	0.92	1.11	1.04	0.92	0.56	0.81	0.70	1.10	0.28	0.77	0.47	0.46	1.07	0.43
1990	0.79	0.67	0.76	1.36	0.87	1.43	1.22	0.84	0.63	0.50	0.73	1.07	0.24	0.63	0.50	0.35	1.07	1.77
1995	2.02	1.59	3.12	4.11	2.13	4.63	2.97	2.51	2.94	2.13	1.62	2.96	0.65	1.69	3.42	0.54	2.48	4.33

Table 3b

Import penetration (1980 = 1)

	France			Germany			Netherlands			Sweden			United Kingdom			USA		
	1	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
Total																		
1985	1.18	1.19	1.21	1.13	1.14	1.36	1.01	1.17	1.31	1.01	0.99	1.33	1.23	1.27	1.38	1.42	1.44	1.55
1990	1.39	1.39	1.52	1.28	1.21	1.45	1.15	1.29	1.67	1.09	0.93	1.48	1.37	1.38	1.53	1.50	1.62	2.10
1995	1.48	1.36	1.68	1.42	1.24	1.82	1.05	1.18	1.87	1.23	0.94	1.43	1.50	1.62	3.90	1.78	1.82	3.24
Group A																		
1985	1.16	1.16	1.14	1.10	1.12	1.29	0.99	1.12	1.25	0.99	1.00	1.25	1.26	1.36	1.50	1.34	1.46	1.27
1990	1.32	1.40	1.39	1.20	1.18	1.37	1.09	1.26	1.57	1.03	0.95	1.36	1.35	1.42	1.43	1.28	1.60	1.74
1995	1.33	1.34	1.45	1.22	1.14	1.51	0.94	1.17	1.56	1.20	0.99	1.43	1.39	1.66	3.83	1.47	1.82	2.19
Group B																		
1985	1.43	1.68	1.60	1.34	1.75	1.88	1.20	2.06	1.79	1.36	1.27	2.09	1.50	2.22	1.97	1.57	1.99	1.78
1990	2.17	2.31	1.96	1.77	2.64	2.42	1.50	2.06	2.45	1.97	1.48	2.37	1.98	1.98	2.49	1.56	2.04	2.72
1995	2.54	2.97	3.02	2.01	4.08	3.33	1.62	2.49	2.70	1.47	1.28	3.80	2.16	3.05	5.98	1.79	1.78	3.15
Group C																		
1985	1.10	1.50	1.39	0.88	1.51	1.82	0.95	1.34	1.52	0.79	1.81	1.94	0.87	1.60	2.10	1.10	1.71	2.05
1990	1.56	2.11	1.99	1.05	2.25	1.92	1.07	2.28	2.76	0.71	2.09	1.67	0.93	1.88	2.15	0.64	1.87	2.21
1995	1.29	1.87	1.70	1.29	1.88	2.20	0.93	1.88	2.38	0.65	1.14	0.86	0.86	2.60	4.99	0.58	1.89	2.79
Group D																		
1985	1.02	1.61	1.36	1.02	1.08	1.19	0.92	0.95	0.99	1.09	1.32	1.60	1.11	1.65	1.74	1.76	2.02	1.56
1990	1.49	2.17	2.57	1.04	1.58	2.44	0.96	1.67	3.56	1.08	2.23	4.17	1.11	1.95	2.40	1.65	2.62	2.32
1995	1.00	2.32	3.48	0.68	2.24	3.74	1.07	2.66	5.78	1.28	2.79	2.41	0.81	3.07	7.12	1.00	2.54	3.75
Group E																		
1985	1.17	1.16	1.84	1.26	1.10	1.74	1.18	1.38	1.60	1.02	0.60	2.12	1.17	1.30	1.64	1.43	1.04	1.21
1990	1.48	0.85	2.77	1.50	0.82	2.46	1.42	0.99	2.68	1.28	0.34	4.25	1.39	1.24	1.46	2.24	1.24	2.39
1995	1.87	0.83	7.15	1.88	0.97	6.45	1.61	0.68	8.06	1.43	0.34	4.14	2.10	1.56	9.55	3.71	1.64	5.78
Group F																		
1985	0.96	1.07	0.77	1.12	0.89	1.03	0.91	1.16	0.83	0.78	0.77	0.54	0.94	1.24	0.78	0.78	0.54	1.23
1990	1.36	1.36	0.67	1.49	1.03	1.53	1.33	1.38	1.30	1.03	0.76	0.71	0.97	1.16	1.43	0.88	0.98	1.00
1995	1.29	2.35	1.55	3.53	2.66	8.51	1.79	2.42	3.86	1.34	1.03	1.02	1.04	4.04	8.16	0.89	2.24	2.76

4 Employment effects of trade integration

An econometric specification of the labour demand equation which results from a simple Cobb-Douglas production function is derived e.g. by Hine and Wright (1998); see also Greenaway, Hine and Wright (1999). This leads to a dynamic panel data approach as used in Hine and Wright (1998) for the UK. The main difference is that we split our industry sample into three segments as mentioned above. The specification can be seen in equation (1)

$$EMP_{it} = \sum_{p=1,2} d_{t-p} EMP_{it-p} + \sum_{g=1,2,3} \sum_{p=0,1,2} b_{gt-p} D_g PROD90_{it-p} + \sum_{g=1,2,3} \sum_{p=0,1,2} b_{gt-p} D_g LCPE_{it-p}$$

$$\sum_{g=1,2,3} \sum_{p=0,1,2} b_{gt-p} D_g IMP_{it-p} + \sum_{g=1,2,3} \sum_{p=0,1,2} b_{gt-p} D_g EXP_{it-p} + u_{it} \qquad (1)$$

where $u_{it} = m_i + n_{it}$ is the error term. Variables are in logarithmic terms. Subscripts *i*, *g* and *t* refer to industry and industry segment and time respectively. We also included a time dummy to capture the effects of policy interventions, exogenous productivity growth, etc. The equation is estimated using the Arellano-Bond estimator which allows the inclusion of lags for the explained and the explanatory variables in the estimation as indicated above. These lags allow particularly the presence of adjustment lags. The specification potentially suffers from simultaneous determination of some of the variables or multi-collinearity between some variables. By using a panel data approach – instead of just using cross-country/cross-industry studies – this shortcoming is expected to be less serious. In the regression we included two lags for the dependent as well as for the independent variables and used the one-step robust estimator as recommended by Arellano-Bond (1991) which allows for heteroskedasticity in the error terms. The Sargan test statistics are reported from the one-step homoskedastic estimator.

Let us first discuss the results of the specification without splitting the import penetration variable into various subgroups of countries. The results are listed in Table 4.

Overall, the regressions performed well. The Sargan test of over-identifying restrictions rejects the null that these are valid. The null of no first- and second-order autocorrelation in the residuals is rejected in all cases. The lagged dependent variable is always significant for t-1, and for some countries negative significant in t-2. As expected, production has a positive impact on employment in period t. This effect is more pronounced in the skill-intensive sectors. However, there are some negative albeit smaller effects in periods t-1 and t-2 in some countries. For labour costs per employee, one would expect a negative sign as higher labour costs reduce labour demand. This hypothesis is confirmed *grosso modo* although there are some country differences. The coefficients are in most cases negative in period t, but positive in period t-1, and seem to be on average larger in the skill-intensive segments.

Table 4

Regression results (robust estimates)

Dependent variable: Employment

	FRA			**GER**			**NL**			**SWE**			**UK**			**USA**		
EMP_{t-1}	0.792	0.000	***	1.047	0.000	***	0.869	0.000	***	0.897	0.000	***	0.771	0.000	***	0.867	0.000	***
EMP_{t-2}	-0.021	0.768		-0.265	0.012	**	-0.155	0.101		-0.253	0.002	***	0.116	0.018	**	-0.096	0.114	
$PROD_{1,t}$	0.165	0.023	**	0.201	0.002	***	0.263	0.002	***	0.028	0.701		0.067	0.282		0.481	0.001	***
$PROD_{1,t-1}$	0.015	0.713		-0.097	0.043	**	-0.117	0.112		-0.061	0.280		-0.169	0.084	*	-0.266	0.007	***
$PROD_{1,t-2}$	-0.039	0.329		0.022	0.706		0.014	0.838		-0.052	0.305		0.083	0.212		-0.023	0.729	
$PROD_{2,t}$	0.083	0.011	**	0.186	0.000	***	0.208	0.002	***	0.022	0.508		0.072	0.084	*	0.173	0.000	***
$PROD_{2,t-1}$	-0.022	0.494		-0.150	0.052	*	-0.083	0.077	*	0.004	0.874		0.000	0.990		-0.050	0.259	
$PROD_{2,t-2}$	0.016	0.488		0.078	0.224		0.050	0.231		-0.078	0.115		-0.127	0.000	***	-0.168	0.000	***
$PROD_{3,t}$	0.264	0.000	***	0.354	0.001	***	0.793	0.000	***	0.271	0.001	***	0.408	0.000	***	0.310	0.000	***
$PROD_{3,t-1}$	0.212	0.072	*	-0.191	0.159		-0.474	0.000	***	-0.130	0.133		-0.271	0.025	**	-0.219	0.000	***
$PROD_{3,t-2}$	-0.192	0.008	***	0.037	0.497		0.147	0.065	*	-0.005	0.917		-0.072	0.228		-0.042	0.472	
$LCPE_{1,t}$	-0.157	0.298		-0.217	0.386		-0.961	0.000	***	-0.589	0.000	***	-0.323	0.003	***	-0.447	0.003	***
$LCPE_{1,t-1}$	0.203	0.080	*	0.467	0.121		0.993	0.000	***	0.566	0.000	***	0.337	0.000	***	0.896	0.000	***
$LCPE_{1,t-2}$	0.016	0.766		-0.178	0.246		-0.179	0.158		-0.181	0.337		-0.042	0.585		-0.310	0.046	**
$LCPE_{2,t}$	0.020	0.420		0.145	0.264		-0.799	0.000	***	-0.538	0.000	***	-0.551	0.000	***	-0.181	0.114	
$LCPE_{2,t-1}$	0.114	0.000	***	0.280	0.039	**	0.603	0.000	***	0.545	0.000	***	0.398	0.000	***	0.508	0.005	***
$LCPE_{2,t-2}$	-0.062	0.197		-0.304	0.131		0.135	0.254		-0.153	0.091	*	0.129	0.003	***	-0.095	0.472	
$LCPE_{3,t}$	-0.675	0.000	***	0.113	0.052	*	-0.564	0.000	***	-0.715	0.000	***	0.452	0.003	***	-0.292	0.042	**
$LCPE_{3,t-1}$	0.598	0.000	***	0.004	0.969		0.329	0.031	**	0.603	0.000	***	-0.595	0.000	***	0.236	0.362	
$LCPE_{3,t-2}$	-0.105	0.091	*	-0.213	0.061	*	-0.094	0.407		-0.158	0.244		0.142	0.182		0.143	0.458	
$IMP_{1,t}$	-0.053	0.743		-0.060	0.773		-0.077	0.233		-0.082	0.297		0.274	0.062	*	-0.131	0.305	
$IMP_{1,t-1}$	0.127	0.198		0.007	0.969		-0.055	0.521		0.070	0.551		0.274	0.456		-0.259	0.014	**
$IMP_{1,t-2}$	-0.014	0.956		0.073	0.804		-0.010	0.875		-0.273	0.159		0.259	0.018	**	0.058	0.733	
$IMP_{2,t}$	-0.141	0.173		-0.266	0.039	**	-0.011	0.782		-0.212	0.031	**	-0.242	0.118		-0.437	0.096	*
$IMP_{2,t-1}$	0.047	0.649		0.014	0.921		0.061	0.034	**	0.333	0.003	***	0.343	0.010	**	0.621	0.022	**
$IMP_{2,t-2}$	-0.151	0.166		-0.107	0.226		-0.022	0.572		-0.151	0.084	*	-0.044	0.765		-0.285	0.229	
$IMP_{3,t}$	-0.115	0.542		-0.219	0.010	**	0.034	0.087	*	-0.085	0.005	***	-0.311	0.021	**	-0.864	0.010	**
$IMP_{3,t-1}$	0.084	0.176		-0.199	0.000	***	-0.016	0.555		-0.030	0.658		0.067	0.514		0.402	0.184	
$IMP_{3,t-2}$	-0.270	0.244		-0.065	0.375		0.047	0.134		0.059	0.426		0.078	0.301		0.134	0.437	
$EXP_{1,t}$	-0.136	0.249		-0.515	0.001	***	0.264	0.042	**	-0.592	0.000	***	-0.616	0.007	***	-0.141	0.756	
$EXP_{1,t-1}$	-0.160	0.080	*	0.292	0.000	***	-0.030	0.767		0.307	0.084	*	-1.359	0.020	**	-0.305	0.126	
$EXP_{1,t-2}$	-0.249	0.196		-0.086	0.414		0.004	0.965		0.258	0.303		1.477	0.011	**	0.577	0.016	**
$EXP_{2,t}$	0.048	0.785		0.291	0.100		0.086	0.357		-0.100	0.448		-0.104	0.532		-0.003	0.993	
$EXP_{2,t-1}$	-0.127	0.479		0.151	0.370		-0.014	0.846		-0.139	0.380		-0.075	0.599		0.033	0.930	
$EXP_{2,t-2}$	0.118	0.507		0.062	0.696		0.045	0.568		0.117	0.400		-0.138	0.445		-0.246	0.554	
$EXP_{3,t}$	0.037	0.685		0.126	0.075	*	-0.016	0.629		-0.100	0.040	**	0.186	0.059	*	0.357	0.054	*
$EXP_{3,t-1}$	0.365	0.059	*	0.126	0.007	***	0.002	0.967		0.093	0.008	***	-0.026	0.685		-0.497	0.013	**
$EXP_{3,t-2}$	0.101	0.032	**	0.189	0.003	***	-0.048	0.272		-0.069	0.490		-0.164	0.032	**	0.221	0.406	
Sargan		0.000	***		0.000	***		0.000	***		0.000	***		0.000	***		0.000	***
AB1		0.002	***		0.005	***		0.007	***		0.001	***		0.002	***		0.000	***
AB2		0.194			0.306			0.939			0.991			0.579			0.231	
Obs.	292			283			301			308			292			308		

Note: Sargan test statistics are reported from one-step homoskedastic estimator.

Table 5

Regression results; country groups for import penetration

Dependent variable: Employment

	FRA			GER			NL			SWE			UK			USA		
EMP_{t-1}	0.811	0.000	***	0.744	0.000	***	0.670	0.000	***	0.683	0.000	***	0.693	0.000	***	0.858	0.000	***
EMP_{t-2}	0.024	0.763		-0.073	0.453		-0.070	0.453		-0.173	0.034	**	0.203	0.023	**	-0.052	0.364	
$PROD_{1,t}$	0.003	0.974		0.322	0.000	***	0.193	0.003	***	0.049	0.526		0.268	0.001	***	0.416	0.000	***
$PROD_{1,t-1}$	0.051	0.299		-0.083	0.365		-0.076	0.177		-0.108	0.052	*	-0.204	0.036	**	-0.315	0.001	***
$PROD_{1,t-2}$	-0.106	0.033	**	-0.073	0.353		0.027	0.603		0.025	0.672		0.042	0.573		0.063	0.188	
$PROD_{2,t}$	0.052	0.111		0.204	0.001	***	0.176	0.002	***	-0.006	0.894		-0.006	0.821		0.182	0.000	***
$PROD_{2,t-1}$	-0.006	0.859		-0.160	0.043	**	-0.064	0.135		-0.015	0.509		0.045	0.008	***	-0.030	0.484	
$PROD_{2,t-2}$	0.014	0.597		0.107	0.120		-0.005	0.926		-0.048	0.136		-0.152	0.000	***	-0.109	0.025	**
$PROD_{3,t}$	0.207	0.001	***	0.284	0.000	***	0.404	0.000	***	0.180	0.007	***	0.339	0.000	***	0.250	0.000	***
$PROD_{3,t-1}$	0.133	0.106		-0.046	0.608		-0.239	0.009	***	-0.070	0.521		-0.206	0.000	***	-0.185	0.000	***
$PROD_{3,t-2}$	-0.137	0.145		0.016	0.794		0.133	0.051	*	0.021	0.542		-0.052	0.178		-0.074	0.139	
$LCPE_{1,t}$	-0.066	0.342		-0.047	0.567		-0.773	0.000	***	-0.734	0.000	***	-0.361	0.000	***	-0.479	0.000	***
$LCPE_{1,t-1}$	0.076	0.206		0.243	0.006	***	0.921	0.000	***	0.520	0.000	***	0.381	0.000	***	0.851	0.000	***
$LCPE_{1,t-2}$	0.123	0.346		-0.065	0.602		0.030	0.839		-0.148	0.423		0.044	0.525		-0.171	0.279	
$LCPE_{2,t}$	0.025	0.195		0.054	0.601		-0.745	0.000	***	-0.682	0.000	***	-0.376	0.000	***	0.013	0.912	
$LCPE_{2,t-1}$	0.092	0.000	***	0.452	0.000	***	0.654	0.000	***	0.517	0.000	***	0.282	0.004	***	0.397	0.023	**
$LCPE_{2,t-2}$	-0.079	0.014	**	-0.266	0.155		0.223	0.118		-0.162	0.196		0.276	0.003	***	-0.200	0.057	*
$LCPE_{3,t}$	-0.650	0.000	***	0.053	0.236		-0.540	0.000	***	-0.735	0.000	***	0.249	0.047	**	-0.083	0.559	
$LCPE_{3,t-1}$	0.504	0.001	***	-0.145	0.046	**	0.499	0.000	***	0.468	0.004	***	-0.198	0.118		0.114	0.618	
$LCPE_{3,t-2}$	-0.067	0.389		0.092	0.238		0.255	0.013	**	-0.011	0.931		0.089	0.194		0.171	0.259	
$IMPA_{1,t}$	0.427	0.049	**	-0.920	0.054	*	-0.161	0.027	**	-0.913	0.063	*	0.341	0.059	*	0.928	0.052	*
$IMPA_{1,t-1}$	0.055	0.761		0.233	0.583		-0.087	0.130		1.236	0.047	**	0.699	0.069	*	-2.425	0.000	***
$IMPA_{1,t-2}$	-0.609	0.077	*	0.146	0.756		-0.038	0.570		-0.167	0.701		0.611	0.017	**	-0.947	0.103	
$IMPA_{2,t}$	-0.051	0.780		-0.543	0.060	*	-0.006	0.917		-0.311	0.058	*	0.317	0.005	***	-0.823	0.118	
$IMPA_{2,t-1}$	0.316	0.123		0.522	0.018	**	-0.135	0.017	**	0.092	0.424		-0.117	0.418		0.627	0.228	
$IMPA_{2,t-2}$	-0.309	0.031	**	0.041	0.707		-0.027	0.653		-0.321	0.047	**	-0.009	0.954		-0.418	0.321	
$IMPA_{3,t}$	-0.233	0.064	*	-0.165	0.010	**	-0.006	0.827		0.067	0.466		-0.732	0.000	***	-2.431	0.000	***
$IMPA_{3,t-1}$	0.389	0.026	**	-0.150	0.063	*	-0.009	0.855		-0.122	0.216		0.618	0.000	***	-0.161	0.690	
$IMPA_{3,t-2}$	-0.262	0.000	***	0.020	0.627		0.020	0.663		0.273	0.115		0.137	0.336		-0.064	0.848	
$IMPB_{1,t}$	-2.074	0.354		0.326	0.692		-1.000	0.072	*	-0.109	0.907		2.684	0.022	**	-1.245	0.776	
$IMPB_{1,t-1}$	0.851	0.192		-0.964	0.215		0.356	0.392		-1.057	0.369		-0.387	0.815		-4.779	0.017	**
$IMPB_{1,t-2}$	-0.641	0.515		-0.399	0.722		0.428	0.390		0.143	0.926		3.379	0.001	***	11.726	0.000	***
$IMPB_{2,t}$	0.446	0.425		3.565	0.123		-0.510	0.148		-5.372	0.080	*	-0.093	0.944		3.482	0.714	
$IMPB_{2,t-1}$	0.341	0.383		-0.226	0.884		1.549	0.002	***	1.451	0.516		-0.312	0.841		1.825	0.693	
$IMPB_{2,t-2}$	-0.203	0.666		-5.418	0.046	**	-0.022	0.960		-0.449	0.853		3.110	0.000	***	15.397	0.001	***
$IMPB_{3,t}$	1.601	0.394		5.488	0.003	***	0.719	0.400		-2.723	0.235		-8.069	0.004	***	5.316	0.730	
$IMPB_{3,t-1}$	-0.263	0.918		-6.194	0.044	**	-0.878	0.098	*	1.914	0.098	*	-3.035	0.022	**	13.701	0.177	
$IMPB_{3,t-2}$	-0.901	0.319		-2.505	0.381		0.283	0.717		2.048	0.454		-6.049	0.000	***	-7.946	0.555	
$IMPC_{1,t}$	-2.645	0.000	***	1.235	0.009	***	0.408	0.197		1.067	0.053	*	3.849	0.004	***	-0.420	0.037	**
$IMPC_{1,t-1}$	1.297	0.006	***	-0.053	0.914		-0.079	0.814		-1.719	0.001	***	1.944	0.011	**	-1.115	0.000	***
$IMPC_{1,t-2}$	1.683	0.000	***	0.011	0.984		-0.365	0.206		0.208	0.678		1.088	0.245		0.327	0.159	
$IMPC_{2,t}$	-0.860	0.004	***	-0.936	0.208		0.025	0.862		0.804	0.319		-0.474	0.505		-1.145	0.071	*
$IMPC_{2,t-1}$	-0.004	0.994		-0.732	0.300		-0.152	0.551		-1.620	0.045	**	2.604	0.000	***	1.307	0.001	***
$IMPC_{2,t-2}$	0.146	0.789		0.854	0.322		0.194	0.543		1.400	0.195		0.302	0.507		-1.368	0.000	***
$IMPC_{3,t}$	1.642	0.010	**	2.480	0.003	***	-0.139	0.327		0.188	0.676		0.856	0.029	**	0.837	0.020	**
$IMPC_{3,t-1}$	-1.560	0.000	***	0.029	0.974		-0.268	0.142		-0.140	0.185		0.303	0.355		-1.606	0.001	***
$IMPC_{3,t-2}$	1.687	0.000	***	1.316	0.111		-0.035	0.777		-1.261	0.003	***	0.226	0.469		0.655	0.050	*

(Table 5 continued)

Table 5 (continued)

$IMPD_{1,t}$	-6.284	0.029	**	2.567	0.003	***	-0.545	0.328		0.340	0.653		-2.320	0.031	**	-0.180	0.779	
$IMPD_{1,t-1}$	5.960	0.107		-3.683	0.012	**	-0.001	0.998		-1.101	0.217		-0.457	0.368		2.198	0.025	**
$IMPD_{1,t-2}$	-3.049	0.027	**	1.697	0.112		-0.295	0.450		0.223	0.719		0.032	0.972		-0.958	0.148	
$IMPD_{2,t}$	-0.603	0.304		-0.901	0.260		0.434	0.281		1.420	0.128		1.370	0.015	**	-0.872	0.194	
$IMPD_{2,t-1}$	1.493	0.003	***	-1.085	0.310		0.756	0.122		-1.966	0.001	***	1.512	0.048	**	1.197	0.060	*
$IMPD_{2,t-2}$	-1.380	0.004	***	-0.701	0.377		0.257	0.440		2.013	0.275		1.677	0.111		-0.365	0.322	
$IMPD_{3,t}$	-2.336	0.004	***	-4.467	0.000	***	0.246	0.112		-0.053	0.900		-0.483	0.427		-1.607	0.001	***
$IMPD_{3,t-1}$	1.477	0.146		-0.194	0.832		0.478	0.003	***	-0.669	0.218		0.189	0.245		1.819	0.000	***
$IMPD_{3,t-2}$	-1.150	0.220		0.985	0.361		0.278	0.038	**	-0.484	0.526		-0.537	0.009	***	0.134	0.695	
$IMPE_{1,t}$	1.578	0.321		-1.197	0.001	***	0.112	0.592		0.029	0.943		-0.989	0.175		-2.598	0.081	*
$IMPE_{1,t-1}$	-1.385	0.399		2.162	0.000	***	0.060	0.715		-0.375	0.051	*	-0.016	0.986		1.072	0.357	
$IMPE_{1,t-2}$	0.595	0.522		-0.779	0.164		-0.132	0.524		-0.242	0.623		0.540	0.356		1.539	0.058	*
$IMPE_{2,t}$	-0.700	0.026	**	-0.040	0.940		-0.035	0.761		0.416	0.230		-0.748	0.000	***	0.426	0.406	
$IMPE_{2,t-1}$	-0.341	0.219		0.382	0.171		0.071	0.651		1.018	0.000	***	0.461	0.037	**	-0.155	0.830	
$IMPE_{2,t-2}$	0.241	0.316		-0.106	0.835		-0.035	0.739		0.597	0.073	*	-0.546	0.002	***	0.021	0.966	
$IMPE_{3,t}$	3.342	0.001	***	-0.956	0.032	**	-0.350	0.131		-0.381	0.403		1.581	0.000	***	-0.924	0.149	
$IMPE_{3,t-1}$	-3.529	0.029	**	0.720	0.006	***	-0.380	0.411		-0.757	0.231		-0.894	0.095	*	2.427	0.000	***
$IMPE_{3,t-2}$	0.887	0.579		1.071	0.022	**	0.741	0.257		-0.596	0.236		1.325	0.006	***	-1.434	0.037	**
$IMPF_{1,t}$	-6.401	0.170		-2.201	0.016	**	1.288	0.492		3.114	0.175		6.537	0.283		0.375	0.991	
$IMPF_{1,t-1}$	-5.096	0.240		-0.307	0.734		-3.181	0.031	**	-4.293	0.358		-11.219	0.059	*	72.438	0.030	**
$IMPF_{1,t-2}$	-7.176	0.232		1.409	0.458		-3.473	0.004	***	3.759	0.495		-21.195	0.000	***	-64.896	0.010	**
$IMPF_{2,t}$	1.568	0.166		-0.637	0.788		-2.021	0.314		0.201	0.942		-1.722	0.122		3.740	0.903	
$IMPF_{2,t-1}$	-1.891	0.094	*	-10.802	0.000	***	-1.599	0.250		-3.535	0.009	***	-1.384	0.406		17.552	0.622	
$IMPF_{2,t-2}$	0.284	0.912		-3.322	0.185		-7.050	0.204		2.903	0.359		2.064	0.173		-79.838	0.003	***
$IMPF_{3,t}$	-3.091	0.077	*	1.548	0.047	**	-6.071	0.000	***	-2.160	0.118		-1.616	0.874		-50.202	0.016	**
$IMPF_{3,t-1}$	0.885	0.739		1.375	0.157		0.714	0.737		-4.987	0.000	***	38.119	0.000	***	88.215	0.021	**
$IMPF_{3,t-2}$	-12.925	0.000	***	-6.401	0.000	***	9.781	0.000	***	-2.571	0.350		7.232	0.216		32.287	0.344	
$EXP_{1,t}$	-0.723	0.012	**	-0.017	0.918		0.211	0.025	**	-0.426	0.002	***	-0.752	0.008	***	-0.663	0.189	
$EXP_{1,t-1}$	0.204	0.404		0.124	0.264		0.032	0.794		0.079	0.742		-1.065	0.009	***	-0.883	0.000	***
$EXP_{1,t-2}$	-0.203	0.410		0.003	0.981		0.185	0.106		0.103	0.638		1.753	0.000	***	0.910	0.006	***
$EXP_{2,t}$	0.072	0.694		0.522	0.001	***	0.098	0.336		-0.184	0.245		-0.373	0.000	***	-0.078	0.762	
$EXP_{2,t-1}$	-0.050	0.803		0.065	0.657		0.109	0.157		0.057	0.670		-0.057	0.533		0.158	0.762	
$EXP_{2,t-2}$	0.145	0.357		0.013	0.943		0.026	0.775		0.324	0.075	*	-0.081	0.250		-0.563	0.188	
$EXP_{3,t}$	-0.024	0.769		-0.020	0.509		-0.007	0.829		-0.208	0.147		0.038	0.134		0.441	0.010	**
$EXP_{3,t-1}$	0.193	0.022	**	0.002	0.926		-0.022	0.214		0.192	0.224		-0.055	0.042	**	-0.512	0.001	***
$EXP_{3,t-2}$	0.203	0.000	***	0.120	0.000	***	-0.110	0.000	***	-0.124	0.055	*	-0.050	0.292		-0.137	0.460	
Sargan		0.068	*		0.020	**		0.036	**		0.002	***		0.013	**		0.001	***
AB1		0.003	***		0.004	***		0.005	***		0.002	***		0.001	***		0.000	***
AB2		0.925			0.560			0.135			0.646			0.159			0.197	
Obs.	292			283			301			308			292			308		

Note: Sargan test statistics are reported from one-step homoskedastic estimator

Let us come to imports. As imports should displace domestic production, one would expect a negative effect on employment. From the hypothesis above the effect should also be more pronounced in the skill-intensive sectors for two reasons: first, import penetration was higher in these industries and, second, trade-induced labour-saving technical progress should be stronger in these industries. In our results the import penetration variables confirm our hypothesis: negative employment effects are stronger in the skill-intensive sectors in most countries with the exception of France (where a significant coefficient is found in period t-2) and the Netherlands. Sweden shows a particularly small (albeit negative significant) coefficient. Germany, the UK and the US also show a negative impact in the medium-skill industry segment (at low significance) as well. More importantly, none of the countries show a significant effect in the less skill-intensive industry segment 1.

With respect to export orientation, the evidence is rather mixed. As one expects that trade augments production, the effect should be positive. Germany, for example, shows a negative significant impact in industry segment 1 and a positive impact in industry segment 3. A negative effect in segment 1 is also found for Sweden and the UK. These (surprising) results confirm the findings by Hine and Wright (1998) where it is argued that export orientation also has a disciplining effect on employment.

In a next step we test for the impact of imports of various country groups on employment (see Tables 2 and 3 above). Most of the literature focused on trade with developing (and traditionally specialized countries), and splitting the sample can give a more differentiated picture. We estimated the following equation:

$$EMP_{it} = \sum_{p=1,2} d_{t-p} EMP_{it-p} + \sum_{g=1,2,3} \sum_{p=0,1,2} b_{gt-p} D_g PROD90_{it-p} + \sum_{g=1,2,3} \sum_{p=0,1,2} b_{gt-p} D_g LCPE_{it-p}$$

$$\sum_{g=1,2,3} \sum_{p=0,1,2} \sum_{c} b^{c}_{gt-p} D^{c}_{g} IMP^{c}_{it-p} + \sum_{g=1,2,3} \sum_{p=0,1,2} b_{gt-p} D_g EXP_{it-p} + u_{it} \qquad (2)$$

where *c* denotes the country groups A-F. This differs from equation (1) only in splitting up the import penetration variables to the country groups A-F. Table 5 reports the results.

In this case the Sargan test becomes significant for all countries. The Arellano-Bond test for first- and second-order autocorrelation in the first differenced residuals rejects for first-order autocorrelation but does not reject for second-order autocorrelation. Results for the lagged dependent variable, PROD and LCPE are qualitatively similar as above and we shall not discuss them any further. From a traditional approach one would expect that import penetration from developing economies should matter mainly in the less skill-intensive sectors. Thus let us look first at the impacts of trading partners B (southern OECD countries), D (East Asian Tigers) and E (less successful catching-up countries). For the latter we found a negative significant impact on employment in the less skill-intensive industry for Germany and the US (here the trade effects of Mexico are important) and for the medium-skill segment for the UK. The evidence for the skill-intensive segment is mixed. Country group D (the East Asian Tigers) had a negative impact on employment in the skill-intensive segments in France, Germany and the US, and – surprisingly – a positive one in the Netherlands. No significant effects were found for Sweden and the UK. Further, there are almost no effects from trade integration with country group B (southern OECD countries) with the exception of the UK, where the effect is strong in the skill-intensive segment. Employment effects of the other country groups are rather mixed across industry segments and countries. Especially for the US, however, a negative impact can be seen for imports from Japan in all industry segments and for segments 1 and 3 for imports from northern OECD countries.

5 Effects on productivity

Let us finally test more directly on the effects of trade integration on productivity dynamics. In this section we use value added productivity and output productivity (at constant 1990 prices) as dependent variables.

Table 6

Regression results (value added productivity as dependent variable)

	FRA			**GER**			**NL**			**SWE**			**UK**			**USA**		
VPR_{t-1}	0.542	0.000	***	0.558	0.000	***	0.493	0.000	***	0.761	0.000	***	0.643	0.000	***	0.676	0.000	***
VPR_{t-2}	-0.024	0.795		0.105	0.389		0.020	0.867		0.005	0.938		0.076	0.248		0.253	0.000	***
$LCPE_{1,t}$	0.309	0.001	***	0.875	0.067	*	0.463	0.007	***	0.779	0.000	***	0.462	0.002	***	1.012	0.000	***
$LCPE_{1,t-1}$	-0.191	0.395		-0.701	0.056	*	0.010	0.957		-0.963	0.000	***	-0.393	0.000	***	-0.957	0.000	***
$LCPE_{1,t-2}$	-0.078	0.725		-0.071	0.791		-0.057	0.720		0.489	0.004	***	-0.045	0.640		0.158	0.486	
$LCPE_{2,t}$	0.073	0.208		0.327	0.341		0.943	0.000	***	0.627	0.000	***	0.549	0.001	***	1.036	0.000	***
$LCPE_{2,t-1}$	-0.340	0.000	***	-0.420	0.169		-0.498	0.013	**	-0.589	0.000	***	-0.438	0.000	***	-1.082	0.000	***
$LCPE_{2,t-2}$	0.186	0.000	***	0.024	0.890		-0.088	0.688		0.281	0.022	**	-0.065	0.440		0.448	0.139	
$LCPE_{3,t}$	0.630	0.000	***	0.014	0.907		0.869	0.000	***	1.080	0.000	***	-0.035	0.865		0.733	0.015	**
$LCPE_{3,t-1}$	-0.249	0.002	***	-0.036	0.909		-0.280	0.045	**	-0.760	0.000	***	0.175	0.243		0.064	0.914	
$LCPE_{3,t-2}$	0.034	0.756		0.102	0.483		-0.064	0.632		-0.035	0.884		-0.132	0.283		-0.676	0.079	*
$IMP_{1,t}$	-0.136	0.665		-0.529	0.090	*	0.216	0.114		0.121	0.642		0.525	0.083	*	-0.126	0.643	
$IMP_{1,t-1}$	-0.273	0.051	*	0.399	0.180		0.272	0.104		0.140	0.330		-0.193	0.671		0.434	0.334	
$IMP_{1,t-2}$	0.796	0.002	***	-0.312	0.473		-0.035	0.843		-0.005	0.980		-0.249	0.151		0.382	0.211	
$IMP_{2,t}$	-0.061	0.800		-0.466	0.018	**	-0.056	0.196		-0.556	0.039	**	0.206	0.092	*	-0.537	0.150	
$IMP_{2,t-1}$	0.953	0.000	***	0.696	0.000	***	0.052	0.204		0.456	0.331		-0.154	0.395		0.075	0.793	
$IMP_{2,t-2}$	-0.488	0.108		0.062	0.472		-0.046	0.560		-0.367	0.284		0.038	0.847		0.535	0.229	
$IMP_{3,t}$	-0.425	0.113		0.104	0.357		-0.005	0.807		-0.048	0.206		0.022	0.924		-0.467	0.270	
$IMP_{3,t-1}$	0.208	0.437		0.234	0.186		0.059	0.027	**	0.097	0.253		0.392	0.027	**	1.420	0.018	**
$IMP_{3,t-2}$	-0.752	0.200		0.243	0.009	***	-0.032	0.262		-0.024	0.827		-0.180	0.011	**	-0.247	0.406	
$EXP_{1,t}$	-0.281	0.444		0.439	0.004	***	-0.374	0.053	*	-0.218	0.633		-0.773	0.097	*	0.293	0.577	
$EXP_{1,t-1}$	-0.056	0.755		-0.082	0.410		-0.594	0.115		-0.161	0.334		0.875	0.151		0.502	0.159	
$EXP_{1,t-2}$	-0.046	0.851		-0.144	0.353		0.259	0.495		0.399	0.324		-0.463	0.421		-1.283	0.001	***
$EXP_{2,t}$	-0.618	0.191		-0.178	0.515		-0.251	0.013	**	-0.440	0.266		0.139	0.168		-1.894	0.000	***
$EXP_{2,t-1}$	0.156	0.597		-0.245	0.514		0.004	0.937		0.546	0.336		0.029	0.872		0.738	0.189	
$EXP_{2,t-2}$	0.525	0.077	*	0.197	0.394		-0.076	0.483		0.109	0.643		0.101	0.658		0.904	0.277	
$EXP_{3,t}$	0.216	0.307		-0.005	0.932		-0.028	0.288		0.278	0.001	***	-0.078	0.558		0.270	0.550	
$EXP_{3,t-1}$	-0.161	0.519		-0.148	0.353		-0.042	0.233		-0.139	0.033	**	-0.142	0.258		-0.021	0.965	
$EXP_{3,t-2}$	-0.207	0.114		-0.178	0.011	**	0.037	0.441		0.210	0.000	***	0.280	0.008	***	-0.744	0.006	***
Sargan		0.000	***		0.000	***		0.000	***		0.000	***		0.000	***		0.000	***
AB1		0.003	***		0.005	***		0.010	**		0.001	***		0.001	***		0.001	***
AB2		0.876			0.630			0.287			0.021	**		0.096	*		0.345	
Obs.	292			283			301			308			292			308		

Note: Sargan test statistics are reported from one-step homoskedastic estimator.

The estimated equation is

$$PR_{it} = \sum_{p=1,2} d_{t-p} PR_{it-p} + \sum_{g=1,2,3} \sum_{p=0,1,2} D_g LCPE_{it-p} + \sum_{g=1,2,3} \sum_{p=0,1,2} D_g IMP_{it-p} + \sum_{g=1,2,3} \sum_{p=0,1,2} D_g EXP_{it-p} + u_{it} \quad (3)$$

where *PR* denotes value added productivity (*VPR90*) or output productivity (*OPR90*), respectively. We estimated this regression again by the Arellano-Bond estimator as discussed above. Results are given in Tables 6 and 7.

Table 7

Regression results (output productivity as dependent variable)

	FRA			**GER**			**NL**			**SWE**			**UK**			**USA**		
OPR_{t-1}	0.723	0.000	***	0.888	0.000	***	0.621	0.000	***	0.656	0.000	***	0.471	0.000	***	0.750	0.000	***
OPR_{t-2}	-0.086	0.124		-0.089	0.166		-0.027	0.758		0.092	0.300		0.118	0.011	**	0.250	0.005	***
$LCPE_{1,t}$	0.045	0.746		0.924	0.073	*	1.241	0.000	***	0.649	0.001	***	0.677	0.021	**	0.408	0.058	*
$LCPE_{1,t-1}$	0.007	0.953		-1.110	0.003	***	-0.969	0.000	***	-0.719	0.027	**	-0.184	0.277		-1.397	0.000	***
$LCPE_{1,t-2}$	-0.101	0.582		0.022	0.930		-0.103	0.545		0.048	0.848		-0.223	0.222		0.423	0.011	**
$LCPE_{2,t}$	-0.088	0.145		0.470	0.142		0.982	0.000	***	0.803	0.002	***	0.909	0.073	*	0.696	0.147	
$LCPE_{2,t-1}$	-0.427	0.000	***	-1.225	0.001	***	-0.479	0.019	**	-0.745	0.007	***	-0.804	0.008	***	-0.997	0.027	**
$LCPE_{2,t-2}$	0.309	0.106		0.544	0.155		-0.370	0.009	***	0.001	0.996		0.208	0.253		-0.013	0.945	
$LCPE_{3,t}$	0.488	0.000	***	-0.031	0.806		0.766	0.000	***	0.980	0.000	***	-0.298	0.165		0.350	0.030	**
$LCPE_{3,t-1}$	-0.366	0.001	***	0.054	0.736		-0.258	0.096	*	-0.482	0.006	***	0.364	0.040	**	-0.402	0.227	
$LCPE_{3,t-2}$	0.153	0.164		0.008	0.950		-0.351	0.083	*	-0.240	0.263		0.251	0.253		-0.303	0.262	
$IMP_{1,t}$	-0.548	0.162		0.120	0.777		0.005	0.973		0.277	0.303		0.904	0.045	**	-0.212	0.421	
$IMP_{1,t-1}$	0.026	0.901		-0.270	0.447		0.084	0.305		0.016	0.913		-0.181	0.663		0.704	0.000	***
$IMP_{1,t-2}$	1.038	0.012	**	0.244	0.322		0.115	0.541		-0.137	0.445		0.345	0.193		0.139	0.449	
$IMP_{2,t}$	0.690	0.210		0.305	0.362		0.109	0.413		-0.163	0.673		0.362	0.441		-0.127	0.759	
$IMP_{2,t-1}$	0.143	0.723		0.000	1.000		-0.060	0.723		-0.078	0.704		-0.429	0.374		0.813	0.007	***
$IMP_{2,t-2}$	-0.092	0.700		0.200	0.025	**	0.148	0.279		-0.209	0.643		0.033	0.910		-0.670	0.317	
$IMP_{3,t}$	-0.126	0.742		0.194	0.007	***	-0.062	0.066	*	-0.115	0.024	**	0.104	0.827		1.057	0.085	*
$IMP_{3,t-1}$	0.131	0.423		0.164	0.000	***	0.005	0.934		0.179	0.000	***	0.350	0.130		0.339	0.559	
$IMP_{3,t-2}$	-0.207	0.293		0.084	0.195		-0.048	0.257		-0.145	0.050	*	-0.128	0.523		-0.690	0.051	*
$EXP_{1,t}$	-0.098	0.851		0.513	0.000	***	-0.235	0.308		0.220	0.553		-1.690	0.016	**	-1.338	0.020	**
$EXP_{1,t-1}$	-0.426	0.002	***	-0.850	0.000	***	0.046	0.723		-0.086	0.853		1.634	0.050	*	0.537	0.165	
$EXP_{1,t-2}$	1.008	0.013	**	0.401	0.025	**	-0.003	0.992		0.366	0.216		-0.493	0.523		1.072	0.005	***
$EXP_{2,t}$	-0.682	0.127		-0.628	0.004	***	-0.485	0.019	**	0.840	0.563		-0.421	0.441		-1.746	0.006	***
$EXP_{2,t-1}$	0.528	0.256		0.571	0.027	**	0.263	0.150		0.264	0.676		0.220	0.570		-0.494	0.604	
$EXP_{2,t-2}$	0.197	0.629		-0.146	0.585		-0.099	0.539		0.082	0.861		-0.074	0.801		1.124	0.016	**
$EXP_{3,t}$	-0.061	0.657		-0.174	0.005	***	-0.018	0.581		0.286	0.001	***	-0.243	0.318		-1.198	0.000	***
$EXP_{3,t-1}$	-0.417	0.180		-0.101	0.031	**	0.055	0.377		-0.118	0.047	**	-0.151	0.367		0.109	0.693	
$EXP_{3,t-2}$	0.071	0.707		-0.245	0.000	***	0.057	0.286		0.338	0.000	***	0.275	0.065	*	0.009	0.980	
Sargan		0.001	***		0.000	***		0.000	***		0.000	***		0.000	***		0.000	***
AB1		0.009	***		0.001	***		0.003	***		0.012	**		0.019	**		0.019	**
AB2		0.147			0.131			0.208			0.070	*		0.039	**		0.914	
Obs.	292			283			301			308			292			308		

Note: Sargan test statistics are reported from one-step homoskedastic estimator

6 Conclusions

The evidence provided in this paper shows that the overall effects of trade integration have a different pattern to the one that one would expect from using a standard Heckscher-Ohlin framework. In the descriptive part we have seen that import penetration rates in a group of advanced economies (and to a lesser extent also export orientation) were rising relatively stronger in the skill-intensive industries. In our econometric results we find that the negative effects on employment are more pronounced in the skill-intensive industries in all six OECD countries investigated in this study. This is also the case for trade integration with developing countries. This aspect is hardly encountered in the literature on trade and labour markets. These results on the patterns of trade integration and the effects on employment would suggest a downward pressure on relative wages of skilled workers in the advanced countries. This is, however, not in line with the empirical evidence, which shows a widening of the wage differential between skilled and unskilled workers.

However, if this pattern implies a relatively faster skill-biased technical progress in these industries (the argument by Wood, 1994) combined with the findings by Haskel and Slaughter (2002) that it is the sector bias of skill-biased technical change (SBTC) that caused the rising skill premia, trade integration would be a plausible cause for the rising skill premia. In a second set of regressions we thus tested for the effects of trade integration (mainly import penetration) on labour productivity. Although the overall results are less clear, the effects of trade on productivity are more often positively significant at least for larger economies. Thus there is at least some evidence that trade integration has spurred labour productivity growth especially in the skill-intensive segments (which are facing more competitive pressure from international integration). In this way trade can be an important cause of the rising wage differential.

From a policy perspective the advanced countries are thus facing a tricky situation: As trade integration is higher in the skill-intensive industries, this means that they are losing the competitive advantage in these industries. For defending these industries, productivity growth must be relatively faster in these industries and, given that technical progress is of the SBTC-type, this implies a widening wage differential. Lowering the skilled to unskilled wage rate may also make the skill-intensive industries more (cost) competitive but this seems to be unattainable given the SBTC form of technical progress.

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Appendix

Table A1

Industries available in STAN and Bilateral Trade Database (BTD)

Description	ISIC	Note
Food, beverages and tobacco	3100	
Textiles, apparel and leather	3200	
Wood products and furniture	3300	
Paper, products and printing	3400	
Chemicals excl. drugs	3512X	3510+3520-3522
Drugs and medicines	3522	
Petroleum refineries and products	3534A	3530+3540
Rubber and plastic products	3556A	3550+3560
Non-metallic mineral products	3600	
Iron and steel	3710	
Non-ferrous metals	3720	
Metal products	3810	
Office and computing equipment	3825	
Machinery and equipment nec	382X	3820-3825
Radio, TV and communication equipment	3832	
Machinery and equipment nec	383X	3830-3832
Shipbuilding and repairing	3841	
Other transport equipment nec	3842A	3842+3844+3849
Motor vehicles	3843	
Aircraft	3845	
Discrepancy (scrap metals)	384D	3840-(3841+3842+3843+3844+3845+3849)
Professional goods	3850	
Other manufacturing	3900	
Total manufacturing	**3000**	

Table A2

Industries ranked by skill intensity

Description	ISIC	Skill intensity	Rank
Textiles, apparel and leather	3200	0.058	1
Wood products and furniture	3300	0.084	2
Food, beverages and tobacco	3100	0.093	3
Non-metallic mineral products	3600	0.104	4
Rubber and plastic products	3556A	0.106	5
Iron and steel	3710	0.110	6
Other transport equipment nec	3842A	0.120	7
Other manufacturing	3900	0.124	8
Metal products	3810	0.132	9
Non-ferrous metals	3720	0.133	10
Motor vehicles	3843	0.171	11
Paper, products and printing	3400	0.183	12
Machinery and equipment nec	382X	0.188	13
Petroleum refineries and products	3534a	0.244	14
Chemicals excl. drugs	3512X	0.282	15
Radio, TV and communication equipment	3832	0.302	16
Professional goods	3850	0.302	17
Machinery and equipment nec	383X	0.303	18
Shipbuilding and repairing	3841	0.352	19
Aircraft	3845	0.401	20
Drugs and medicines	3522	0.410	21
Office and computing equipment	3825	0.552	22

Table A3

Country groupings

Country	Name	Group
AUS	Australia	A
AUT	Austria	A
BLX	Belgium/Luxembourg	A
CAN	Canada	A
CHE	Switzerland	A
DNK	Denmark	A
FIN	Finland	A
FRA	France	A
GER	Germany	A
IRL	Ireland	A
ITA	Italy	A
NL	Netherlands	A
NOR	Norway	A
NZL	New Zealand	A
SWE	Sweden	A
UK	United Kingdom	A
US	United States	A
ESP	Spain	B
GRC	Greece	B
ISL	Iceland	B
PRT	Portugal	B
TUR	Turkey	B
JPN	Japan	C
HKG	Hong Kong (China)	D
KOR	Korea	D
SGP	Singapore	D
TWN	Chinese Taipei	D
ARG	Argentina	E
BRA	Brazil	E
CHN	China	E
IDN	Indonesia	E
IND	India	E
MEX	Mexico	E
MYS	Malaysia	E
PHL	Philippines	E
ROW	Rest of World	E
THA	Thailand	E
CSK	Former Czechoslovakia	F
CZE	Czech Republic	F
HUN	Hungary	F
POL	Poland	F

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