OECD WORKERS IN THE GLOBAL ECONOMY: INCREASINGLY VULNERABLE?

CHAPTER 3 OF THE 2007 *OECD EMPLOYMENT OUTLOOK*

BACKGROUND MATERIAL

"OECD Workers in the global economy: Increasingly vulnerable?",
Chapter 3 of the OECD *Employment Outlook 2007,*
ANNEXES 3.B to 3.D

1. The material presented in the following pages supplements that presented in Chapter 3 of the *OECD Employment Outlook 2007* (OECD, 2007). This material is organised into three annexes, as follows:

- Annex 3.B provides additional explanation of the industry classifications and data sources used in the econometric analysis presented in Section 2 of the chapter.

- Annex 3.C provides further details on the empirical methodology used to analyse the impact of globalisation on labour demand. In particular, Section 3.C.1 shows how the various elasticities, reported in Table 3.2 are calculated from the estimated coefficients of a translog cost function; and Section 3.C.2 shows how the simulation results in Table 3.4 are derived.

- Annex 3.D analysis the robustness of the results obtained in two parts of the econometric analysis in Section 2 of the chapter. The sensitivity analysis in Section 3.D.1 shows that the estimation results for the impact of offshoring on total sectoral labour demand, which are presented in Table 3.1, are qualitatively similar when outliers are excluded from the estimation sample or alternative methods are used to control for technological change. Section 3.D.2 provides further details regarding specification and results for the analysis of changes in the elasticity of labour demand over time, as reported in Figures 3.10-3.11 and Tables 3.3-3.4.

3.B Data

2. This annex provides additional details on the industry classifications and data sources used in the econometric analysis presented in Section 2 of the chapter.

3.B.1 Industry classification

3. As much as possible, the empirical analysis makes use of the industrial classification used in the OECD Structural Analysis (STAN) and Input-Output databases. The STAN classification is based on the International Standard Industrial Classification (ISIC) Rev 3 and Table 3.B.1 provides the correspondence between the STAN industry labels and ISIC Rev. 3 industry codes. The agriculture and mining industries (ISIC 01-14) were excluded from the sectoral analysis.

Table 3.B.1. **Industries used in sectoral analysis of foreign competition**
Correspondence between STAN industries and International Standard Industry Classification (ISIC Rev.)

STAN industries	ISIC codes
Agriculture, hunting, forestry and fishing	01-05
Mining and quarrying (energy)	10-12
Mining and quarrying (non-energy)	13-14
Food products, beverages and tobacco	15-16
Textiles, textile products, leather and footwear	17-19
Wood and products of wood and cork	20
Pulp, paper, paper products, printing and publishing	21-22
Coke, refined petroleum products and nuclear fuel	23
Chemicals excluding pharmaceuticals	24 excl 2423
Pharmaceuticals	2423
Rubber & plastics products	25
Other non-metallic mineral products	26
Iron & steel	271 + 2731
Non-ferrous metals	272 + 2732
Fabricated metal products, except machinery & equipment	28
Machinery & equipment, nec	29
Office, accounting & computing machinery	30
Electrical machinery & apparatus, nec	31
Radio, television & communication equipment	32
Medical, precision & optical instruments	33
Motor vehicles, trailers & semi-trailers	34
Building & repairing of ships & boats	351
Aircraft & spacecraft	353
Railroad equipment & transport equip nec	352 + 359
Manufacturing nec; recycling (include Furniture)	36-37
Production, collection and distribution of electricity	401
Manufacture of gas; distribution of gaseous fuels through mains	402
Steam and hot water supply	403
Collection, purification and distribution of water	41
Construction	45
Wholesale & retail trade; repairs	50-52
Hotels & restaurants	55
Land transport; transport via pipelines	60
Water transport	61
Air transport	62
Supporting and auxiliary transport activities; activities of travel agencies	63
Post & telecommunications	64
Finance & insurance	65-67
Real estate activities	70
Renting of machinery & equipment	71
Computer & related activities	72
Research & development	73
Other Business Activities	74
Public admin. & defence; compulsory social security	75
Education	80
Health & social work	85
Other community, social & personal services	90-93
Private households with employed persons & extra-territorial organisations & bodies	95-99

3.B.2 Description of data sources used

OECD Structural Analysis (STAN) database

4. STAN is primarily based on member countries' annual National Accounts, but also makes use of data from other sources, such as national industrial surveys/censuses, to complement the information from the National Accounts. Since many of the data points are estimated, they do not represent official member country submissions. The current version of STAN is based on the *International Standard Industrial Classification of all Economic Activities, Revision 3* (ISIC Rev. 3) and covers all activities (including services).

OECD Input-Output database

5. The input-output data used in this chapter are obtained from the 2006 edition of the OECD's Input-Output Database (OECD, 2006b). Input-Output tables describe the sale and purchase relationships between producers and consumers within an economy. They can be produced by illustrating flows between the sales and purchases (final and intermediate) of *industry outputs* or by illustrating the sales and purchases (final and intermediate) of *product outputs*. The OECD Input-Output Database is presented on the former basis, reflecting in part the collection mechanisms for many other data sources such as research and development data, employment statistics, pollution data, energy consumption, which are in the main collected by establishments, and so industry. Many of the *industry-by-industry* input-output tables have been derived from Member Countries' supply-use tables, using the fixed-product sales structure assumption. Furthermore, some additional adjustments have been made to the supply-use tables, usually to deal with disclosure problems. As such, the input-output tables should not be regarded as official country estimates. To the extent that the supply-use tables are consistent with National Accounts data and the STAN Database, the input-output tables maintain this consistency. Not all countries, however, integrate their supply-use tables into the national accounts' production process, and therefore on occasions differences may exist.

European Household Community Survey (ECHP)

6. European Community Household Panel (ECHP) is a longitudinal survey of households and individuals conducted by Eurostat for the period 1994-2001. The main advantage of this dataset is that it provides comparable information on households and individuals in 15 European Union countries. The ECHP consists of eight waves which correspond to eight approximately annual interview rounds.

7. It is not straightforward to link the information in the ECHP to external data on market conditions in specific industries as most information in the ECHP relates to the date of the interview and interviews are not conducted at regular time intervals. It is possible, for example, that an individual is interviewed in January of one year and then not again until December of the next year. An individual may even be interviewed twice in a single year, but not at all in either the proceeding or following year.

8. In order to link the information in the ECHP with industry-level data, the information had to be re-organized in calendar time. One can do this by constructing the complete labour market histories of the individuals in the ECHP. We considered three possible three labour market states: i) employment; ii) unemployment; and iii) out of the labour market. The complete labour market histories can be constructed using i) information on the labour market status at the time of the interview; ii) information about the start of the current or the end of a previous job; and iii) the so-called "calendar" with information on labour market states for each month in the year preceding the interview. Broadly speaking, the start and

end dates are used to identify whether workers are employed or not at any given time. Information at the date of the interview along with calendar information is used to find out whether individuals were in work, were unemployed, or inactive.

9. The resulting dataset is an unbalanced panel of individuals with complete labour market histories by month and year for the period 1993-2001. In order to make the dataset more manageable, it was aggregated into quarters for the analysis of individual job separations and to years for the analysis of individual wages.

10. The econometric analysis based on ECHP data makes use of quite an aggregate industrial classification which is defined in terms of NACE Rev 1. industry codes. Table 3.B.2 provides the correspondence between the ISIC codes used to define STAN industries and the industrial classification which is available in the ECHP. The analysis of individual workers in Chapter 3 of OECD (2007) is limited to the agricultural and manufacturing sectors.

Table 3.B.2. **Industries used in worker-level analysis of foreign competition**
Correspondence between ECHP and STAN industries

ECHP industries[a]	**ISIC equivalence**
A+B Agriculture hunting and forestry + Fishing	01-05
C+E Mining and quarrying + Electricity gas and water supply	10-12; 13-14, 401; 402; 403 and 41
DA Manufacture of food products beverages and tobacco	15-16
DB+DC Manufacture of textiles clothing and leather products	17-19
DD+DE Manufacture off wood and paper products;publishing and printing	20; 21-22
DF-DI Manufacture of coke refined petroleum/chemicals/rubber & plastic/…products etc…	23; 24 excl. 2423; 2423; 25; 26
DJ+DK Manufacture of metal products machinery and equipement n.e.c.	271 + 2731; 272 + 2732; 28; 29; 30; 31; 32; 33; 34; 351; 353; 352 + 359
DL-DN Other manufacturing	36-37
F Construction	45
G Wholesale and retail trade; repair of motor vehicles motorcycles and personal/household goods	50-52
H Hotels and restaurants	55
I Transport storage and communication	60-64
J Financial intermediation	65-67
K Real estate renting and business activities	70-74
L Public administration and defense; compulsory social security	75
M Education	80
N Health and social work	85
O-Q Other community social and personal service activities; private households with employed persons; extra-territorial organizations and bodies	90-99

a) Main activity of the local unit of the business or organisation in current job (PE007B).

National data sources for labour market data by skill

11. The information on employment and earnings by skill category which is used in OECD (2007) to analyse how foreign competition affects the skill structure of labour demand (*cf.* Table 3.2), was obtained from the national data sources. Table 3.B.3. identifies the sources used and provides information about sample coverage and the definition of skill employed.

Table 3.B.3. **Source of national earnings data used for the analysis of foreign competition and the skill structure of labour demand**

Country	Period covered	Industries	Employees definition	Earnings definition	Source	Coverage
Belgium	1999-2004	NACE rev 1. industries excluding Agriculture (01-05) and Social and personal services (75-99)	Employees	Average monthly earnings	Structure of Earnings Survey	All persons employed in a firm excluding temporary workers ("Intérimaires"), persons working at home, self-employed and persons working abroad.
Canada	1990-2005	48 STAN industries	Employees	Average hourly earnings	Labour Force Statistics, Statistics Canada	All employees.
Finland	1995-2004	48 STAN industries	Employees	Average monthly earnings	Structure of Earnings data	Employees (not self-employed persons) in firms, having at least 5 employees. Highest managements are partly excluded. Also part-time workers are excluded from monthly earnings calculations. Monthly earnings are gross earnings and they include regular monthly pay and overtime-payments. All irregularly or yearly paid payments (yearly paid bonuses, holiday-payments etc.) are excluded from these earnings.
Norway	1997-2005 (earnings) & 2000-2005 (employees)	31 industries from NACE rev1 adjusted to correspond to the 48 industries using share of employment by industry from STAN.	Employees	Average Total monthly earnings	Wage statistics	Persons aged 16-64 (FT and PT workers without adjustement taking into account total hours worked). Total monthly earnings cover basic paid salaries, variable additional allowances and bonuses, commissions and the like. Overtime pay is not included in total monthly earnings.
Portugal	1995-2005	48 STAN industries	Employees	Average monthly earnings	Quadros de Pessoal	All enterprises that have at least one person at work registered at the Compulsory Social Security.
Sweden	1993-2005	48 STAN industries	Employees	Average gross annual earnings	Registerbaserade arbetsmarknadsstatistiken	All employees who worked at least 1 hour per week during November of the given year. Employees includes owner managers of incorporated enterprises who are listed on the stock exchange, but not of privately held corporations (e.g. family firms) or non-incorporated enterprises.
United Kingdom	1994-2005	48 STAN industries	Employees	Average weekly earnings	British Labour Force Survey	Average calculated for males aged 16-64 and females aged 16-59.
United States	1994-2002	36 STAN industries based on the US-SIC classification	Employees	Average weekly earnings	C urrent Population Survey (March)	All employees aged 15-64.

Other data sources used

12. Exchange-rate information and consumer-price indices are from the IMF's International Financial Statistics (IFS). The goods trade data are from the United Nations Commodity Trade Statistics Database which provide annual international trade statistics data detailed by commodities and partner countries (COMTRADE). Bilateral services trade data for the period 1999-2004 are from the OECD database on Trade In Services by Partner country (TISP). These data were complemented with total sectoral services data from the WTO. Finally, unemployment rates were taken from the OECD database on Labour Force Statistics.

3.C. Methodology

13. This annex explains two parts of the empirical methodology used to analyse the impact of globalisation on labour demand in the chapter. Section 3.C.1 shows how the various elasticities reported in Table 3.2 are calculated from the estimated coefficients of a translog cost function, while Section 3.C.2 shows how the simulation results in Table 3.4 are derived.

3.C.1 Elasticity definitions for analysis of skill structure of labour demand

14. The elasticity of factor demand *j* with respect to a change in factor prices is given by:

$$\varepsilon_{js} = \frac{\partial \ln v_j}{\partial \ln w_s} = \frac{\alpha_{js}}{s_j} + s_s - \phi_{js} \qquad \text{(C1)}$$

where $\phi = 1$ if $j = s$ and $\sum_{j=1}^{N} \varepsilon_{js} = 0$.

15. The elasticity of factor demand j with respect to a change in the capital stock or output is given by:

$$\varepsilon_{jk} = \frac{\partial \ln v_j}{\partial \ln x_k} = \frac{\delta_{jk}}{s_j} \qquad \text{(C2)}$$

16. Finally, the semi-elasticity of factor demand with respect to demand shifter z is given by:

$$\varepsilon_{jr} = \frac{\partial \ln v_j}{\partial z_r} = \frac{\delta_{jr}}{s_r} \qquad \text{(C3)}$$

3.C.2. The wage and employment effects of labour-demand shocks in partial equilibrium

17. The approach of Hasan et al. (2007) is adopted to calculate the wage and employment responses to a hypothetical labour-demand shock which are reported in Table 3.4. Inverse labour demand and labour supply can be represented by:

$$\ln w = \ln A - (1/\eta_D) \ln l \qquad \text{(C4a)}$$

$$\ln w = (1/\eta_S) \ln l \qquad \text{(C4b)}$$

where η_D and η_S represent the absolute elasticities of labour demand and supply respectively. The vertical intercept of inverse labour demand, A, captures shocks that affect labour productivity and/or output demand.

18. In labour market equilibrium, the equilibrium wage, w^*, is given by:

$$\ln w^* = \frac{(1/\eta_S) \ln A}{(1/\eta_D) + (1/\eta_S)} \qquad \text{(C.5a)}$$

Similarly, equilibrium employment is given by:

$$\ln l^* = \frac{\ln A}{(1/\eta_D) + (1/\eta_S)} \qquad \text{(C.5b)}$$

19. Rewriting (C.5a) and (C.5b) gives the proportional response in wages and employment to a proportional vertical shift in the labour demand curve:

$$\frac{\partial \ln w^*}{\partial \ln A} = \frac{(1/\eta_S)}{(1/\eta_D)+(1/\eta_S)} \tag{C.6a}$$

$$\frac{\partial \ln l^*}{\partial \ln A} = \frac{1}{(1/\eta_D)+(1/\eta_S)} \tag{C.6b}$$

3.D Econometric analysis

20. This annex analyses the robustness of the results obtained in two parts of the econometric analysis presented in Section 2 of the chapter. The sensitivity analysis in Section 3.D.1 shows that the estimation results for the impact of offshoring on total sectoral labour demand, which are presented in Table 3.1, are qualitatively similar when outliers are excluded from the estimation sample or alternative methods are used to control for technological change. Section 3.D.2 provides further details regarding specification and results for the analysis of changes in the elasticity of labour demand over time, as reported in Figures 3.10-3.11 and Tables 3.3-3.4.

3.D.1 Offshoring and sectoral labour demand

In order to analyse the sensitivity of the results reported in Table 3.1, Panel B two robustness checks were conducted. First, outlier robust regressions were estimated with the help of the *rreg* command in STATA. This involves first excluding any outlier observations from the standard model using Cook's distance (D>1) and then iterating the model using the absolute residuals from the previous regression as weights. Second, the baseline model was re-estimated using industry and country-specific trends instead of R&D intensity. Contrary to what one would expect R&D intensity is associated with a positive or insignificant coefficient in the conditional labour demand regressions in Panel B of Table 3.1. One plausible explanation is that this reflects the multi-collinearity problem that arises when including R&D and offshoring simultaneously in the regressions. As there is no direct way to address this issue country and sector-specific trends are included instead of R&D intensity to control for technological change that occurs independent of offshoring.

The outlier robust results are reported in Table 3.D.1. The results are very similar in nature to those of the baseline regressions in Table 3.1. As before narrow offshoring exerts a statistically significant and negative effect on labour demand conditional on the level of output. In addition, offshoring from other industries (difference) has a negative effect on industry employment conditional on output. Once one allows for scale effects one observes that the negative effect of offshoring on employment entirely disappears. There is some indication that offshoring from other industries raises employment in the services sector.

Table 3.D.1. **Outlier robust regression results over five-year differences**

	Panel A. **Conditional**					
	All industries		Manufacturing industries		Service industries	
log (Wage/Price of materials)	-0.124	(2.32)**	-0.227	(3.40)***	0.006	(0.06)
log Capital stock	0.145	(5.53)***	0.143	(5.03)***	0.253	(3.30)***
log Output	0.178	(6.68)***	0.151	(5.06)***	0.141	(1.66)
R&D intensity	0.595	(4.03)***	0.779	(3.57)***	0.318	(1.23)
Offshoring (narrow)	-0.083	(3.33)***	-0.070	(2.67)***	0.635	(0.67)
Offshoring (difference)	-0.137	(2.50)**	-0.111	(1.97)*	0.026	(0.08)
Constant	-0.004	(2.28)**	-0.005	(2.75)***	0.002	(0.32)
Observations	237		179		57	
R-squared	0.44		0.43		0.41	
	Panel B. **Unconditional**					
	All industries		Manufacturing industries		Service industries	
log (Wage/Price of materials)	-0.383	(8.06)***	-0.422	(7.10)***	-0.037	(0.45)
log Capital stock	0.229	(8.73)***	0.201	(7.27)***	0.290	(4.53)***
log (Price of output/Price of materials)	0.295	(3.13)***	0.404	(3.01)***	-0.110	(0.73)
R&D intensity	0.495	(3.11)***	0.614	(2.70)***	0.317	(1.24)
Offshoring (narrow)	-0.017	(0.69)	-0.014	(0.58)	0.580	(0.58)
Offshoring (difference)	0.060	(1.30)	0.037	(0.80)	0.483	(2.28)**
Constant	-0.001	(0.67)	-0.002	(1.17)	0.005	(1.15)
Observations	237		178		57	
R-squared	0.41		0.41		0.35	

* significant at 10%; ** significant at 5%; significant at 1%.

The control variables generally have the correct sign except for R&D intensity which has a positive and significant effect on employment in most specifications. In order to address this issue both labour demand models were re-estimated with OLS for the full sample excluding R&D. When doing so narrow offshoring is no longer significant in the conditional model. This probably reflects the omitted variable bias that arises when excluding R&D intensity due to the negative correlation between R&D intensity and offshoring within the same industry. In an effort to control for technological change independent of offshoring industry and country-specific trends are gradually added to the regressions. After including both country and industry-specific trends the coefficients on narrow offshoring and offshoring from other industries become again statistically significant. In particular, the inclusion of industry-specific trends appears to be important. However, including trends has a tendency to absorb the explanatory power of the control variables.

The consequences of including industry and country-specific trends in the unconditional model of labour demand are similar in the sense that the coefficients on offshoring become increasingly negative when controlling more fully for unobserved trends. When including both industry and country-specific trends a weak negative effect of narrow offshoring on labour demand is observed. This suggests that the scale effects associated with narrow offshoring are insufficient to completely offset the jobs lost due to its technology effect. However, the positive scale effect is still substantial. The coefficient on offshoring from other industries is positive, but statistically insignificant.

In sum, the sensitivity analysis suggests that the main results presented in Table 3.1 are robust to the exclusion of outliers and the way one controls for technological change. The results consistently indicate that offshoring has a negative on employment conditional on output and no effect or a small positive effect when allowing for both scale and technology effects.

Table 3.D.2. **Regression results over five-year differences with industry and country-specific trends**

	Panel A. **Conditional**							
Log (Wage/Price of materials)	-0.237	(1.99)**	-0.158	(0.89)	-0.093	(1.43)	-0.025	(0.23)
Log Capital stock	0.207	(2.40)**	0.240	(2.09)**	0.072	(1.37)	0.047	(0.74)
Log Output	0.162	(3.94)***	0.214	(2.60)***	0.178	(4.39)***	0.168	(2.84)***
Offshoring (narrow)	-0.060	(1.54)	-0.048	(1.13)	-0.123	(2.72)***	-0.117	(2.52)**
Offshoring (difference)	-0.012	(0.53)	-0.008	(0.33)	-0.056	(2.15)**	-0.049	(1.80)*
Constant	-0.003	(0.79)	-0.012	(1.19)	0.006	(0.97)	0.003	(0.27)
Country dummies	No		Yes		No		Yes	
Sector dummies	No		No		Yes		Yes	
Observations	238		238		238		238	
R-squared	0.46		0.52		0.75		0.81	
	Panel B. **Unconditional**							
Log (Wage/Price of materials)	-0.406	(4.48)***	-0.306	(1.74)*	-0.287	(4.60)***	-0.061	(0.58)
Log Capital stock	0.256	(2.89)***	0.293	(2.56)**	0.127	(2.00)**	0.061	(0.87)
Log (Price of output/Price of materials)	0.291	(1.23)	0.301	(1.26)	0.131	(0.87)	0.088	(0.63)
Offshoring (narrow)	0.020	(0.64)	-0.006	(0.16)	-0.019	(0.51)	-0.087	(1.75)*
Offshoring (difference)	0.043	(2.46)**	0.028	(1.25)	0.016	(0.83)	0.018	(0.67)
Constant	0.000	(0.05)	-0.005	(0.51)	0.014	(1.94)*	0.009	(0.79)
Country dummies	No		Yes		No		Yes	
Sector dummies	No		No		Yes		Yes	
Observations	238		238		238		238	
R-squared	0.41		0.48		0.69		0.79	

* significant at 10%; ** significant at 5%; significant at 1%.

3.D.2. The trend in the elasticity of labour demand.

Static labour demand

The underlying estimates that were used to draw Figure 3.10 of the chapter along with those obtained from a number of alternative specifications are reported in Table 3.D.3. All the difference-specifications were estimated in three-year moving averages. It can be seen that almost all the estimates used for Figure 3.10 are negative and statistically significant (five-year differences, total) at the 1% confidence interval. Re-estimating the same specification, but in three-year differences, leads to qualitatively similar results. When the elasticity of labour demand is estimated separately for the manufacturing and the services sector, a very similar pattern is found for the manufacturing sector, as for the overall economy, but there is no clear evidence of an increase in the elasticity of labour demand in the services sector. To the extent that services are less tradable than manufacturing outputs this may indicate that globalisation is part of the story. The results for the services sector, however, should be interpreted with caution as these estimates are based on tiny samples due to numerous gaps in the data.[1]

Table 3.D.3. **Elasticity estimates from static model of conditional labour demand**

	3-year differences		5-year differences		5-year differences, Manufacturing industries		5-year differences, Manufacturing industries plus additional controls		5-year differences, Service industries	
1983	-0.286	(0.086)***								
1984	-0.267	(0.065)***								
1985	-0.257	(0.059)***	-0.220	(0.096)**	-0.276	(0.132)**	-0.303	(0.135)**	-0.193	(0.074)***
1986	-0.194	(0.057)***	-0.229	(0.072)***	-0.250	(0.087)***	-0.280	(0.095)***	-0.263	(0.094)***
1987	-0.094	(0.058)	-0.173	(0.056)***	-0.153	(0.066)**	-0.166	(0.07)**	-0.262	(0.086)***
1988	-0.103	(0.058)*	-0.101	(0.054)*	-0.041	(0.063)	-0.048	(0.061)	-0.272	(0.100)***
1989	-0.237	(0.117)**	-0.116	(0.065)*	-0.094	(0.084)	-0.144	(0.086)*	-0.200	(0.075)***
1990	-0.350	(0.125)***	-0.261	(0.115)**	-0.324	(0.159)**	-0.381	(0.152)**	-0.118	(0.056)**
1991	-0.299	(0.156)*	-0.389	(0.130)***	-0.515	(0.178)***	-0.501	(0.155)***	-0.082	(0.071)
1992	-0.169	(0.062)***	-0.285	(0.129)**	-0.330	(0.172)*	-0.291	(0.138)**	-0.112	(0.080)
1993	-0.159	(0.060)***	-0.173	(0.067)***	-0.152	(0.083)*	-0.143	(0.070)**	-0.197	(0.089)**
1994	-0.256	(0.061)***	-0.164	(0.063)***	-0.153	(0.075)**	-0.215	(0.066)***	-0.227	(0.091)**
1995	-0.282	(0.068)***	-0.218	(0.067)***	-0.219	(0.078)***	-0.266	(0.071)***	-0.194	(0.085)**
1996	-0.384	(0.062)***	-0.263	(0.068)***	-0.275	(0.08)***	-0.289	(0.072)***	-0.153	(0.067)**
1997	-0.476	(0.061)***	-0.364	(0.060)***	-0.411	(0.073)***	-0.386	(0.071)***	-0.141	(0.050)***
1998	-0.527	(0.063)***	-0.481	(0.058)***	-0.568	(0.069)***	-0.513	(0.064)***	-0.157	(0.046)***
1999	-0.481	(0.070)***	-0.554	(0.055)***	-0.661	(0.063)***	-0.600	(0.062)***	-0.195	(0.046)***
2000	-0.459	(0.058)***	-0.532	(0.060)***	-0.621	(0.074)***	-0.611	(0.072)***	-0.221	(0.047)***
2001	-0.395	(0.072)***	-0.471	(0.057)***	-0.509	(0.073)***	-0.565	(0.077)***	-0.278	(0.054)***
2002	-0.331	(0.084)***	-0.397	(0.071)***	-0.407	(0.089)***	-0.439	(0.091)***	-0.314	(0.058)***

* significant at 10%; ** significant at 5%; significant at 1%.

1 . This also explains why the results between manufacturing and the economy overall can be so similar.

The elasticities of labour demand displayed in Table 3.D.3 correspond to conditional (or 'constant output') elasticities, and therefore do not capture the effect of an increase in market competition on the elasticity of labour demand. In order to estimate the total elasticity of labour demand, which takes account of both substitution and scale effects, unconditional labour-demand models were also estimated over time. These results are reported in Table 3.D.4 and also suggest that the labour demand has become more elastic. However, the estimated elasticities are similar and mostly smaller in absolute value than those obtained from the conditional model, which seems inconsistent with the theory of labour demand (Hamermesh, 1993). Slaughter (2001), who experiences similar problems using data for the United States, suggests that this problem arises because shifts in labour demand cannot be adequately accounted for with the available data.[2] For this reason, the focus in the remainder of Section 3.2 and the sensitivity analysis of the present section is on conditional elasticities, rather than the total elasticity of labour demand.

Table 3.D.4. **Elasticity estimates from static model of unconditional labour demand**

	3-year differences		5-year differences		5-year differences, Manufacturing industries		5-year differences, Manufacturing industries plus additional controls		5-year differences, Service industries	
1983	-0.168	(0.093)*								
1984	-0.202	(0.069)***								
1985	-0.225	(0.059)***	-0.219	(0.094)**	-0.249	(0.136)*	-0.225	(0.142)	-0.162	(0.081)*
1986	-0.210	(0.057)***	-0.261	(0.071)***	-0.269	(0.093)***	-0.255	(0.099)**	-0.244	(0.099)**
1987	-0.112	(0.056)**	-0.203	(0.057)***	-0.181	(0.073)**	-0.175	(0.075)**	-0.251	(0.089)***
1988	-0.111	(0.059)*	-0.125	(0.055)**	-0.085	(0.067)	-0.093	(0.066)	-0.267	(0.102)***
1989	-0.235	(0.119)**	-0.128	(0.068)*	-0.132	(0.094)	-0.181	(0.093)*	-0.195	(0.077)**
1990	-0.328	(0.121)***	-0.264	(0.119)**	-0.341	(0.167)**	-0.395	(0.161)**	-0.110	(0.057)*
1991	-0.259	(0.149)*	-0.385	(0.131)***	-0.501	(0.180)***	-0.488	(0.154)***	-0.080	(0.071)
1992	-0.098	(0.059)*	-0.249	(0.117)**	-0.271	(0.150)*	-0.227	(0.112)**	-0.109	(0.079)
1993	-0.118	(0.067)*	-0.131	(0.059)**	-0.107	(0.069)	-0.109	(0.059)*	-0.170	(0.099)*
1994	-0.217	(0.068)***	-0.135	(0.066)**	-0.120	(0.079)	-0.209	(0.069)***	-0.217	(0.099)**
1995	-0.261	(0.068)***	-0.202	(0.068)***	-0.196	(0.080)**	-0.256	(0.073)***	-0.187	(0.090)**
1996	-0.364	(0.062)***	-0.253	(0.067)***	-0.257	(0.079)***	-0.272	(0.073)***	-0.139	(0.068)**
1997	-0.439	(0.063)***	-0.351	(0.058)***	-0.394	(0.073)***	-0.370	(0.072)***	-0.135	(0.052)**
1998	-0.501	(0.063)***	-0.458	(0.058)***	-0.545	(0.070)***	-0.494	(0.067)***	-0.161	(0.047)**
1999	-0.455	(0.072)***	-0.536	(0.056)***	-0.644	(0.065)***	-0.581	(0.065)***	-0.203	(0.046)***
2000	-0.439	(0.057)***	-0.516	(0.063)***	-0.606	(0.076)***	-0.591	(0.074)***	-0.232	(0.046)***
2001	-0.389	(0.073)***	-0.445	(0.058)***	-0.484	(0.076)***	-0.529	(0.081)***	-0.282	(0.053)***
2002	-0.343	(0.081)***	-0.396	(0.074)***	-0.411	(0.091)***	-0.447	(0.090)***	-0.287	(0.052)***

* significant at 10%; ** significant at 5%; significant at 1%.

An important question is whether the upward trend in the estimated elasticity of labour demand in Figure 3.10 could result from problems with the empirical specification that was used and thus be spurious. Two key identifying assumptions were relied upon in estimating these elasticities: i) that the data on sectoral employment reflect the long-term level of labour demand; and ii) that labour supply responds very strongly to changes in wages. Since it is not possible to directly verify the validity of either of these assumptions, it is important to assess the robustness of the estimation results to alternative estimation strategies.

Dynamic labour demand

In terms of the first identifying assumption, one worry would be that Figure 3.10 is picking up an increase in the speed with which labour demand reacts to changes in wages, rather than an increase in the total response, once a new equilibrium level of employment is reached. In recent decades, many OECD

2. Including import penetration and the industry-specific exchange rate to control for the location of the demand curve does not appear to make a big difference.

governments have implemented structural reforms, such as relaxing employment protection legislation or encouraging more vigorous product market competition, which may have had the effect of speeding up the response of employment to changes in the economic environment (OECD, 2006). In order to ensure that the estimated trend in the labour-demand elasticity captures the long-term relationship between wages and labour demand, the estimations were conducted in five-year differences, thereby removing much of the variation due to changes in short-term dynamics.

An alternative to estimating a static labour demand model in long differences is to estimate a dynamic labour demand model which explicitly accounts for short-term dynamics. The following dynamic specification of labour demand was estimated:

$$\ln L_{it} = \alpha_o + \alpha_1 L_{it-1} + \sum_{j=1}^{J} \alpha_j \ln w_{ijt} + \sum_{j=1}^{J} \alpha_j \ln w_{ijt-1} + \sum_{k=1}^{K} \beta_k \ln x_{ikt} + \sum_{k=1}^{K} \beta_k \ln x_{ikt-1} \qquad \text{(D.1)}$$

where L refers to labour demand in industry-country pair i at time t, w the price of labour and materials, and x to the capital stock and output. Each regression makes use of five years of data.[3] The dynamic model in equation (D.1) is estimated with both fixed effects and difference-GMM (Arellano and Bond, 1991). The fixed effects estimates are biased due to the correlation of the (transformed) lagged dependent variable and the random error term. In principle, difference-GMM allows one to take account of this bias, but tends to be less precise. The short-term elasticities are directly given by the estimated wage coefficients. In order to get the long-term elasticities one needs to adjust the wage coefficients using the coefficients on the lagged dependent variable which measure the speed of adjustment. Table 3.D.5. reports the short-term elasticities, the coefficients on the lagged dependent variable and the corresponding long-term-elasticities.

The short-term elasticities estimated with fixed effects and GMM both suggest that the elasticity of labour demand has increased, which is consistent with the static estimates of labour demand discussed above. The trend in the long-term elasticity depends on that in the short-term elasticity and that in the speed of adjustment. The fixed effects and the GMM results are very different. While the fixed effects estimates suggest that the speed of adjustment has declined over time and therefore that the long-term elasticity has increased by more than the short-term elasticity, the GMM estimates point at an increase in the speed of adjustment, which would have had a negative effect on the trend elasticity of labour demand. Fitting the long-term elasticities based on the GMM estimates with a regression line suggests that the long-term elasticity increased somewhat over the sample period, but that this increase is considerably smaller than that based on the fixed effects estimates. It is not clear which specification should be preferred. While the fixed effects estimates are biased due to the presence of the lagged dependent variable, it is unclear whether and how this bias affects the estimated time pattern in the adjustment parameter. The GMM estimator is especially developed to address the bias that arises due to the presence of the lagged dependent variable, but tends to be less efficient. These results thus provide a mixed answer to the question whether structural reform may have accounted for the increase in demand elasticity documented in Figure 3.10. It seems nevertheless reasonable to conclude that structural reform may have contributed to the increase in the (short-term) labour demand elasticity. While the precise contribution of structural reform is uncertain, it seems unlikely that it can fully account for the observed increase in the elasticity of labour demand.

3 . For example, to estimate the elasticity for 1984 data for the period 1980-1984 were used.

Table 3.D.5. **Elasticity estimates from dynamic model of conditional labour demand**

	Fixed Effects			Difference GMM			Difference GMM with endogenous wage		
	α_w	α_1	$\alpha_w /(1-\alpha_1)$	α_w	α_1	$\alpha_w /(1-\alpha_1)$	α_w	α_1	$\alpha_w /(1-\alpha_1)$
1984	-0.232	0.487	-0.452						
1985	-0.234	0.620	-0.616						
1986	-0.154	0.727	-0.565						
1987	-0.077	0.684	-0.243	-0.240	0.799	-1.193	-0.218	0.774	-0.965
1988	-0.105	0.708	-0.360	-0.361	0.667	-1.085	-0.328	0.681	-1.029
1989	-0.259	0.689	-0.832	-0.407	0.617	-1.062	-0.390	0.611	-1.001
1990	-0.235	0.661	-0.693	-0.498	0.613	-1.285	-0.478	0.592	-1.172
1991	-0.352	0.592	-0.863	-0.352	0.526	-0.743	-0.306	0.505	-0.619
1992	-0.313	0.517	-0.648	-0.481	0.500	-0.963	-0.449	0.505	-0.907
1993	-0.260	0.761	-1.085	-0.373	0.447	-0.674	-0.386	0.440	-0.689
1994	-0.295	0.738	-1.126	-0.406	0.592	-0.996	-0.411	0.607	-1.044
1995	-0.365	0.558	-0.825	-0.289	0.520	-0.602	-0.337	0.560	-0.766
1996	-0.328	0.638	-0.905	-0.323	0.407	-0.544	-0.356	0.431	-0.624
1997	-0.429	0.702	-1.438	-0.197	0.423	-0.341	-0.226	0.482	-0.437
1998	-0.460	0.758	-1.904	-0.204	0.557	-0.461	-0.304	0.550	-0.677
1999	-0.574	0.708	-1.968	-0.590	0.619	-1.548	-0.628	0.617	-1.639
2000	-0.528	0.760	-2.200	-0.858	0.569	-1.991	-0.865	0.550	-1.923
2001	-0.422	0.730	-1.563	-0.811	0.530	-1.727	-0.803	0.550	-1.787
2002	-0.348	0.783	-1.607	-0.794	0.559	-1.800	-0.766	0.590	-1.871

Wage endogeneity

As is standard in the literature, the labour demand elasticity was estimated on the assumption that labour supply is perfectly elastic.[4] While such an assumption may be reasonable when using firm-level data, it is of questionable validity at the industry level.[5] To the extent that this identifying assumption is violated, the elasticity of labour demand will be upward biased due to the positive correlation between wages and labour supplies. However, the extent to which such an assumption affects the estimated change in demand elasticity *over time* is unclear. Should the correlation between the wage variable and labour supplies have increased over time, then the estimation results probably would be biased towards finding a spurious increase in the (absolute) elasticity of labour demand. The trend increase in the labour market participation of women or the rising proportion of immigrants may have tended to raise labour supply elasticity, and created such a bias. The results presented in Figure 3.10 of the chapter only account for this kind of bias to the extent that it only concerns the correlation in the wage variable and the *time-invariant* component of the error term. We will now attempt to address this problem more fully using to different strategies: difference GMM and instrumental variable estimation.

Difference GMM does not only allow one to control for the bias that arises due to the correlation between the lagged dependent variable and the error term in a dynamic model, but also for endogeneity related to any of the other explanatory variables. The dynamic model was therefore re-estimated with Difference-GMM so that the wage variable was treated as endogenous. The GMM estimates in the last three columns of Table 3.D.5 are very similar to the GMM estimates that treat the wage variable treat as exogenous, which provides some indication that changes in the composition of labour supply are unlikely to fully account for the rise in the elasticity of labour demand.

An alternative estimation strategy is to make use of instruments to account for changes in the composition of the labour force. Above we noted two changes in the composition of the labour force that may have rendered labour supply more elastic and thereby account for the observed trend in the elasticity of labour demand: increased female labour force participation and immigration. In order to directly address the bias that may result from changes in the composition of the labour force one needs an instrument that affects female force participation and/or immigration and not labour demand. While for immigration no suitable instrument seems to be available, a number of potentially useful variables that affect female labour supply are provided by Bassanini and Duval (2006).

In principle, policy variables that have an important effect on female labour supply are ideal to account for the effect of increased female labour force participation on the elasticity of labour demand as they are unlikely to be correlated to the unobserved component of labour demand as a result of, for

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4. As a result, shifts in labour supply, as captured in our regression model by changes in the wage variable, trace out the labour demand curve (Slaughter, 2001). The location of the labour demand schedule is pinned down by controlling for output and capital. Note that the regressions do not explicitly control for labour productivity, which may also lead to shifts in the labour–demand curve. R&D intensity, a standard proxy used in this context, is only available from 1987 onwards. In an effort to control for factor-biased technological change import penetration and the industry-specific exchange rate were included as a robustness check. This did not change the results in any significant way.

5. In as far as workers change sectors in response to inter-industry wage differentials in the long-run as in the Heckscher-Ohlin-Viner model, the assumption of elastic labour supply may be less problematic over relatively long time horizons. This is another reason for estimating the model in five-year differences.

example, unobserved productivity shocks. Two such policy variables are considered: family cash benefits and relative marginal tax rates on second earners. 'Family cash benefits' reflect the increase in household disposable income from child benefits for a single couple. As such, this variable reduces the need for mothers to work when having a family and increases the incentive to have children, which in itself may be expected to have a negative effect on female labour supply. 'Relative marginal tax rates on second earners' is defined as the ratio of the marginal tax rate on the second earner to the tax wedge for a single-earner couple with two children. The higher this ratio the lower will be the incentives for the second earner to participate in the labour force. Thus, both policy variables are expected to reduce female labour supply. Data for both variables were obtained from Bassanini and Duval (2006).

In addition to these two policy variables two other variables were also considered: the average number of children and the average number of years of education of the female population aged 25 years and above. Over relatively short time horizons the decision to have children and to invest in education are unlikely to be related to current market conditions, while both may be expected to have an important effect on female labour supply. These variables may therefore be useful complements to the policy variables described above. Data on the number of children and the female education were also taken from Bassanini and Duval (2006).

Even when using several instruments at the same time their performance is expected to be quite weak as they only vary across countries and time and not across industries. In an effort to overcome this problem each of these variables was multiplied by the share of female employees in industry employment. These shares are averaged across countries and time and are calculated from the EU LFS. To the extent that women are more inclined to work in certain industries as a result of historical or cultural factors the impact of the instruments is likely to differ across industries. Thus, each of the instruments varies along all three dimensions of the data.

Table 3.D.6 reports the estimated labour demand elasticities for four different instrumental variable specifications using: i) the two policy variables; ii) the policy variables plus the number of children; ii) the policy variables plus female education; and finally, iv) all four instruments combined. While the results are fairly similar across the four specifications, they may also be deemed inconclusive. For the majority of years the estimated labour demand elasticities are insignificant. There where the estimated elasticities are statistically significant they tend to be substantially larger than for the corresponding years in our base-line specification. This is in line with expectations, because female labour supply tends to be more responsive to changes in wages thereby reducing the scope for elasticity-dampening feedback effects, which translates into more elastic labour demand. Finally, the estimates suggest that, if anything, labour demand has become increasingly elastic over time.

Table 3.D.6. **Instrumental variable estimates of conditional labour demand elasticity**

	5-year differences with IV							
	Policy		Policy + Children		Policy + Education		All	
1984								
1985								
1986								
1987	-0.580	(1.641)	-1.841	(1.729)	0.585	(0.577)	-0.099	(0.494)
1988	0.781	(1.445)	-0.177	(0.623)	0.761	(0.463)	0.554	(0.424)
1989	0.102	(2.445)	-0.325	(0.596)	0.631	(0.39)	0.440	(0.346)
1990	2.135	(3.54)	0.378	(0.438)	0.801	(0.544)	0.516	(0.38)
1991	0.588	(0.906)	0.557	(0.579)	1.099	(0.737)	0.871	(0.567)
1992	-0.266	(0.371)	-0.349	(0.377)	0.164	(0.362)	0.114	(0.360)
1993	0.331	(0.479)	0.488	(0.486)	0.536	(0.427)	0.570	(0.427)
1994	0.301	(0.491)	0.384	(0.466)	0.341	(0.419)	0.393	(0.402)
1995	0.034	(1.331)	0.022	(0.938)	-0.459	(1.015)	-0.327	(0.806)
1996	-0.432	(0.786)	-0.163	(0.628)	0.211	(0.701)	0.306	(0.603)
1997	-0.710	(0.253)***	-0.672	(0.232)***	-0.438	(0.226)*	-0.404	(0.204)**
1998	-0.542	(0.206)***	-0.501	(0.201)**	-0.416	(0.193)**	-0.369	(0.188)*
1999	-0.374	(0.506)	-0.424	(0.501)	-0.229	(0.512)	-0.277	(0.504)
2000	-1.183	(0.307)***	-1.127	(0.249)***	-1.160	(0.303)***	-1.116	(0.247)***
2001	-0.790	(0.168)***	-0.660	(0.149)***	-0.821	(0.169)***	-0.675	(0.149)***
2002	-0.352	(0.235)	-0.173	(0.211)	-0.404	(0.235)*	-0.227	(0.206)

Robust standard errors, * significant at 10%; ** significant at 5%; significant at 1%.

In sum, it appears unlikely that changes in the speed of labour demand adjustment or the composition of labour supply can fully account for the observed increase in the elasticity of labour demand.

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