Organisation de Coopération et de Développement Economiques
Organisation for Economic Co-operation and Development

19-Oct-2006

English - Or. English

DIRECTORATE FOR SCIENCE, TECHNOLOGY AND INDUSTRY
COMMITTEE FOR INFORMATION, COMPUTER AND COMMUNICATIONS POLICY

DSTI/ICCP/IE(2006)1/FINAL
Unclassified

Working Party on the Information Economy

POTENTIAL IMPACTS OF INTERNATIONAL SOURCING ON DIFFERENT OCCUPATIONS

English - Or. English

JT03216218

FOREWORD

This report was presented to the Working Party on the Information Economy (WPIE) at its meeting in June 2006, as part of its work on global value chains and ICT skills and employment and as a contribution to the Organisation's work on growth, globalisation and services issues. It was recommended to be made public by the Committee for Information, Computer and Communications Policy in October 2006.

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TABLE OF CONTENTS

POTENTIAL IMPACTS OF INTERNATIONAL SOURCING ON DIFFERENT OCCUPATIONS

1. Summary

This paper uses trade and employment data to examine the relationship between the share of employment potentially affected by offshoring and economic and structural factors, including trade in business services and foreign direct investment, using simple descriptive regressions for a panel of OECD economies between 1996 and 2003. It extends the earlier model [see DSTI/ICCP/IE(2005)8/FINAL] to test whether there are differences in the factors driving the shares of potentially offshorable "non-clerical" occupations, or professionals such as managers, consultants and engineers, and clerical occupations in total employment. Separate indicators for manufacturing and services foreign direct investment are included.

The results show a positive statistical association between the share of both "non-clerical" and clerical occupations potentially affected by offshoring and exports of business services, and a negative association with imports of business services. However, the results also show important differences between different types of occupations as they behave differently over time (the share of professionals, or "non-clerical" generally growing over time and the share of clerical declining), and are affected differently by the economic and structural variables included in the model. In particular, net outward manufacturing FDI, ICT investment, and the relative size of the services sector all have a positive association with the share of employment in potentially offshorable professionals ("non-clerical" occupations), but are negative with clerical occupations. On the other hand, union density has a positive statistical association with clerical occupations but negative with professionals, or "non-clerical" occupations. These results have important implications for policy, as they clearly suggest that different factors are driving the performance of different occupational groups.

2. Introduction[1]

Services now account for around two-thirds of output and foreign direct investment in most developed countries, and for up to 20-25% of total international trade. The importance of services in international trade remains comparatively modest because many services have only recently become tradable, and many others remain non-tradable. Rapid advances in information and communication technologies (ICTs) and the ongoing global liberalisation of trade and investment in services have increased the tradability of many service activities and created new kinds of tradable services. Many service sector activities are thus becoming increasingly internationalised, especially since ICTs enable the production of services to be increasingly location independent. This has led to the globalisation of services activities and facilitated the ICT-enabled offshoring[2] of services, with associated changes in trade and cross-border investment in service activities and employment patterns.

This paper builds on earlier work quantifying the share of employment potentially affected by the ICT-enabled offshoring of services (van Welsum and Vickery, 2005a, van Welsum and Reif, 2006a,b). At

1 We would like to thank Nigel Pain from the OECD Economics Department for help and advice in preparing this paper. Comments from participants at the CRIW-NBER Conference on International Services Flows (28-29 April 2006, Bethesda, Maryland, US), and in particular from our discussant Lori Kletzer, are also gratefully acknowledged.

2 Under the definition of offshoring adopted in this paper, offshoring includes both international outsourcing (where activities are contracted out to independent third parties abroad) and international insourcing (to foreign affiliates). The cross-border aspect is the distinguishing feature of offshoring, *i.e.* whether services are sourced within the domestic economy or abroad – not whether they are sourced from within the same company or from external suppliers (outsourcing).

present there are no official data measuring the extent of offshoring of services. So it is necessary to use indirect measures such as data on trade in services, employment data, input-output tables, and trade in intermediate products. Evidence from company surveys can also be a useful complement. This paper combines the information from both trade and employment data to examine the relationship between the share of employment potentially affected by offshoring and other economic and structural factors using some simple descriptive regressions for a panel of OECD economies between 1996 and 2003. Initial estimates of the statistical association between the share of employment potentially affected by service sector offshoring, trade in business services and foreign direct investment are provided by van Welsum and Reif (2006a,b). In this paper the model is extended to test whether there are differences in the factors driving the shares of potentially offshorable clerical and "non-clerical" occupations (professionals) in total employment. Separate indicators for manufacturing and services foreign direct investment are now also included.

It is important to take care with the interpretation of the results, as they are not drawn from the empirical testing of a formal theoretical model of the underlying structural relationships. Thus, it is not possible to separate out completely the effects from demand and supply side developments. However, the results provide guidance on the statistical associations that are found to exist between the variables included in these descriptive regressions.

The structure of the rest of this paper is as follows. A number of different measures of the extent to which services activities have become globalised are discussed in Section 2. Section 3 then summarises the work undertaken at the OECD to obtain estimates of potentially offshorable ICT-using occupations in a number of OECD economies. The fourth section contains the new empirical analysis of the factors associated with the evolution over time of the share of these potentially offshorable occupations in total employment, for the total but also broken down into clerical and "non-clerical" types of occupations. Indicators of international trade and investment, national economic structure and economy-wide framework factors are all found to be important influences.

3. The globalisation of ICT-enabled services

Trade in ICT-enabled services

The extent of international trade in ICT-related services and business services can be approximated by summing the IMF Balance of Payments categories "computer and information services" and "other business services" (see Appendix Table 1 for details on which services are included in these categories). Data on computer and information services are not available for all countries. For some, such as India, they are included under "other business services", along with other services.[3] The "other business services" category may have variable shares of IT and ICT-enabled services in different countries. Moreover, the data are reported in current USD and can be affected by currency movements.

Most exports and imports (over 80%) of other business services and computer and information services are still accounted for by OECD countries. The 30 countries that accounted for the largest value shares in 2004 are shown in Figure 1. There are many OECD countries among those with the largest value shares, but some non-OECD members are also present (including some of the BRICS[4] – China, India, Russia and Brazil, but also Hong Kong, China and Israel for example). Nevertheless, Eastern European and

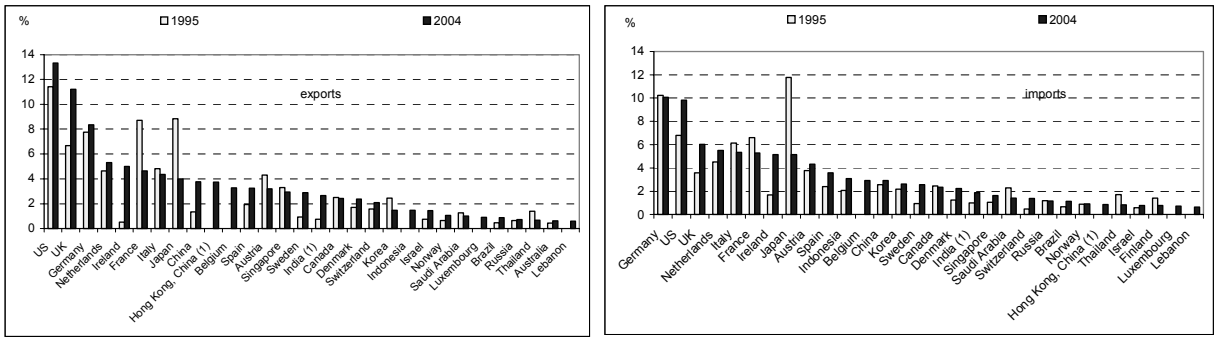
3. For India, the category "other business services" includes all services except travel, transport and government services. However, Indian firms are now extensively exporting ICT-enabled services and business process services and the remaining services included in the category are likely to be small in comparison. Furthermore, data on overseas revenues from annual reports of top Indian export firms show patterns similar to the IMF data.

4. BRICS: Brazil, Russia, India, China and South Africa.

Baltic countries, as well as some developing economies, are experiencing rapid growth in exports and imports (Figure 2), although most are starting from very low levels. Ireland is the highest ranked OECD country for growth of both exports and imports. Average annual growth of the total reported export values between 1995 and 2004 is around 9.6%, and around 7.6% for imports.

Figure 1. Share of the value of reported total[1] imports and exports of other business services and computer and information services, 30 selected other countries, 1995 and 2004[1]

Decreasing order of the total reported value share in 2004, percentages

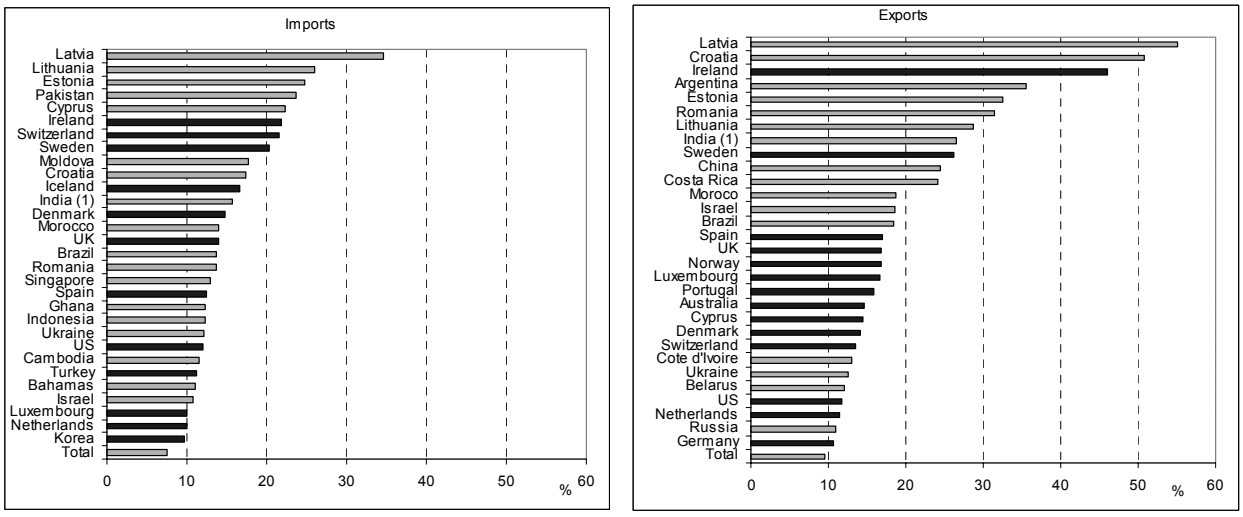


1. The reported total for all countries does not necessarily correspond to a world total. For some countries, such as India, it is not possible to isolate other business services and computer and information services. As a consequence, for India, the category includes total services, minus travel, transport and government services (*i.e.* including construction, insurance and financial services as well as other business services and computer and information services). The data are in current USD and may therefore be affected by currency movements. Data for Hong Kong, China and India are for 2003.

Source: OECD calculations based on IMF Balance of Payments Database (March 2006).

Figure 2. Thirty selected countries with rapid average annual growth of imports and exports of computer and information and other business services

(CAGR 1995-2004[1])



Note: 1. Except India 1995-2003.

Source: OECD calculations based on IMF Balance of Payments Database (March 2006).

The increasing importance of trade in services, and of trade in business services and computer and information services in particular, for most countries is also illustrated in Table 1 below. In most countries the share of services trade in total trade increased between 1995 and 2003. Business services and computer and information services also tend to account for a relatively large and increasing share of services trade.

Table 1. Relative importance of trade in services and trade in the sum of "other business services" and "computer and information services", selected countries, 1995 and 2003
(percentages)

	Exports						*Imports*					
	S inT		**BCIS in T**		**BCIS in S**		**S in T**		**BCIS in T**		**BCIS in S**	
	1995	2003	1995	2003	1995	2003	1995	2003	1995	2003	1995	2003
Australia	23.3	23.1	1.7	3.3	7.3	14.3	23.0	20.0	2.8	2.8	12.3	14.2
Austria	35.8	32.5	13.3	12.2	37.0	37.5	30.1	31.9	11.1	15.0	36.9	47.1
Canada	11.9	13.0	3.1	4.1	26.3	31.8	16.7	17.2	3.3	3.9	20.0	22.5
China	13.0	9.6	2.5	3.8	19.6	39.6	18.6	12.3	5.1	2.5	27.5	20.6
Denmark	23.3	32.9	7.2	12.9	30.8	39.1	24.3	34.0	5.8	11.5	24.0	33.9
Finland	15.5	13.0	6.2	4.4	40.1	34.0	25.4	20.2	10.3	6.8	40.4	33.8
France	23.2	21.4	6.6	5.5	28.6	25.7	19.8	18.8	5.4	5.6	27.1	29.8
Germany	13.3	14.1	3.5	4.5	26.7	32.2	22.4	22.2	4.7	6.1	20.9	27.3
India	17.8	28.3	5.6	16.9	31.3	59.7	21.3	27.4	5.6	9.3	26.4	34.0
Ireland	10.1	29.8	2.8	16.6	27.7	55.6	26.8	50.3	10.8	21.8	40.2	43.3
Italy	20.8	19.4	4.5	5.8	21.6	30.0	22.0	20.6	6.7	7.1	30.3	34.6
Sweden	16.4	23.1	2.7	9.9	16.4	42.9	21.2	25.7	3.1	10.6	14.8	41.1
UK	24.5	33.2	5.7	11.5	23.4	34.8	20.0	24.5	3.0	4.6	14.8	18.8
US	27.4	29.8	4.0	6.8	14.5	22.9	15.9	16.9	2.1	3.0	13.0	17.8

Where: S in T = services trade in total trade, BCIS in T = other business services and computer and information services in total trade, and BCIS in S = other business services and computer and information services in services trade.

Source: OECD calculations based on IMF Balance of Payments Database (August 2005).

Trade in business and computer and information services accounts for a relatively modest, but increasing, share of GDP in most countries (Table 2). The share tends to be somewhat larger in smaller countries than in larger countries. There was a particularly large increase in the share in Ireland between 1995 and 2003, reflecting Ireland's rapid shift into service activities over that period (Barry and van Welsum, 2005).

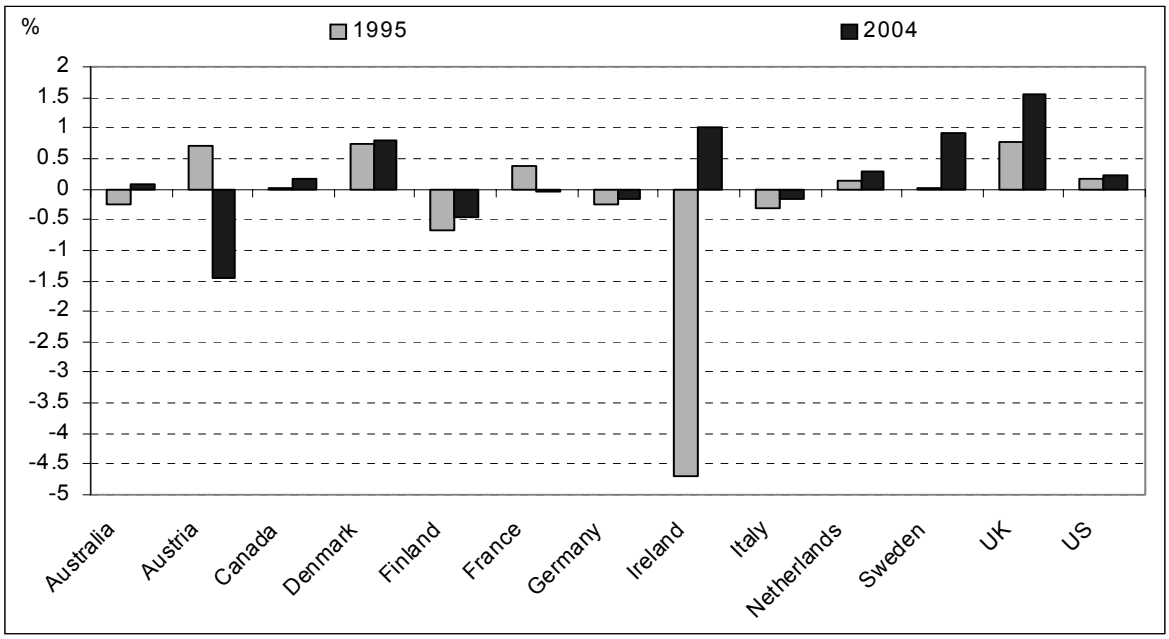
Table 2. Exports and imports of "other business" and "computer and information" services as a share of GDP, selected countries, 1995 and 2003
(percentages)

	Exports		Imports	
	1995	2003	1995	2003
Australia	0.32	0.57	0.57	0.58
Austria	4.97	6.32	4.27	7.64
Canada	1.18	1.58	1.15	1.34
Denmark	2.61	5.84	1.87	4.51
Finland	2.29	1.66	2.99	2.10
France	1.55	1.44	1.15	1.46
Germany	0.87	1.60	1.13	1.96
Ireland	2.09	13.88	6.85	14.88
Italy	1.21	1.46	1.52	1.75
Netherlands	3.08	4.70	2.94	5.10
Sweden	1.03	4.36	1.02	3.92
UK	1.63	2.96	0.86	1.31
US	0.43	0.63	0.25	0.42

Source: OECD calculations based on IMF Balance of Payments Database (August 2005).

The trade balance (in current USD) in the sum of the IMF categories "other business services" and "computer and information services" as a percentage of GDP for selected countries in 1995 and 2004 is shown in Figure 3. The United States have a relatively large and still increasing surplus in trade in these categories, although it is relatively small as a percent of GDP. The United Kingdom also has a large and growing surplus, and the share in GDP is also increasing, in spite of the impression that may be given by the many (media) reports on the extent of offshoring and related imports. Ireland registered a surplus in the sum of these categories for the first time in 2004. Previously it had registered a large surplus in the category "computer and information services" alone, but a deficit for the sum of the two categories.

Figure 3. Trade balance in the sum of the categories "other business services" and "computer and information services" as a percentage of GDP (all in current USD), selected countries, 1995 and 2004



Source: OECD calculations based on IMF Balance of Payments World Economic Outlook Databases (March 2006).

FDI in services[5]

The stock share of services in total FDI is another indicator of the extent of globalisation of services (Table 3). In most countries, the share of services has increased between 1995 and 2003, and the stock of services tends to account for more than half of the total stock, and up to 88% in Germany for inward investment, and up to 82% in outward investment in France in 2003.

5. FDI data as currently collected may not be an ideal proxy for the activities of multinationals abroad because of a variety of ownership and measurement problems (*e.g.* differences across countries and data sets as to the definition of minority-held overseas investments included in FDI statistics), but it is the only widely available measure of the scale of cross-border investment for many countries. As multinationals can be very large enterprises with multiple establishments that span a large number of industries, assigning their investments to their "primary" industry can be problematic as their activities in other industries can be relatively high in receiving countries and attributing investment based on the "primary" industry of the investor may be misleading. In many small open countries the size of the inward and outward FDI stocks relative to GDP may also be affected by large investments in holding companies. Furthermore, enterprise-level FDI data may not be comparable with establishment-level performance data. This section uses data from the OECD Direct Investment Statistics Database. Not all OECD countries record FDI in the same way, however. See the *OECD Direct Investment Statistics Yearbook* for methodological details.

Table 3. The share of FDI in services in total FDI, 1995 and 2003

	inward		outward	
	1995	2003	1995	2003
Australia	47.0	52.7	35.1	34.2
Austria	65.2	76.8	69.9	79.1
Canada	30.7	29.2	40.0	55.1
Denmark	73.4	77.1	64.5	69.6
Finland	39.5	64.9	9.7	13.2
France	67.4	80.5	80.0	81.8
Germany	76.1	88.1	67.6	81.1
Italy	55.8	54.5	63.6	59.1
Netherlands	55.2	63.1	49.5	58.1
Sweden	33.0	38.8	31.7	42.5
United Kingdom	46.6	66.1	40.1	61.7
United States	51.0	62.6	55.2	74.1

Source: OECD calculations based on OECD Direct Investment Statistics Database.

A further indicator of globalisation of services is given by the share of this type of FDI in GDP. In all countries, both the total share of FDI (inward and outward) and the share of services FDI in GDP have increased between 1995 and 2003 (Table 4).

Table 4. Share of FDI in GDP, 1995 and 2003

	Total inward		Services inward		Total outward		Services outward	
	1995	2003	1995	2003	1995	2003	1995	2003
Australia	25.8	37.9	12.1	20.0	14.2	28.6	5.0	9.8
Austria	7.3	21.0	4.8	16.1	4.9	21.8	3.4	17.3
Canada	21.2	32.1	6.5	9.4	20.3	36.5	8.1	20.1
Denmark	12.1	41.3	8.9	31.8	12.5	42.6	8.0	29.7
Finland	6.5	31.0	2.6	20.1	11.5	46.9	1.1	6.2
France	12.2	29.1	8.2	23.4	13.0	40.3	10.4	32.9
Germany	7.6	27.5	5.8	24.2	10.2	30.4	6.9	24.7
Italy	5.8	12.3	3.2	6.7	8.8	16.3	5.6	9.6
Netherlands	29.4	89.3	16.2	56.4	43.0	103.6	21.3	60.1
Sweden	12.3	39.9	4.1	15.5	29.0	53.3	9.2	22.7
United Kingdom	17.6	33.7	8.2	22.3	26.9	68.4	10.8	42.3
United States	7.3	12.9	3.7	8.1	9.5	16.4	5.3	12.2

Source: OECD calculations based on OECD Direct Investment Statistics Database.

However, most of this FDI in services is not in services that can necessarily be traded with the help of ICTs. The sectors distinguished in the OECD FDI data base are listed in Appendix Table 2. It is difficult to know which category would be most suitable to match the categories used as proxies for ICT-enabled trade in services,[6] but probably the best approximation is given by "business activities", which can be obtained by subtracting "real estate" from "real estate and business activities". Unfortunately, this breakdown is not widely available (eight countries in the sample, and not necessarily for all years considered), but "real estate" tends to account for a relatively small share of that category.

6 "Real estate and business activities" represents section K of ISIC 3 (minus if available "of which real estate"), but the connection is loose between service products and service activities determined for large enterprises. Business services can be provided internally within multinationals with main activities elsewhere, *e.g.* in manufacturing.

3. Employment potentially affected by offshoring

To get an idea of the "outer limits" of employment potentially affected by offshoring, van Welsum and Vickery (2005a) calculate the share of people employed who are mainly performing the type of functions that could potentially be carried out anywhere, using data on employment by occupation by industry. This analysis, using occupational data for several OECD countries, suggests that around 20% of total employment carries out the kinds of functions that are potentially geographically footloose as a result of rapid technological advances in ICTs and the increased tradability of services, and could therefore potentially be affected by international sourcing of IT and ICT-enabled services.

The classifications were not harmonised internationally, but the same methodology and rationale were applied to the individual country data sources.[7] As this analysis was carried out in order to obtain an order of magnitude on the share of people employed performing tasks that could potentially be carried out anywhere, no additional assumptions were made as to what proportion of each occupational group was actually likely to be affected by offshoring in practice. Thus, the whole of each selected occupation was then included in the calculations.

Occupations were selected by examining detailed occupational and task descriptions on the basis of the following four criteria, or "offshorability attributes": *i*) intensive use of ICTs, *ii*) an output that can be traded/transmitted enabled by ICTs, *iii*) high codifiable knowledge content, and *iv*) no face-to-face contact requirements. The occupational selections that resulted from this exercise are reported in Appendix Tables 3 - 6. For further details on the methodological background see van Welsum and Vickery (2005a,b), and OECD (2004a).

Other studies have taken a similar approach. Blinder (2005), and as quoted in Mankiw and Swagel, (2005), finds a similar estimate of around 20% of total employment potentially affected by offshoring in the United States in 2004. He uses the concept of "personally deliverable services" and "impersonally deliverable services". However, the estimates of employment potentially affected by offshoring vary widely. For example, Bardhan and Kroll (2003) produced estimates of 11% of total employment in the United States in 2001 as potentially affected by offshoring, and Forrester Research, as reported by Kirkegaard (2004) up to 44% of total employment. The differences in these estimates can be explained by the selection criteria that are applied to the occupational data. Thus, Bardhan and Kroll (2003) only included occupations in which at least some offshoring was already known to have taken place or being planned, yielding a more conservative estimate of the share of employment potentially affected, whereas the Forrester study used less detailed occupational categories resulting in a larger estimate of jobs potentially affected. A different but related approach was taken by Jensen and Kletzer (2005) looking at tradable versus non-tradable occupations based on Gini coefficients, where they make the assumption that an industry or occupation that is highly geographically concentrated is tradable. The list of tradable occupations they find for the United States overlaps with the list in van Welsum and Vickery (2005a) and

7 The European data are Labour Force Survey data provided by Eurostat. The occupational classification system in those data is the ISCO – International Standard Classification of Occupations, and NACE – the industrial classification system of the European Union – is used for sectoral classification. For the United States, data from the Current Population Survey were used. The Current Population Survey collects information on both the industry and the occupation of the employed and unemployed. However, beginning with data from January 2003, the 1990 Census Industrial Classification System was replaced by one based on the North American Industry Classification (NAICS), and the 1990 Census Occupational Classification was replaced by one derived from the US Standard Occupational Classification (SOC). Further information is available on the web site of the US Bureau of Labor Statistics at: http://www.bls.gov/opub/hom/pdf/homch1.pdf (accessed November 2004): Chapter 1: Labor Force Data derived from the Current Population Survey. For Canada Labour Force Data provided by Statistics Canada were used. The occupational classification is in SOC91. For Australia data from the Labour Force Survey provided by the Australian Bureau of Statistics were used. The occupational classification is in Australian Standard Classification of Occupations (ASCO) second edition.

used in this paper, but the methodology of Jensen and Kletzer (2005) identifies a larger set of tradable occupations. According to their methodology, around 30% of employment in the United States can be considered as "tradable". They find little evidence of slower employment growth in tradable occupations (and activities).

The evolution over time of the share of employment potentially affected by offshoring is illustrated in Figure 4 below. Even though the levels of these shares are not directly comparable, the evolution of the trends is interesting. The share of occupations potentially affected by offshoring in the EU15 increased from 17.1% in 1995 to 19.2% in 2003. For Canada it was more or less flat around 19.5% until 2001, after which it declined to 18.6% by 2003. For the United States the share declined by more than a percentage point from 19.2% in 1995 to 18.1% in 2002.[8] In Australia, the share increased between 1996 and 2001 (except in 1999) but started to decline in 2001.

While it is difficult to draw inferences from these trends without further analysis, since the trends are affected by a multitude of factors, the evolutions shown are consistent with anecdotal observations on the ICT-enabled offshoring that is taking place. For example, Canada serves as an offshoring location, mainly from the United States, but may have become comparatively less important a location recently as other countries such as India have started to emerge. Similarly, Australia possibly also experienced competition for attracting, or keeping, activities that can be sourced internationally from India and other emerging locations in the region. Thus, the declining share in the United States, Canada and Australia towards the end of the period could be consistent with the offshoring of IT-related and back-office activities (with some "potential offshoring" having become "actual offshoring"), for example, even though this is unlikely to account for all of the decline. Another possible explanation could be a differential pace of technological change with a relatively more rapid adoption and integration of new technologies, leading to relatively more jobs disappearing sooner as they become automated and/or digitised.[9] These countries have also benefited from relatively stronger ICT-related productivity growth which may be changing the distribution of occupations. The increasing share for Europe is compatible with an overall increase in services employment as well as the finding from surveys that European firms tend to offshore within Europe (see Millar, 2002, and Marin, 2004, for example). At least one EU country, Ireland, is also a major destination country of offshoring activities from the United States (IT-related activities in particular). Other factors could also be important, *e.g.* cyclical developments and changes in labour supply and labour quality. Finally, the coming and going of Y2K preparations as well as the ICT boom and bust could have had some influence on shifts in ICT-related occupations.

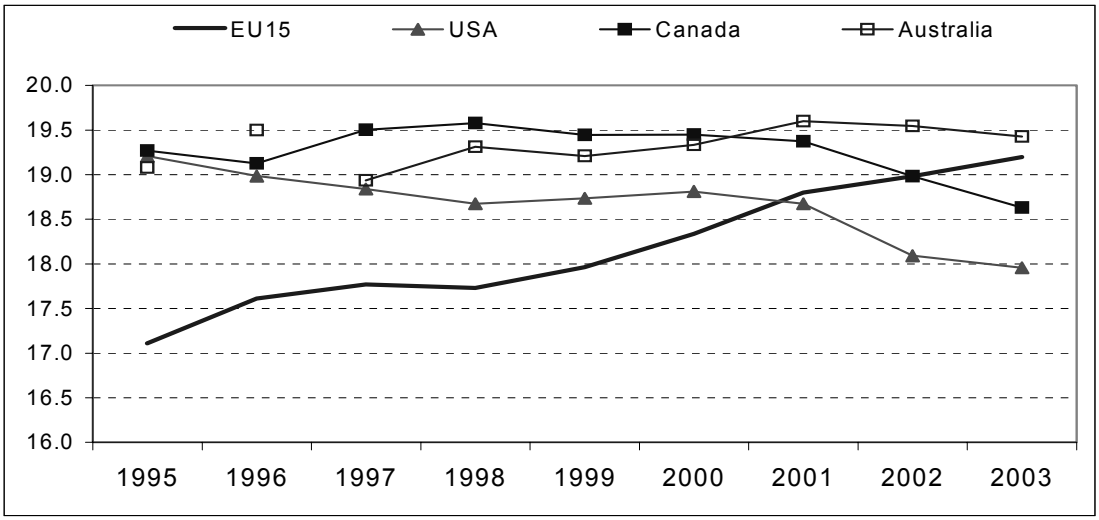
The offshoring phenomenon does not necessarily have to result in a decline in services employment though. Many existing services sectors have expanded, new services have emerged, and with ongoing technological developments and services trade liberalisation it is likely yet more are to be created. Furthermore, with the elasticity of demand of internationally traded services greater than one (*e.g.* Pain and van Welsum, 2004; van Welsum, 2004; Mann, 2004), rapid growth in countries such as India and China should also lead to reinforced exports from OECD countries. The offshoring phenomenon itself will also create new jobs in the domestic economy. However, it could be that certain types of occupations will experience slower growth than they otherwise might have done, and others more rapid growth.

8 The number for 2003 (just under 18%) is an estimate as both the occupational and industrial classification systems were changed in 2003 in the United States.

9 A parallel can be drawn here with some of the work undertaken by Autor *et. al.* (2003) and Levy and Murnane (2004). These authors argue that the tasks most vulnerable to being substituted by technology are those where information processing can be described in rules. If a significant part of a task can be described by rules, this increases the likelihood of the task being offshored, since the task can then be assigned to offshore producers with less risk and greater ease of supervision.

Figure 4. The share of ICT-intensive using occupations potentially affected by offshoring in total employment: EU15, US, Canada, and Australia 1995-2003[1]

(percentages)



Note: 1. Includes estimates where a full data set was not available. Because of classification changes, the number for the United States for 2003 is also an estimate. There is a break in the data for Australia, with data for 1995 and 1996 in ASCO first edition and subsequent data in ASCO second edition. Due to differences in classifications the levels are not directly comparable.

Source: OECD calculations and van Welsum and Vickery (2005a), based on EULFS, US Current Population Survey, Statistics Canada and Australian Bureau of Statistics (2004/5).

As the trends in Figure 4 are expressed as shares, there are several possibilities to explain changes in these trends. For example, a decline in the share could be explained by an absolute decline in the number of people employed in the categories identified as potentially affected by offshoring. Alternatively, it could be that this selection of occupations is growing at a slower pace than total employment. The relatively slower growth of employment potentially affected by offshoring is in fact what explains most of the declines observed in the trends, except for the United States where the absolute number of people employed in the categories identified as potentially affected by offshoring has declined (see Box 1 in the Appendix). These observations would therefore tend to support the idea that offshoring may lead to slower growth of employment in occupations potentially affected by offshoring and not necessarily to actual declines in employment.

Disaggregating employment potentially affected by offshoring

As offshoring and technology may have a different effect on workers with different types of skills (*e.g.* Autor *et al*, 2003), the share of employment potentially affected by offshoring is broken down into two sub-categories: clerical and "non-clerical" professional occupations potentially affected by offshoring (Figures 5 and 6). This is important as the clerical group includes the types of jobs that can be substituted for by ICTs (through the digitisation and/or automation of certain tasks and types of codifiable knowledge) so a differential pace of adoption and integration of technology can have a different effect across countries.

Looking at the share of clerical occupations for each country at the beginning and end of the respective available data periods it can be seen that for the United States and Australia, and Canada to a lesser extent, there is an obvious decline. This is consistent both with the destruction of these types of jobs as a result of technological advances and with the offshoring of back-office activities. For the EU15

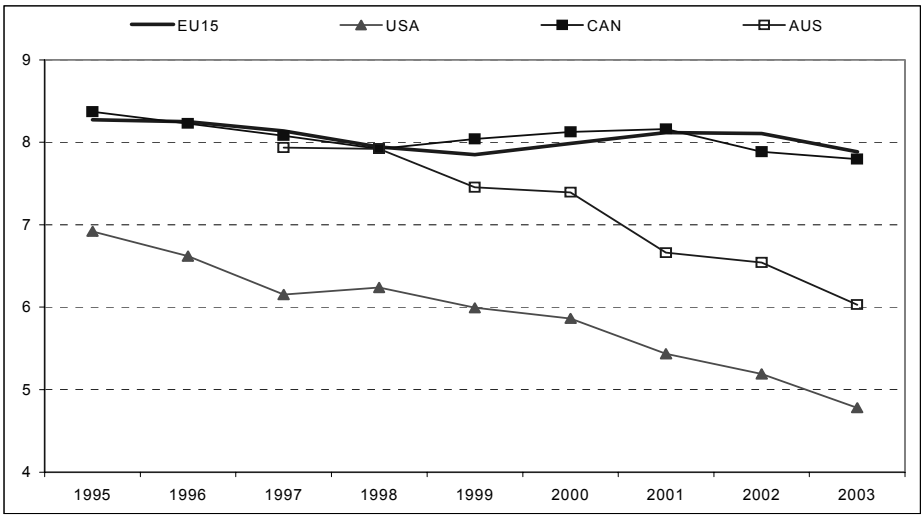
countries the evidence is more mixed. In some countries a decline in the share can be observed (Austria, Belgium, Germany, Finland, France, Ireland, Netherlands, Portugal), but in other countries there is an increase (Denmark, Spain, Greece, Italy, Luxembourg, Sweden and the United Kingdom). It is likely that there are different explanations underlying these evolutions, for example the varying importance of the size of the services sector and the public sector in the economy, and the differential pace of technology adoption and integration. However, it also means that while there are many reports about clerical-type occupations being offshored, in some countries at least more still are being created at home. For example, in the United Kingdom employment growth in IT and call centre occupations potentially affected by offshoring over the period 2001-2005 was 8.8% compared to 3.2% for total employment, in spite of many media reports of these kinds of jobs being offshored. Nevertheless, *Computer Weekly* (February 2006 issue) reports that the effects of offshoring are now being felt in the IT job market in the United Kingdom with more and more IT employers offshoring and outsourcing basic development and programming work.

Even though technology may account for at least some of the relative decline in the occupations potentially affected by offshoring, the possibility that some of these jobs have been offshored cannot be ruled out. For example, Baily and Lawrence (2005) argue that at least some of the declines in low-wage ICT-enabled occupations in the United States, a concept close but not equivalent to the group of clerical workers identified above, took place as a result of activities being shifted overseas. Looking at IT specialist occupations, they also find that the net loss of computer programmers in the United States was most likely the result of offshoring. Nevertheless, even the largest projections of jobs to be offshored, as often reported in the media, are in fact relatively small compared to annual job churning in OECD labour markets (OECD, 2004b).

Appendix tables 3-6 illustrate the occupations which have been included as "potentially affected by offshoring", and which of those are considered as "clerical" occupations. The following two graphs illustrate the evolution over time of the share of these clerical occupations and "non-clerical" occupations, or professionals (*e.g.* managers, professionals and engineers), in total employment.

Figure 5. The share of clerical occupations potentially affected by offshoring in total employment: EU15[1], US, Canada, and Australia 1995-2003[2]

(percentages)

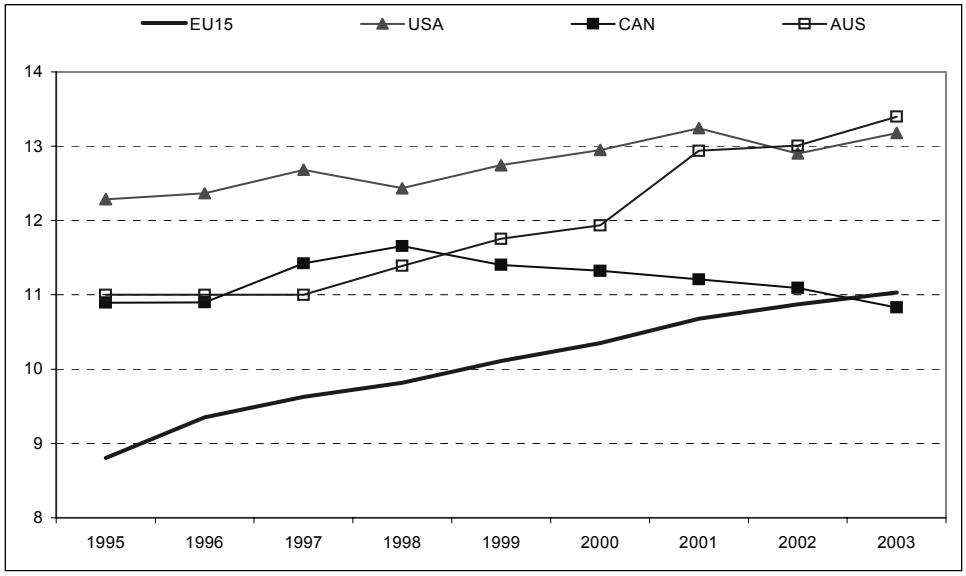


Notes: 1. 1995 and 1996 exclude Finland and Sweden; 1998 excludes Ireland, and 2003 excludes Denmark, Luxembourg and the Netherlands.

2. Because of classification changes, the number for the United States for 2003 is an estimate. Due to differences in classifications the levels are not directly comparable.

Source: OECD calculations, based on EULFS, US Current Population Survey, Statistics Canada and Australian Bureau of Statistics (2004/5).

Figure 6. The share of "non-clerical" occupations (professionals) potentially affected by offshoring in total employment: EU15[1], US, Canada, and Australia 1995-2003[2]
(percentages)



Notes: 1. 1995 and 1996 exclude Finland and Sweden; 1998 excludes Ireland, and 2003 excludes Denmark, Luxembourg and the Netherlands.

2. Because of classification changes, the number for the United States for 2003 is an estimate. Due to differences in classifications the levels are not directly comparable.

Source: OECD calculations, based on EULFS, US Current Population Survey, Statistics Canada and Australian Bureau of Statistics (2004/5).

The 3-year averages for the share of clerical occupations in the occupations potentially affected by offshoring are shown in Table 5. Again, the levels of the shares are not directly comparable as the classifications were not harmonised internationally, but the direction of the trends over time is. The share of potentially offshorable employment accounted for by clerical occupations varies widely across countries, being over 60% in Italy and Portugal compared to around 30% in Australia, Ireland, Sweden the United Kingdom and the United States.

Table 5. The share of clerical occupations in employment potentially affected by offshoring, three-year averages[1], 1995-2003

(percentages)

	clerical in offshoring		
	1995-1997	1998-2000	2001-2003
Australia	41.9	39.3	32.8
Canada	42.6	41.2	41.8
United States	34.5	32.2	28.1
Austria	44.6	42.5	39.7
Belgium	38.0	36.7	33.2
Germany	49.1	44.8	42.3
Denmark	38.9	38.3	37.6
Spain	55.7	53.3	51.3
Finland	31.6	30.6	26.6
France	42.0	39.9	36.2
Greece	46.6	51.4	51.5
Ireland	22.0	33.0	30.8
Italy	65.8	62.8	61.9
Luxembourg	57.9	51.9	48.6
Netherlands	42.8	39.4	39.7
Portugal	63.8	67.8	62.9
Sweden	30.3	28.8	28.0
United Kingdom	33.8	31.7	32.9

Note: 1. Three years or as many as available. Includes estimates where a full data set was not available. Due to differences in classifications the levels of the shares are not directly comparable between the European and non-European countries.

Source: OECD calculations based on EULFS, US Current Population Survey, Statistics Canada and Australian Bureau of Statistics (2004/5).

The distribution by industry of the total share of employment potentially affected by offshoring, as well as the clerical and "non-clerical" (professionals) breakdown, is shown for Europe for 2003 and 1995 in Appendix Table 7. Services industries tend to account for large shares of these types of employment and the "non-clerical" share tends to be higher than the clerical share, except in hotels and restaurants, and some of the manufacturing and agricultural sectors. Similar observations can also be made for the United States, as illustrated by a selection of industries shown in Appendix Table 8.

4. Empirical analysis

The empirical work in this paper extends and refines the models estimated by van Welsum and Reif (2006a,b), in an attempt to identify the key factors associated with the share of economy-wide employment that is potentially offshorable in the United States, Canada, Australia and nine European Union member states[10] over the period 1996-2003.

In the empirical model the share of employment that is potentially offshorable is related to a set of factors controlling for international openness, the national economic structure, and economy wide framework influences. The controls for openness include indicators of exports and imports of business services and a number of different measures of foreign direct investment (FDI) stocks. The controls for economic structures are the shares of services and high-tech industries in GDP, and the share of ICT

10 The EU15 countries excluding Belgium, Greece, Ireland, Luxembourg, Spain and Portugal. The choice of countries is determined by the availability of the necessary data.

investments in total gross fixed capital formation. Finally, economy-wide framework factors are controlled for by the inclusion of the OECD product market regulation indicator, trade union density and an indicator of human capital. Each of these series is described in greater detail below.[11] The choice of variables is motivated by findings from a vast background literature, including studies of the factors determining the overall share of the service sector in the economy, studies of services sector employment, and studies of the effect of trade and technology on employment.

The empirical work in this paper extends and improves the model used in previous analysis in two ways. First, the dependent variable is disaggregated into potentially offshorable clerical and "non-clerical" (professionals) occupations (see Figures 5 and 6 above), permitting a test of whether there are common influences on both. Secondly, there is an improved treatment of the FDI data used in the regression analysis. In the earlier papers use was made of only the aggregate stocks of inward and outward FDI. In this paper more disaggregated data are used for FDI, allowing tests to be undertaken of whether FDI in manufacturing has similar effects to FDI in market services.

Ideally, it would be appropriate to begin with a simple structural model of the factors affecting the relative demand for all potentially offshorable ICT-using occupations. Using the first order marginal productivity conditions from an (unknown) production function with two types of labour (ICT and non-ICT using labour), such a model might be expected to include measures of the relative output and relative wages of ICT-using occupations. Control variables might also be included to pick up possible differences in the extent of (labour-augmenting) technical progress in the two broad types of occupations. As in the literature on the demand for skilled and unskilled labour, possible controls are indicators for both trade and technology.

Unfortunately, while it is possible to control for output and technology effects directly, data on occupational wages are not readily available in most countries at the level of detail required. Their effect can be captured only indirectly by including a number of variables that can be expected to have an influence on real wages. It should be noted that although it is not possible to estimate a full structural model, the estimates we show are not a pure reduced form model either, since potentially endogenous current dated terms in output and/or trade and technology remain in the model.

Description of the data

Trade effects are approximated by including both imports and exports of other business and computer and information services as a share of GDP.[12] The literature on trade-related displacement suggests that imports can be expected to have a negative association with the share of potentially offshorable occupations, while exports should have a positive relationship. The FDI measures used in this paper are the net outward stock of FDI in manufacturing and in services as a share of national GDP.[13] The predictions

11 Even though GDP per capita was found to be associated with the share of services sector employment (Messina, 2004) it is not included in the regressions in this paper. In a time series context it does not make sense to include the level of GDP per capita in a regression of an ultimately bounded variable. The first difference of GDP per capita was tested at an early stage of the empirical analysis, but was found to be insignificant and is thus dropped from the model reported in this paper. This is not necessarily surprising as the countries in sample all have relatively high levels of GDP per capita. Nevertheless, with the exception of Austria, the countries with a relatively low share of potentially offshorable employment are also those with a comparatively lower level of GDP per capita. Time dummies pick up common cyclical effects.

12 The trade data are from IMF Balance of Payments statistics and GDP is taken from the OECD ANA (Annual National Accounts) database.

13 The foreign direct investment data are taken from the OECD Direct Investment Statistics Database. However, as multinationals can be very large enterprises with multiple establishments that span a large number of industries, assigning their investments to their "primary" industry can be problematic. Thus, it is possible that some manufacturing

from the literature are ambiguous about the overall direction of the relationship between FDI and the share of employment potentially affected by offshoring, and it is quite possible that the effects may vary according to the characteristics of particular types of potentially offshorable employment and the sectors in which FDI takes place, just as the relationship between trade and FDI depends on the level of aggregation (Pain and van Welsum, 2004; van Welsum, 2004).

The share of services sector[14] value added in total value added and the share of high-tech industries[15] value added in total value added are included as indicators of the industrial structure of the economy.[16] Other things being equal, the larger the share of the services sector in the economy, the larger the aggregate demand for ICT-using occupations can be expected to be. The share of ICT investment[17] in total national gross fixed capital formation is also included in order to approximate technology adoption and integration. The ICT investment data are from an unpublished OECD database based on national account sources.

It is possible that the intensity of product market competition may influence the speed at which new technologies are adopted and the subsequent use made of them to adjust employment and labour tasks. An OECD indicator of anti-competitive product market regulations is thus included as a control in the regressions. This measure is an average of separate indicators of regulation in selected non-manufacturing industries.[18] A lower value of the aggregate indicator suggests that regulations are less restrictive and that there is a higher degree of competitive pressures in the economy. Other things being equal, there should be a negative relationship between this variable and the share of potentially offshorable employment. Messina (2004) includes a measure of entry-barriers to the creation of new firms in the economy as an indicator of product market regulations and finds a significant and negative effect on the share of services sector employment.

Two additional economy-wide structural variables are included to capture institutional and supply-side influences on (unobserved) real wages – union density and human capital. Trade union density indicators may of course provide information about the degree of flexibility in national labour markets, as well as the relative strength of workers in wage bargaining.[19] A number of existing papers suggest that

FDI contains services activities and vice versa. For Denmark and Sweden it was necessary to interpolate missing stock data using the available information on the composition of investment flows.

14 ISIC Rev.3 categories 50-99: 50-55: Wholesale and retail trade; repairs; hotels and restaurants; 60-64: Transport, storage and communications; 65-74: Finance, insurance, real estate and business services; 75-99: Community, social and personal services.

15 ISIC Rev.3 categories: 2423: chemicals excluding pharmaceuticals; 30: office, accounting and computing machinery; 32: radio, television and communication equipment; 33: medical, precision and optical instruments; 353: aircraft and spacecraft.

16 These are taken from the OECD STAN database; missing values have been estimated using the "60-Industry Database" from the Groningen Growth and Development Centre of the University of Groningen (Netherlands), available at: http://www.ggdc.net/dseries/60-industry.html (last accessed 28 April, 2005).

17 ISIC Rev.3 categories: 30: office, accounting and computing machinery; 3130: Insulated wire and cable; 3210: Electronic valves and tubes and other electronic components; 3220: Television and radio transmitters and apparatus for line telephony and line telegraphy; 3230: Television and radio receivers, sound or video recording or reproducing apparatus, and associated goods; 3312: Instruments and appliances for measuring, checking, testing, navigating and other purposes; 3313: Industrial process control equipment; 5150: Wholesale of machinery, equipment and supplies; 6420: Telecommunications; 7123: Renting of office machinery and equipment (including computers); 72: computer and related activities.

18 The original version of these data is described in Nicoletti and Scarpetta (2003), with subsequently updated series available at: http://www.oecd.org/document/1/0,2340,en_2649_34117_2367297_1_1_1_1,00.html

19 The data on trade union density rates come from OECD Labour Force Statistics Indicators and OECD 2004c (Table 3.3). Factors other than union density rates, including union coverage and hiring and firing restrictions, may also be important but are not included here.

union density rates are related to the growth of service sector occupations. For example, Messina (2004) finds that a fall in union density rates is associated with an increase in services sector employment. Similarly, Nickell *et al* (2004) find evidence that countries with higher levels of employment protection were slower in reallocating resources from declining sectors (agriculture, manufacturing, and other production) into the services sector, possibly because stronger employment protection makes labour shedding in declining sectors more costly. The analysis in the present paper does not consider employment at the sectoral level, but an analogy can be drawn as labour market inflexibilities are likely to affect occupational shifts as well as sectoral changes. The *a priori* effect of this variable is ambiguous though, as it can both prevent a reallocation of resources into ICT-intensive using occupations, and hinder the speed at which existing ICT-intensive using jobs can be transferred abroad. In the latter case, the share of potentially offshorable occupations in total employment will be at a higher level than it would otherwise have been.

Human capital is approximated by the average years of education per person (de la Fuente and Doménech, 2002a,b, and OECD, 2003). It is expected that this variable should be positively related to the share of potentially offshorable occupations, since higher levels of human capital are positively correlated with the supply of ICT-literate people in the workforce. Such increases in supply should help to restrain the growth of real wages of workers in ICT occupations and hence support demand. Nickell *et al* (2004) find a strong positive effect of increases in educational attainment on the output share of the "other services" sector in the economy in Australia, Canada, France, Italy, Japan, Netherlands, Sweden, Germany, the United Kingdom and the United States.[20]

Thus the final specification used in the empirical work has the basic form:

$$\left[\frac{OFF\_j}{EMP}\right]_{it} = \alpha_i + \beta_1\left[\frac{X}{GDP}\right]_{it} + \beta_2\left[\frac{M}{GDP}\right]_{it} + \beta_3\left[\frac{NETMFDI}{GDP}\right]_{i,t-1} + \beta_4\left[\frac{NETSFDI}{GDP}\right]_{i,t-1}$$
$$+ \beta_5\, ICTIRAT_{i,t-1} + \beta_6\, SERVICES_{i,t-1} + \beta_7\, HITECH_{i,t-1} + \beta_9\, PMR_{i,t} + \beta_{10}\, UNIONS_{t-1}$$
$$+ \beta_{11}\, HK_{i,t-1} + \varepsilon_{it} \qquad [1]$$

where the dependent variable is the share of potentially offshorable employment of type *j* in total employment in country *i*, X and M are exports and imports of business and computer information services, NETMFDI and NETSFDI are the net outward stocks of manufacturing and services FDI, ICTRAT is the share of ICT investments in total investment, SERVICES and HITECH are the share of service sector output and hi-tech sector output in GDP, PMR is the product market regulation indicator, UNIONS denotes union density and HK denotes human capital. All the GDP share variables use data at current prices. The reported regressions also include country-specific fixed effects, capturing otherwise unobserved factors specific to each country that do not vary over time, and annual time dummies, capturing otherwise unobserved effects that are common to all countries in each year.

This model is estimated using three different measures of the dependent variable – total potentially offshorable employment, potentially offshorable clerical employment and potentially offshorable non-clerical employment ("professionals"). The equations for the two sub-categories are estimated jointly to improve the efficiency of the estimates by allowing for potential correlations in the respective equation variances. Joint estimation also allows tests to be undertaken for common parameters in both equations.

As the two sub-categories sum to total potentially offshorable employment, and the same explanatory factors are used in all three equations, the coefficients in the jointly-estimated clerical and "non-clerical"

20 But in the sector "business services" they found a greater role for changes in relative prices.

equations will sum to those in the equation for the aggregate measure. The main advantage of estimating the equations for the individual categories is thus to establish whether different factors affect the different types of occupations. It does not provide an alternative picture of the factors driving the evolution of total potentially offshorable employment.

Results

The stylised preliminary results are shown in Table 6. The results show it is important to differentiate between different types of occupations as the results differ for four of the explanatory variables (net outward manufacturing FDI, ICT investment, relative size of the services sector and union density). In particular, these variables have a positive statistical association with the share of "non-clerical" occupations (professionals), but a negative association with the share of clerical occupations. They show that it is important to allow for different types of occupations as the disaggregation matters to the results. Furthermore, contrary to what was found in previous analysis (van Welsum and Reif, 2006a,b), a negative association between the share of employment potentially affected by offshoring and imports of business and computer and information services is now found, which could point to some sign of displacement. This difference in the results could be related to the use of some different and more disaggregated data that were not used in the previous analysis.

Table 7 contains the detailed results from using fixed effects, simultaneous equation and instrumental variables estimation techniques. Estimation for the basic fixed effect single and multivariate regression models is for a sample of 12 countries over 1996-2003. The multivariate instrumental variables estimates (by 3SLS) are for the same countries, but over 1997-2003.

Table 6. Stylised regression results for "non-clerical" (professionals) and clerical occupations

	Total offshoring	"Non-clerical"	Clerical
Exports computer and business services/GDP	+	+	+
Imports computer and business services/GDP	-	-	-
Net outward manufacturing FDI	-	+	-
Net outward services FDI	+	+	+
ICT investment	+	+	-
Services sector	+	+	-
High-tech sector	+	+	+
Product market regulation	-	-	-
Union density	-	-	+
Human capital	+	+	+

A + indicates a positive statistical association between the share of employment potentially affected by offshoring and the variable in question, a – a negative statistical association. Details of significance and confidence levels are given in Table 7.

An initial set of results using total potentially offshorable employment as the dependent variable is shown in column [1]. The results from joint estimation of equations for the clerical and "non-clerical" (professional) components are reported in column [2]. Although a joint test for common parameters in both equations is strongly rejected [p-value = 0.00], the imposition of common parameters on four explanatory factors – product market regulation, imports of business and computer services, human capital and the share of hi-tech industries in GDP cannot be rejected [p-value=0.42]. The results from imposing these restrictions and discarding one highly insignificant variable are shown in column [3].

The final column of Table 7 shows the results obtained from estimating the simultaneous equation model in [3] by three-stage least squares (3SLS). This combines an instrumental variable approach to produce consistent estimates and generalised least squares to account for the correlation structure in the

disturbances across equations. A year is dropped from the estimation period to allow higher order lagged variables to be used as instruments. All current dated terms, with the exception of the product market regulation indicator, are instrumented in column [4], as is the lagged ICT investment ratio, to allow for the possibility that it is acting as a proxy lagged dependent variable. The 3SLS model results have a similar pattern to those from the simultaneous equation models, though there are some differences in the magnitude and significance of the coefficients.

The following subsections discuss the estimation results for the international openness variables, the economic structure variables and the economy-wide framework variables in turn.

International openness

International trade and the FDI measures are both found to be significant. Exports of business and computer information services are found to have a positive and significant association with the share of employment potentially affected by offshoring – as expected. The impact on potentially offshorable professionals, or "non-clerical", employment is significantly larger than that for potentially offshorable clerical employment, as can be seen from the results in columns [2] to [4]. In contrast, the coefficient on imports of business and computer information services is negatively signed, implying that increasing imports are associated with a reduction in the share of potentially offshorable occupations at the aggregate level, with similar sized effects on both types of potentially offshorable employment. Although the trade variables may be endogenous, especially if companies' decisions about international sourcing and employment are made simultaneously, the basic findings remain even in the 3SLS estimates in which the trade variables are treated as endogenous.

The results for the two net outward FDI measures vary across the different occupational categories and the different econometric techniques. In the single equation for total potentially offshorable employment (column [1]) only the net services FDI variable is significant, with a higher net outward stock of services FDI being positively associated with the share of potentially offshorable employment. The simultaneous equation estimates show that this effect largely arises from a positive association with potentially offshorable professionals, or "non-clerical" occupations. The impact on clerical occupations is significant only in the 3SLS estimates, and even then the coefficient is significant only at the 10% level. This result is consistent with a scenario where skill intensive headquarter services (*e.g.* management, R&D, marketing, design) continue to be provided from the home country, at least initially, while there is a reduced need for administrative support functions when relatively more of the activity is located abroad.

The net outward manufacturing FDI stock does not have a significant overall impact on the aggregate share of potentially offshorable employment. The simultaneous equation estimates show that this arises because there are offsetting effects on clerical and "non-clerical" occupations (professionals). In particular, an increase in the net outward manufacturing FDI stock is associated with a decline in the employment share of potentially offshorable clerical occupations. In contrast, such a change in the manufacturing FDI stock is associated with an increase in the employment share of potentially offshorable professionals ("non-clerical occupations"). This latter effect is significant in the simultaneous equation estimates in [2] and [3], but not in the 3SLS estimates. The same type of scenario of a relative increase in the need for highly skilled headquarter services combined with a reduced need for clerical type occupations could again explain this result, with the negative effect on the latter stronger in this case.

A common element of the findings for both FDI variables is that they are associated with a rise in the share of professionals, or "non-clerical" occupations relative to the share of clerical occupations. This is consistent with other studies that have found that outward FDI is positively associated with a rise in the relative demand for skilled labour in the home economy (see, for example, Head and Ries (2002)).

There are many different factors that might be reflected in the coefficients on the FDI variables. It is also the case that FDI data can, at times, be a poor measure of the actual scale of activities that multinational companies undertake. However, as shown in van Welsum and Reif (2006a,b), the inclusion of FDI variables does not significantly bias the coefficients on the other explanatory factors.

Economic structure

The share of ICT investment in gross fixed capital formation, the share of services in GDP and the share of high-tech industries in GDP are all significantly positively associated with the share of employment potentially affected by offshoring (column [1]), as might be expected. However, there are noticeable differences in their effects on clerical and "non-clerical" ICT-using occupations (professionals).

The ICT investment term has a significant positive association only with "non-clerical" occupations (professionals) – as shown in [2] the coefficient on this term in the clerical occupations terms is not significant and is thus discarded in [3] and [4]. This means the share of "non-clerical" to clerical is rising. However, there is no sign that, overall, ICTs are having a destructive effect on ICT-using clerical occupations.

The service sector share has a significant positive association with "non-clerical" occupations (professionals), but a small negative association with ICT-using clerical occupations. The latter effect is statistically significant in the simultaneous equation models shown in columns [2] and [3], but not in the 3SLS estimates. The initial estimates also suggest that the share of high-tech output in GDP matters mainly for the "non-clerical" employment share (see [2]), but it is not possible to reject the imposition of a common coefficient in the clerical and "non-clerical", or professionals, employment equations, with the resulting estimate being statistically significant, as shown in [3].

Economy-wide framework factors

A reduced level of anti-competitive product market regulations and a higher level of human capital are both found to be positively associated with the aggregate share of potentially offshorable occupations in total employment. Both of these factors encourage the adoption and usage of ICT technologies. Subsequent tests indicated that both also have similar effects on the two types of ICT-using occupations, with common coefficients being imposed on these terms in the estimates shown in column [3] and column [4].

Union density is not found to be significantly related to the aggregate share of potentially offshorable occupations in total employment. However, it does appear to affect the composition of this share, having a negative association with the share of "non-clerical" occupations (professionals) and a positive association with the share of clerical occupations, although the latter effect is not significant in the 3SLS estimates. These results suggest that higher levels of union density act to slow the general adjustment that is taking place from clerical to "non-clerical" occupations (professionals) in all the economies included in the sample used in this paper.

5. Conclusions

This paper summarises analysis of the factors affecting the share of potentially offshorable professionals or "non-clerical" (*e.g.* managers, professionals and engineers) and clerical occupations in total employment. The analysis suggests that the share of exports of business services in GDP, the share of ICT investment in total investment, the share of the service sector in GDP and improvements in human capital have all been especially important factors behind the general upward tendency in the share of employment in potentially offshorable professionals (non-clerical occupations). The remaining variables

considered also help to raise the employment share, with the exception of the share of imports of business services in GDP.

The exports to GDP ratio and human capital also help to raise the share of employment in potentially offshorable clerical occupations, as does the share of hi-tech output in GDP and reductions in product market regulations. However, these factors have been offset by rising imports of business services, the decline in trade union densities and the rising share of services in GDP.

Overall, the principal findings appear to be robust to changes in estimation techniques and specifications of the model. Indicators of international trade and investment, the structure of national economies and economy-wide framework factors are all important for understanding the cross-country pattern of the share of potentially offshorable occupations in total employment. Although the development of corresponding data sources for the relative wages of the various types of occupations would help to separate out demand and supply-side influences more clearly, the results from the descriptive regressions in this paper provide useful guidance for both policy development and for further work in this area.

Further work in this area could follow a number of paths to improve understanding of the effects of international sourcing. A major area would be to strive to improve the occupational selections, for example by co-ordinating with work undertaken in the United States (*e.g.* Blinder, 2005 and Jensen and Kletzer, 2005) and by generating occupational lists through repeated independent occupational choice exercises. Controlling for differences in ICT-content of occupations, over time and across countries, would be another extension. Finally, further separating out the effects of technology on occupations from those of offshoring should also be explored.

International harmonisation of the definition of offshoring and the data classifications, as well as data collection itself, would greatly enhance the scope for the formulation of consistent and sound policy recommendations and would enhance the scope for comparison of the various studies on the effects of offshoring.

Table 7. Factors associated with the share of employment (total, non-clerical ("professionals") and clerical occupations) that is potentially offshorable

	[1]	[2]		[3]		[4]	
Dependent variable	**Total**	**Non-Clerical**	**Clerical**	**Non-Clerical**	**Clerical**	**Non-Clerical**	**Clerical**
$(X/GDP)_t$	1.1504 (7.6)*	0.7310 (7.0)*	0.4194 (4.6)*	0.6776 (8.4)*	0.4586 (6.5)*	1.0390 (4.4)*	0.7891 (3.4)*
$(M/GDP)_t$	-0.4457 (2.8)*	-0.2763 (2.5)*	-0.1693 (1.8)†	-0.2108 (2.8)*	-0.2108 (2.8)*	-0.5278 (2.0)*	-0.5278 (2.0)*
$(NETMFDI/GDP)_{t-1}$	-0.0012 (0.1)	0.0395 (1.9)†	-0.0408 (3.2)*	0.0498 (2.5)*	-0.0457 (3.8)*	0.0352 (1.4)	-0.0518 (3.3)*
$(NETSFDI/GDP)_{t-1}$	0.0543 (3.8)*	0.0422 (3.1)*	0.0121 (1.3)	0.0386 (3.0)*	0.0137 (1.5)	0.0380 (2.7)*	0.0153 (1.7)†
$(ICTIRAT)_{t-1}$	0.1876 (3.5)*	0.1918 (4.7)*	-0.0042 (0.1)	0.2036 (6.2)*		0.3079 (4.7)*	
$SERVICES_{t-1}$	0.0994 (1.8)†	0.1590 (3.4)*	-0.0596 (2.1)*	0.1540 (3.7)*	-0.0578 (2.0)*	0.1621 (3.2)*	-0.0330 (0.9)
$HTECH_{t-1}$	0.4833 (2.3)*	0.3315 (2.1)*	0.1518 (1.3)	0.2063 (2.2)*	0.2063 (2.2)*	0.2232 (1.7)†	0.2232 (1.7)†
PMR_t	-0.5642 (2.9)*	-0.3206 (2.0)*	-0.2436 (2.0)*	-0.2803 (2.9)*	-0.2803 (2.9)*	-0.4208 (2.8)*	-0.4208 (2.8)*
$UNIONS_{t-1}$	-0.0472 (1.1)	-0.0978 (2.4)*	0.0506 (1.9)†	-0.0936 (2.4)*	0.0495 (1.8)†	-0.1114 (2.3)*	0.0363 (1.1)
HK_{t-1}	2.0099 (3.8)*	0.8028 (2.3)*	1.2072 (4.7)*	1.0833 (4.4)*	1.0833 (4.4)*	1.0210 (3.4)*	1.0210 (3.4)*
$\overline{R}^2$	0.966	0.984	0.987	0.983	0.987	0.981	0.987
Standard Error	0.502	0.319	0.238	0.321	0.238	0.342	0.243
Mean of Dep. Var.	18.61	11.39	7.23	11.39	7.23	11.39	7.23
Estimation Method	OLS	MVR		MVR		3SLS	

Notes: (X/GDP) is the share of exports of other business and computer and information services in GDP, (M/GDP) is the share of imports of other business and computer and information services in GDP, (NET FDI/GDP) is the net stock of outward foreign investment as a share of GDP, (ICTI/INV) is the share of ICT investment in total fixed investment, SERVICES is the share of the services sector in total value added, HTECH is the share of high-tech industries in total value added, PMR is a product market regulations indicator, UNIONS denotes the trade union density rate, and HK is the average years of education per person.

Country fixed effects and annual time dummies are included in all regressions. Heteroscedastic-consistent t-statistics are in parentheses.

* Denotes a coefficient significant at the 5% level.

† Denotes a coefficient significant at the 10% level.

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APPENDIX

Appendix Table 1. IMF balance of payments categories

7.	**Computer and information services**
7.1	Computer services
7.2	Information services
7.2.1	News agency services
7.2.2	Other information provision services
9.	**Other business services**
9.1	Merchanting and other trade-related services
9.1.1	Merchanting
9.1.2	Other trade-related services
9.2	Operational leasing services
9.3	Miscellaneous business, professional, and technical services
9.3.1	Legal, accounting, management consulting, and public relations
9.3.1.1	Legal services
9.3.1.2	Accounting, auditing, bookkeeping, and tax consulting services
9.3.1.3	Business and management consulting, and public relations
9.3.2	Advertising, market research, and public opinion polling
9.3.3	Research and development
9.3.4	Architectural, engineering, and other technical services
9.3.5	Agricultural, mining, and on-site processing services
9.3.5.1	Waste treatment and depollution
9.3.5.2	Agricultural, mining and other on-site processing services
9.3.6	Other business services
9.3.7	Services between related enterprises, n.*i.e.*

Source: OECD (2002).

Appendix Table 2. Sectors distinguished in the OECD Direct Investment Statistics Database

PRIMARY SECTOR
  Agriculture and Fishing
  Mining and Quarrying
  of which: Extraction of petroleum and gas
MANUFACTURING
of which: Food products
Total textile and wood activities
Total petroleum, chemical, rubber, plastic products
Total metal and mechanical products
Total machinery, computers, RTV, communication
Total vehicles and other transport equipments
SERVICE SECTOR
  Electricity, Gas and Water
  Construction
  Trade and Repairs
  Hotels and Restaurants
  Transports, Communication
  of which: Total land, sea and air transport
Telecommunications
  Financial Intermediation
  of which: Monetary intermediation
Other financial intermediation
of which: Financial holding companies
Insurance and activities auxiliary to insurance
Total other financial intermediation and insurance activities
  Real Estate and Business Activities
  of which: Real estate
  Other Services
UNALLOCATED
TOTAL

Appendix Table 3. Europe: Occupations potentially affected by offshoring

3 Digit ISCO-88
123: Other specialist managers
211: Physicists, chemists, and related professionals
212: Mathematicians, statisticians and related professionals
213: Computing professionals
214: Architects, engineers, and related professionals
241: Business professionals
242: Legal professionals
243: Archivists, librarians, and related information professionals
312: Computer associate professionals
341: Finance and sales associate professionals
342: Business services agents and trade brokers
343: Administrative associate professionals
411: Secretaries and keyboard-operating clerks
412: Numerical clerks
422: Client information clerks

Note: Occupations in shading have been classified as clerical.

Source: van Welsum and Vickery (2005a), based on EULFS (2004).

Appendix Table 4. United States: Occupations potentially affected by offshoring

CPS categories			
accountants and auditors	23	Archivists and curators	165
underwriters	24	Economists	166
other financial officers	25	Urban planners	173
management analysts	26	Authors	183
architects	43	Technical writers	184
aerospace engineer	44	Editors and reporters	195
metallurgical and materials engineers	45	Air traffic controllers	227
mining engineers	46	Computer programmers	229
petroleum engineers	47	Tool programmers, numerical control	233
chemical engineers	48	Supervisors and Proprietors, Sales Occupations	243
nuclear engineers	49	Insurance sales occupations	253
civil engineers	53	Real estate sales occupations	254
agricultural engineers	54	Securities and financial services sales occupations	255
Engineers, electrical and electronic	55	Sales occupations, other business services	257
Engineers, industrial	56	Supervisors, computer equipment operators	304
Engineers, mechanical	57	Supervisors, financial records processing	305
marine and naval architects	58	Chief communications operators	306
engineers, n.e.c.	59	Computer operators	308
surveyors and mapping scientists	63	Peripheral equipment operators	309
computer systems analysts and scientists	64	Secretaries	313
operations and systems researchers and analysts	65	Typists	315
Actuaries	66	Transportation ticket and reservation agents	318
Statisticians	67	File clerks	335
Mathematical scientists, n.e.c.	68	Records clerks	336
Physicists and astronomers	69	Bookkeepers, accounting, and auditing clerks	337
Chemists, except biochemists	73	Payroll and timekeeping clerks	338
Atmospheric and space scientists	74	Billing clerks	339
Geologists and geodesists	75	Cost and rate clerks	343
Physical scientists, n.e.c.	76	Billing, posting, and calculating machine operators	344
Agricultural and food scientists	77	Telephone operators	348
Biological and life scientists	78	Bank tellers	383
Forestry and conservation scientists	79	Data-entry keyers	385
Medical scientists	83	Statistical clerks	386
Librarians	164		

Note: Occupations in shading have been classified as clerical.

Source: van Welsum and Vickery (2005a), based on US Current Population Survey.

Appendix Table 5. Canada: Occupations potentially affected by offshoring

SOC91 Canada			
A121	Engineering, Science and Architecture Managers	C012	Chemists
A122	Information Systems and Data Processing Managers	C013	Geologists, Geochemists and Geophysicists
A131	Sales, Marketing and Advertising Managers	C014	Meteorologists
A301	Insurance, Real Estate and Financial Brokerage Managers	C015	Other Professional Occupations in Physical Sciences
A302	Banking, Credit and Other Investment Managers	C021	Biologists and Related Scientists
A303	Other Business Services Managers	C031	Civil Engineers
A311	Telecommunication Carriers Managers	C032	Mechanical Engineers
A312	Postal and Courier Services Managers	C033	Electrical and Electronics Engineers
A392	Utilities Managers	C034	Chemical Engineers
B011	Financial Auditors and Accountants	C041	Industrial and Manufacturing Engineers
B012	Financial and Investment Analysts	C042	Metallurgical and Materials Engineers
B013	Securities Agents, Investment Dealers and Traders	C043	Mining Engineers
B014	Other Financial Officers	C044	Geological Engineers
B022	Professional Occupations in Business Services to Management	C045	Petroleum Engineers
B111	Bookkeepers	C046	Aerospace Engineers
B112	Loan Officers	C047	Computer Engineers
B114	Insurance Underwriters	C048	Other Professional Engineers, n.e.c.
B211	Secretaries (except Legal and Medical)	C051	Architects
B212	Legal Secretaries	C052	Landscape Architects
B213	Medical Secretaries	C053	Urban and Land Use Planners
B214	Court Recorders and Medical Transcriptionists	C054	Land Surveyors
B311	Administrative Officers	C061	Mathematicians, Statisticians and Actuaries
B312	Executive Assistants	C062	Computer Systems Analysts
B412	Supervisors, Finance and Insurance Clerks	C063	Computer Programmers
B512	Typists and Word Processing Operators	C152	Industrial Designers
B513	Records and File Clerks	C172	Air Traffic Control Occupations
B514	Receptionists and Switchboard Operators	E012	Lawyers and Quebec Notaries
B521	Computer Operators	E031	Natural and Applied Science Policy Researchers, Consultants and Program Officers
B522	Data Entry Clerks	E032	Economists and Economic Policy Researchers and Analysts
B523	Typesetters and Related Occupations	E033	Economic Development Officers and Marketing Researchers and Consultants
B524	Telephone Operators	F011	Librarians
B531	Accounting and Related Clerks	F013	Archivists
B532	Payroll Clerks	F021	Writers
B533	Tellers, Financial Services	F022	Editors
B534	Banking, Insurance and Other Financial Clerks	F023	Journalists
B553	Customer Service, Information and Related Clerks	F025	Translators, Terminologists and Interpreters
B554	Survey Interviewers and Statistical Clerks	G131	Insurance Agents and Brokers
C011	Physicists and Astronomers		

Note: Occupations in shading have been classified as clerical.

Source: van Welsum and Vickery (2005a), based on Statistics Canada.

Appendix Table 6. Australia: Occupations potentially affected by offshoring

ASCO 4-digit	
1221 Engineering Managers	2521 Legal Professionals
1224 Information Technology Managers	2522 Economists
1231 Sales and Marketing Managers	2523 Urban and Regional Planners
1291 Policy and Planning Managers	2534 Journalists and Related Professionals
2111 Chemists	2535 Authors and Related Professionals
2112 Geologists and Geophysicists	3211 Branch Accountants and Managers (Financial Institution)
2113 Life Scientists	3212 Financial Dealers and Brokers
2114 Environmental and Agricultural Science Professionals	3213 Financial Investment Advisers
2115 Medical Scientists	3294 Computing Support Technicians
2119 Other Natural and Physical Science Professionals	3392 Customer Service Managers
2121 Architects and Landscape Architects	3399 Other Managing Supervisors (Sales and Service)
2122 Quantity Surveyors	5111 Secretaries and Personal Assistants
2123 Cartographers and Surveyors	5911 Bookkeepers
2124 Civil Engineers	5912 Credit and Loans Officers
2125 Electrical and Electronics Engineers	5991 Advanced Legal and Related Clerks
2126 Mechanical, Production and Plant Engineers	5993 Insurance Agents
2127 Mining and Materials Engineers	5995 Desktop Publishing Operators
2211 Accountants	6121 Keyboard Operators
2212 Auditors	6141 Accounting Clerks
2221 Marketing and Advertising Professionals	6142 Payroll Clerks
2231 Computing Professionals	6143 Bank Workers
2292 Librarians	6144 Insurance Clerks
2293 Mathematicians, Statisticians and Actuaries	6145 Money Market and Statistical Clerks
2294 Business and Organisation Analysts	8113 Switchboard Operators
2299 Other Business and Information Professionals	8294 Telemarketers
2391 Medical Imaging Professionals	

Note: Occupations in shading have been classified as clerical.

Source: van Welsum and Vickery (2005a), based on Australian Bureau of Statistics.

Appendix Box 1. Detailed analysis of the US occupational data

Looking at the year-on-year change in the occupational data for the US (1995-2002) at the level of the individual occupations shows:

- All of the occupations selected as potentially affected by offshoring experienced at least one year-on-year decline.
- 45 out of the 67 occupations included in the US selection experienced an absolute decline between 2001 and 2002, as did the overall selection of occupations potentially affected by offshoring and total employment.
- The overall selection of occupations potentially affected by offshoring experienced 3 absolute declines between 1995-2002; to compare the individual occupations against the overall selection, the following 47 occupations experienced **at least** 3 absolute declines:

Accountants and auditors	23	Urban planners	173
Architects	43	Authors	183
Metallurgical and materials engineers	45	Technical writers	184
Mining engineers	46	Editors and reporters	195
Petroleum engineers	47	Air traffic controllers	227
Engineers, electrical and electronic	55	Computer programmers	229
Engineers, industrial	56	Supervisors and Proprietors, Sales Occupations	243
Engineers, mechanical	57	Insurance sales occupations	253
Marine and naval architects	58	Real estate sales occupations	254
Engineers, n.e.c.	59	Supervisors, computer equipment operators	304
Operations and systems researchers and analysts	65	Computer operators	308
Actuaries	66	Peripheral equipment operators	309
Statisticians	67	Secretaries	313
Physicists and astronomers	69	Typists	315
Chemists, except biochemists	73	Transportation ticket and reservation agents	318
Atmospheric and space scientists	74	File clerks	335
Geologists and geodesists	75	Payroll and timekeeping clerks	338
Physical scientists, n.e.c.	76	Billing clerks	339
Biological and life scientists	78	Cost and rate clerks	343
Forestry and conservation scientists	79	Telephone operators	348
Medical scientists	83	Bank tellers	383
Librarians	164	Data-entry keyers	385
Archivists and curators	165	Statistical clerks	386
Economists	166		

The estimates for 2003 show a further absolute decline in the selection of occupations potentially affected by offshoring.

Appendix Table 7. Share of employment potentially affected by offshoring for Europe[1], by industry, 2003 and 1995

NACE	Industry	2003 Total Offshoring	2003 Clerical	2003 Non-clerical	1995 Total Offshoring	1995 Clerical	1995 Non-clerical
1	Agriculture, hunting and related service activities	1.8	1.0	0.8	2.5	1.9	0.6
2	Forestry, logging and related activities	4.3	2.1	2.2	6.2	4.3	1.8
5	Fishing; service activities incidental to fishing	2.0	1.2	0.9	2.5	1.7	0.8
10	Mining of coal and lignite; extraction of peat	10.5	2.4	8.1	6.6	3.2	3.4
11	Extraction of crude petroleum and natural gas;	43.5	10.7	32.8	31.5	10.7	20.8
12	Mining of uranium and thorium ores	19.2	11.7	7.5	13.4	6.8	6.6
13	Mining of metal ores	19.1	8.0	11.0	10.7	4.0	6.7
14	Other mining and quarrying	10.5	5.4	5.1	8.1	4.2	3.8
15	Manufacture of food products and beverages	11.6	4.5	7.1	10.9	4.9	6.0
16	Manufacture of tobacco products	22.6	8.4	14.2	15.1	5.7	9.4
17	Manufacture of textiles	13.2	7.0	6.2	11.2	6.6	4.6
18	Manufacture of wearing apparel; dressing and dyeing of fur	9.5	4.8	4.7	5.6	3.0	2.6
19	Tanning and dressing of leather; manufacture of leatherwear	9.5	6.1	3.5	7.8	5.9	1.9
20	Manufacture of wood	7.9	4.0	3.9	6.9	3.8	3.1
21	Manufacture of pulp, paper and paper products	14.7	5.1	9.7	13.6	5.6	8.1
22	Publishing, printing and reproduction of recorded media	23.3	8.8	14.5	21.0	9.9	11.1
23	Manufacture of coke, refined petroleum products and nuclear fuel	35.6	9.3	26.3	33.0	11.4	21.6
24	Manufacture of chemicals and chemical products	31.2	7.9	23.3	26.7	8.7	18.0
25	Manufacture of rubber and plastic products	14.9	6.0	8.9	14.6	5.9	8.7
26	Manufacture of other non-metallic mineral products	14.1	5.6	8.4	11.2	5.7	5.6
27	Manufacture of basic metals	13.7	6.1	7.5	11.6	4.5	7.1
28	Manufacture of fabricated metal products	12.8	5.4	7.4	11.8	6.0	5.7
29	Manufacture of machinery and equipment, n.e.c.	20.6	6.5	14.1	19.2	7.2	12.0
30	Manufacture of office machinery and computers	52.0	7.7	44.3	49.5	9.4	40.1
31	Manufacture of electrical machinery and apparatus, n.e.c.	23.6	6.4	17.2	21.3	6.5	14.7
32	Manufacture of radio, television and communication equipment	32.2	6.2	26.1	27.3	6.8	20.5
33	Manufacture of medical, precision and optical instruments	26.9	7.7	19.3	22.1	6.8	15.3
34	Manufacture of motor vehicles, trailers and semi-trailers	17.1	4.3	12.8	12.7	4.5	8.2
35	Manufacture of other transport equipment	25.2	4.8	20.4	19.0	5.5	13.5
36	Manufacture of furniture; manufacturing n.e.c.	12.1	6.2	6.0	9.7	5.6	4.1
37	Recycling	11.8	6.3	5.4	11.4	6.0	5.4
40	Electricity, gas, steam and hot water supply	32.7	13.6	19.2	26.8	12.2	14.6
41	Collection, purification and distribution of water	28.3	12.4	16.0	24.3	13.0	11.3
45	Construction	9.4	3.8	5.6	9.2	4.2	5.0
50	Sale, maintenance and repair of motor vehicles and motorcycles	15.2	7.0	8.1	13.6	6.6	7.0
51	Wholesale trade and commission trade	38.1	10.1	28.0	35.7	11.0	24.7
52	Retail trade	11.7	3.7	8.0	9.6	3.6	6.0
55	Hotels and restaurants	4.5	3.0	1.5	4.0	2.8	1.2
60	Land transport; transport via pipelines	9.4	4.7	4.7	8.4	4.7	3.7
61	Water transport	19.7	9.8	9.9	13.9	6.9	7.0
62	Air transport	23.8	11.8	11.9	20.5	9.3	11.3
63	Supporting and auxiliary transport activities; activities of travel agencies	25.3	14.8	10.5	23.0	13.3	9.6
64	Post and telecommunications	28.5	12.6	15.9	16.1	9.2	6.9
65	Financial intermediation, except insurance and pension funding	62.1	38.2	24.0	55.4	37.1	18.3
66	Insurance and pension funding, except compulsary social security	71.1	33.8	37.3	73.5	35.2	38.2
67	Activities auxiliary to financial intermediation	67.7	25.1	42.6	74.5	30.5	44.0
70	Real estate activities	44.0	14.9	29.1	43.9	16.3	27.6
71	Renting of machinery and equipment	27.3	12.5	14.7	26.1	11.8	14.4
72	Computer and related activities	79.4	9.0	70.5	73.9	12.8	61.1
73	Research and development	41.1	6.1	35.1	36.3	7.9	28.4
74	Other business activities	47.7	17.3	30.3	49.1	20.3	28.8
75	Public administration and defence; compulsary social security	22.0	14.1	7.9	23.0	16.0	7.0
80	Education	7.6	4.2	3.3	6.3	3.7	2.5
85	Health and social work	7.5	5.6	1.9	8.2	6.3	1.8
90	Sewage and refuse disposal, sanitation and similar activities	9.1	5.2	3.9	8.0	4.2	3.8
91	Activities of membership organisation, n.e.c.	26.5	16.9	9.6	24.7	17.2	7.5
92	Recreational, cultural and sporting activities	15.0	6.5	8.5	14.5	6.4	8.0
93	Other service activities	8.5	5.1	3.4	8.6	5.0	3.6
95	Private households with employed persons	1.6	1.3	0.3	0.8	0.5	0.2
99	Extra-territorial organisations and bodies	30.1	15.8	14.4	28.3	18.2	10.1

Notes. 1. EU15 except Luxembourg in 2003, and EU15 except Finland and Sweden in 1995. The total share for the top ten ranked industries in the total offshoring category in 2003 and 1995 are in shading.

Source: OECD calculations based on EULFS.

Appendix Table 8. Share of employment potentially affected by offshoring for the US, 20 industries with a high total share, 2002[1] and 1995

		2002			1995	
Industry	Total offshoring	Clerical	Non-clerical	Total offshoring	Clerical	Non-clerical
890 Accounting, auditing, and bookkeeping services	81.2	25.5	55.7	84.7	26.7	58.0
710 Security, commodity brokerage, and investment companies	62.3	5.4	56.8	70.6	11.2	59.4
732 Computer and data processing services	60.6	3.6	57.0	62.6	5.6	57.0
882 Engineering, architectural, and surveying services	58.9	3.7	55.2	62.2	8.6	53.6
711 Insurance	57.3	10.5	46.8	64.7	16.4	48.3
892 Management and public relations services	57.1	5.9	51.1	56.6	8.5	48.2
701 Savings institutions, including credit unions	55.3	29.3	26.1	48.1	31.4	16.7
442 Telegraph and miscellaneous communications services	49.6	12.6	36.9	25.6	12.1	13.5
700 Banking	48.0	28.6	19.4	53.8	32.6	21.2
362 Guided missiles, space vehicles, and parts	45.9	2.7	43.1	36.6	6.4	30.2
852 Libraries	45.5	8.0	37.6	56.2	12.6	43.6
432 Services incidental to transportation	45.2	35.1	10.1	57.3	51.6	5.8
930 Environmental quality and housing programs administration	44.6	9.8	34.9	38.6	11.2	27.4
702 Credit agencies, n.e.c.	44.2	6.5	37.7	48.5	12.7	35.7
712 Real estate, including real estate-insurance offices	43.5	5.8	37.8	44.3	6.4	37.9
472 Not specified utilities	43.0	0.0	43.0	26.8	0.0	26.8
663 Catalog and mail order houses	40.6	6.2	34.4	34.3	6.4	27.9
921 Public finance, taxation, and monetary policy	40.5	10.7	29.8	45.3	11.4	33.9
891 Research, development, and testing services	38.5	4.6	33.9	43.6	8.6	35.0
511 Metals and minerals, except petroleum	36.4	10.1	26.3	32.7	6.7	25.9

Notes: 1. Data for 2002 were used here as the 2003 data are not directly comparable with the 1995 data because of classification changes.

Source: OECD calculations based on US CPS.