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Offshoring and the Skill Structure of Employment in Belgium

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1. Introduction

In the current era of globalisation, production processes are becoming ever more fragmented across different locations. This fragmentation often implies the transfer abroad of activities, which is also commonly referred to as offshoring. One of the main concerns in developed countries regarding the consequences of offshoring is about the worsening of the labour market position of low-skilled workers. Indeed, according to the traditional idea underlying offshoring, firms shift low-skilled intensive stages of production to low-skilled abundant countries, thereby influencing the within-industry skill composition of labour demand. In other words, just like technological change, offshoring is generally believed to be skill-biased, shifting labour demand from low-skilled to high-skilled workers.

In the academic literature, it has become standard to measure offshoring by the share of imported intermediates in total non-energy intermediates as first suggested in Feenstra and Hanson (1996). The issue of the changes in the skill structure of labour demand induced by offshoring has generally been addressed at the industry-level within the framework of a flexible cost function from which a system of cost or employment share equations by skill level is derived. Early papers for the US (Feenstra and Hanson, 1996 and 1999) as well as subsequent ones for European countries (e.g. Strauss-Kahn, 2003, for France; Hijzen et al., 2005, for the UK; Ekholm and Hakkala, 2006, for Sweden) have found that offshoring harms the relative position of low-skilled workers. Moreover, it is offshoring to low-wage countries in particular that leads to a worsening of the labour market position of low-skilled workers (Anderton and Brenton, 1999; Egger and Egger, 2003; Dumont, 2006; Geishecker, 2006).

The aim of this paper is to address the issue of the impact of offshoring on the skill structure of labour demand for Belgium. Industry-level data clearly show that there has been considerable skill upgrading of employment in both manufacturing and market services in Belgium over the past decade. The share of workers with primary or lower secondary education has fallen between 1999 and 2009 from 47% to 31% in manufacturing and from 32% to 22% in market services. Besides that, there is also industry-level evidence of increased offshoring for Belgium. Materials offshoring was already at a rather high level at the end of the 1990's and has grown moderately between 1999 and 2004, while business services offshoring, starting from a low level in 1999, has risen fast until 2004.

In order to determine to what extent offshoring has influenced the skill structure of labour demand in Belgium, we estimate an employment share equation for the low-skilled that includes offshoring and is derived from a translog cost function. Filling a gap in the existing literature, we take not only materials offshoring, but also business services offshoring into account. Moreover, while previous papers have focused exclusively on manufacturing industries, we extend the analysis to market services industries. Last but not least, we control for the influence of technological change through the inclusion of the R&D intensity and a split of the capital stock into ICT and non-ICT capital.

The core of this paper is divided into four chapters. The relevant empirical literature is reviewed in Chapter 2, while Chapter 3 contains a description of the dataset and stylised facts regarding skill upgrading and offshoring in Belgium. In Chapter 4 the model, the estimation strategy and the results are presented. Finally, concluding remarks are made in Chapter 5.

2. Relevant empirical literature

Within the vast body of academic literature on the consequences of globalisation for developed economies, a growing number of contributions have been looking specifically at offshoring measured by the share of imported intermediates in total intermediates. Among the possible consequences, the impact of offshoring on the skill structure of labour demand has been a major issue. In order to focus on contributions that are immediately comparable to the framework sketched in this paper, we have narrowed this literature review down to papers that investigate this issue using industry-level data within the framework of a flexible cost function from which expressions for the input cost shares or factor demand shares are derived. Among the forms for the flexible cost function, the translog has been the most popular. However, a few authors have tested other functional forms, e.g. Falk and Koebel (2002) or Dumont (2006).

Feenstra and Hanson (1996) are the first to measure offshoring by the share of imported intermediates in total intermediates and to consider explicitly its impact on low-skilled and high-skilled labour proxied by production and non-production workers. Although they do not refer to a cost function, their approach is comparable as they regress the average annual growth in the wage share of non-production workers on that of materials offshoring plus controls for 435 US manufacturing industries. They find that offshoring has a significant positive impact for the period 1979-1990. A subsequent paper by the same authors – Feenstra and Hanson (1999) – distinguishes between narrow and broad offshoring and extends the framework to include several alternative specifications of high-tech and computer capital. This lowers the contribution of materials offshoring to the rise in the non-production workers' wage share considerably.

In the wake of these two studies for the US, several papers have analysed this issue for – mostly large – European economies. Most of these papers explicitly define a cost function framework. Anderton and Brenton (1999) look at the effect of offshoring to low-wage countries on the wage bill and employment share of manual workers in six textile and five non-electrical machinery industries in the UK for the years 1970-1986. Their estimations in first differences indicate that this effect is negative.[1] Falk and Koebel (2002) specify a Box-Cox cost function from which they derive a system of seven variable input demands including imported materials and three skill levels for labour measured by educational attainment. Estimating the parameters of this system with non-linear SUR (seemingly unrelated regression) for 26 German manufacturing industries over 1978-1990, they find that the cross-price elasticities of the three skill levels with respect to imported materials are non-significant. However, in one of their specifications the elasticity of the demand for unskilled labour with respect to the volume of imported materials is significant negative. For France, Strauss-Kahn (2003) examines the impact of materials offshoring on the employment share of low-skilled workers in 50 manufacturing industries between 1977 and 1993. The distinction between high-skilled and low-skilled is defined in terms of occupations. Her estimation strategy is based on annual average changes just like in Feenstra and Hanson (1996). The results point to a significant negative impact of narrow offshoring to both OECD and non-OECD countries on the low-skilled employment share.

The fall of the iron curtain leads to an increased focus on offshoring to Central and Eastern European countries (CEEC). Egger and Egger (2003) look at Austrian manufacturing. Their sample covers 20 industries over 1990-1998 and skill levels are based on occupations. They regress the relative employment of high-skilled on narrow materials offshoring to CEEC using 2SLS and 3SLS with instrumental variables. According to the results, offshoring to CEEC has a significant positive impact, explaining about a quarter of the rise in this share. Geishecker (2006) investigates the same question for Germany, i.e. the threat of offshoring to CEEC for the low-skilled in manufacturing in the 90's. He uses GMM in differences to estimate a cost share equation for production workers with data for 22 industries over 1991-2000 and finds a significant and sizeable negative effect of both narrow and broad offshoring to CEEC.

Furthermore, Hijzen et al. (2005) present evidence for the UK with skill levels based on occupations. They include narrow offshoring as an explanatory variable in systems of either cost shares or employment shares and apply fixed effects ISUR (iterated SUR) to estimate these with data for 50 manufacturing industries over 1982-1998. The results point to a strong negative impact of offshoring on the demand for unskilled labour. The approach chosen in Ekholm and Hakkala (2006) is similar. These authors also estimate systems of either cost shares or employment shares, but use pooled ISUR, for 20 Swedish manufacturing industries between 1995 and 2002. In terms of results, they report a significant positive impact of offshoring to low-wage countries on labour demand for workers with tertiary education and the opposite for workers with upper secondary education.

Dumont (2006) tests two flexible cost functions (generalised Leontief and minflex Laurent generalised Leontief) to show that the choice of functional form may alter the impact of offshoring on the cost shares by skill level. He estimates a system of cost share equations by iterated 3SLS separately for 12 manufacturing industries with data for the years 1985-1996 pooled over 5 EU

[1] It is, however, not entirely clear in this paper whether the authors replicate the standard offshoring measure of Feenstra and Hanson (1996) or just use total imports for the products corresponding to the industries in the sample.

countries (Belgium, Denmark, France, Germany and the UK). Low-skilled labour is proxied by manual workers. The results show that offshoring to high-skill abundant and low-skill abundant countries has, respectively, a positive and a negative impact on the cost share of low-skilled labour. Finally, Kratena (2010) treats offshoring as a direct substitution process between imported intermediate inputs on the one hand and labour of different skill levels and domestic inputs on the other hand. He estimates a set of cost share equations separately for three small open economies (Austria, Denmark and the Netherlands) by fixed effects ISUR for 13 manufacturing industries over the period 1995-2004 and finds positive cross-price elasticities for (almost) all skill levels.

To sum up, several salient features of this literature should be highlighted. First, mostly large economies have been examined. Second, there has been an exclusive focus on the manufacturing sector, while service industries have not yet been analysed. Third, analogous to the previous point, the offshoring of business services has been largely neglected in this literature. Finally, in terms of the results, the large consensus regarding the negative impact of offshoring on the demand for low-skilled labour stands out, especially for offshoring to low-wage countries. The conclusions about the impact on the demand for high-skilled labour are less clear-cut: in some cases, it is positive, in others non-significant or even negative.

3. Stylised facts

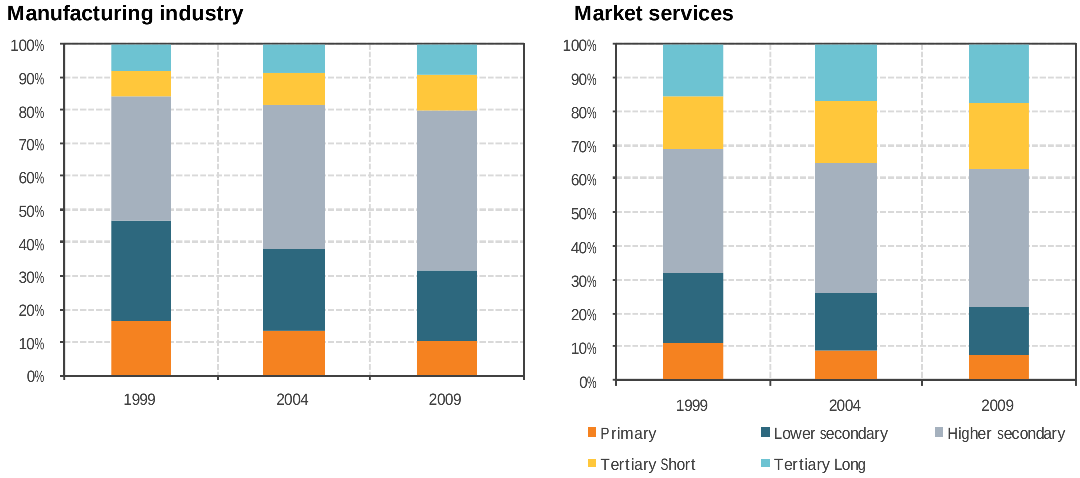
The industry-level data presented here cover 103 industries, which are listed in Appendix Tables A3.1 and A3.2. A systematic split is made between manufacturing including construction (63 industries) and market services (40 industries). Data sources are indicated in Appendix 2 Table A2.1.

In this chapter we focus on employment shares by skill level and offshoring intensities. Descriptive statistics for the variables that are not discussed here but are part of the econometric analysis can be found in Table A2.2 in Appendix 2.

3.1. Skill upgrading

In Belgium, like in other European countries, there has been considerable skill upgrading of employment over the past decade. As can be seen in Graph 1, this upgrading occurred in both manufacturing and market services. Over the whole period 1999-2009, the share of high-skilled (tertiary long) and medium-skilled (higher secondary and tertiary short) workers increased at the expense of the low-skilled workers (primary and lower secondary). Between 1999 and 2009, the share of workers with primary or lower secondary education has fallen from 47% to 31% in manufacturing and from 32% to 22% in market services.

Graph 1 - Employment shares by skill level (1999-2009)



Source: own calculations based on FPB qualitative labour market data

Table 1 shows that not only the share of low-skilled workers decreased dramatically, but also their absolute number. Between 1999 and 2009, employment of low-skilled workers in Belgian manufacturing dropped by almost 40% from 420 000 to 260 000. This fall was partially offset by an increase in medium and high-skilled workers. Overall total manufacturing employment decreased by 8%, from 900 000 to 830 000. In market services, the fall in low-skilled employment was also substantial, but less than in manufacturing (-18% between 1999 and 2009, from 705 000 to 580 000), and it was more than compensated by a rise in medium and high-skilled workers, resulting in an increase in total employment by 19%, from 2 215 000 to 2 630 000. Comparing the two sub-periods 1999-2004 and 2004-2009 in Table 1, we can see that the skill upgrading of Belgian employment slowed down somewhat, but remained substantial over the years 2004-2009.

Table 1 - Employment by skill level (1999-2009, growth rates)

	1999-2004	2004-2009	1999-2009
Manufacturing	-5%	-3%	-8%
Primary	-25%	-24%	-43%
Lower secondary	-21%	-17%	-34%
Higher secondary	9%	9%	19%
Tertiary Short	15%	7%	23%
Tertiary Long	6%	6%	12%
Market services	8%	10%	19%
Primary	-14%	-11%	-24%
Lower secondary	-10%	-5%	-15%
Higher secondary	14%	16%	32%
Tertiary Short	26%	19%	50%
Tertiary Long	16%	12%	30%

Source: own calculations based on FPB qualitative labour market data

In order to match the availability of the industry-level wage data by skill level, we will henceforth restrict the time span to the years 1999-2004. Moreover, we limit the number of skill categories to two: higher-skilled, which corresponds to higher secondary and tertiary, and low-skilled, which includes primary and lower secondary. This split is consistent with the observed trend in skill upgrading shown in Table 1.

Regarding skill upgrading, two further stylised facts deserve to be illustrated here. First, we examine to what extent the decline in the employment share of low-skilled workers comes from changes in the allocation of employment *between* industries or *within* industries. Following Berman et al. (1994), the change in the aggregate share of low-skilled workers (ΔE^L) can be decomposed into two components:

$$\Delta E^L = \sum_{i=1}^{n} \overline{E_i^L} \Delta E_i + \sum_{i=1}^{n} \overline{E_i} \Delta E_i^L$$

for i = 1,..., n industries; E_i^L is the share of low-skilled workers in employment of industry i, E_i is the share of employment of industry i in total employment, and a bar over a term denotes a mean over time. The first term on the right-hand side is the *between* industries component; the second term is the *within* industries component.

Table 2 presents the results of a dynamic[2] shift-share analysis for the period 1999-2004, separately for manufacturing and market services.[3] The fall in the overall employment share of low-skilled workers overwhelmingly occurred within industries (in both manufacturing and market services). In other words, between 1999 and 2004, shifts of employment away from industries with high shares of low-skilled workers (the between component) did not contribute much to the observed overall skill upgrading. This finding is in line with empirical evidence for many other OECD-countries.

Table 2 - Industry decomposition of the fall in the low-skilled employment share (1999-2004)

	Between	Within
Manufacturing	0.2%	99.8%
Market services	3.4%	96.6%

Source: own calculations based on FPB qualitative labour market data

A second interesting point is to compare changes in the employment share of the low-skilled with changes in their wage bill share. Over the period 1999-2004, the wage bill share of low-skilled workers in both manufacturing and market services fell by more than 20%. Decomposing this change shows that 70 to 75% was due to a decrease in relative employment of low-

2 Dynamic means decomposing year-on-year changes according to the formula given above and aggregating the results over time. It turns out that for our data the dynamic results do not differ much from the results of a static analysis based on the aggregate change between 1999 and 2004.

3 As mentioned above, our data contain 63 manufacturing and 40 market services industries. A more detailed industry breakdown should increase the relative importance of the between industries component, but based on the experience of Berman et al. (1994) we do not expect the general conclusions to change fundamentally.

skilled workers and only 25 to 30% can be attributed to a fall in relative wages. This observation indicates that Belgium, like other continental European countries, has a less flexible labour market than for instance the US or the UK. As argued below, this leads us to focus our modelling on employment rather than wages.

3.2. Offshoring

The scarcity of direct evidence regarding the transfer abroad of economic activities has prompted most authors in the field of offshoring to make use of the indirect measure suggested in Feenstra and Hanson (1996). It consists in measuring the industry-level intensity of offshoring by the share of imported intermediates in total non-energy inputs.[4] Following Amiti and Wei (2005) a distinction can be made between imported intermediate materials and business services. Hence, define materials offshoring (*OM*) and business services offshoring (*OS*) as:

$$OM_i = \frac{\sum_m IIM_{mi}}{I_i} \qquad OS_i = \frac{\sum_s IIS_{si}}{I_i}$$

where *IIM* stands for imported intermediate materials, *IIS* for imported intermediate business services and *I* for total non-energy inputs, *i* is the industry index, *m* the index for materials (manufactured goods) and *s* the index for business services.

When use table of imports are available, the offshoring intensities given above can be easily computed.[5] Furthermore, the imported intermediates can be split according to the country (or country group) of origin of the imports so as to distinguish between offshoring to different countries, in particular between high-wage and low-wage countries. Such splits are computed by a proportional method since use tables of imports by country of origin do not exist. The proportional computation of the amount of imported intermediates from country *c* for industry *i* implies multiplying the amount of imported intermediates for each product by the share of country *c* in the total imports of that product. Hence, the regional offshoring intensities become:

$$OM\_c_i = \frac{\sum_m \frac{M_{mc}}{M_m} IIM_{mi}}{I_i} \qquad OS\_c_i = \frac{\sum_s \frac{M_{sc}}{M_s} IIS_{si}}{I_i}$$

where *OM_c* and *OS_c* stand for materials and business services offshoring intensities to country *c*, M_m or M_s is total imports of product *m* or *s* and M_{mc} or M_{sc} is imports of product *m* or *s* from country *c*.

4 Some authors divide by output, e.g. Ekholm and Hakkala (2006) or Geishecker (2006), and some even by value added, e.g. Hijzen et al. (2005).

5 In line with the initial approach in Feenstra and Hanson (1996), some authors, e.g. Egger and Egger (2003) or Ekholm and Hakkala (2006), compute the offshoring intensity for industry *i* by multiplying the amount of intermediates of each product by the share of imports in total supply for that product. This so-called ‘proportional method’ is applied when use tables of imports are not available.

For Belgium, total materials and business services offshoring can be computed with data from a series of constant price supply-and-use tables (SUT) that is described in Avonds et al. (2007).[6] It runs from 1995 to 2004, but we have again restricted the time span to the years 1999-2004 so as to match the availability of wage data by skill level. Use tables of imports are contained in this database. Their construction is based on the original method described in Van den Cruyce (2004) for the input-output reference years. For intermediate years, they are interpolated and balanced so as to respect import totals by product. The possibility of computing volume measures of offshoring is particularly important since value measures tend to underestimate the extent of offshoring. Materials and business services are defined here in terms of the CPA[7] by products 15-37 and 72-74 respectively. Using detailed import data by country of origin and product, we calculate offshoring intensities for three regions: OECD, which includes 22 OECD member states[8], CEEC, which corresponds to ten Central and Eastern European countries[9], and ASIA, which includes eight newly industrialised economies of Asia as well as China and India[10].

Table 3 Materials and business services offshoring, total and split by region of origin

	Materials offshoring			Business services offshoring		
	1999	2004	avg grt	1999	2004	avg grt
Manufacturing						
Total	36.38%	36.94%	0.3%	1.05%	1.53%	7.9%
OECD	32.52%	31.68%	-0.5%	0.97%	1.43%	8.1%
CEEC	1.01%	1.71%	11.1%	0.02%	0.03%	14.2%
ASIA	1.16%	1.39%	3.7%	0.02%	0.02%	-2.3%
Market services						
Total	8.87%	10.02%	2.5%	4.22%	5.68%	6.1%
OECD	7.85%	8.64%	1.9%	3.94%	5.31%	6.2%
CEEC	0.15%	0.29%	13.8%	0.06%	0.12%	14.4%
ASIA	0.35%	0.54%	8.9%	0.07%	0.06%	-2.0%

Source: own calculations

Trends in offshoring are shown in Table 3 separately for manufacturing and market services. Starting from a high level of 36.4% in 1999, the intensity of materials offshoring in manufacturing grows only slowly to reach 36.9% in 2004. Business services offshoring in manufacturing is at a much lower level, but grows relatively fast from 1.1% in 1999 to 1.5% in 2004. In market services, materials offshoring also stands at a higher level than business services offshoring, and

6 These tables are deflated using a separate price index for imports and domestic production for each product.

7 Standard Classification of Products by Activity in the European Community.

8 Austria, Australia, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxemburg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the UK and the US. These countries plus Turkey were the OECD member states by the middle of the 1970's.

9 Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, the Slovak Republic and Slovenia.

10 China, Hong Kong, India, Indonesia, Malaysia, the Philippines, Singapore, South Korea, Thailand and Taiwan.

the latter again grows at a faster pace. The figures for the regional offshoring intensities show that offshoring to OECD countries, i.e. high-wage countries, largely dominates for both materials and business services. Especially for the latter, offshoring to CEE and Asian countries is still very small during the period considered here. Nonetheless, it stands out from Table 3 that between 1999 and 2004 offshoring to CEE countries grows fastest with average annual growth rates above 10% for both materials and business services.

4. Econometric analysis

4.1. Model specification

In line with most empirical literature in this field, we specify a model based on the translog cost function to analyse the impact of offshoring on the skill structure of labour demand. Translog cost functions are frequently used for empirical analyses. Belonging to the category of flexible functional forms, one attractive feature of the translog cost function is that it puts no a priori restrictions on elasticities. Instead of estimating the translog cost function directly, it is more convenient to estimate a system of cost share equations derived from it.

The translog cost function is presented in its most general form in Appendix 1. The model estimated below departs in a number of ways from the general outline given in equation (A.4) in Appendix 1. First of all, on the left-hand side, we replace cost shares by employment shares. A justification for this can be found in the characteristics of the Belgian labour market. Belgium has, like other continental European countries, a more rigid labour market than for instance the US or the UK. In countries with a rigid labour market the deterioration of the relative position of low-skilled workers is primarily reflected in the structure of (un)employment and less by a growing wage gap between low-skilled and higher-skilled workers. Therefore, it is not surprising that employment share specifications are also the preferred model choice for France in Strauss-Kahn (2003) and for Austria in Egger and Egger (2003).[11] Moreover, replacing wage bill shares by employment shares reduces the potential endogeneity bias[12] stemming from the presence of wages on the right-hand side of the equation system. In the case of a cost share model, endogeneity is highly likely given the definitional relationship between the dependent variable (cost share) and the (relative) wage term. But even in an employment share model, there is a potential problem of endogeneity between the employment share and the wage term. For this reason, we lag the wage terms in our equation system. Contrary to cost shares, employment share specifications based on labour expressed in numbers of persons do necessarily exclude input factors other than labour.

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11 It has also been tested as alternative specification or robustness check by other authors, e.g. Anderton and Brenton (1999), Hijzen et al. (2005) and Ekholm and Hakkala (2006).

12 This endogeneity problem leads to biased and inconsistent estimators.

As in most other studies, capital is taken to be a quasi-fixed factor. By treating capital as exogenous in the short-term, we assume that adjustment costs may exist and prevent capital to equal its long-term equilibrium level. By including the capital stock rather than capital-intensity we stick closer to theory.

Finally, we extend the standard translog cost framework by including two types of demand shifters. The first is offshoring, both materials and business services offshoring. Furthermore, we include the R&D intensity, which should control for skill-biased technological change. The inclusion of these two explanatory variables is consistent with the fact that our model focuses exclusively on within industry skill upgrading.

Accordingly, our model takes the following form:

$$E_{it}^{L} = \beta_L + \delta_{LL} \ln W_{it-1}^{L} + \delta_{LH} \ln W_{it-1}^{H} + \delta_{LY} \ln Y_{it} + \delta_{LK} \ln K_{it} + \gamma_{LR} RD_{it} + \gamma_{LM} OM_{it} + \gamma_{LS} OS_{it} \qquad (1)$$

$$E_{it}^{H} = \beta_H + \delta_{HL} \ln W_{it-1}^{L} + \delta_{HH} \ln W_{it-1}^{H} + \delta_{HY} \ln Y_{it} + \delta_{HK} \ln K_{it} + \gamma_{HR} RD_{it} + \gamma_{HM} OM_{it} + \gamma_{HS} OS_{it} \qquad (2)$$

where E_i^L and E_i^H denote industry *i*'s employment share of the low-skilled (*L*) and higher-skilled (*H*) workers, W_i^L and W_i^H denote the corresponding industry specific wage rates, *Y* is value added, *K* is capital stock, *RD* is R&D intensity, *OM* is materials offshoring and *OS* is business services offshoring.

As explained in Appendix 1, we can now apply, without loss of generality, the symmetry condition $\delta_{LH} = \delta_{HL}$. Moreover, a 'well-behaved' cost function should be homogeneous of degree 1 in prices, which imposes restrictions (A.2) given in Appendix 1. Applying all these restrictions to the model above, it follows that:

$$\begin{gathered} \beta_L + \beta_H = 1 \\ \delta_{LL} = \delta_{HH} = -\delta_{LH} = -\delta_{HL} \qquad \delta_{LY} = -\delta_{HY} \qquad \delta_{LK} = -\delta_{HK} \\ \gamma_{LR} = -\gamma_{HR} \qquad \gamma_{LM} = -\gamma_{HM} \qquad \gamma_{LS} = -\gamma_{HS} \end{gathered} \qquad (3)$$

Given restrictions (3), our model is reduced to one single equation. Adding industry dummies D_i and a stochastic error term u_{it}, the specification to be estimated is as follows:

$$E_{it}^{L} = \beta_L + \delta_{LL} \ln\left(\frac{W_{it-1}^{L}}{W_{it-1}^{H}}\right) + \delta_{LY} \ln Y_{it} + \delta_{LK} \ln K_{it} + \gamma_{LR} RD_{it} + \gamma_{LM} OM_{it} + \gamma_{LS} OS_{it} + \theta_i D_i + u_{it} \qquad (4)$$

In (4), the impact of materials and business services offshoring on the employment share of low-skilled workers is given by the coefficients γ_{LM} and γ_{LS}. The own-price elasticities of low-skilled and higher-skilled workers can be calculated using the estimated coefficient $\hat{\delta}_{LL}$ and the fitted value $\hat{E}^L$:

$$\varepsilon_{LL} = \frac{\hat{\delta}_{LL}}{\hat{E}^L} - \left(1 - \hat{E}^L\right) \qquad\qquad \varepsilon_{HH} = \frac{\hat{\delta}_{LL}}{(1 - \hat{E}^L)} - \hat{E}^L \qquad (5)$$

A number of studies, e.g. Feenstra and Hanson (1996), Anderton and Brenton (1999), Strauss-Kahn (2003) and Egger and Egger (2003), estimate the model by taking first differences in order to control for industry specific time-invariant effects. However, according to Griliches and Hausman (1986) using first differences tends to exacerbate potential problems of measurement error in the data. For this reason, we prefer to estimate the model in levels by fixed effects, as is also done in Hijzen et al. (2005), Geishecker (2006) and Kratena (2010).

Modelling a set of industries equations implicitly limits the analysis to within industry skill upgrading. In our case, however, this is not really a limiting factor, as during the period considered here almost all skill upgrading occurred within and not across industries.

4.2. Results

In this section, the results of the estimation of equation (4) will be discussed. As this implies constraining all β, δ and γ parameters to be the same for all industries, we have split the sample into manufacturing (63 industries) and market services (40 industries) to account for their different nature and production technology. The respective estimation results are shown in Tables 4 and 5. The own-price elasticities for low-skilled and higher-skilled workers calculated according to (5) are reported at the bottom of the tables.[13]

For *manufacturing*, we start by estimating equation (4) omitting the R&D intensity variable. The results – presented in column (a) of Table 4 – show that both materials and business services offshoring have a statistically significant negative impact on the employment share of low-skilled workers. However, the two offshoring variables may partially capture skill-biased technological change. To control for this, we include the R&D intensity.[14] According to the results in column (b), this reduces the negative impact of business services offshoring somewhat, while the negative impact of materials offshoring increases slightly. As an alternative control for skill-biased technological change, we split the capital stock into ICT and non-ICT capital. The estimation results including this split in column (c) point to similar changes in the impact of materials and business services offshoring on the low-skilled employment share. When including both the R&D intensity and the ICT and non-ICT capital in the specification, the impact of business services offshoring further falls and that of materials offshoring further rises as can be seen in column (d). This is our preferred specification.

The results for the other variables in our preferred specification are broadly in line with what may be expected based on theory and previous empirical work. Although not significant, the own-price elasticities of both low-skilled and higher-skilled workers are negative and the elasticity of the former is higher in absolute terms. The R&D intensity has a significant negative im-

[13] The values and standard errors of the elasticities reported here are based on the fitted employment shares for the last year of the dataset (i.e. 2004).

[14] Given that R&D intensities are only available at a higher level of aggregation than the other variables, we have computed clustered standard errors for the estimations including the R&D intensity variable so as to avoid the bias discussed in Moulton (1990).

pact on the low-skilled employment share and so does the non-ICT capital stock, whereas the impact of ICT capital turns out to be non-significant. Finally, a positive relationship is found between value added and the low-skilled employment share, which is consistent with the idea that labour shedding during periods of weak economic growth principally harms the relative position of low-skilled workers.

Table 4 Estimation results with total and regional offshoring intensities in manufacturing

	(a)	(b)	(c)	(d)	(e)
Dependent variable	low-skilled employment share	low-skilled employment share	low-skilled employment share	low-skilled employment share	low-skilled employment share
ln(relative wage)	-0.160	-0.116	-0.038	-0.001	0.013
	(0.116)	(0.166)	(0.115)	(0.168)	(0.170)
ln(capital stock)	-0.117**	-0.136**			
	(0.046)	(0.058)			
ln(value added)	0.017	0.016	0.024*	0.023*	0.016
	(0.014)	(0.013)	(0.012)	(0.013)	(0.010)
R&D-intensity		-0.221**		-0.202**	-0.234***
		(0.076)		(0.070)	(0.058)
Materials offshoring	-0.188*	-0.212**	-0.209**	-0.229**	
	(0.096)	(0.088)	(0.089)	(0.082)	
Services offshoring	-4.478***	-4.015***	-4.058***	-3.636***	-3.448***
	(0.893)	(0.865)	(0.817)	(0.689)	(0.485)
ln(non-ICT capital stock)			-0.206***	-0.216***	-0.207***
			(0.045)	(0.044)	(0.048)
ln(ICT capital stock)			0.019	0.017	0.016
			(0.019)	(0.024)	(0.023)
Materials offshoring to OECD					-0.194**
					(0.079)
Materials offshoring to CEEC					-1.358**
					(0.625)
Materials offshoring to ASIA					-0.0141
					(0.221)
Constant	1.189***	1.352***	1.691***	1.801***	1.789***
	(0.317)	(0.425)	(0.301)	(0.354)	(0.358)
Observations	315	315	315	315	315
R-squared	0.353	0.377	0.428	0.449	0.486
Number of industries	63	63	63	63	63
Own-price elasticity of low-skilled	-1.062***	-0.942**	-0.734**	-0.636	-0.597
	(0.311)	(0.446)	(0.312)	(0.455)	(0.463)
Own-price elasticity of higher-skilled	-0.625***	-0.554**	-0.428**	-0.370	-0.346
	(0.186)	(0.266)	(0.183)	(0.267)	(0.270)

Source: own calculations

Remarks: 63 manufacturing industries covered; all specifications estimated with fixed effects; heteroskedasticity and autocorrelation robust standard errors reported in parentheses; standard errors are clustered in specifications (b), (d) and (e) to account for the different aggregation level of the R&D intensity variable; reported significance levels: * p<0.1, ** p<0.05, *** p<0.01.

Contributions to the change in the low-skilled employment share can be calculated for the offshoring intensities and the technology variables based on their coefficients in column (d). Materials offshoring and business services offshoring rise by respectively 0.56 and 0.48 percentage points between 1999 and 2004, accounting for respectively 2% and 23% of the fall in the low-skilled employment share during that period. Things are different for the R&D intensity as it decreases in the manufacturing industry by 0.17 percentage points over the years 1999-2004. Thus, given its negative coefficient, it leads to a rise in the low-skilled employment share. However, this effect remains rather small (less than 1% of the change in the low-skilled employment share). The contribution of the increase in the non-ICT capital stock to the observed fall in the low-skilled employment share amounts to 23% between 1999 and 2004.

The possibility of splitting the offshoring intensities by region has been discussed above. The regional offshoring intensities may be included in equation (4) instead of the total offshoring intensities. In the last column of Table 4, estimation results for our preferred specification with materials offshoring intensities for the three regions OECD, CEEC and ASIA are reported.[15] Materials offshoring to either OECD or CEE countries has a significant negative impact on the low-skilled employment share, whereas the impact of materials offshoring to ASIA is not significant. Since materials offshoring to OECD countries falls by 0.8 percentage points over the years 1999-2004, it actually raises the low-skilled employment share by an amount that corresponds to 2% of the total change in the share. This is largely compensated by materials offshoring to CEE countries. The 0.7 percentage point increase in this variable leads to a contribution of 12% to the fall in the low-skilled employment share. Given the 21% contribution of business services offshoring in this specification, the overall fall in the low-skilled employment share that is due to offshoring amounts to 32%.

Several features of these results for manufacturing deserve to be discussed in greater detail. First, the overall contribution of offshoring to the shift away from low-skilled workers in manufacturing is statistically significant and sizeable: 24%-32% of the fall in the low-skilled employment share between 1999 and 2004. The estimations show that this essentially comes from business services offshoring although the size of the overall contribution of materials offshoring rises when regional splits are introduced. It is noteworthy that this rise is driven by offshoring to CEE countries. The preponderance of business services offshoring is, to some extent, at odds with employment trends for blue-collar and white-collar workers in Belgian manufacturing. Along traditional lines of reasoning, we would expect materials offshoring to affect mainly blue-collar jobs and business services offshoring to affect mainly white-collar jobs. However, in our data on low-skilled employment the numbers of blue-collar and white-collar workers both fall at similar rates. We may of course conjecture that the negative impact of the (non-ICT) capital stock affects in particular blue-collar workers among the low-skilled, which would reconcile our findings with the trends in low-skilled blue-collar and white-collar employment. Nonetheless, this issue should be analysed in greater depth in future work and for a longer period. Sec-

[15] We have not included regional splits for business services offshoring in the estimation since it is almost entirely limited to the OECD region.

ond, we find evidence that it is non-ICT capital rather than ICT capital that contributes to reducing the low-skilled employment share in manufacturing. Our interpretation of this finding is that it is investment in specialised machinery and equipment for manufacturing rather than investment in computers and other ICT-equipment that puts pressure on low-skilled employment in manufacturing. This runs counter to the findings for US manufacturing in the 1980's reported in Feenstra and Hanson (1999). Third, according to our results, the contributions of the offshoring variables and the variables measuring skill-biased technological change to the fall in the low-skilled employment share are approximately equivalent. This differs again from Feenstra and Hanson (1999), who conclude that the impact of skill-biased technological change is dominating, but is more in line with the findings in Geishecker (2006). To settle the issue, this should be checked with a dataset for a longer time span.

The results for *market services* are shown in Table 5. We have estimated the same sequence of specifications as for manufacturing except for the last one. The specification in column (a) corresponds again to equation (4) without the R&D intensity. Materials offshoring does not have a significant impact on the low-skilled employment share, while business services offshoring has a significant negative impact. Introducing the R&D intensity substantially alters the results for the offshoring intensities as can be seen from column (b). Neither materials nor business services offshoring has a significant impact anymore on the low-skilled employment share. In other words, business services offshoring only captured the impact of the omitted R&D intensity in the first specification. To a lesser extent, this is also true when splitting the capital stock into non-ICT and ICT capital as done in column (c). The impact of materials offshoring remains non-significant, and the value of the negative coefficient of business services offshoring falls as compared to column (a), but is still significant. Column (d) shows the results for our preferred specification including both the R&D intensity and the split of the capital stock. There is no significant impact of either of the offshoring intensities, whereas both the R&D intensity and the ICT capital stock have a significant negative impact.

Calculating the contributions to the overall fall in the low-skilled employment share based on the last specification, we find that the R&D intensity accounts for 33% of the fall and ICT capital for 11%. Regarding the other variables in this specification, the non-ICT capital stock does not significantly alter the skill structure of employment in market services, whereas value added significantly limits the shift towards higher-skilled workers. Finally, the own-price elasticities of both higher-skilled and low-skilled workers are negative but non-significant.

Our main finding for market services is that offshoring did not influence the shift away from low-skilled workers during the period 1999-2004. The shift in the skill structure of employment is to a large extent driven by (skill-biased) technological change in the form of R&D and investment in computers and other ICT-equipment. Determining whether offshoring has had an impact on the skill structure of employment in market services in more recent years is an important issue for future research.

Table 5 Estimation results with total offshoring intensities in market services

	(a)	(b)	(c)	(d)
Dependent variable	low-skilled employment share	low-skilled employment share	low-skilled employment share	low-skilled employment share
ln(relative wage)	0.175***	0.186**	0.148***	0.170**
	(0.047)	(0.060)	(0.042)	(0.056)
ln(capital stock)	-0.095***	-0.037		
	(0.022)	(0.049)		
ln(value added)	0.023*	0.023**	0.040***	0.033***
	(0.012)	(0.006)	(0.012)	(0.006)
R&D-intensity		-3.565*		-3.034*
		(1.747)		(1.477)
Materials offshoring	0.094	-0.050	0.133	-0.003
	(0.102)	(0.130)	(0.091)	(0.113)
Services offshoring	-0.679***	-0.291	-0.561*	-0.273
	(0.247)	(0.363)	(0.295)	(0.409)
ln(non-ICT capital stock)			-0.055**	-0.028
			(0.026)	(0.048)
ln(ICT capital stock)			-0.038***	-0.021**
			(0.011)	(0.006)
Constant	0.946***	0.539	0.689***	0.485
	(0.191)	(0.352)	(0.220)	(0.365)
Observations	200	200	200	200
R-squared	0.405	0.555	0.481	0.580
Number of industries	40	40	40	40
Own-price elasticity of low-skilled	-0.050	-0.005	-0.158	-0.067
	(0.187)	(0.239)	(0.168)	(0.224)
Own-price elasticity of higher-skilled	-0.017	-0.002	-0.053	-0.022
	(0.063)	(0.079)	(0.056)	(0.074)

Source: own calculations

Remarks: 40 market services industries covered; all specifications estimated with fixed effects; heteroskedasticity and autocorrelation robust standard errors reported in parentheses; standard errors are clustered in specifications (b) and (d) to account for the different aggregation level of the R&D intensity variable; reported significance levels: * p<0.1, ** p<0.05, *** p<0.01.

5. Conclusion

Offshoring is a prominent explanation put forward for the skill upgrading of employment in developed economies. This paper has examined to what extent offshoring has had an impact on the skill structure of employment in Belgium over the period 1999-2004. An estimation framework based on a translog cost function has been drawn up, from which an estimation equation for the employment share of low-skilled workers has been derived. A term accounting for offshoring has been included. We have taken this equation to the data based on an industry-level dataset for Belgium covering the years 1999 to 2004. By taking not only manufacturing but also market services industries into account, a gap in the existing literature has been filled.

Following the standard measurement in the literature, offshoring intensities by industry are computed as the share of imported intermediate materials or business services in total non-energy intermediates. On the one hand, materials offshoring had already reached a high level in 1999 and keeps on growing slowly. On the other hand, business services offshoring is only at its beginnings in the wake of service trade liberalisation and communication technology developments, but grows fast. Moreover, these intensities have been split according to the geographic origin of the imports so as to specifically identify offshoring to low-wage countries. Unsurprisingly, it turns out that for Belgium most offshoring goes to OECD countries. However, offshoring to Central and Eastern European countries has been increasing at a rapid pace.

According to the results of the estimations for manufacturing, the contribution of offshoring to the fall in the employment share of low-skilled workers amounts to 24%-32% between 1999 and 2004. This is approximately equivalent in size to the contribution of (skill-biased) technological change. Both materials offshoring and business services offshoring make a significant contribution, but it is mainly the latter that drives the overall result. Moreover, splitting materials offshoring by region in the estimations shows that it is mostly offshoring to Central and Eastern European countries that entails a fall in the low-skilled employment share. For market services industries, we find no evidence of an impact of either materials or business services offshoring on the low-skilled employment share. Skill upgrading in market services is to a large extent due to technological change in the form of investment in computers and other ICT-equipment.

These results are important complements with respect to findings in previous papers showing that neither materials nor business services offshoring have had a significant impact on overall industry-level employment in Belgium over 1995-2003 (Michel and Rycx, 2011) and that only business services offshoring in manufacturing has had a productivity-enhancing effect between 1995 and 2004 (Michel, 2011). Nevertheless, the robustness of our results should be further strengthened by extending the time span covered beyond the period 1999-2004.

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Appendix 1 – The translog cost function

Transcendental logarithmic[16] or translog production and cost functions were introduced in the first half of the seventies in a number of papers, e.g. Christensen et al. (1971) and Berndt and Wood (1975), and have been frequently used in empirical work since then. They belong to the category of the so-called flexible functional forms that were developed in an attempt to impose as little a priori restrictions as possible.[17] More precisely, translog cost functions allow substitution elasticities to be unrestricted – they must not even be constant – and they are nonhomothetic, meaning that cost-minimizing relative input demands may depend on the level of output[18], hence allowing for U-shaped average cost functions.

Denoting total variable costs *C*, the prices of *N* variable input factors P_j and output *Y*, the general formulation of the translog cost function is as follows:[19]

$$\ln C = \beta_0 + \sum_{j=1}^{N} \beta_j \ln P_j + \frac{1}{2}\sum_{j=1}^{N}\sum_{k=1}^{N} \delta_{jk} \ln P_j \ln P_k + \beta_Y \ln Y + \frac{1}{2}\delta_{YY}(\ln Y)^2 + \sum_{j=1}^{N} \delta_{jY} \ln P_j \ln Y \quad \text{(A.1)}$$

In a classic KLEMS framework, equation (A.1) represents a five-factor model (*N*=5), with capital (K), labour (L) and three intermediate inputs (energy (E), materials (M) and services (S)) as variable factors of production. Labour can further be divided into different skill levels, augmenting the number of production factors *N*. It is standard to take into account capital as a quasi-fixed factor (at least in the short-run). In this case the number of variable input factors *N* is reduced by one, capital costs are excluded from C, and capital enters the cost function in the same way as output.

In equation (A.1), $N(N-1)/2$ symmetry conditions ($\delta_{jk} = \delta_{kj}$) can be imposed without loss of generality. Moreover, a 'well-behaved' cost function should be homogeneous of degree 1 in prices, meaning that a proportional increase in all variable input prices should shift total variable costs by the same proportion. This implies the following restrictions:

$$\sum_{j=1}^{N} \beta_j = 1 \quad ; \quad \sum_{j=1}^{N} \delta_{jk} = \sum_{k=1}^{N} \delta_{jk} = \sum_{j=1}^{N} \delta_{jY} = 0 \quad \text{(A.2)}$$

According to Shephard's lemma, the cost-minimizing input quantities X_j can be derived by differentiating total costs with respect to the prices of the input factors:

$$\frac{\partial C}{\partial P_j} = X_j \quad \text{(A.3)}$$

[16] Transcendental means non-algebraic and a logarithmic function is one form of non-algebraic function.

[17] Another popular flexible functional form is the Generalised Leontief function.

[18] Implying returns to scale of the dual production function are not constrained a priori, not even constant (see Berndt (1991), p.469-470).

[19] For ease of presentation, time and industry subscripts have been omitted.

Differentiating the translog cost function (A.1) with respect to input prices and applying Shephard's lemma (A.3), one obtains a set of N cost share equations of the form:

$$S_j = \beta_j + \sum_{k=1}^{N} \delta_{jk} \ln P_k + \delta_{jY} \ln Y \qquad \text{(A.4)}$$

with the following adding-up condition:

$$\sum_{j=1}^{N} S_j = \sum_{j=1}^{N} \frac{P_j X_j}{C} = 1 \qquad \text{(A.5)}$$

In the empirical literature, instead of estimating the translog cost function (A.1) directly, most authors estimate the system of cost share equations (A.4).[20]

As pointed out above, one attractive feature of flexible functional forms like translog cost functions is that they put no a priori restrictions on elasticities. The own price elasticities ε_{jj} and cross price elasticities ε_{jk} , and the elasticities of substitution σ_{jk} are given by the formulas below:

$$\varepsilon_{jj} = \frac{\delta_{jj}}{S_j} - \left(1 - S_j\right) \qquad \text{(A.6)}$$

$$\varepsilon_{jk} = \frac{\delta_{jk}}{S_j} + S_k \qquad j \neq k \qquad \text{(A.7)}$$

$$\sigma_{jk} = \frac{\varepsilon_{jk}}{S_k} = \frac{\delta_{jk}}{S_j S_k} + 1 \qquad j \neq k \qquad \text{(A.8)}$$

These elasticities are not constant, but differ at every data point. It is common practice to compute them either at the means of the data, or for the first, central or last year of the sample. When computing estimates of these elasticities, fitted cost shares should be used rather than observed cost shares.[21]

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20 This implies efficiency gains, notably because the number of parameters to be estimated is lower. It is also noteworthy that some authors, e.g. Baltagi and Rich (2005), simultaneously estimate the cost function and the system of cost share equations.

21 Then, given that the elasticities are nonlinear functions of the estimated parameters, the standard errors of the elasticities must be computed by the 'delta method'. This is done automatically by the command *predictnl* in Stata.

Appendix 2 – Data sources and descriptive statistics

Table A2.1 Data sources

Variable	Name	Data source	Splits	References
Y	Output	Harmonised SUT (FPB[1]) based on data from NAI[2]		Avonds et al. (2007)
VA	Value added	Harmonised SUT (FPB[1]) based on data from NAI[2]		Avonds et al. (2007)
IIM, IIS	Intermediates	Harmonised SUT (FPB[1]) based on data from NAI[2]	Imported (by region based on detailed trade data from NBB[3])	Van den Cruyce (2004), Avonds et al. (2007), Michel and Rycx (2011)
K	Capital stock	Own calculations based on detailed investment data from NBB[3]	ICT and non-ICT	Biatour et al. (2007), Michel (2011a)
L	Labour *(number of workers)*	Social Accounting matrix (SAM – FPB[1]) based on NAI[2] data	By level of education	Bresseleers et al. (2007)
W	Labour compensation	Own calculation based harmonised SUT (FPB[1]) and on NAI[2] data	By level of education	Avonds et al. (2007), Dumont (2008)
R&D	R&D stock	Own calculations based on R&D expenditure data from BSP[4]		Biatour, Dumont and Kegels (2011)

Remarks: 1 Federal Planning Bureau
2 National Accounts Institute
3 National Bank of Belgium
4 Belgian Science Policy (belspo)

Table A2.2 Descriptive statistics

	1999	2004	abs change	avg grt
Manufacturing				
Relative wage of low-skilled	0.73	0.70	-0.03	-0.9%
Value added (bn of 2000 €)	52.18	55.79	3.61	1.3%
ICT capital (bn of 2000 €)	7.43	7.32	-0.11	-0.3%
Non-ICT capital (bn of 2000 €)	101.45	109.58	8.13	1.6%
R&D intensity	0.0743	0.0725	-0.0017	-0.5%
Market services				
Relative wage of low-skilled	0.61	0.58	-0.03	-1.0%
Value added (bn of 2000 €)	104.15	119.28	15.13	2.7%
ICT capital (bn of 2000 €)	26.34	34.14	7.79	5.3%
Non-ICT capital (bn of 2000 €)	211.73	241.30	29.57	2.6%
R&D intensity	0.0104	0.0158	0.0055	8.8%

Source: see table A2.1; own calculations

Appendix 3 – Industry classification

Table A3.1 List of manufacturing industries, SUT-code and description

14A	Mining and quarrying of stone, sand, clay and chemical and fertilizer materials, production of salt, and other mining and quarrying n.e.c.
15A	Production, processing and preserving of meat and meat products
15B	Processing and preserving of fish and fish products
15C	Processing and preserving of fruit and vegetables
15D	Manufacture of vegetable and animal oils and fats
15E	Manufacture of dairy products
15F	Manufacture of grain mill products, starches and starch products
15G	Manufacture of prepared animal feeds
15H	Manufacture of bread, fresh pastry goods, rusks and biscuits
15I	Manufacture of sugar, chocolate and sugar confectionery
15J	Manufacture of noodles and similar farinaceous products, processing of tea, coffee and food products n.e.c.
15K	Manufacture of beverages except mineral waters and soft drinks
15L	Production of mineral waters and soft drinks
16A	Manufacture of tobacco products
17A	Preparation and spinning of textile fibres, weaving and finishing of textiles
17B	Manufacture of made-up textile articles, except apparel, other textiles, and knitted and crocheted fabrics
18A	Manufacture of wearing apparel; dressing and dyeing of fur
19A	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20A	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw
21A	Manufacture of pulp, paper and paper products
22A	Publishing
22B	Printing and service activities related to printing, reproduction of recorded media
23A	Manufacture of coke, refined petroleum products and nuclear fuel
24A	Manufacture of basic chemicals
24B	Manufacture of pesticides and other agro-chemical products
24C	Manufacture of paints, varnishes and similar coatings, printing ink and mastics
24D	Manufacture of pharmaceuticals, medicinal chemicals and botanical products
24E	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations
24F	Manufacture of other chemical products
24G	Manufacture of man-made fibres
25A	Manufacture of rubber products
25B	Manufacture of plastic products
26A	Manufacture of glass and glass products
26B	Manufacture of ceramic products
26C	Manufacture of cement, lime and plaster
26D	Manufacture of articles of concrete, plaster and cement; cutting, shaping and finishing of stone; manufacture of other non-metallic mineral products
27A	Manufacture of basic iron and steel and of ferro-alloys and tubes
27B	Other first processing of iron and steel; manufacture of non-ferrous metals; casting of metals
28A	Manufacture of structural metal products, tanks, reservoirs, containers of metal, central heating radiators, boilers and steam generators; forging, pressing, stamping and roll forming of metal
28B	Treatment and coating of metals; general mechanical engineering
28C	Manufacture of cutlery, tools, general hardware and other fabricated metal products
29A	Manufacture of machinery for the production and use of mechanical power, except aircraft and vehicle engines
29B	Manufacture of other general purpose machinery
29C	Manufacture of agricultural and forestry machinery and of machine tools
29D	Manufacture of domestic appliances
30A	Manufacture of office machinery and computers

31A	Manufacture of electric motors, generators and transformers, of electricity distribution and control apparatus, and of insulated wire and cable
31B	Manufacture of accumulators, batteries, lamps, lighting equipment and electrical equipment
32A	Manufacture of radio, television and communication equipment and apparatus
33A	Manufacture of medical, precision and optical instruments, watches and clocks
34A	Manufacture of motor vehicles
34B	Manufacture of bodies (coachwork) for motor vehicles, of trailers and parts and accessories for motor vehicles
35A	Building and repairing of ships and boats; manufacture of locomotives and rolling stock, and of aircraft
35B	Manufacture of motorcycles and bicycles and other transport equipment n.e.c.
36A	Manufacture of furniture
36B	Manufacture of jewellery and related articles
36C	Manufacture of musical instruments, sports goods, games and toys; miscellaneous manufacturing
37A	Recycling
45A	Site preparation
45B	General construction of buildings and civil engineer works; erection of roof covering and frames
45C	Construction of motorways, roads, airfields, sports facilities and water projects; other construction work
45D	Building installation
45E	Building completion; renting of construction or demolition equipment with operator

Table A3.2 List of market services industries, SUT-code and description

50A	Sale, maintenance and repair of motor vehicles and motorcycles, parts and accessories
50B	Retail sale of automotive fuel
51A	Wholesale trade and commission trade, except of motor vehicles and motorcycles
52A	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods
55A	Hotels and other provision of short-stay accommodation
55B	Restaurants, bars, canteens and catering
60A	Transport via railways
60B	Other scheduled passenger land transport; taxi operation; other land passenger transport
60C	Freight transport by road; transport via pipelines
61A	Sea and coastal water transport
61B	Inland water transport
62A	Air transport
63A	Activities of travel agencies and tour operators; tourist assistance activities n.e.c.
63B	Cargo handling and storage, other supporting transport activities; activities of other transport agencies
64A	Post and courier activities
64B	Telecommunications
65A	Financial intermediation, except insurance and pension funding
66A	Insurance and pension funding, except compulsory social security
67A	Activities auxiliary to financial intermediation
70A	Real estate activities
71A	Renting of automobiles and other transport equipment
71B	Renting of machinery and equipment and personal and household goods
72A	Computer and related activities
73A	Research and development
74A	Legal activities, accounting activities; market research and public opinion polling
74B	Business and management consultancy activities; management activities of holding companies
74C	Architectural and engineering activities and related technical consultancy
74D	Advertising
74E	Labour recruitment and provision of personnel
74F	Investigation and security activities; industrial cleaning; miscellaneous business activities n.e.c.
80A	Education (market sector)
85A	Human health activities
85B	Veterinary activities
85C	Social work activities
91A	Activities of membership organisations
92A	Motion picture and video activities; radio and television activities
92B	Other entertainment activities
92C	News agency activities and other cultural activities
92D	Sporting and other recreational activities
93A	Other service activities n.e.c.