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ABSTRACT

Does Offshoring of Materials and Business Services Affect Employment? Evidence from a Small Open Economy

The fear of massive job losses has prompted a fast-growing literature on offshoring and its impact on employment in advanced economies. This paper examines the situation for Belgium. It improves the offshoring intensity measure by computing a volume measure of the share of imported intermediates in output and it is among the first to address both materials and business services offshoring to high-wage and low-wage countries. Estimations of static and dynamic industry-level labour demand equations augmented by offshoring intensities do not reveal a significant impact of either materials or business services offshoring on total employment for Belgium between 1995 and 2003.

JEL Classification: F15, J22

Keywords: offshoring, imported intermediate inputs, supply and use tables, industry-level employment, labour demand equations, panel data

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I. Introduction

The world economy is becoming ever more integrated through various channels. Offshoring – the shift of economic activities abroad – is one of them. It receives widespread attention in advanced economies where shifts of activities to low-wage countries are perceived as a major threat to jobs and a source of downward pressure on wages. Traditionally, offshoring used to be an issue only for manufacturing activities, for which such shifts abroad have since long occurred on a regular basis. But in recent years, the threat of offshoring has also come to be felt in service activities as their output has become increasingly tradable.

The perceived threat has prompted a fast-growing empirical literature on offshoring and its impact on the labour markets of advanced economies. It is mainly based on industry-level data and starts off with Feenstra and Hanson (1996, 1999), two papers that have tried to explain wage inequalities between production and non-production workers in US manufacturing through offshoring. In the wake of these pioneering contributions, employment became the main focus of the literature as researchers turned their attention to European countries. Strauss-Kahn (2002) and Falk and Koebel (2002) use a neoclassical labour demand framework to estimate the employment impact of offshoring for different skill categories of workers in manufacturing for France and Germany. Recent contributions to the literature have brought about several improvements and extensions. First of all, initiated by Amiti and Wei (2005) and Falk and Wolfmayr (2005), a small strand of the literature has also focused on the so far neglected impact of offshoring on total employment at the industry-level. Second, regarding the intensity of offshoring, which is traditionally measured through the share of imported intermediates in total inputs or output, some progress has been made by drawing data on imported intermediates directly from use tables of imports instead of computing them indirectly by combining data on the use of intermediates from input-output tables with data on imports.[1] Third, Egger and Egger (2003) have pioneered a split according to the origin of the imported intermediates so as to distinguish between offshoring to high-wage and to low-wage countries. Finally, the analysis has been extended to offshoring of services and its employment impact in Amiti and Wei (2005).

This paper addresses the issue of offshoring and its impact on labour demand for Belgium considering that it is the typical example of a small open economy, for which offshoring is a major threat. The first step is to take a look at trends in offshoring. For this purpose, we use a series of supply-and-use tables for Belgium that are all consistent with the national accounts vintage of 2007 and that contain use tables of imports for all years from 1995 to 2003 in prices of 2000. From these tables the standard offshoring intensity is computed in constant prices, thereby improving on the measures found in the literature, which are generally in current prices and based on input-output tables of different national accounts vintages and for reference years only. We also distinguish between materials and business services offshoring and split the offshoring intensities into high-wage and low-wage regions using detailed import data by country of origin. In order to determine the impact of offshoring on industry-level employment, we rely on the offshoring-augmented neoclassical labour demand framework that is used in most of the literature. Manufacturing and service industries are separated for the estimations, which always include both materials and business services offshoring in order to obtain complete results. As in Amiti and Wei (2006) and Cadarso et al. (2008), the labour

[1] See, for example, Hijzen et al. (2005).

demand equation is estimated using both static and dynamic panel data techniques. The latter technique had not yet been applied for service industries.

This paper is organised as follows: in section 2, offshoring is defined and offshoring trends for Belgium are presented. Section 3 provides some theoretical elements and the labour demand equations, while the relevant empirical literature is reviewed in section 4. The estimation results are presented in section 5. Finally, section 6 concludes.

II. Defining and Measuring Offshoring

Offshoring has been described under many different names: international fragmentation, vertical specialisation or foreign outsourcing to name just the most widely used. All these terms stand for a common phenomenon: the splitting up of the production process into many separate activities and the shift of some of these activities abroad. Following the terminology of several international organisations[2], we will call this offshoring.

Due to a lack of appropriate data on shifted activities, most measures of offshoring are based on trade flows, i.e. a consequence of offshoring, rather than the shift of activity itself. The share of imported intermediates in total intermediate inputs or output has by now become the standard measure for the intensity of offshoring.[3] It is computed with data from input-output tables (IOT) or supply and use tables (SUT).[4] However, it ignores cases of offshoring that do not give rise to imports and includes

[2] See OECD (2007a), UNCTAD (2004) and WTO (2005).

[3] Hijzen et al. (2005) and Hijzen (2005) use value-added as denominator for this share, but then it suffers from the high volatility of industry-level value-added over time.

[4] SUT are industry-by-product tables that enable the analysis of output, intermediate consumption and final demand. They are the basis for the derivation of symmetric product-by-product IOT.

imports that are not due to offshoring. Moreover, focusing on intermediates implies leaving out cases where the final stage of the production process is offshored.

Our data on imports of intermediate inputs for Belgium are taken from a series of constant price SUT for the period 1995-2003 with a breakdown into 120 industries and 320 product categories. They are compatible with the 2007 vintage of the Belgian national accounts and the methodology of their compilation is described in Avonds et al. (2007). SUT are more appropriate than IOT for constructing an imported intermediate input measure for offshoring. The widely-used product-by-product IOT refer to by homogeneous industries, whereas SUT refer to heterogeneous industries. The latter are preferable when linking imported intermediate inputs to employment data by industry from the national accounts, for which industries are always heterogeneous.[5]

In most of the literature, imported intermediate inputs have been computed in a proportional way combining data on intermediate inputs from IOT or SUT with trade data. Intermediate inputs of a product are multiplied for every industry by the share of imports in total supply for that product. Summing over the products for every industry allows to obtain imported intermediate inputs by industry. The data on imported intermediate inputs contained in the series of SUT for Belgium represent a substantial improvement in this respect as they are drawn from use tables of imports. For the reference years 1995 and 2000, these tables have been computed according to a specific method based on detailed information on imports by firm and product that is described in Van den Cruyce (2004). The structure of the tables for these reference years has been

[5] For greater detail on this issue, see Michel (2008, p.25). It is of course true that the difference between heterogeneous and homogeneous industries tends to become small when there is a great industry and product detail available. But this is generally not the case in industry-level studies of the employment impact of offshoring where the number of industries is less than 100. Feenstra and Hanson (1996) and Amiti and Wei (2006) are exceptions to this rule.

used for the calculation of use tables of imports for the remaining years.[6] Another improvement compared to previous studies is that the series of SUT for Belgium contain constant price data on imported intermediate inputs.[7] The main problem with a measure based on imported intermediate inputs in current prices is that it tends to understate the magnitude of offshoring due to an endogenous price effect. Since activities are offshored because imported intermediate inputs are cheaper than domestically produced intermediate inputs, the offshoring intensity in value terms will be biased downwards.

To compute the offshoring intensity we divide industry-level imported intermediate inputs by output rather than by total intermediate inputs. Data on output (*Y*) by industry are also taken from the SUT. Denoting industries and products by subscripts *i* and *j*, total offshoring by *ot* and imported intermediate inputs by *III*, we can write for the industry-level offshoring intensity:

$$ot_i = \frac{\sum_j III_{ij}}{Y_i}; i = 1,..., I; j = 1,..., J$$

Different types of activities may be offshored and this is reflected in the different kinds of products that are imported as intermediate inputs. Traditionally, offshoring was confined to manufacturing activities because their output is easily tradable. However, progress in information and communication technologies has made it possible to transfer the output of certain service activities over long distances. This has prompted the

[6] Some authors, e.g. Hijzen et al. (2005) or Falk and Wolfmayr (2005, 2008), also rely on use tables of imports available from the source they take their data from. But no information is provided on how these tables have been calculated.

[7] Separate price indices for domestic output and imports have been used for the deflation; see Avonds et al. (2007).

offshoring of service activities, which occurs not only between high-wage countries, but also between high-wage and low-wage countries. Stories abound of call centres of American companies being moved to India or the Philippines or of accounting departments of Western European multinationals being transferred to Eastern Europe. Hence, the aim of distinguishing between trends in the offshoring of manufacturing and services activities warrants a split of the offshoring measure. The share of imported intermediate manufacturing goods in output is referred to as materials offshoring (*om*) and covers 185 product categories from the SUT between CPA15 and CPA37[8]. The share of imported intermediate services is called service offshoring (*os*), and we will restrict it to business services covering 15 product categories from the SUT between CPA72 and CPA74, since they contain the service categories such as accounting or call centres that have been most frequently offshored.[9] All other product categories have been excluded either because they cannot be traded or because imports of these product categories cannot be interpreted as offshoring, e.g. imported agricultural or energy products or imported transport services. Then, considering that the total number of products *J* is made up of *J'* manufacturing goods and *J-J'* services:

$$om_i = \frac{\sum_{j=1}^{J'} III_{ij}}{Y_i} \text{ and } os_i = \frac{\sum_{j=J'+1}^{J} IIS_{ij}}{Y_i}$$

[8] CPA stands for the 'Statistical Classification of Products by Activity in the European Economic Community'.

[9] Business services offshoring has received growing attention in the literature in recent years, e.g. in UNCTAD (2004), Amiti and Wei (2005, 2006) and Falk and Wolfmayr (2008).

Some authors opt for a more restrictive measure called 'narrow offshoring' initially defined by Feenstra and Hanson (1999).[10] To compute it only imported intermediate inputs from the 'same' industry are taken into account, i.e. imported intermediate inputs of the product category that constitutes the main output of the industry. However, we prefer the 'broad offshoring' defined above over 'narrow offshoring' since we believe that the shift of activities abroad is not necessarily limited to core activities only.

Since the classical offshoring scenario consists in the shift of a production stage from a high-wage to a low-wage country, the relevance of the analysis can be increased by splitting the imports of intermediates by country of origin and identifying those coming from low-wage countries. Egger and Egger (2003) were the first to suggest such a split of the offshoring intensity. However, in the SUT no information is available on the country of origin of imported intermediate inputs. Therefore, we rely on a proportional method combining the data on offshoring from the SUT with data on Belgian imports broken down by country of origin. For manufactured goods, the data on imports by country of origin at the 5-digit CPA-level come from merchandise trade statistics, while for business services imports, we use balance of payments data by country of origin for the categories 'computer and information services' and 'miscellaneous business, professional and technical services'.[11] We distinguish three groups of countries or regions: OECD is made up of 22 OECD countries (Austria, Australia, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxemburg, the Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, the United

[10] The measure also used in other papers, e.g. Ekholm and Hakkala (2005), Hijzen et al. (2005) or OECD (2007b).

[11] The source for all import data for Belgium is the National Bank of Belgium (NBB).

Kingdom and the United States); CEEC corresponds to the ten Central and Eastern European member states that have joined the EU recently (Bulgaria, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, the Slovak Republic and Slovenia); ASIA groups together China, India and eight economies from South-East Asia (Hong Kong, Indonesia, Malaysia, the Philippines, Singapore, South Korea, Thailand and Taiwan). Together, those three groups account for more than 90% of Belgian imports. Both CEEC and ASIA contain typical offshoring destinations.

The proportional method works as follows: first, we calculate the share of each region in total Belgian imports for all the products in the SUT that are relevant for materials or business services offshoring. Then, for each product separately, we multiply the imported intermediate inputs by these regional import shares and obtain, as a result, imported intermediate inputs by region of origin for each industry-product combination. Finally, for each industry, we sum those regional imported intermediates over products - manufacturing goods or business services –, divide by the industry's output and thereby obtain offshoring intensities by region *om_oecd*, *om_ceec*, *om_asia*, *os_oecd*, *os_ceec* and *os_asia* for all industries. Let *M_k* stand for Belgian imports from region *k* and *M* for total Belgian imports. Then:

$$om\_k_i = \frac{1}{Y_i} \sum_{j=1}^{J'} III_{ij} \frac{M\_k_j}{M_j} \text{ and } os\_k_i = \frac{1}{Y_i} \sum_{j=J'+1}^{J} III_{ij} \frac{M\_k_j}{M_j},\ k = oecd, ceec, asia$$

The results for Belgium over the period 1995-2003 are shown in Table 1 for the private sector industries and the two sub-groups manufacturing industries and market services industries.[12] For the private sector as a whole, the intensity of materials offshoring is much higher than that of business services offshoring, but the average growth rate of the latter is much higher. Both these features are true for the total as well as for the regional offshoring intensities. This is not really surprising given that services offshoring is a recent phenomenon. The offshoring intensities for the regions CEEC and ASIA are very low over the whole period and the bulk of offshored activities are located in the OECD countries. Nonetheless, the growth rates of materials and business services offshoring are highest for the CEEC region.

[Insert Table 1 here]

For the manufacturing industries, the contrast between materials and business services offshoring is even stronger both in levels and growth rates. Things are different for market services industries. Total materials offshoring is much lower but still on the rise, while total business services offshoring has reached substantially higher levels. Regarding regional offshoring intensities, the pattern is similar for manufacturing and market services industries. Most of offshoring goes to OECD countries, but the fastest growth rates of the offshoring intensities are recorded for the CEEC.

III. Theory and Labour Demand Equation

The motivation of firms to engage into offshoring, i.e. to shift parts of their production process to another country, comes from the cost arbitrages they make. They try to locate

[12] The offshoring measures for the reported industry groups are output weighted averages. There are 58 manufacturing industries and 35 service industries.

each stage of the production process where factor prices make this most profitable. The classical scenario is that they take advantage of lower labour costs in developing economies if the gains outweigh the extra coordination costs of the more complex production process and the extra transport costs for the intermediate goods or services to be provided to the other stages of the production process. Put briefly, offshoring is a "new vehicle of internationalisation where international arbitrage cuts value-added processes into ever smaller slices produced in different locations".[13]

Regarding the impact of offshoring on employment, which is the main channel of adjustment in a rigid labour market like in Belgium, the same basic line of argument is as follows: on the one hand, shifting a stage of the production process abroad will cause lay-offs of workers that used to perform this activity giving rise to unemployment in the short-run; on the other hand, there will be gains from offshoring in the form of enhanced efficiency. The productivity of workers in downstream parts of the production process will be raised through cheaper inputs or a higher quality of inputs at the same price. These inputs used to be produced by the laid-off workers and are now imported. Hence, in the long-run one would expect to observe an expansion of production and in turn higher employment as offshoring improves the efficiency of the production process and competitiveness. However, the employment effect of the productivity gains may also turn out to be negative as emphasized by Amiti and Wei (2005). Enhanced productivity in downstream activities may depress the demand for workers in those activities. Thus, the overall employment impact of offshoring is uncertain. Moreover, there are also caveats to be taken into account: the outcome depends on the initial relative factor demands, and

[13] Kohler (2004), p.793.

may also be influenced by the degree of rigidity of the labour market and a country's terms of trade that may be altered by offshoring.

Evaluating the employment impact of offshoring empirically is best done in a neoclassical factor demand framework as derived in Hamermesh (1993). This may be adapted to take offshoring into account. As done by most authors, we simply specify a log-linear labour demand equation taking the prices of labour and capital (*w* and *r*) as well as output (*Y*) into account. This proves convenient for estimation since the parameters can be interpreted as elasticities. Letting *L* denote employment and subscripts *i* and *t* respectively industry and years, the equation takes the following form:

$$\ln L_{it} = \alpha + \beta_1 \ln w_{it} + \beta_2 \ln r_{it} + \gamma \ln Y_{it} \qquad (1)$$

Theory predicts β_1, the own-price elasticity of labour, to be negative, whereas β_2, the cross-price elasticity with respect to capital should be positive. The income elasticity of labour demand, γ, is also expected to be positive.

To the extent that offshoring is measured through imported intermediate inputs, it may be treated as an extra factor of production whose price will have an impact on labour demand reflecting the idea that offshoring represents foreign labour services that are a substitute for domestic labour services. Hence, the price of imported intermediate inputs may enter the log-linear labour demand equation as a proxy for the price of foreign labour. The elasticity of labour demand with respect to the price of imported intermediates is expected to be positive. When import prices for intermediate inputs fall, i.e. when offshoring becomes relatively cheaper, then this should depress labour demand.

However, since data on the price of imported intermediates are difficult to come by, Amiti and Wei (2005, p.329) suggest to use the offshoring intensity as an "inverse proxy". Implicitly, this rests on the assumption of a negative own-price elasticity of the volume of imported intermediates for a given level of output. It is nonetheless worth mentioning that this inverse relationship is less clear-cut for the value measure of the offshoring intensity used in the literature because of the price effect, which casts some doubts on whether it is a good inverse proxy. But this should be solved by using a volume measure as we have done. In the end, the argument comes down to the same as what most authors do to measure the impact of offshoring on labour demand: augment the labour demand equation by one or more variables that measure offshoring. In our case, these are the regional offshoring variables *om_oecd*, *om_ceec*, *om_asia*, *os_oecd*, *os_ceec* and *os_asia* defined in the previous section:

$$\ln L_{it} = \alpha + \beta_1 \ln w_{it} + \beta_2 \ln r_{it} + \gamma \ln Y_{it} + \sum_{k=oecd,ceec,asia} \left(\theta_{1k} \ln om\_k_{it} + \theta_{2k} \ln os\_k_{it} \right) \qquad (2)$$

Controlling for output Y implies that the scale of the production may not change in response to offshoring, i.e. feedback from offshoring to labour demand through increased production is eliminated from a conditional labour demand equation such as (2). We would then predict a negative employment impact of offshoring, i.e. θ_{1k} and $\theta_{2k} < 0$.[14]

[14] Amiti and Wei (2005, 2006) as well as OECD (2007a, 2007b) also specify an unconditional labour demand equation by controlling for output price instead of output volume. In such a setting output may be increased in response to productivity gains through offshoring and lead to enhanced labour demand. Hence, the parameters θ_{1k} and θ_{2k} are not expected to be negative anymore, but their sign is undetermined as the above-mentioned opposing effects come into play. We have also estimated such an unconditional labour demand equation, but the results are rather disappointing.

Equation (2) defines static labour demand. It can easily be transformed to become testable by adding time and industry dummies α_t and ε_i as well as a disturbance term u_{it}. To capture lagged effects, it is useful to also include first order lags of the explanatory variables. Moreover, the price of capital – the rental rate – r_{it} is dropped by making the assumption that for capital “all firms face the same price, which […] is some function of time”.[15] In other words, r_{it} is taken to be part of the time dummies α_t. The testable form of equation (2) then becomes:

$$
\begin{aligned}
\ln L_i &= \alpha_t + \beta_1 \ln w_{it} + \beta_2 \ln w_{it-1} + \gamma_1 \ln Y_{it} + \gamma_2 \ln Y_{it-1} \\
&+ \sum_{k=oecd,ceec,asia} \left(\theta_{1k} \ln om\_k_{it} + \theta_{2k} \ln os\_k_{it} + \theta_{3k} \ln om\_k_{it-1} + \theta_{4k} \ln os\_k_{it-1} \right) \\
&+ \varepsilon_i + u_{it}
\end{aligned}
\tag{3}
$$

Finally, we introduce an autoregressive element to take labour demand dynamics into account. Let labour demand in year *t* depend on labour demand in the previous year *t-1* by including the lagged dependent variable, L_{it-1}, among the explanatory variables:[16]

$$
\begin{aligned}
\ln L_i &= \alpha_t + \lambda \ln L_{it-1} + \beta_1 \ln w_{it} + \beta_2 \ln w_{it-1} + \gamma_1 \ln Y_{it} + \gamma_2 \ln Y_{it-1} \\
&+ \sum_{k=oecd,ceec,asia} \left(\theta_{1k} \ln om\_k_{it} + \theta_{2k} \ln os\_k_{it} + \theta_{3k} \ln om\_k_{it-1} + \theta_{4k} \ln os\_k_{it-1} \right) \\
&+ \varepsilon_i + u_{it}
\end{aligned}
\tag{4}
$$

The aim is to bring equations (3) and (4) to the data at the industry-level to estimate the sign and magnitude of the θ parameters, which reflect the impact of

15 Amiti and Wei (2005, p.330).

16 This could have been derived by explicitly modelling adjustment costs – mainly hiring and firing costs – for adapting the employment level, see Hamermesh (1993). As argued in Mahy (2005) these adjustment costs are high in Belgium.

offshoring. But before discussing the econometric methodology, let us first take a look at the assumptions and findings of the related empirical literature.

IV. Relevant Empirical Literature

The focus of our analysis is the impact of the offshoring intensity on total industry-level employment without a distinction by skill-levels, although the bulk of the empirical literature has focused on the differential impact of the offshoring intensity on skill categories of workers. The aim has been to determine whether on average low-skilled workers are hit more severely by offshoring than high-skilled workers in the form of either unemployment or wage reductions. The papers are mostly based on industry-level data. The early contributions to this strand of the literature have been surveyed in Hijzen (2005). Most of the more recent papers, e.g. Hijzen et al. (2005), OECD (2007b) or Kratena (2008), suggest that offshoring does indeed have a negative impact on employment and wages of low-skilled workers. We are aware of seven papers that have estimated the sign and magnitude of the total employment impact of offshoring with industry-level data. Four of them – Falk and Wolfmayr (2005, 2008) and OECD (2007a, 2007b)[17] – examine a panel of respectively EU and OECD countries, while the three remaining ones – Amiti and Wei (2005, 2006) and Cadarso et al. (2008) – concentrate on one single country – respectively the UK, the US, and Spain. All of them rely on a labour demand framework similar to the one derived in the previous chapter.

The data, the econometric methodology, the features of the offshoring variable and the econometric results of these seven papers are summarised in Tables 2a, 2b and 3.

[17] Note that OECD (2007b) also contains estimations for industry-level employment by skill-level.

Apart from the aspect of the country focus – panel or single country – there are major differences in the datasets regarding the industry detail (column 3 of Table 2a): in the cross-country studies the industry-level data are pooled over the countries in the sample and only three papers present data on service industries. Another important difference is the way of measuring the dependent variable, i.e. industry-level employment. It seems that only Cadarso et al. (2008) use data in hours (column 5 of Table 2a). Moreover, Table 2b shows quite some variation in the offshoring intensity measure used in those papers. This is very likely to affect the estimated employment impact of offshoring.

[Insert Table 2a here]

[Insert Table 2b here]

Despite a common theoretical framework, the exact labour demand equations and the estimation methods also differ substantially and this has an impact on the results. A static conditional labour demand including wage and output as controls is the rule, but unconditional or dynamic labour demand equations are also specified in some of the papers. To some extent, this is linked to the available data. While the cross-country studies estimate cross-sections in five-year differences by ordinary least squares due to a lack of data for intermediate years, the single country studies are based on various more robust panel data methods. Amiti and Wei (2005) alternatively use first differences and fixed effects, Amiti and Wei (2006) introduce IV- and GMM-estimation, and Cadarso et al. (2008) rely on more recent dynamic panel data methods.

[Insert Table 3 here]

Table 3 shows that the findings on the impact of offshoring on total industry employment depend on the type of offshored activity – materials or business services – and on whether manufacturing or service industries are considered. For the manufacturing industries, the cross-country studies find either a non-significant or negative impact of both materials and business services offshoring. The results for the single country studies show that even a positive impact may occur. When the offshoring intensity is split by region, it is rather offshoring to low-wage countries that has a negative impact while offshoring to high-wage countries is not significant. Overall, the results depend to a large extent on whether an autoregressive term is included. This is, of course, not possible in the long difference specifications of the cross-country studies. Regarding service industries, the evidence on the employment impact of offshoring is scarce. While the impact of materials offshoring on service industries is not of great interest, the one of services offshoring on service industries deserves greater attention. But, hindered by the lack of reliable data on service industries, only two papers examine this explicitly though with rather small datasets. They find a negative or non-significant coefficient on their services offshoring variable. Finally, even when the coefficients of the offshoring variables are found to be significant – mostly negative, sometimes positive – they are generally small. In other words, none of these estimations reveals evidence of massive job losses due to offshoring.

V. Results

Other data

The data used to compute the offshoring intensities have already been described previously. The national accounts (NA) are the source for the data on employment by industry. We restrict the analysis to employees for which we have data on the number of hours[18] corrected for calendar effects. The industry breakdown is 58 manufacturing and 35 market services industries (see the Appendix). Total average employment growth in hours for all industries amounts to 1.3% for the period 1995-2003. This is driven by market services for which the average growth rate is 2.4%, while employment has fallen in manufacturing industries by 1.2% on average per year. The number of hours worked per year is stable in both manufacturing and services, but the level is higher in the former: 1555 hours worked on average in 2003 in manufacturing against 1420 in market services.

For Y_i, we use industry-level value-added in prices of the year 2000. The wage rate per hour, w_i, is computed by deflating industry-level compensation of employees with the output price for each industry and dividing this by industry-level employment in hours. The average wage rate for all industries in 2003 is 26.9 euros/hour. It is higher in manufacturing (30.9) than in market services (25.4). The average growth rate over 1995-2003 is 1.2% for all industries (2.4% for manufacturing and 0.7% for market services). Summary descriptive statistics for these variables are provided in the Appendix.

[18] There are no data on worked hours for self-employed. Nonetheless, we have performed the following robustness check for the estimations below: first, we computed a level of employment in hours by industry for the self-employed making the assumption that, on average, they work the same number of hours as employees; then, we added this to the number of hours worked by employees to obtain total hours worked by industry; finally, we redid the estimations below using these total hours by industry instead of hours worked by employees by industry as dependent variable. Hence, implicitly we made the assumption that the average wage rate is the same for employees and self-employed. The results did not change significantly compared to those reported below.

Static labour demand

To start with, the static labour demand equation – equation (3) – has been estimated by fixed effects over the period 1995-2003 separately for the manufacturing sector (58 industries) and the service sector (35 industries).[19] In terms of methodology, this is comparable to what has been applied in Amiti and Wei (2005, 2006) for US and UK data. But we have pushed things one step further by splitting up the offshoring intensity variables by region. Tables 4 and 5 report the results. In both tables, column (1) shows the estimated labour demand equation with total materials and business services offshoring, i.e. without any regional split-up. The columns (2)-(4) provide the results when the split-up offshoring intensity variables are included. As opposed to the ideal case of equation (3), they are introduced separately for the three regions (OECD, CEEC, ASIA) in the labour demand equations to avoid problems of multicollinearity.

[Insert Table 4 here]

[Insert Table 5 here]

The coefficients of the control variables w and Y are significant and of the expected sign. For the manufacturing sector, the contemporaneous wage elasticity (0.25) is within the reference confidence interval [0.15; 0.75] defined by Hamermesh (1993, p.92) for this type of labour demand equation. This elasticity tends to be lower in estimations with industry-level data than in estimations using firm-level data. This

[19] Using fixed effects estimation with a panel where the number of industries, i.e. individuals N, largely exceeds the number of time periods T implies that the coefficients of our equation should be interpreted as structural elasticities rather than short-run or long-run elasticities given that the estimation essentially relies on the variation between industries for the variables.

explains why the result is at the lower end of the interval. It is also in line with previous results for Belgium that are summarised in Dhyne (2001).[20] The story is somewhat different for the service sector, where the coefficients on both w_t and w_{t-1} are significant and negative. The coefficient on w_t amounts to more or less 0.7, which is rather high but still within the above-mentioned confidence interval. However, the contemporaneous and lagged coefficients taken together are well beyond the upper limit of the interval.[21] Finally, the elasticities of labour demand with respect to value-added are respectively 0.2 and 0.5 for the manufacturing sector and the service sector. This is broadly in line with earlier findings.

The main variables of interest here are the offshoring intensity variables. For the manufacturing sector, our results show that the offshoring intensity has little impact on employment. Regarding materials and business services offshoring without a regional split, only the lagged materials offshoring intensity om_{t-1} has a significant but positive coefficient, which runs counter to our theoretical predictions for conditional labour demand made in section 3. But even this significant elasticity of 0.05 is relatively small. This finding is in line with results reported in Amiti and Wei (2006). None of the regional offshoring intensity variables for OECD and CEEC is significant and for ASIA only contemporaneous materials offshoring intensity om_asia_t has a significant but positive impact on employment. For the service sector, the only significant – but again positive –

[20] See Dhyne (2001, p.161). Again, the wage-elasticity of labour demand is found to be substantially higher in estimations using firm-level data. This is confirmed by more recent estimations in Mahy (2005).

[21] As mentioned previously, we have also estimated unconditional labour demand equations by controlling for output price instead of output volume. The results are disappointing with respect to the controls: both the wage elasticities and the output price elasticities are mostly not significant. The offshoring elasticities are not substantially different from the conditional labour demand estimations in Tables 4 and 5.

coefficient for any of the offshoring intensity variables is for lagged materials offshoring to CEEC (om_ceec_{t-1}). However, as said before, materials offshoring is not of great interest for service industries. Overall, the business services offshoring intensity does not have a significant impact even for employment in the service sector. [22]

The finding that the employment impact of offshoring is mostly insignificant is consistent with the growth rates of the offshoring intensity variables shown in Table 1. Offshoring is indeed on the rise – except for materials offshoring to the OECD region – but the growth rates do not seem to be strong enough to have a substantial impact on the labour market. This does not mean that there are no jobs lost due to offshoring, but rather that the amount of jobs lost because of offshoring is simply not very big compared to the total number of jobs in the economy. Hence, our findings are in line with what has been argued by several authors, e.g. Bhagwati et al. (2004) or OECD (2007a): job losses due to offshoring are small compared to annual turnover in the labour market.

Dynamic labour demand

The econometric methodology for estimating the dynamic labour demand – equation (4) – is based on Bond (2002). A similar methodology is followed in Cadarso et al. (2008). Amiti and Wei (2005, 2006) also produce some results from estimations of dynamic labour demand. Bond (2002, p.156) argues that adopting a dynamic specification is sometimes useful "for identifying the parameters of interest, even when the dynamics themselves are not the principal focus of attention". When the number of cross-section units exceeds the number of time periods, estimating a dynamic equation by ordinary

[22] We have tested the robustness of our results with respect to the offshoring measure by using the offshoring intensities computed with total intermediate inputs instead of output in the denominator. But this gives rise to only marginal changes in the results.

least squares (OLS) will structurally overestimate the autoregressive coefficient, whereas fixed effects (FE) estimation tends to underestimate this coefficient. The generalised method of moments (GMM) estimator offers a solution to the inconsistency of the OLS and FE estimators. The method is referred to as GMM-DIF because the first differenced equation is estimated using lagged levels of the dependent variable as instruments. Nonetheless, the GMM-DIF estimate of the autoregressive coefficient is often found to be downward biased in finite samples, in particular when the dependent variable has near unit root properties. In that case, instruments in the first differenced equation are weak as shown by Blundell and Bond (1998). This can be improved upon by applying an extended GMM estimation method (GMM-SYS), which combines the equation in first differences with the equation in levels and uses lagged differences of the dependent variable as instruments for the latter in addition to the levels that again serve as instruments for the first-differenced equation. Two types of tests are used to assess the model and the validity of the two types of GMM-estimates: the Arellano-Bond first and second order autocorrelation tests (m1 and m2) for the first-differenced residuals and the Sargan test for the validity of the over-identifying restrictions of the GMM.[23]

Since Bond (2002, p.155) recommends "investigating the time series properties of the individual series […] when using these GMM estimators for dynamic panel data methods", we first estimate AR(1)-specifications for L_t, w_t and Y_t. The results are reported in the appendix.[24] They show that L_t has near unit root properties, while things are less clear for w_t and Y_t. The very strong downward bias in some of the GMM-DIF estimators of the autoregressive coefficient is striking. The results for the autocorrelation lead us to

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[23] For a more detailed description of these estimation methods and tests, see Bond (2002).

[24] Note that we use one-step GMM-estimators for all the estimations, i.e. for the dynamic labour demand below, too.

discard the GMM-DIF estimates in most cases and to prefer the GMM-SYS estimates. Nonetheless, the results are weak regarding the validity of the over-identifying restrictions.

The estimation results for the dynamic labour demand equations for both the manufacturing and the service sector are presented in Table 6. Only total materials and business services offshoring intensities are included. We have also done the estimations with the regional offshoring intensities but do not report the detailed results here. We will mention the main features of these results in the text. Explanatory variables may be treated as predetermined or endogenous in the GMM-estimations. We take the wage rate w to be predetermined. The main focus is on the results for GMM-SYS as the other three methods produce biased estimators for the autoregressive coefficient. The autocorrelation tests reject the null of no first order autocorrelation and do not reject the null of no second order autocorrelation. However, the validity of the over-identifying restrictions is always rejected by the Sargan test. Things get better in this respect, i.e. the validity of the over-identifying restrictions is not rejected anymore, when computing two-step estimators instead of the one-step estimators that we have reported here. But the correction for heteroskedasticity that is needed to obtain robust results inflates the standard errors of the estimators so much that merely the autoregressive coefficient remains significant. This sheds some doubt on the dynamic results, and so does the very low autoregressive coefficient in the GMM-DIF estimations. The same conclusions can be drawn from the dynamic labour demand estimations with the regional offshoring intensities.

[Insert Table 6 here]

For the manufacturing sector, the coefficients of the control variables w_t and Y_t turn out to be non-significant in the GMM-SYS estimation. This is due to relatively bigger robust standard errors. Moreover, the sign of the coefficients of w_{t-1} and Y_{t-1} even runs counter to intuition and these coefficients are significant. The results for the control variables come closer to what we expect for the service sector. The coefficients of w_t and Y_t are respectively significant negative and significant positive. Overall, the same observations can be made for all the specifications that contain the regional offshoring intensities.

The results for the offshoring intensity variables do not change very much compared to the estimations of the static labour demand equations since there is again little evidence of an employment impact of offshoring. For the manufacturing sector, things are straightforward: none of the total or regional offshoring intensity variables is significant in the GMM-SYS estimations except for the lagged business services offshoring intensity to CEEC (os_ceec_{t-1}), which turns out to be marginally significant, i.e. at the 10%-level, with a negative but very small coefficient. For the service sector, it is the contemporaneous business services offshoring intensities (os_t, os_oecd_t, os_ceec_t and os_asia_t,) that have a significant positive but rather small impact on labour demand. Hence, the dynamic labour demand estimations confirm the result of the static ones of no employment impact of offshoring. Moreover the results for the instruments are weak. The arguments put forward previously to explain the lack of an employment impact of our offshoring intensity measures are also valid in the dynamic labour demand context.

VI. Conclusion

The fears raised by offshoring are mostly related to the consequences for the labour market and especially employment in advanced economies. They used to be focused on manufacturing, but by now they also extend to certain kinds of business services that have become increasingly tradable and thereby subject to offshoring. In this paper, we have taken a look at the situation for Belgium presenting evidence on both materials and service offshoring through an improved volume measure of imported intermediate inputs from high-wage and low-wage countries. We have also estimated their employment impact at the industry-level in a partial equilibrium framework for the period 1995-2003.

Regarding the extent of offshoring for Belgium, the levels of the offshoring intensities are very different for materials and business services: the intensity proves to be high for the former and still relatively low for the latter even in 2003. In terms of the growth rates, the intensity of materials offshoring stagnates, whereas the intensity of business services offshoring is on the rise. A split of the intensities by region shows that for materials it is offshoring to high-wage countries that drags the growth rate down, and that the highest growth rates over the period 1995-2003 can be observed for offshoring to Central and Eastern European countries.

The estimations of both static and dynamic labour demand equations for 58 manufacturing industries and 35 service industries fail to reveal a substantial impact of the offshoring intensities on total employment in these industries. This is true for both materials and service offshoring to all regions. Hence, the main conclusion to be drawn is that, at the industry-level, offshoring has not massively depressed employment during the years 1995 to 2003. This is consistent with the view that materials offshoring is mature and not rising anymore, while service offshoring still remained at low levels in Belgium during this period despite substantial growth rates. Moreover, our results are in line with the argument put forward by many observers that job losses because of offshoring remain small compared to total job turnover in an economy. Nonetheless, these are results at the industry-level. They do not mean that there are no jobs lost due to offshoring as they may indeed hide disparities in demand for different skill categories, which is influenced by offshoring, as well as differences in trends at the level of the firms. Both these issues deserve to be carefully examined in future research.

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Table 1 Materials and business services offshoring for Belgium split by region of origin

	Materials offshoring (om)			Business services offshoring (os)		
	1995	2003	avg gr	1995	2003	avg gr
Private sector						
Total	13,21%	12,96%	-0,2%	1,00%	2,02%	9,2%
OECD-22 (_oecd)	12,01%	11,33%	-0,7%	0,96%	1,92%	9,0%
CEEC (_ceec)	0,22%	0,50%	10,8%	0,01%	0,03%	19,3%
ASIA (_asia)	0,34%	0,50%	4,8%	0,01%	0,02%	8,1%
Manufacturing						
Total	29,76%	28,69%	-0,5%	0,45%	1,15%	12,4%
OECD-22 (_oecd)	27,03%	25,08%	-0,9%	0,43%	1,09%	12,2%
CEEC (_ceec)	0,53%	1,21%	10,9%	0,00%	0,02%	23,3%
ASIA (_asia)	0,75%	1,02%	3,8%	0,01%	0,01%	10,6%
Market services						
Total	3,50%	4,32%	2,7%	1,52%	2,77%	7,8%
OECD-22 (_oecd)	3,18%	3,81%	2,3%	1,46%	2,63%	7,6%
CEEC (_ceec)	0,04%	0,09%	10,3%	0,01%	0,04%	17,6%
ASIA (_asia)	0,11%	0,21%	7,8%	0,02%	0,03%	6,8%

Source: own calculations

Table 2a Summary of the data and econometric methodology used in studies on the total employment impact of offshoring

	Period	Country/ region	Industry detail	Labour demand	Depend. variable[d]	Controls	Econometric methodology
Falk and Wolfmayr (2005)	1995-2000[a]	EU7	144 manuf. (pooled)	Cond., static	FT+PT	Wage, output	LD
Falk and Wolfmayr (2008)	1995-2000[a]	EU5	105 manuf. 100 serv. (pooled)	Cond., static	FT+PT	Wage, output	LD
OECD (2007a)	1995-2000[a]	OECD12	266 manuf. (pooled)	Cond. & uncond., static	FTE and FT+PT	Wage, output, output price, invest. deflator	LD
OECD (2007b)	1995-2000[a]	OECD17	182 manuf. 58 serv. (pooled)	Cond. & uncond., static	na[e]	Wage, output, output price, capital stock, R&D intensity	LD
Amiti and Wei (2005)	1995-2001	UK	69 manuf. 9 serv.	Cond. & uncond., static & dynamic	na[e]	Wage, output[f], output price, output price	LD, FD and FE[g]
Amiti and Wei (2006)	1992-2000	US	96 manuf.[b]	Cond. & uncond., static & dynamic	na[e]	Wage, output, output price, import share, hi-tech capital	LD, FD, FE, IV and GMM
Cadarso et al. (2008)	1993-2002	Spain	93 manuf.[c]	Cond., dynamic	hours	Wage, output	FD, FE and DPD

Legend: EU7 = Austria, Denmark, Finland, Germany, Italy, the Netherlands and Sweden; EU5 = Austria, Finland, Germany, Italy and the Netherlands; OECD12 = Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Norway, South Korea, Sweden and the United States; OECD17 = Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, the United Kingdom and the United States; FT+PT: total number of full-time and part-time employed; FTE: full-time equivalents; LD: long differences; FD: first differences; FE: fixed effects; IV: instrumental variables; GMM: generalised method of moments; DPD: dynamic panel data methods (both difference and systems GMM).

Remarks: a: no data for intermediate years; b: 450 industries for some estimations; c: separate data on the offshoring intensity is available for only 26 more aggregated industries; d: total industry employment; e: no information is provided on how total industry employment is measured; f: nominal output for service industries; g: also includes a specification with a lagged dependent variable among the explanatory variables, but no information is provided on whether this is estimated using a GMM-technique.

Table 2b Summary of the offshoring measures used in studies on the total employment impact of offshoring

	Source - Calculation	Denominator	Value/ Volume	Narrow/ Broad	Materials offshoring	Services offshoring	Regional data
Falk and Wolfmayr (2005)	Imported use tables	Output	Current prices	narrow	yes	no	yes[g]
Falk and Wolfmayr (2008)	Imported use tables	Output	Current prices	both[c]	yes	yes[e]	yes[h]
OECD (2007a)	Imputed	Total intermediate inputs[a]	Current prices	broad	yes	yes[f]	no
OECD (2007b)	Imputed	Value-added	Current prices	both[d]	yes	yes[f]	no
Amiti and Wei (2005)	Imputed	Total intermediate inputs[a]	Current prices	broad	yes	yes[f]	no
Amiti and Wei (2006)	Imputed	Total intermediate inputs[a]	Current prices	broad	yes	yes[f]	no
Cadarso et al. (2008)	Imported use tables	Output	Deflated[b]	narrow	yes	no	yes[i]

Remarks: a: excluding energy inputs; b: no information is provided on how this measure has been deflated; c: broad offshoring only for services; d: includes ‘narrow offshoring’ and ‘difference offshoring’, which sum to ‘broad offshoring’; e: total services offshoring and business services offshoring; f: business services offshoring only; g: distinction between low-wage countries (CEEC and Asian countries) and high-wage countries; h: for materials offshoring, distinction between high-wage countries, CEEC, and China and East Asian countries, and for services offshoring, distinction between high-wage and low-wage countries; i: for enlarged region of CEEC only.

Table 3 Summary of the estimated coefficients for the offshoring variables in studies on the total employment impact of offshoring

	Manufacturing industries		Service industries	
	Materials offshoring	Services offshoring	Materials offshoring	Services offshoring
Falk and Wolfmayr (2005)	ns/-[b]	x	x	x
Falk and Wolfmayr (2008)	ns	ns	x	ns/-[i]
OECD (2007a)	-	-	x	x
OECD (2007b)[a]	-/ns[c]	-/ns[f]	x	x
Amiti and Wei (2005)	ns	+	-[h]	-[h]
Amiti and Wei (2006)	ns/+[d]	ns/-[g]	x	x
Cadarso et al. (2008)	ns/-[e]	x	x	x

Legend: ns: not significant; +: positive; -: negative; x: not estimated.

Remarks: a: labour demand equations augmented by ‘narrow offshoring’ and ‘difference offshoring’ are also estimated for all industries, i.e. without a distinction between manufacturing and service industries, where ‘narrow offshoring’ is negative significant and ‘difference offshoring’ not significant in conditional labour demand and ‘difference offshoring’ is positive significant and ‘narrow offshoring’ not significant in unconditional labour demand; b: negative only for offshoring to low-wage countries for less skill-intensive industries; c: not significant for broad offshoring and in the unconditional labour demand specification; d: positive, but very small in some specifications; e: negative only for offshoring to CEEC for medium high-tech industries; f: not significant in the unconditional labour demand specification; g: negative only in a few specifications; h: small sample size for service industries; i: only total services offshoring considered, negative coefficient only for offshoring to low-wage countries.

Table 4 Static conditional labour demand equations for the manufacturing sector, 1995-2003

	Fixed effects estimation for 1995-2003, equation (3), dependent variable L_t			
	(1)	(2)	(3)	(4)
w_t	-0.288 (0.127)**	-0.296 (0.132)**	-0.268 (0.120)**	-0.227 (0.099)**
w_{t-1}	0.040 (0.151)	0.046 (0.148)	0.032 (0.132)	0.020 (0.138)
Y_t	0.219 (0.079)***	0.222 (0.080)***	0.217 (0.072)***	0.200 (0.071)***
Y_{t-1}	0.064 (0.076)	0.061 (0.076)	0.066 (0.076)	0.068 (0.073)
om_t	0.035 (0.027)			
om_{t-1}	0.046 (0.023)**			
os_t	0.013 (0.009)			
os_{t-1}	-0.004 (0.010)			
om_oecd_t		0.012 (0.043)		
om_oecd_{t-1}		0.025 (0.026)		
os_oecd_t		0.013 (0.009)		
os_oecd_{t-1}		-0.004 (0.010)		
om_ceec_t			-0.004 (0.022)	
om_ceec_{t-1}			-0.011 (0.018)	
os_ceec_t			0.012 (0.009)	
os_ceec_{t-1}			-0.004 (0.009)	
om_asia_t				0.034 (0.010)***
om_asia_{t-1}				0.019 (0.013)
os_asia_t				0.013 (0.009)
os_asia_{t-1}				-0.004 (0.010)
cons	1.697 (0.699)**	1.638 (0.689)**	1.479 (0.799)*	1.835 (0.710)**
N	464	464	464	464
R^2	0.934	0.937	0.917	0.923
AIC	-984.46	-976.65	-976.09	-1000.68
BIC	-922.36	-914.55	-913.99	-938.59
Joint significance F(15,57)-test for all parameters				
p-value	[0.000]	[0.000]	[0.000]	[0.000]
Joint significance tests (F(2,34)-test, p-value)				
w_t and w_{t-1}	[0.073]	[0.076]	[0.052]	[0.024]
Y_t and Y_{t-1}	[0.019]	[0.017]	[0.005]	[0.005]
om_k_t and om_k_{t-1}	[0.086]	[0.651]	[0.815]	[0.004]
os_k_t and os_k_{t-1}	[0.306]	[0.314]	[0.373]	[0.294]

Source: own calculations, all estimations done with STATA.

Remarks: 58 manufacturing industries covered (see appendix for industry detail); all equations include year dummies; heteroskedasticity-robust standard errors in parentheses; in the last two lines, k is either void (for materials or service offshoring without a geographical split), or equal to i, e or a for the three regions defined above.

Legend: * p-value<0.1, ** p-value<0.05, *** p-value<0.01.

Table 5 Static conditional labour demand equations for the market service sector, 1995-2003

	Fixed effects estimation for 1995-2003, equation (3), dependent variable L_t			
	(1)	(2)	(3)	(4)
w_t	-0.720 (0.171)***	-0.717 (0.168)***	-0.638 (0.164)***	-0.716 (0.194)***
w_{t-1}	-0.394 (0.115)***	-0.396 (0.114)***	-0.367 (0.101)***	-0.304 (0.091)***
Y_t	0.509 (0.099)***	0.509 (0.099)***	0.447 (0.099)***	0.510 (0.113)***
Y_{t-1}	0.157 (0.100)	0.157 (0.103)	0.112 (0.096)	0.115 (0.120)
om_t	-0.037 (0.042)			
om_{t-1}	-0.004 (0.025)			
os_t	-0.017 (0.027)			
os_{t-1}	0.001 (0.028)			
om_oecd_t		-0.018 (0.037)		
om_oecd_{t-1}		-0.009 (0.023)		
os_oecd_t		-0.016 (0.027)		
os_oecd_{t-1}		-0.000 (0.029)		
om_ceec_t			0.028 (0.021)	
om_ceec_{t-1}			0.041 (0.018)**	
os_ceec_t			0.009 (0.024)	
os_ceec_{t-1}			0.005 (0.025)	
om_asia_t				-0.045 (0.027)
om_asia_{t-1}				0.018 (0.027)
os_asia_t				-0.004 (0.025)
os_asia_{t-1}				0.007 (0.024)
cons	1.840 (0.958)*	1.892 (0.955)*	3.187 (1.010)***	1.879 (1.074)*
N	280	280	280	280
R^2	0.801	0.802	0.776	0.803
AIC	-422.13	-420.04	-435.65	-427.87
BIC	-367.61	-365.52	-381.13	-373.35
Joint significance F(15,34)-test for all parameters				
p-value	[0.000]	[0.000]	[0.000]	[0.000]
Joint significance tests (F(2,34)-test, p-value)				
w_t and w_{t-1}	[0.001]	[0.001]	[0.000]	[0.001]
Y_t and Y_{t-1}	[0.000]	[0.000]	[0.000]	[0.000]
om_k_t and om_k_{t-1}	[0.612]	[0.735]	[0.038]	[0.263]
os_k_t and os_k_{t-1}	[0.783]	[0.822]	[0.924]	[0.912]

Source: own calculations, all estimations done with STATA.

Remarks: 35 service industries covered (see appendix for industry detail); all equations include year dummies; heteroskedasticity-robust standard errors in parentheses; in the last two lines, k is either void (for materials or service offshoring without a geographical split), or equal to i, e or a for the three regions defined above.

Legend: * p-value<0.1, ** p-value<0.05, *** p-value<0.01.

Table 6 Dynamic conditional labour demand estimations, equation (4), manufacturing and market service sector, total materials and service offshoring intensities, 1995-2003

	Manufacturing sector				Service sector			
	OLS-lev	FE	GMM-DIF	GMM-SYS	OLS-lev	FE	GMM-DIF	GMM-SYS
L_{t-1}	0.960***	0.715***	0.290***	0.885***	0.979***	0.949***	0.837***	0.894***
se(L_{t-1})	(0.028)	(0.047)	(0.102)	(0.131)	(0.008)	(0.065)	(0.095)	(0.040)
w_t	-0.086	-0.048	-0.406**	-0.169	-0.407***	-0.322***	-0.346*	-0.403**
se(w_t)	(0.114)	(0.127)	(0.162)	(0.367)	(0.096)	(0.092)	(0.208)	(0.181)
w_{t-1}	0.079	0.122	-0.186*	0.444**	0.350***	0.258**	0.329*	0.288
se(w_{t-1})	(0.102)	(0.084)	(0.102)	(0.188)	(0.098)	(0.103)	(0.190)	(0.197)
Y_t	0.218**	0.162*	0.208*	0.188	0.307***	0.261***	0.272***	0.345***
se(Y_t)	(0.092)	(0.088)	(0.121)	(0.166)	(0.060)	(0.048)	(0.084)	(0.071)
Y_{t-1}	-0.178**	-0.123***	0.069*	-0.176**	-0.276***	-0.270***	-0.228**	-0.197***
se(Y_{t-1})	(0.073)	(0.040)	(0.040)	(0.073)	(0.057)	(0.083)	(0.092)	(0.060)
om_t	0.012	0.009	0.042**	0.019	0.010	0.013	0.020	0.020
se(om_t)	(0.013)	(0.013)	(0.019)	(0.024)	(0.013)	(0.009)	(0.015)	(0.012)
om_{t-1}	-0.009	0.001	0.048***	0.015	-0.015	-0.011	0.010	-0.012
se(om_{t-1})	(0.013)	(0.018)	(0.014)	(0.025)	(0.012)	(0.015)	(0.018)	(0.024)
os_t	0.011	0.009	0.004	0.003	0.024*	0.012	0.021*	0.028**
se(os_t)	(0.007)	(0.006)	(0.009)	(0.011)	(0.012)	(0.010)	(0.012)	(0.013)
os_{t-1}	-0.010*	-0.012	-0.007	-0.011	-0.009	-0.017	-0.018	-0.020
se(os_{t-1})	(0.006)	(0.009)	(0.009)	(0.010)	(0.012)	(0.014)	(0.015)	(0.023)
m1			[0.566]	[0.012]			[0.015]	[0.012]
m2			[0.625]	[0.940]			[0.790]	[0.946]
Sargan			[0.000]	[0.000]			[0.011]	[0.000]

Source: own calculations, all estimations done with STATA.

Remarks: 58 manufacturing and 35 service industries covered (see appendix for industry detail); all equations include year dummies; wage variables taken as predetermined in GMM-estimations; OLS-lev: ordinary least squares estimation for levels; FE: fixed effects estimation; GMM-DIF: difference generalised method of moments estimator (one step) using L_{t-2}, L_{t-3}, w_{t-2} and w_{t-3} as instruments for the differenced equation; GMM-SYS: systems generalised method of moments estimator (one step) using L_{t-2}, L_{t-3}, w_{t-2} and w_{t-3} as instruments for the differenced equation, as well as ΔL_{t-1} and Δw_{t-1} as instruments for the levels equation; all reported standard errors are heteroskedasticity-robust; m1 and m2: Arellano-Bond tests for first-order and second-order autocorrelation of the first-differenced residuals – p-values reported (H_0: no autocorrelation); Sargan: test of validity of over-identifying restrictions for GMM-estimators – p-values reported (H_0: overidentifying restrictions valid).

Table A1 List of industries, SUT-code and description

14A1	Mining and quarrying of stone, sand, clay and chemical and fertilizer materials, production of salt, and other mining and quarrying n.e.c.
15A1	Production, processing and preserving of meat and meat products
15B1	Processing and preserving of fish and fish products
15C1	Processing and preserving of fruit and vegetables
15D1	Manufacture of vegetable and animal oils and fats
15E1	Manufacture of dairy products
15F1	Manufacture of grain mill products, starches and starch products
15G1	Manufacture of prepared animal feeds
15H1	Manufacture of bread, fresh pastry goods, rusks and biscuits
15I1	Manufacture of sugar, chocolate and sugar confectionery
15J1	Manufacture of noodles and similar farinaceous products, processing of tea, coffee and food products n.e.c.
15K1	Manufacture of beverages except mineral waters and soft drinks
15L1	Production of mineral waters and soft drinks
16A1	Manufacture of tobacco products
17A1	Preparation and spinning of textile fibres, weaving and finishing of textiles
17B1	Manufacture of made-up textile articles, except apparel, other textiles, and knitted and crocheted fabrics
18A1	Manufacture of wearing apparel; dressing and dyeing of fur
19A1	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20A1	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw
21A1	Manufacture of pulp, paper and paper products
22A1	Publishing
22B1	Printing and service activities related to printing, reproduction of recorded media
23A1	Manufacture of coke, refined petroleum products and nuclear fuel
24A1	Manufacture of basic chemicals
24B1	Manufacture of pesticides and other agro-chemical products
24C1	Manufacture of paints, varnishes and similar coatings, printing ink and mastics
24D1	Manufacture of pharmaceuticals, medicinal chemicals and botanical products
24E1	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations
24F1	Manufacture of other chemical products
24G1	Manufacture of man-made fibres
25A1	Manufacture of rubber products
25B1	Manufacture of plastic products
26A1	Manufacture of glass and glass products
26B1	Manufacture of ceramic products
26C1	Manufacture of cement, lime and plaster
26D1	Manufacture of articles of concrete, plaster and cement; cutting, shaping and finishing of stone; manufacture of other non-metallic mineral products
27A1	Manufacture of basic iron and steel and of ferro-alloys and tubes
27B1	Other first processing of iron and steel; manufacture of non-ferrous metals; casting of metals
28A1	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
28B1	Treatment and coating of metals; general mechanical engineering
28C1	Manufacture of cutlery, tools, general hardware and other fabricated metal products
29A1	Manufacture of machinery for the production and use of mechanical power, except aircraft and vehicle engines
29B1	Manufacture of other general purpose machinery
29C1	Manufacture of agricultural and forestry machinery and of machine tools
29D1	Manufacture of domestic appliances
30A1	Manufacture of office machinery and computers

31A1	Manufacture of electric motors, generators and transformers, of electricity distribution and control apparatus, and of insulated wire and cable
31B1	Manufacture of accumulators, batteries, lamps, lighting equipment and electrical equipment
32A1	Manufacture of radio, television and communication equipment and apparatus
33A1	Manufacture of medical, precision and optical instruments, watches and clocks
34A1	Manufacture of motor vehicles
34B1	Manufacture of bodies (coachwork) for motor vehicles, of trailers and parts and accessories for motor vehicles
35A1	Building and repairing of ships and boats; manufacture of locomotives and rolling stock, and of aircraft
35B1	Manufacture of motorcycles and bicycles and other transport equipment n.e.c.
36A1	Manufacture of furniture
36B1	Manufacture of jewellery and related articles
36C1	Manufacture of musical instruments, sports goods, games and toys; miscellaneous manufacturing
37A1	Recycling
50A1	Sale, maintenance and repair of motor vehicles and motorcycles, parts and accessories
50B1	Retail sale of automotive fuel
51A1	Wholesale trade and commission trade, except of motor vehicles and motorcycles
52A1	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods
55A1	Hotels and other provision of short-stay accommodation
55B1	Restaurants, bars, canteens and catering
60A1	Transport via railways
60B1	Other scheduled passenger land transport; taxi operation; other land passenger transport
60C1	Freight transport by road; transport via pipelines
61A1	Sea and coastal water transport
61B1	Inland water transport
62A1	Air transport
63A1	Activities of travel agencies and tour operators; tourist assistance activities n.e.c.
63B1	Cargo handling and storage, other supporting transport activities; activities of other transport agencies
64A1	Post and courier activities
64B1	Telecommunications
65A2	Financial intermediation, except insurance and pension funding
66A2	Insurance and pension funding, except compulsory social security
67A1	Activities auxiliary to financial intermediation
70A1-	Real estate activities
71A1	Renting of automobiles and other transport equipment
71B1	Renting of machinery and equipment and personal and household goods
72A1	Computer and related activities
73A1	Research and development
74A1	Legal activities, accounting activities; market research and public opinion polling
74B1	Business and management consultancy activities; management activities of holding companies
74C1	Architectural and engineering activities and related technical consultancy
74D1	Advertising
74E1	Labour recruitment and provision of personnel
74F1	Investigation and security activities; industrial cleaning; miscellaneous business activities n.e.c.
85A1	Human health activities
85B1	Veterinary activities
85C1	Social work activities
92A1	Motion picture and video activities; radio and television activities
92B1	Other entertainment activities

Remark: line separates manufacturing from service industries.

Table A2 Descriptive statistics for the dependent variable (employment, L_t) and the control variables (wage, w_t, and value added, Y_t), manufacturing sector, market service sector and all industries, 1995-2003

Manufacturing sector

	1995	2003	Δ	avg g rate
Employment (millions of hours)	1026	930	-96	-1,2%
Employment (thousands of employees)	653	598	-55	-1,1%
Worked hours (hours per employee year)	1571	1555	-16	-0,1%
Real wage rate (euros per hour)	25,5	30,9	5,4	2,4%
Value-added (millions of euros)	38337	42874	4537	1,4%
Value added price (deflator =100 in 2000)	99,5	100,4	1,0	0,1%

Market service sector

	1995	2003	Δ	avg g rate
Employment (millions of hours)	2042	2471	429	2,4%
Employment (thousands of employees)	1445	1740	295	2,3%
Worked hours (hours per employee year)	1413	1420	7	0,1%
Real wage rate (euros per hour)	24,0	25,4	1,4	0,7%
Value-added (millions of euros)	94517	115884	21367	2,6%
Value added price (deflator =100 in 2000)	92,3	106,5	14,2	1,8%

All industries

	1995	2003	Δ	avg g rate
Employment (millions of hours)	3068	3402	333	1,3%
Employment (thousands of employees)	2098	2338	240	1,4%
Worked hours (hours per employee year)	1462	1455	-7	-0,1%
Real wage rate (euros per hour)	24,5	26,9	2,4	1,2%
Value-added (millions of euros)	132854	158758	25904	2,3%
Value added price (deflator =100 in 2000)	94,3	104,8	10,5	1,3%

Source: Belgian Institute of National Accounts (INA).

Remarks: Δ: absolute change; avg g rate: average growth over the period 1995-2003; employment (millions of hours) corresponds to L_t; wage rate (euros per hour) corresponds to w_t; value-added (millions of euros) corresponds to Y_t; value-added price (deflator =100 in 2000) corresponds to P_t.

Table A3 Autoregressive characteristics of employment (L_t), wage (w_t) and value added (Y_t), manufacturing and market service sector, 1995-2003

Alternative estimation methods for the AR(1) for L_t, 1995-2003

	Manufacturing sector				Service sector			
	OLS-lev	FE	GMM-DIF	GMM-SYS	OLS-lev	FE	GMM-DIF	GMM-SYS
L_{t-1}	0.998***	0.718***	0.395***	0.873***	1.008***	0.928***	0.865***	1.082***
se(L_{t-1})	(0.006)	(0.054)	(0.082)	(0.070)	(0.004)	(0.051)	(0.068)	(0.046)
m1			[0.689]	[0.000]			[0.063]	[0.036]
m2			[0.536]	[0.311]			[0.831]	[0.901]
Sargan			[0.000]	[0.000]			[0.011]	[0.000]

Alternative estimation methods for the AR(1) for w_t, 1995-2003

	Manufacturing sector				Service sector			
	OLS-lev	FE	GMM-DIF	GMM-SYS	OLS-lev	FE	GMM-DIF	GMM-SYS
w_{t-1}	0.958***	0.503***	0.670***	0.765***	0.986***	0.646***	0.050	0.639***
se(w_{t-1})	(0.018)	(0.065)	(0.121)	(0.090)	(0.015)	(0.093)	(0.259)	(0.194)
m1			[0.000]	[0.001]			[0.355]	[0.015]
m2			[0.446]	[0.461]			[0.215]	[0.140]
Sargan			[0.001]	[0.000]			[0.029]	[0.004]

Alternative estimation methods for the AR(1) for Y_t, 1995-2003

	Manufacturing sector				Service sector			
	OLS-lev	FE	GMM-DIF	GMM-SYS	OLS-lev	FE	GMM-DIF	GMM-SYS
Y_{t-1}	0.987***	0.644***	0.362	0.705***	1.005***	0.631***	0.344	1.023***
se(Y_{t-1})	(0.015)	(0.043)	(0.236)	(0.071)	(0.009)	(0.076)	(0.489)	(0.068)
m1			[0.103]	[0.032]			[0.444]	[0.007]
m2			[0.244]	[0.296]			[0.263]	[0.273]
Sargan			[0.000]	[0.000]			[0.000]	[0.001]

Source: own calculations, all estimations done with STATA.

Remarks: 58 manufacturing and 35 service industries covered (see appendix for industry detail); all equations include year dummies; OLS-lev: ordinary least squares estimation for levels; FE: fixed effects estimation; GMM-DIF: difference generalised method of moments estimator (one step) using respectively L_{t-2} and L_{t-3}, w_{t-2} and w_{t-3} or Y_{t-2} and Y_{t-3} as instruments for the differenced equation; GMM-SYS: systems generalised method of moments estimator (one step) using respectively L_{t-2} and L_{t-3}, w_{t-2} and w_{t-3} or Y_{t-2} and Y_{t-3} as instruments for the differenced equation, and ΔL_{t-1}, Δw_{t-1} or ΔY_{t-1} as instruments for the levels equation; heteroskedasticity-robust standard errors for se(L_{t-1}), se(w_{t-1}) and se(Y_{t-1}); m1 and m2: Arellano-Bond tests for first-order and second-order autocorrelation of the first-differenced residuals – p-values reported (H_0: no autocorrelation); Sargan: test of validity of over-identifying restrictions for GMM-estimators – p-values reported (H_0: overidentifying restrictions valid).