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Qualitative Employment Multipliers for Belgium, Results for 2000 and 2002

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Abstract - The paper describes how an input-output table can be linked to detailed employment data in order to provide qualitative employment multipliers. Qualitative employment multipliers specify the direct and indirect labour use by final demand products of worker types differentiated by gender, age class, professional status, educational attainment level, labour regime or a combination of these characteristics.

The paper discusses the methodological issues involved in compiling qualitative employment multipliers, with special attention to the homogenisation of employment data, and presents results for the Belgian economy for 2000 and 2002. These are based on input-output tables, a make matrix and disaggregated employment data for these years. It explores how qualitative employment multipliers can be updated.

The paper suggests three descriptive applications of qualitative employment multipliers. The first is to identify activities with a high employment multiplier for low-skilled workers. The second is to compute the high-skilled labour content of the production of ICT goods and services. The third is to generate qualitative employment multipliers per final demand component, distinguishing exports, investment and household or government consumption.

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Executive Summary

This paper introduces the notion of qualitative employment multipliers. Employment multipliers give the cumulative employment generation by final demand product. This includes employment in firms that directly service final demand (in the form of exports, final consumption or investments) as well as indirect employment in their chain of suppliers. The employment multipliers are called qualitative because for each final demand product a set of multipliers was computed. Each of these give the employment use of a specific gender, age class, professional status, education level and labour regime (full-time versus part-time)

Qualitative employment multipliers provide a link between final demand products and disaggregated employment data at the industry level. This involves homogenising employment data. In contrast to intermediate demand, few methods have been put forward for homogenising employment data. In the paper this is done using industry technology, while the intermediate inputs in the input-output table itself can be homogenised by commodity technology. Several arguments are given as to why it is impractical and less appropriate to homogenise disaggregated employment data using commodity technology, but we do not want to draw any definitive conclusions on that matter.

The paper first presents results for non qualitative employment multipliers for the Belgian economy for the year 2000. A traditional example is the case of manufacturing. While only 16% of all workers are employed in manufacturing, final demand for manufactured goods was responsible for 24% of cumulated employment[1]. This difference is due to the high indirect employment generation in manufacturing. One person directly employed to produce manufactured goods is associated with 1.08 persons indirectly employed, while for total final demand the indirect employment generation is limited to 0.52 persons. We say that manufacturing has a high relative employment multiplier of 2.08 (=1 + 1.08) [2]. Despite this high relative employment multiplier the manufacturing cumulated employment share of 24% remains low compared to the 38% share for manufactured goods in final demand. This is due to the low absolute employment multiplier of manufacturing. A million euro of final demand expenditures on manufactured goods only leads to the cumulated employment of 7.7 persons, while for total final demand, this is 12 persons.

In qualitative terms, final demand for manufactured goods has generated 30% of (cumulated) male employment and 28% of low-skilled employment, but only 17% of female employment and 14% of part-time cumulative employment. The low share of part-time workers in manufac-

1 The cumulative employment approach reallocates all employment related to intermediate supplies of goods and services towards the final demand products that use them. What is gained by manufactured goods is lost in other products, since total cumulated employment still equals total employment.

2 The relative employment multiplier of a final demand product is the ratio of its cumulated to its direct employment generation.

turing already partly explains its low absolute employment multiplier as the latter is expressed in number of persons (and not in full-time equivalents).

The paper proposes three more developed descriptive uses of qualitative employment multipliers. In the first, qualitative employment multipliers are used to identify the final demand products that generate the most low-skilled employment. We found that 10 goods or services, representing only 6.3% of total final demand were responsible for 17.1% of cumulated low-skilled employment. Thus, even if most low-skilled workers still work in other activities, stimulating demand for these activities could be an efficient way to increase the employment of low-skilled persons.

The second application is in the context of the technology-skill literature. Since qualitative employment multipliers include both direct and indirect employment they are a good measure for testing the relation between the production of new goods and services (such as ICT in 2000) and the use of high-skilled labour. The technology–skills literature expects this relation to be positive. We found that in 2000 34% of cumulative employment generated by final demand for ICT goods was tertiary schooled. For ICT services this is 40%. For non-ICT goods and services these figures are down to 22% and 35% respectively. Still, a million euro spent on ICT services generates less tertiary schooled employment than does a million spent on non-ICT services.

In the third application, the distinction between input-output products is used to generate distinct employment multipliers for the major components of final demand. Our results confirm predictions derived from trade theory that Belgian exports use less (cumulative) employment than consumption and investment. Thus the famous Leontief Paradox does not arise for Belgium in 2000. As for the use of high-skilled labour, a new paradox may arise though, because while exports use relatively more tertiary schooled workers than consumption by households, it is government consumption -which faces the least international competition- that makes the most intensive use of tertiary schooled workers.

The differences in employment multipliers have influenced the employment generation of final demand components. With its final demand share of 16.2%, government consumption is responsible for 26.5% of cumulative employment and as much as 40% of tertiary schooled employment in 2000. Most of this 40% is generated by education services (47%), followed by social work services (28%). The low employment multipliers for exports have translated their final demand share of 45% into a cumulated employment share of 33% in 2000. Their cumulative employment share of tertiary schooled workers was limited to 28%.

The paper ends by showing some results for 2002 based on updated versions of the input-output and make tables for that year. Along with these results, the issue of updating qualitative employment multipliers is briefly discussed.

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1. Introduction

Employment multipliers relate the final demand for domestically produced goods and services with the employment that is cumulatively (directly + indirectly) used in the production process.

An employment multiplier can be expressed in two ways. It can be a ratio of employment to final demand or to one of its components, such as private consumption, investments or exports. Alternatively an employment multiplier can be defined as the ratio of the cumulated over the direct employment generated by final demand of a product. This relative employment multiplier[3] states how the employment of 1 000 workers directly involved in an industry's final demand production is related to the employment of, say, 600 more workers in the industry's chain of domestic suppliers.

Output and employment multipliers are generally considered as giving the effects of shocks in final demand. Depending on whether the A matrix does or does not include the household sector, the multipliers yield either direct + indirect effects alone or include induced effects as well[4]. We focus here on the descriptive properties of employment multipliers and introduce the notion of qualitative employment multipliers.

For a given year, employment multipliers specify the total number of workers that have been involved directly and indirectly in the production of various final demand products. They describe the labour use in a given economy. Qualitative employment multipliers also specify the labour use of final demand products but in addition differentiate workers by gender, age class, professional status, educational attainment level or a combination of these or other characteristics. Thus the multiplier is used descriptively, but the description is enriched.

The novelty of this work is in not merely showing employment multipliers for a few distinct labour types[5], but providing a method that does this consistently and simultaneously for a large number of worker characteristics. The paper discusses two important methodological issues in this field: that of homogenisation of industry based employment data and that of aggregation of (qualitative) employment multipliers.

First consider the homogenisation issue. To generate differences between labour categories, we use the Belgian SAM sub-account for labour demand that was created for the period 1999-2005. This database, created at the Federal Planning Bureau, gives employment data by category at a

3 Miller & Blair (1985) make the same distinction between (what we call) absolute and relative employment multipliers. Both expressions are called employment multipliers. Some authors, such as Reuda Cantuche (2007) work with an absolute interpretation of employment multipliers. Others, such as Avonds, Deguel & Gilot (2003) and Bivens (2003), use the relative representation. In the case of output multipliers, the absolute multiplier equals the relative one, since it already translates euros into euros.

4 See Miller & Blair (1985) and West & Jensen (1980). We do not consider induced income effects in this paper.

5 Other authors have already done this. For recent examples, see Koller (2006) and Schaffer (2007).

detailed industry level[6]. In these data, industries are a group of firms that produce the same major output, but may have a secondary product[7]. In a traditional symmetric input-output framework, both the final demand and employment are specified at the product level, since the industries in the symmetric input-output table are homogenised. Thus, the problem is that of linking labour data at a heterogeneous industry level with final demand at the product level.

The issue of homogenising intermediate demand by using either industry or product technology has since long been the subject of debate among IO scholars and practitioners (see Avonds (2007), Konijn (2002)). The homogenisation of employment data has received less attention. Homogenised data for hours worked have been used recently for distinguishing women's and men's contributions to final demand in Germany (Schaffer, 2007). The author only adds the distinction between men and women and does not mention how the detailed labour volume data have been homogenised. This could be done by using a commodity technology or an industry technology type of approach.

Koller (2006) briefly discusses the homogenisation of employment data using commodity technology. The author tried to derive a commodity by employment category matrix with a distinction between employees and self-employed and between jobs and full-time equivalents for Austria. His Enhanced Almon Method worked well to homogenise intermediate demand, but yielded implausible results -which the author choose not to publish- for wages and salaries per employee (job).

Our objective is to generate a richer set of employment multipliers, detailing the relation between final demand products and employment categories by gender, age class, professional status and education level and all combinations of these characteristics. Section 2 presents how this can be done using an IO table, detailed employment data and a make matrix. Our method combines the use of industry technology for homogenising detailed employment data with a symmetric IO table that was itself derived using commodity technology. The discussion in section 2 gives the arguments around this choice.

The paper also looks at the issue of aggregating employment multipliers and shows how they can be used to represent the employment importance of an economic activity. This is important if one advocates the descriptive use of employment multipliers. This is done in section 3, which gives the main results for the qualitative employment multipliers in Belgium in 2000 at the level of 9 and 36 products.

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6 Industry employment totals from the national accounts (published in October 2006) have been detailed by gender, age class and professional status using detailed social security data and further disaggregated by educational levels using Labour Force Survey data. For a description of the compilation method, see Bresseleers, V. *et al* (2007).

7 It is more straightforward to collect labour data at firm or heterogeneous industry level, than to do so at the level of (local) units within firms that produce the same product. Survey data, such as the Labour Force Survey, do not often provide such information, while the plant level data in social security sources is insufficiently oriented at differentiating between different products.

The usefulness of qualitative employment multipliers as a descriptive tool results in particular from the fact that they provide a link between products and employment categories. In this way, qualitative employment multipliers enable the provision or verification of stylized facts in varying economic issues. In section 4 we give three examples of how this link between specific activities or products and employment types can be useful for economic theory or policy making.

First, we will show how qualitative employment multipliers can be used to identify activities that generate high employment for low-skilled workers. Low-skilled workers are defined as workers having completed only primary or lower secondary schooling. Second, qualitative employment multipliers are used to find out whether the production of ICT goods and services in Belgium is based on more high-skilled labour, as suggested by the technology-skill-complementarity literature. High-skilled labour is defined as tertiary schooled labour.

A third application is in the field of international trade theory. Final demand components such as household and government consumption, or exports and investments have very different product compositions. As a consequence, their employment multipliers can differ substantially. We tested the prediction, derived from trade theory, that Belgian exports would make less use of labour than other final demand components, assuming that Labour is a comparatively scarce production factor. We also compared the labour use of exports with that of other final demand components in terms of the skills levels.

In section 5, some of the results given for the year 2000 are shown for the year 2002. Along with the results for 2002 we discuss the important issue of updating employment multipliers. It is suggested that relative employment multipliers are less influenced by price changes and therefore more stable over time. However, this remains an issue for further research.

In section 6, some conclusions are formulated.

2. Deriving Qualitative Employment Multipliers

Employment multipliers are an extension of output multipliers, which themselves are given by the Leontief inverse. The vector n of (absolute) total employment multipliers is given by:

$$n' = l'(I - A^d)^{-1} \cdot \quad (1)$$

In (1), *l* is a vector of employment to output coefficients. The expression behind it is the Leontief inverse, with I the identity matrix and A^d the matrix of technical coefficients for domestically produced intermediate inputs, better known as the (domestic) input-output table. Each element of the vector n gives the direct + indirect employment generated by a specific final demand product. Although critiques have been formulated to this way of compiling employment multipliers, the model in (1) is still the conventional way to calculate them[8].

In this section we will generalise the row vector n′ of total employment multipliers in (1) towards a matrix N of qualitative employment multipliers. Each row of N will give the use of a specific employment category (for example: female, low-skilled, aged 20 to 25…). Each column will continue to be associated to a single final demand product.

To be able to link qualitative employment data at the (heterogenuous) industry level to the IO model outlined in (1), we will make use of the information contained in the Make table (M), which is the output part of the Supply table[9]. The rows of a Make table represent products, the columns industries, so that each element m_{ij} represents the amount of product i made by industry j. The Make table reflects the heterogeneity of industries and allows to distinguish industry’s main and secondary products.

The sections 2.1 to 2.3 show how the Make table can be used to translate final demand shocks into output and employment shocks. In section 2.4 we discuss this approach.

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8 Much of the literature on IO multipliers focuses on the issue of bias in their compilation. Simonovitis (1975) reported that under certain stochastic conditions, the non linear form of the Leontief inverse can transform white noise in the estimation of the coefficients in the matrix A^d into biased (overestimated) estimates of output and employment multipliers. This implies that the multipliers in (1) overestimate the true ones on average. Some authors have tried to estimate the size of this bias as well as the influence of aggregation and the IO compilation method on it. The results of Dietzenbacher (1995), Roland-Holst (1989) and Dietzenbacher (2006) are relatively comforting since they find on average no or only a small positive bias. Ten Raa and Rueda-Cantuche (2007) find larger potential bias and provide solutions based on circumventing the nonlinearities by using the Supply and Use framework.

9 A supply table further contains the imports and a transition by products from basic prices to purchaser prices involving product totals for trade and transport margins and product taxes and subsidies (ESA 1995 regulations).

2.1. The Output Multipliers of Final Demand

In an input-output model, the relation between final demand and output is given by:

$$q = (I - A^d)^{-1} \cdot f^d \tag{2}$$

In (2), f^d is the vector of final demand for domestic output. Final demand for domestic output includes all consumption, investments, exports and stock changes of goods and services that have been produced domestically. It excludes domestically produced intermediate uses and directly imported final demand.

The expression before f^d is the Leontief inverse. A^d is the matrix of technical coefficients for domestically produced intermediate inputs. This input-output table is of the product by product (p/p) type. Likewise, f^d is a vector of products. So far we only assumed the existence of a domestic p/p input-output table.

When using (2) as an impact model, one assumes that the coefficients of A^d are stable in the case of a final demand change. As can be seen by replacing f^d with a unity matrix (of shocks), the Leontief inverse can be interpreted as a matrix of output multipliers of final demand shocks, where each column yields the effect of a single product shock in final demand on all outputs.

The results in vector q are given in terms of products. To shift from products to industries one can use the matrix D of (product) market shares by industry. It is given by:

$$D = M' \cdot \hat{q}^{-1} \tag{3}$$

Here, M' is the transposed Make matrix, while $\hat{q}$ is a diagonal matrix of outputs by product. Post multiplying both sides in (3) with q yields:

$$Dq = M' i = g \tag{4}$$

g is defined as the vector of industry output totals. Using (4), we can rewrite (2) as:

$$g = D \cdot (I - A^d)^{-1} \cdot f^d \tag{5}$$

Thus pre-multiplying the Leontief inverse with a matrix of market shares yields the industry output levels as a function of final demand. Equation (5) is an equilibrium condition that holds in the year from which the IO and Make table are used. Under the additional assumption of constant market shares (constant D), equation (5) gives the impact of a final demand shock on the industry output levels. The industry output multipliers are given by the expression before f^d.

With D invertible[10], it is also possible to rewrite (5) as:

$$g = (I - D \cdot A^d D^{-1})^{-1} \cdot D \cdot f^d \tag{6}$$

[10] This implies that the number of industries equals the number of products.

Because $D\,f^d$ equals final demand by industry, a shock that hits an industry as a whole can be brought in by replacing $D\,f^d$ by the appropriate shock vector.

2.2. The Employment Generated by Final Demand

The employment generation of final demand can be obtained by pre-multiplying the expression on the right hand of (5) or (6) with an employment coefficient matrix L. This is a matrix of employment to output ratios given by:

$$L = S \cdot \hat{g}^{-1} \tag{7}$$

S is a matrix with in its columns industries. Its rows have every combination of the following labour types: gender, age class, professional status, education level and labour scheme (full-time, part-time). $\hat{g}$ is the diagonal matrix of industry production totals. S can reflect the number of persons (in their main occupation), but also hours or full-time equivalents, if such data are available by type of labour.

The matrix N of employment multipliers of final demand is given by:

$$N = L \cdot D \cdot (I - A^d)^{-1} \tag{8}$$

Each column in this matrix yields the cumulative employment for producing one unit of a final product (e.g. final demand of assembled cars). Each element of that column vector yields the effect of this shock for a single type of labour (e.g. men, aged 25-30, with lower secondary education, blue-collar worker, full-time). Adding up the elements of a column, yields the cumulated employment by product.

The matrix N is further called the matrix of qualitative employment multipliers. These multipliers are absolute multipliers (relating cumulated employment to final demand). For computing relative employment multipliers (relating cumulative to direct employment) it is necessary to separate direct and indirect employment, which is done in the next point.

Remark that the matrix N directly relates labour types with final demand[11]. If one is interested in the combined effects on industries and labour types of final demand, it is possible to compute:

$$\Delta S = L \cdot \Delta\hat{g} \tag{9}$$

Here, $\Delta\hat{g}$ is a diagonal matrix of the vector of industry output changes given by (5) that follow from a shock Δf^d in final demand.

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[11] Post multiplying the multiplier matrix in (8) with the final demand vector yields a vector of employment totals per labour type. For a proof of this, see equation (15) and proposition 1.

2.3. Separating Direct and Indirect Employment

Cumulated employment includes both direct and indirect labour. The indirect employment is generated by the intermediate demand for domestic production. Since the multiplication by the Leontief inverse is responsible for introducing the indirect effects, dropping it in (8) yields the direct employment multipliers, given below:

$$R = L \cdot D \tag{10}$$

Thus the direct employment multipliers are given by post multiplying the matrix L by the market shares matrix D. This multiplication yields a matrix that converts (one unit) product shocks into effects by employment type. The relative employment multipliers are obtained by dividing the elements in matrix N by the corresponding ones in matrix R.

It is not guaranteed that the direct effects given by equation (10) are always a good description of reality, since it imposes that the composition over labour types used in production only depends on the industry, and not on the products made. If for example in an industry high-skilled labour is relatively more involved in the production of a secondary product than in its main product, this would not be picked up by equation (10). The equation would of course take account of the higher skill intensity in the industry that has this secondary product as a main product, but the overall use of skilled labour for making it might still be underestimated.

Because equation (8) is an extension of equation (10), it faces the same problem. Both expressions will tend to underestimate product specific differences in the type of labour used. We will discuss this problem further in section 2.4.

2.4. Discussion

The first two points in this discussion treat the use of our qualitative employment multipliers for estimating the effects of final demand shocks. In point three we discuss the problems that arise if one wants to use them for descriptive purposes only.

2.4.1. The assumption of Constant Market Shares

The assumption of constant market shares says that, whenever there is a demand shock for a product, each industry maintains its market share of that product. We want to make sure that there is no incompatibility between this assumption of a constant D matrix and the use of any possible input-output table. The assumption of constant market shares is often related to the derivation of an input-output table (starting from supply and use tables) under the industry technology hypothesis. But product or commodity technology is seen as a more proper technology assumption[12].

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[12] See United Nations (1999), p 98 and Avonds (2007) for a discussion of this.

However, there is no inconsistency between assuming constant market shares and deriving a p/p input-output table under the product technology assumption! Under product technology, it is assumed that wherever a product is produced, the same input structure is used. In that case, the matrix of p/p technical coefficients A is given by[13] [14]:

$$A = U \cdot M^{-1} = (U \cdot \hat{g}^{-1}) \cdot (\hat{g} \cdot M^{-1}) = B \cdot C^{-1} \qquad (11)$$

In (11), U is the intermediate part of the use table and M is the Make table. The matrix B relates the intermediate use of products to the total production by industry, while the matrix C is a matrix of product shares (the shares of products in each industry's output). The matrix C is related to the matrix D used above. Given the definitions of D and C:

$$\hat{q} \cdot D' \cdot \hat{g}^{-1} = C \qquad (12)$$

Equation (12) expresses that, if the market shares matrix D is constant, any change in output vectors q and g caused by a final demand shock, will imply an adjustment of the product share matrix C. Thus, this matrix cannot be constant.

Although equation (11) comprises a matrix C, this matrix does not have to be constant if final demand changes. As argued by Avonds (2005), the necessary assumption for product technology is the constancy of A. Any change in C can be compensated by a change in B to obtain the same A matrix. Thus (5) and (8) can be combined with an input-output table that is based on product technology.

Still it is interesting to look at what happens if industry technology is used to derive the input-output table. In that case A^d equals B^d.D. Then equation (6) can be rewritten as:

$$g = (I - D \cdot B^d)^{-1} \cdot D \cdot f^d \qquad (13)$$

The expression $D.B^d$ is the industry by industry input-output table under industry technology[15]. If one accepts the assumptions behind this model, (13) can be applied directly to find the impact of final demand shocks (replacing f^d by the shock vector Δf^d) on employment by industry.

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13 The product of matrices B and C^{-1} may generate negatives, which can be removed, as has been done for the Belgian Input-output table, by applying the Almon (2000) method.

14 To simplify the discussion, equation 11 gives the derivation of the full matrix A, while the matrix A^d used in the former equations is obtained by subtracting the IO matrix of imports from A. It is possible to derive the IO matrix of imports respecting the product technology hypothesis, following a method proposed by Konijn, P. (2002). This methodology was used for deriving the Belgian IO matrix of imports of 1995 and 2000 (Avonds *et al* (2003)).

15 See United Nations (1999), p 91.

2.4.2. The Use of Qualitative Employment Multipliers for Impact Studies

Note that the assumption of constant market shares is only needed if one wants to use expressions (8) to (10) to estimate the impact of a shock. For using the qualitative employment multipliers as a descriptive tool this assumption is not necessary.

We underline this, because even with constant market shares, it is not obvious to interpret qualitative employment multipliers as impact multipliers. A qualitative employment multiplier for the year 2000 shows for example that 1 mln euro of final demand for agricultural products has generated, among other types of workers, the employment of 2.5 workers aged over 60 years (see table 3). But what does this tell us about the expected effect of shocks?

In the case of an increase in demand, would this benefit the older farmers as much as the younger farmers? And what in the case of a negative demand shock? Is it not likely that older farmers would tend to stop their activities earlier, given that they can retire? And what is the impact of labour supply? It could be that the demography and educational choices reduce the inflow of young agricultural workers so that their share in the workforce falls…

The possibility of differential reactions to demand shocks of different types of workers, as well as specific supply effects related with ageing, educational choices, female participation to the work force, migration, etc., make it more hazardous to use qualitative employment multipliers for impact studies than total employment multipliers. In the case of the latter, some of these age class, gender or skill specific effects disappear or are reduced by aggregation.

For assessing the impact of final demand shocks on the employment of specific types of labour, qualitative employment multipliers could still be considered as a first step. Since they reflect the situation in a given year, they can give a realistic order of magnitude, but for an impact evaluation, more information on supply behaviour is desirable.

2.4.3. Improving the Qualitative Employment Multipliers

If the cumulated and direct employment multipliers are simply used to describe the employment use by final demand product in a given year, the question remains whether this description is the most accurate one, which alternatives exist and which one is preferred.

If there is prior information on the detailed labour use for the production of a specific secondary product i within an industry j, this can be used to improve the estimate of the direct and cumulated effect in equations (10) and (8). One way to do this is to replace the matrix product $L.D$ with the matrix product $L_1.D_1$, where $L_1.$ is the adjusted matrix of employment coefficients with an additional column (industry) that contains only the product i in industry j for which detailed labour information is available and D_1 is the market shares matrix with an additional row for this new industry (containing only the production of product i in industry j). The matrix product $L_1.D_1$ will yield a different result than $L.D$, but has the same dimensions and interpretation.

In the absence of any prior employment information by product and industry, an alternative for equations (8) and (10) is to try to (pre)homogenise the detailed employment data in table *L* by some mechanic method. Indeed, if one works with a product to product input-output table A^d, why not also transform the employment data by industry into data by product?

This question has to be reformulated, because in fact we have homogenised the matrix *S*, using industry technology. To see this, note that in (8) and (10), the matrix of employment shares *L* is post-multiplied by *D*. This is exactly what would have been done if the employment data in *S* were homogenised using industry technology. Thus the model in (8) and (10) is one where the employment data are homogenised using industry technology, while the IO inputs could be homogenised using the commodity technology or (more generally) the best combination of commodity and industry technology.

So the question whether it is not preferable to try to homogenise the detailed employment data using commodity technology? The reasons why we have not opted for this method are discussed in the next point.

2.4.4. Why not Homogenising Detailed Labour Data by Product Technology?

If product technology is applied, analogously to equation (11) the matrix L could be homogenised as follows:

$$L_q = L \cdot C^{-1} \tag{14}$$

We mention four reasons why this approach is both less practical and less theoretically defendable in the case of detailed labour data compared to the homogenisation of intermediate inputs.

a. The negatives problem

Notice that the homogenised matrix L_q in (14) is obtained in the same way as the matrix of technical coefficients A in (11): by post multiplying a use matrix of input to output ratio's by the inverse of the matrix C. Therefore, like A, the matrix L_q will contain a lot of (small) negative cells. For this well known problem in the case of the A matrix, the literature has put forward solutions like RAS and Almon purification (Almon 2000).

Methods like Almon and RAS remove negative cells by replacing them with zeros (and reducing other coefficients to respect row totals). This may be acceptable for removing small negatives in the context of product inputs[16], but it is more painful in the context of labour types. After applying these methods, one would be forced to present a homogenised L_q matrix where certain production activities exclude women, persons aged between 50-60 years, workers with higher education, or some other category. Any person working in these activities is likely to discover swiftly some labour categories that are actually represented but omitted in the L_q matrix.

16 Large negatives imply a data problem or the incorrectness of the commodity technology hypothesis (Konijn, 2002)

Koller (2006) developed a generalization of Almon's algorithm that allows for replacing negative elements with non-zero elements. His solution is cumbersome though, because one has to formulate a lower bound matrix of labour types (or inputs) by commodities. In our case, we would have to do this for all 2 056 combinations of worker characteristics in our full S matrix[17].

Koller applied his method to employment categories introducing a distinction between full-time equivalents (FTE) and employment (jobs). In order to prevent FTE's to exceed employment figures, the author had to use the results for FTE's as lower bounds in the homogenisation of employment totals.

The fact that such procedures are necessary is disturbing, because it implies that the result for total employment use by commodity depends on the number and type of employment categories introduced in the calculation. It is the treatment of negatives that must be responsible for this feature, because the total employment that could be derived by aggregating the left side in (14) over all employment categories is invariant to the number of rows in L (= the number of employment categories). Our multipliers matrix in (8) also has this desirable feature of invariance with respect to the number of employment categories distinguished.

It is possible to circumvent the negatives problem and still compute employment multipliers based on commodity technology by avoiding the use of an IO table. Ten Raa and Rueda Cantuche (2007) propose to apply commodity technology directly to Supply and Use tables. In their approach the Supply and Use tables are aggregated into rectangular matrices that hold more industries than products. As a result, output and employment multipliers of final demand can be *estimated* using regression techniques. This approach yields multipliers that are said to be unbiased, and can differ substantially with those obtained using an IO table based on pure commodity technology (without correction for negatives that fall out when computing multipliers). For this method to be valid, it is of course necessary that the commodity technology hypothesis is valid both for homogenising intermediate demand and employment. The authors do not differentiate between different employment types. It is not sure how this method would react to different types of labour.

We conclude that, while some authors have been exploring the use of commodity technology to homogenise employment or compute employment multipliers, practical applications seem to be limited to only a few distinctions in labour categories. Some of the proposed solutions imply that total homogenised employment depends on the number of categories distinguished. Given the richness of our employment data, applying commodity technology would imply making painful choices, which is undesirable. We prefer to work with an S matrix with a very large number of labour types and their combinations.

The negatives problem is the first reason for preferring industry over commodity technology for homogenising employment data. In the next points some other arguments are developed.

[17] In comparison, the number of products in the input-output table is only about 300.

b. The weaker technological link

Even if the negatives can be replaced by non negative values or rendered invisible by aggregation, commodity technology is still as hypothetical as is industry technology. While assuming that the composition over labour types only depends on the industry may result in underestimating the differences in labour composition between products, assuming that industries do not matter is likely to lead to overestimating these differences.

On theoretical grounds, commodity technology is less defendable for detailed employment data than for intermediate demand because of the weaker technological link between labour categories and products. Products are usually technologically linked to specific inputs of raw materials, energy sources or intermediate goods and services. To paint houses, one needs paint, to make bread, one needs cereals, to make steel, one needs metal ores. But in principal, all these products can be made by male or female, low, medium or high-skilled, and young or older workers.

One could argue that some activities, like R&D, need more skilled labour while others, like cleaning, can do with unskilled labour. This can be verified by data using broad educational attainment levels (like having completed primary school, secondary or tertiary education) as a proxy for skills. Yet to suppose a mechanical or technological link between worker types and activities, one needs the detail of the professional formation or experience, which is not given here.

It is acceptable to assume a strong technological relation between activities and their main corresponding professions, be it engineers, teachers, accountants, nurses, waiters or metal workers. But different workers may have obtained equal professional skills by a different mixture of education and experience. If skill data only distinguish broad educational attainment levels, the links between activities and skills are no longer purely technological and become much more complex. For example, as a consequence of differences in experience and the rise in educational attainment levels over time, a relation exists between the workers age and their formation level. Industries or firms can realize the same activity using older low schooled workers (with at most lower secondary education) or young medium schooled workers (having finished higher secondary education).

Commodity technology would try to establish a link between a distribution of skill levels and/or age classes and each activity (good or service). Thus, if in the main industry producing a good, this is done by older low-skilled workers, while another industry that produces the same good as a (newer) secondary activity does this with young medium-skilled workers, commodity technology would subtract too much older low-skilled workers from the industry that has the good as a secondary product.

Of course, the argument that the same good or service can be produced using different technologies, can also be used to justify industry technology in the compilation of the IO itself. But the point is that for employment types, similar situations will be more frequent because it is not even necessary to work with a different technology. Besides the interaction between ages and skills, another interaction is possible between gender and labour regime. Two part-time working women can be a substitute for one full-time working man. But not all firms and industries are equally open to women or part-time work, as illustrated by our data (see further).

When the employment data are homogenised using industry technology, the employment that is allocated to each product will be a weighted average of the employment in the industries that produce it. This approach can be more empirical or prudent than applying commodity technology. In the context of gender differences commodity technology implies that each activity has its own unique allocation of male and female workers. While it could be acceptable to assume such a unique allocation as a working hypothesis, most researchers would want to avoid to call it “ideal” or “stable”.

c. The (in)stability of the employment coefficients

The stability of the homogenised employment data or that of the employment multipliers is not crucial if one only wants to use them for describing the employment generation by product in a given year. For this descriptive use, which we advocate, it is more important that employment multipliers can be updated easily. Here industry technology clearly has an advantage over commodity technology, as it avoids the problem of removing the negatives. Part 5 discusses the updating of employment multipliers.

Yet it is interesting to formulate some reflections about the stability of employment coefficients by industry or product.

In the absence of a firm technological link between activities and labour types, employment coefficients in a matrix like L_q should not be expected to be as stable over time as are input output coefficients (the A matrix, when valued in real terms) or data relating the use of professions to activities. In general, the use of labour categories, including gender, age classes or labour regimes, and (low/medium/high) schooled labour also depends on the supply of these labour types and its evolution. Substitutions between most of these labour types can more often be realised without changing the technology of the commodity or firm.

Nevertheless, our data and results reveal large and rather stable differences in the use of low and high schooled workers, male and female workers, different labour regimes or even age classes between industries[18]. Then the question is, if the differences in labour composition between industries are stable, what causes this stability in the absence of a technological link?

[18] Table 1 and 11 give the labour composition by industry for the years 2000 and 2002. Similar results are available for the year 2005, and show that (large) industries tend to have the same evolution in the skill, age and gender composition of their workers with the large differences between them unchanged.

Two reasons are possible: firms and industries would not have to change their labour composition much, because their product mix remains largely the same. Or firms and industries would not or only slowly adjust their labour composition in the light of changes in the product mix. The latter reason is of course in favour of choosing industry technology to homogenise employment data.

It could be developed as follows. If a firm's product mix changes in time, it can quickly adapt its use of intermediate goods and services to the new situation. But the costs of training workers, of hiring and firing them, as well as the actual labour market situation, may withhold it from directly adjusting its labour composition towards more "suitable" worker types for the new activities. Even if a firm decides to replace a part of the workers it considers less suitable, those experienced workers may be taken over by competitors in stead of inexperienced new workers, thus slowing down the "adjustment" of the industries labour composition to the appearance of new products.

d. The influence of firm and industry specific institutional factors

The schoolings level, experience and gender of the workers a firm can attract is likely to be strongly influenced by its hourly wages. Besides wages, remuneration of experience and seniority and labour conditions in a broad sense (stability of employment, possibilities for part-time work, work in shifts, night work…) can be expected to influence the labour composition. All these factors can differ substantially between firms even when they perform similar activities.

They depend among other things on a firm's remuneration policy, on its size, on the strength of labour unions, on its ownership (private or public), on the collective bargaining committee to which a firm adheres or on its work organization (work in shifts, night work etc.). Many of these factors could be influenced by a firm's industry (its main activity) and automatically extended to secondary activities.

e. The connection between employment and wage data

A serious problem with homogenising labour data using commodity technology is that the connection between wages and employment is lost. If wage data are homogenised using the C matrix as in (14), there is no guarantee that the wage data and employment data will match after homogenisation. In the case of detailed wage and employment data it is likely that quite some cells will have negative employment data and positive wage data and vice versa.

Koller (2006) homogenised wages and salaries and employees (jobs) with his commodity technology technique described above. He reported to find implausibly large differences for wages per employee job between commodity-based and (the original) activity based values.

If detailed wage data are homogenised using industry technology, they will remain comparable with the detailed employment data of their industries and no negatives problem will arise. Of course, inconsistencies could still arise between the obtained wage sum by product and the total intermediate use by product if the latter is derived by a method that is based mainly on commodity technology. This is because the wage costs are an important part of value added, which added up with intermediate demand equals the output of a product.

3. The Employment Multipliers for 2000

In this part we discuss the employment multipliers for 2000. That year was chosen because currently it is the last year for which a symmetric Belgian input-output table, compiled on the basis of a complete database, exists. In part 5 we will work with an IO update made for 2002.

In section 3.1, the basic employment data are presented. Section 3.2 discusses the total output and employment multipliers for 2000. In section 3.3 the qualitative employment multipliers are presented and discussed. In section 3.4 the same is done at a more detailed product level.

3.1. The Employment Data

Table 1 shows the employment data for 9 branches. It is comparable to the S matrix in (7), except that the industries have been aggregated into 9 broad groups. The worker characteristics have been aggregated, and combinations between different types of workers are left out[19].

Table 1 introduces a distinction between female and male workers, between 5 age classes and 4 educational attainment levels. A distinction has been made between private sector blue and white collar employees, public sector employees (including both civil servants & contractual workers in the public sector) and self employed. Employees are differentiated further between full-time and part-time workers. The latter include, besides part-time workers, seasonal workers and students.

The employment data in table 1 have been compiled at the Belgian Federal Planning Bureau and are consistent with the totals in national accounts. These data exist annually for the period 1999-2005 (Bresseleers,V. et al, 2007) and can be downloaded[20]. The data are consistent with the EU klems data Belgium provided to Eurostat in December 2006 and the national accounts employment data published in November 2006.

Table 1 reflects large differences in labour composition according to gender, age class, professional status and education level among branches. Thus, it can be expected that final demand products also differ in the type of labour used in their production process. To evaluate the relation between final demand products and employment types, qualitative employment multipliers will be computed. This is necessary not only because the industries in table 1 do not fully reflect products, but also because only multipliers reallocate workers involved in the production of intermediate products towards the final demand products that use it.

19 The full S-matrix used in the calculations has 147 industries and 2 056 combinations of worker characteristics. In the S-matrix all the elements in one column sum to the total number of workers in an industry. In table 1, the shares sum to one for each type.

20 The interested reader can find these employment data up to the level of 29 industries for the period 1999-2005 on the FPB-website (www.plan.be).

Table 1 Employment by Type for non Homogenised Industries, 2000 (shares)

Non homogenised industry:	Agriculture, forestry, fishing	Manufacturing	Mining, water & energy supply	Construction	Trade, repair, hotel and restaurant services	Transport, storage & communication	Financial, real estate & business activities	Public adm., defense education	Health & other services	Total
section	A+B	D	C+E	F	G+H	I	J+K	L+M	N+O+P	
Men	0.68	0.77	0.86	0.93	0.52	0.76	0.59	0.44	0.30	0.57
Women	0.32	0.23	0.14	0.07	0.48	0.24	0.41	0.56	0.70	0.43
29 year or less	0.18	0.24	0.15	0.27	0.30	0.20	0.27	0.16	0.22	0.24
30-39 year	0.24	0.33	0.25	0.30	0.31	0.27	0.30	0.28	0.32	0.30
40-49 year	0.22	0.27	0.27	0.25	0.22	0.34	0.24	0.33	0.31	0.28
50-59 year	0.18	0.14	0.31	0.14	0.13	0.16	0.14	0.21	0.12	0.15
60 and older	0.17	0.01	0.01	0.03	0.04	0.02	0.05	0.02	0.03	0.03
Blue-collar [3]	0.23	0.65	0.09	0.68	0.30	0.24	0.22	0.00	0.29	0.30
White-collar [3]	0.02	0.31	0.56	0.11	0.45	0.19	0.44	0.02	0.34	0.29
Public sector [4]	0.00	0.00	0.34	0.00	0.00	0.52	0.01	0.97	0.18	0.24
Self-employed	0.75	0.04	0.00	0.21	0.25	0.04	0.32	0.00	0.19	0.17
Primary / lower secondary	0.58	0.40	0.27	0.53	0.37	0.42	0.23	0.22	0.28	0.33
Upper secondary	0.35	0.40	0.43	0.38	0.44	0.41	0.33	0.28	0.32	0.36
Tertiary short type	0.05	0.10	0.16	0.05	0.11	0.09	0.19	0.30	0.21	0.16
Tertiary long type + academic	0.02	0.10	0.14	0.04	0.08	0.07	0.25	0.20	0.18	0.15
Part-time employees[1]	0.12	0.09	0.06	0.05	0.26	0.12	0.18	0.27	0.42	0.22
Company Administrators	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.03
Interim workers	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.03
Workers (x 1000) [2]	95	656	31	240	709	292	739	706	623	4091
Share of workers	0.023	0.160	0.008	0.059	0.173	0.071	0.181	0.173	0.152	100
Output (million €) [2]	7467	175969	10734	35862	76772	47364	111026	37333	36128	538654
Share of output	0.014	0.327	0.020	0.067	0.143	0.088	0.206	0.069	0.067	100

1 Self-employed workers are not divided into part-time or full-time workers.

2 The branch totals for output (P1) and workers correspond to those in the Belgian national accounts in "nationale rekeningen Deel 2 Gedetailleerde rekeningen en tabellen 1995-2005", Instituut voor de Nationale Rekeningen, NBB, November 2006.

3 These lines only include private sector blue and white collar workers.

4 Public sector employees include civil servants as well all blue and white collar workers that work in the public sector with a private sector type of contract.

Remark that Table 1 also gives figures on interim workers and self employed company administrators. The importance of indirect effects is enhanced by the way interim workers and self employed company administrators are treated in national accounting. Interim workers belong to the interim industry (NACE 74.50) and company administrators are allocated to industry 74.14. As both industries are a part of branch J+K, all these workers pertain to that branch in table 1.

Firms that hire interim workers and company administrators report intermediate expenditures on interim work and administration services. This will be reflected in their industry input-output coefficients (the A^d matrix) but not in their employment. Thus, the use of interim workers and self employed company administrators is not taken into account when no indirect effects are computed. If A^d is computed correctly, the employment multipliers correctly allocate those interim workers and company administrators to the activities that use their labour.

In the bottom lines of table 1, for each branch employment shares are placed next to total output. What is striking is the low share of workers in manufacturing (16%) compared to its high share (32.7%) in output. The multiplier analysis will show to what extent this result is maintained if indirect labour use is reallocated.

3.2. The total Output and Employment Multipliers

We first discuss the general results for the output and employment generation of final demand. This is done in table 2 for each of the nine products that correspond to the branches in table 1.

The first row in table 2 shows the output multipliers, which yield the output generated by an expenditure of 1 million euro on final domestic demand of the chosen product. The output multipliers are expressed in million euro and give a cumulated effect. The direct effect equals 1.

Table 2 Output & Employment Multipliers by Final Demand Product, 2000 (workers/1 mln €)

Final demand category:	Prod. of agricul-ture, forestry, fishing	Goods of Manu-facturing	Prod. of Mining, water & electr. & gas	Cons-truction activities	Trade, repair, hotel and restau-rant services	Trans-port, storage & commu-nication	Financial, real estate & business activities	Public adm., defense educa-tion	Health & other services	Total final demand [1]
[1] Total output multiplier (mln €)	*1.85*	1.58	1.44	2.09	1.76	1.73	1.47	1.21	1.50	**1.59**
[2] Employment multiplier	17.84	7.74	5.87	13.52	15.64	10.36	7.75	20.42	23.1	**12.04**
[3] Direct effect [2] on employment	12.63	3.73	3.05	6.35	9.98	5.83	4.29	18.92	18.86	**7.9**
[4] Indirect effect on employment [2]-[3]	5.22	4.02	2.83	7.18	5.66	4.53	3.46	1.5	4.24	**4.14**
[5] Relative employment multiplier [5]= [2] / [3]	1.41	2.08	1.93	2.13	1.57	1.78	1.81	1.08	1.22	**1.52**
[6] % in final demand for domestic output	0.7%	37.7%	1.2%	5.5%	14.2%	7.3%	14.6%	10.2%	8.6%	**100**
[7] % in cumulative employment	1.0%	24.2%	0.6%	6.2%	18.5%	6.3%	9.4%	17.3%	16.6%	**100**

[1] The total economy or average multiplier shows the effect of a 1 million euro shock distributed over the final demand categories according tot their share in final demand for domestic output.

[2] Our direct employment effect would be called an initial employment effect by Miller and Blair (1985). Their direct employment effect includes the initial employment effect plus the employment generated by the first round. That is the employment generated among the direct suppliers of an activity affected by a final demand shock. Their indirect employment effect is reduced to the employment generation in all further rounds. Noting the existence of conceptual confusion, West and Jensen (1980) formulated that in the case of income and employment multipliers the direct effect conventionally equals the initial effect, while in the case of output multipliers, the direct effect more often includes the first round effects.

The highest output multipliers are associated with final demand for Construction activities (2.09) and Agricultural products (1.85). In the case of Construction activities, the indirect effect (of 1.09) on output is more important than the direct effect (of 1). In contrast, the output multiplier for Public administration, defense and education services is limited to 1.21, indicating that, through their intermediate use, these services have little backwards linkages with the rest of the economy.

The second row in table 2 gives total employment generated by each final demand product or the (absolute) employment multiplier. It equals the column totals of matrix N in equation (8) aggregated to 9 products. How this aggregation is done is explained in section 3.5.1.

The total final demand employment multiplier equals 12.04 and is given in the last column of table 2. This column could also be interpreted as giving the effect of an average 1 million euro shock of final demand. The shock is average in the sense that it is distributed over products according to their share in final demand for domestic output.

The cumulated employment per million euro spending is the highest for Health and other services (23.1), and Public administration, defense and education (20.42). It is lowest for the Products of mining, electricity, gas and water (5.87) and Products of manufacturing (7.74). The employment multipliers of the various final demand products differ remarkably in size.

This indicates that it is far from neutral for employment which products are hit by a final demand shock. Remark that the employment data used here are the official national account totals by industry, and that the methodology possibly still underestimates employment multiplier differences between products. In the next section we will see if the qualitative employment multipliers can explain some of these differences.

In row [3] and [4] cumulated employment is divided in a direct and an indirect part. The direct employment is computed using equation (10). The indirect employment is the difference between the total and the direct employment. The relative importance of the direct and indirect employment generation is summarized by the relative employment multiplier in row [5]. It equals the total employment multiplier divided by the direct employment multiplier.

For two products, the relative employment multiplier exceeds 2, indicating that indirect employment effects are more important than the direct effects. These are Construction activities and manufactured goods[21]. Thus, a relatively high number of workers is indirectly involved in the production of manufactured goods. Still, with 7.74, the total employment multiplier remains much weaker in the case of manufactured goods than the average of 12.04.

21 Since Belgian is a small open economy, its relative employment multiplier of Manufacturing of 2.08 can be smaller than that of larger countries. Based on direct and indirect employment data from the Bureau of Labor Statistics, Bivens (2003) reported an updated relative employment multiplier of 2.29 for US manufacturing in 2003.

The relative employment multiplier can be compared with the output multiplier, since both are a ratio of cumulated to direct effects. This reveals some interesting differences. While with 1.58 the output multiplier for manufactured goods almost equals the average of 1.59, their relative employment multiplier of 2.08 is the second highest. This indicates that the industries that provide manufactured goods for final demand rely on a chain of suppliers that are themselves much more employment intensive. The reverse happens with Public administration, defense and education, and with Health & other services. Here suppliers use relatively less workers, since the output multiplier exceeds the relative employment multiplier for these services.

Row [6] and [7] of table 2 synthesize the link between final demand and employment in yet a different way. Row [6] gives each products share in final demand. It can be compared directly with row [7], which gives the cumulated employment share of each final demand product[22]. In box 1 these data are used to discuss the employment generation of manufactured goods.

Box 1: The employment generation of final demand for manufactured goods

Table 2 shows that manufactured goods represent 37.7% of final demand and are responsible for 24.2% of cumulative employment. The latter clearly exceeds the 16% employment share of manufacturing presented in table 1.

Thus, while those unfamiliar with IO techniques might believe the influence of manufacturing on employment was limited to 16%, in fact the exports, consumption and investments of domestically manufactured goods was still responsible for 24.2% of employment generation in 2000.

The difference is explained partly by the higher final demand share of Manufactured goods: 37.7% compared to 32.7% for their output share in table 1. A second part is explained by the relatively high indirect employment associated with the production of manufactured goods. The latter is not the consequence of a higher backwards linkage of manufacturing, since its output multiplier is average, but follows from the fact that producers of manufactured goods (supplied to final demand) use less workers than their suppliers.

While final demand for manufactured goods is responsible for 24% of total employment, qualitative employment analysis learns that it generates as much as 30% of male employment and 28% of the low-skilled employment, but only 17% and 14% of female and part-time employment (see table 3). Thus, the employment importance of this activity depends much on the labour type one is interested in.

3.3. Qualitative Employment Multipliers at a high aggregation level

Table 3 shows the qualitative employment analysis.

The first part of table 3 gives absolute employment multipliers per labour type. Like in table 2, the employment multipliers are an aggregation of multipliers computed at the level of the 147 IO industries. This aggregation will be discussed in section 3.5.1.

For men and women a distinction is made between direct and indirect labour use. The other distinctions correspond to those in table 1. The total employment multiplier given in the first row equals that in table 2 (row [2]). The direct and indirect employment use of women and men aggregate to the direct and indirect employment use reported in table 2 (rows [3] and [4]).

[22] The reader can compute this share by multiplying each products final demand share with the ratio of its employment multiplier over the total final demand employment multiplier of 12.04.

Table 3 Qualitative Employment Multipliers by Final Demand Product, 2000 (workers/1 mln €)

Final demand category:	Prod. of agricul-ture, forestry, fishing	Goods of Manu-facturing	Prod. of Mining, water & electr. & gas	Con-struction activities	Trade, repair, hotel and restaurant services	Transport, storage & communi-cation	Financial, real estate & business activities	Public adm., defense educa-tion	Health & other services	Total final demand
Qualitative employment multipliers										
Total multiplier	17.8	7.7	5.9	13.5	15.6	10.4	7.8	20.4	23.1	**12.0**
Men (total)	11.7	5.5	4.6	11.3	8.7	7.3	4.9	9.4	7.6	**6.9**
Direct	8.6	2.8	2.6	5.8	5.0	4.3	2.6	8.4	5.4	**4.2**
Indirect	3.2	2.6	2.0	5.5	3.6	3.0	2.2	1.0	2.2	**2.7**
Women (total)	6.1	2.3	1.3	2.2	7.0	3.0	2.9	11.0	15.5	**5.1**
Direct	4.1	0.9	0.5	0.5	5.0	1.5	1.6	10.6	13.4	**3.7**
Indirect	2.0	1.4	0.8	1.7	2.0	1.5	1.2	0.5	2.1	**1.4**
29 years or less	3.5	2.0	1.1	3.5	4.5	2.4	1.8	3.5	5.1	**2.8**
30-39 years	4.7	2.4	1.6	4.1	4.7	3.0	2.3	5.8	7.3	**3.6**
40-49 years	4.2	2.0	1.6	3.5	3.7	3.2	2.0	6.6	7.0	**3.3**
50-59 years	3.1	1.1	1.3	2.0	2.1	1.6	1.2	4.2	2.9	**1.8**
60 and older	2.5	0.2	0.2	0.4	0.7	0.3	0.4	0.4	0.8	**0.4**
Blue-collar, private	4.5	3.9	1.3	7.8	4.9	2.7	1.2	0.6	6.9	**3.7**
White-collar, private	2.1	2.5	2.6	2.8	6.0	2.7	3.7	0.9	7.5	**3.5**
Public sector	0.4	0.3	1.2	0.6	0.6	3.8	0.5	18.6	4.4	**2.9**
Self-employed	10.8	1.1	0.7	2.4	4.2	1.1	2.4	0.3	4.3	**2.0**
Primary / lower secondary	9.1	3.0	1.8	6.3	5.7	3.9	1.8	4.5	6.8	**4.0**
Upper secondary	6.2	3.0	2.3	5.1	6.5	4.2	2.6	5.8	7.6	**4.4**
Tertiary short type	1.4	0.9	0.9	1.1	1.8	1.2	1.5	6.0	4.7	**2.0**
Tertiary long type	1.1	0.9	0.9	1.0	1.6	1.1	1.9	4.1	4.0	**1.8**
Part-time employees	2.5	1.0	0.6	1.2	3.7	1.5	1.1	5.4	9.3	**2.6**
Administrators	0.2	0.2	0.3	0.3	0.6	0.3	1.3	0.1	0.1	**0.4**
Interim workers	0.1	0.4	0.1	0.3	0.4	0.2	0.3	0.1	0.2	**0.3**
% in Cumulative employment of the specified labour type										
Men	1%	30%	1%	9%	18%	8%	10%	14%	9%	**100%**
Women	1%	17%	0%	2%	19%	4%	8%	22%	26%	**100%**
29 years or less	1%	26%	0%	7%	22%	6%	9%	13%	15%	**100%**
50 and older	2%	23%	1%	6%	18%	6%	10%	21%	14%	**100%**
Low-skilled[1]	2%	28%	1%	9%	21%	7%	6%	12%	15%	**100%**
Medium-skilled[1]	1%	26%	1%	7%	21%	7%	9%	14%	15%	**100%**
High-skilled[1]	0%	18%	1%	3%	13%	4%	13%	28%	20%	**100%**
Part-time empl.	1%	14%	0%	2%	20%	4%	6%	21%	31%	**100%**
All workers	1%	24%	1%	6%	18%	6%	9%	17%	17%	**100%**

1 Low-skilled workers have only completed primary or lower secondary education. Medium-skilled are defined as workers that completed Upper secondary education. All tertiary schooled workers are qualified as high-skilled. In 2000, Low, Medium and High-skilled workers represented respectively 33%, 36% and 31% of all workers.

With 15.5 compared to 7.6, the employment multiplier for women exceeds that for men in Health and other services. In Public administration, defense and education, with 11 for women and 9.4 for men, the employment use is more equilibrated. For the 7 other products, the employment multipliers for men exceed those for women. The female employment multiplier is particularly low in the manufacturing of goods, products of mining, electricity and gas and construction activities. Of course, the aggregation level masks differences at a greater product detail, which will be given in table 5.

It is interesting to note that for women the indirect employment generation of the final demand for manufactured goods is more important than its direct employment generation. The same holds for products of Mining, water, electricity and gas and for Construction activities. For Transport & communication the direct and indirect female employment generation is equal. However, these are also products with low employment multipliers. For total final demand indirect effects are more important for men than for women and even in the mentioned products, the indirect effects for men always exceed those for women.

The information on part-time employees in table 3 already offers a first explanation of the differences in the total employment multiplier. The products with the largest employment multipliers also tend to have large multipliers for part-time work, while the use of part-time work is lower for products with low employment multipliers. In our data part-time employees include also seasonal workers and students, but exclude self-employed.

A one million euro increase in final demand for industrial goods gives rise to one additional part-time employee, while the same increase in final demand for Health & other services (N+O+P) or for Public administration, defense & education (L+M) leads to an increase in part-time employment by respectively 9.3 and 5.4 units.

The other qualitative employment multipliers can also help to explain some of the differences in the total employment multiplier. Agriculture works with a high number of self-employed workers, as indicated by the very high multiplier for self-employed of 10.8 for this product. A relatively great number of these are over 50 or even over 60 years old. For self-employed, the distinction between part-time and full-time could not be made. It is possible that many of the (older) self employed in agriculture do not have a Full-time job.

The bottom of table 3 shows each final demand's product share in the cumulated employment of some labour types. The total cumulative employment of the selected labour type, e.g. male labour, is set to 100% each time[23]. The product share in cumulative employment for workers, already given in table 2, is repeated in the last row of table 3.

23 Each cell at the bottom of table 3 can also be obtained by multiplying each products final demand share (as given in table 2) with the ratio of the products and the total employment multiplier over the specified labour type. Thus, for the use of male labour by manufactured goods, one obtains: 0.30=0.377(5.5/ 6.9).

A final demand product that is important for one labour type may be much less important for the cumulative employment of another. In box 1 we already discussed the cumulative employment shares of manufacturing. Now look at the figures for Public administration, defense and education. This activity, generating 17% of total employment, is responsible for 12% and 14% of the employment generation of low and medium-skilled workers, but as much as 28% of high-skilled (=tertiary schooled) workers. An even greater difference can be found for the Health & other services. This activity generated only 9% of cumulative male employment but as much as 26% of female and 31% of part-time employment.

We will come back to these large differences when we discuss the employment generation by government consumption expenditures.

3.4. Consistency of qualitative employment multipliers

We want to verify here if our qualitative employment multipliers respect employment totals for each labour type. Formally, we state that the distribution of the cumulated employment over worker types has the following property:

<u>Proposition 1:</u> *The total economy distribution of the cumulated employment over employment type equals the total economy distribution over employment types*

<u>Proof of proposition 1</u>

This property follows from equation (8). Post multiplying the employment multiplier matrix N in (8) with the final demand vector, and using (5) to replace the expression behind L yields:

$$N.f^{d} = L \cdot g = S.\hat{g}^{-1}g = S.i \qquad (15)$$

The second and third equality sign in expression (15) is obtained by replacing *L* by its definition in (7) and working out the product of the diagonal matrix and vector with (inversed) industry output totals.

The expression on the left side of (15) equals the total economy cumulative employment, while that after the last equality sign is a row vector with the row totals of the S matrix, which equals the employment totals of each employment type.

<u>Discussion</u>

Proposition 1 can also be verified by comparing the last columns in tables 4 and 1 and noting that both total economy distributions are the same. Table 4 gives the distribution of cumulative employment over worker types for each final demand product. This is distinct from the distribution over products for each worker type given in the second part of table 3.

Table 4 Cumulated Employment Use by Final Demand Product, 2000 (shares)

Final demand category:		Prod. of agricul-ture, forestry, fishing	Prod. of manu-facturing	Prod. of Mining, water & electr. & gas	Cons-truction activities	Trade, repair, hotel and restaurant services	Transport, storage & communi-cation	Financial, real estate & business activities	Public adm., defense educa-tion	Health & other services	Total final demand
Men		0.66	0.70	0.78	0.84	0.55	0.71	0.63	0.46	0.33	**0.57**
	Direct	0.48	0.36	0.44	0.43	0.32	0.42	0.34	0.41	0.23	**0.35**
	Indirect	0.18	0.34	0.34	0.41	0.23	0.29	0.29	0.05	0.09	**0.22**
Women		0.34	0.30	0.22	0.16	0.45	0.29	0.37	0.54	0.67	**0.43**
	Direct	0.23	0.12	0.08	0.04	0.32	0.15	0.21	0.52	0.58	**0.31**
	Indirect	0.11	0.18	0.14	0.12	0.13	0.15	0.16	0.02	0.09	**0.12**
29 year or less		0.19	0.25	0.20	0.26	0.29	0.23	0.23	0.17	0.22	**0.24**
30-39 year		0.26	0.31	0.28	0.30	0.30	0.29	0.30	0.28	0.32	**0.30**
40-49 year		0.23	0.26	0.27	0.26	0.23	0.30	0.26	0.32	0.30	**0.28**
50-59 year		0.17	0.14	0.23	0.15	0.14	0.15	0.16	0.20	0.13	**0.15**
60 and older		0.14	0.03	0.03	0.03	0.04	0.03	0.05	0.02	0.03	**0.03**
Blue-collar private		0.25	0.50	0.23	0.57	0.31	0.27	0.16	0.03	0.30	**0.30**
White-collar private		0.12	0.32	0.44	0.21	0.38	0.26	0.47	0.05	0.33	**0.29**
Public sector		0.03	0.03	0.21	0.04	0.04	0.37	0.07	0.91	0.19	**0.24**
Self-employed		0.60	0.14	0.12	0.17	0.27	0.11	0.30	0.01	0.19	**0.17**
Primary + lower secondary		0.51	0.39	0.31	0.47	0.37	0.38	0.23	0.22	0.29	**0.33**
Upper secondary		0.35	0.39	0.40	0.38	0.42	0.40	0.34	0.28	0.33	**0.36**
Tertiary short type		0.08	0.11	0.14	0.08	0.11	0.11	0.19	0.29	0.20	**0.16**
Tertiary long type + academic		0.06	0.11	0.15	0.08	0.10	0.10	0.24	0.20	0.17	**0.15**
Part-time employees		0.14	0.13	0.09	0.09	0.24	0.14	0.14	0.27	0.40	**22**
Administrators		0.01	0.03	0.05	0.02	0.04	0.03	0.16	0.00	0.01	**0.03**
Interim workers		0.01	0.05	0.02	0.02	0.02	0.02	0.03	0.00	0.01	**0.03**
Total multiplier		1	1	1	1	1	1	1	1	1	**1**

It may seem exaggerated to formulate the identity expressed in (15) in the form of a proposition, but both in the case of aggregation and updating of employment multipliers, that will be discussed further, it is not evident that it continues to hold.

Thanks to property 1 it is meaningful to compare table 4 with table 1 for each activity. When making this comparison, two differences have to be kept in mind. First, heterogeneous branches in table 1 have been replaced by products. The average way industry data have been transformed in product data (using equation (10)) reduces qualitative employment differences between activities. Secondly, labour used in the production of intermediary products has been allocated to the activities that use these products. This redistribution can also reduce qualitative employment differences between activities, but this is not automatically implied.

In table 1 's figures on manufacturing, 23% of the workers are women, while in table 4, 30% (=12%+18%) of the cumulated employment is female[24]. Likewise, the share of long type tertiary formation has increased for activities with few of these workers such as Agriculture, Construction, Trade and Transport if table 4 is compared to table 1.

Despite the increase in the share of women, and a serious drop in the share of blue collar workers (from 65% in table 1 to 50% in table 4, mainly in favour of self-employed), the cumulated employment use of final demand for manufactured goods hardly relies more on schooled labour than does the manufacturing industry itself. The share of primary/ lower secondary educated only falls from 40% to 39%, while that of tertiary schooled increased only 1% to 11%.

Thus, it could be that the average supplier to manufacturing does not use more skilled labour then manufacturing. However, one cannot rule out the alternative explanation that manufacturing firms that supply directly to final demand use less skilled labour then those that mainly provide intermediate goods to other industries. Indeed, a higher skill intensity in the suppliers to manufacturing can be compensated by a difference in skill intensity within manufacturing between producers of final and intermediate goods. This point will be discussed further.

3.5. Qualitative Employment Multipliers at Lower Aggregation Levels

We explain how employment multipliers have been aggregated and what implications this has. These issues are illustrated by discussing employment multipliers at the level of 36 products.

3.5.1. The Aggregation of Qualitative Employment Multipliers

When advocating a descriptive use of employment multipliers, it is important to address the issue of aggregation of (qualitative) employment multipliers. Depending on the desired information, the required aggregation level of activities may differ greatly. However, aggregation of qualitative employment multipliers has implications for their use and interpretation.

The results shown in table 2 to 4 are an aggregation to 9 activities by weighting with the product shares in the final demand for domestic output. Only this weighting guarantees that proposition 1 (and thus equation (15)) continues to hold at a higher aggregation level. While it is obviously desirable that the total distribution of cumulated employment over employment types respects the total economy distribution, aggregating multipliers by final demand shares also has some inconveniences.

Lobbyist willing to demonstrate the importance of an economic activity might be interested in the cumulative employment generation of total output, including the intermediate supply to

[24] The contribution of the indirect effect to augment the cumulated share of women in products of manufacturing is clear, but there was also a smaller contribution from the transfer of branches to products, because the share of women in the direct effect was 25%, which is higher than the 23% reported in table 1. This is due to the higher share of female workers in trade and service branches with a secondary production of manufactured goods.

other activities. This would also be necessary if one was to estimate the effects of a plant closure or relocation[25]. In these cases, there is a direct fall in full output, not just one in final demand.

At the detailed input-output level of industries, an output shock hurting a single activity[26] can still be treated, because at that level the employment multipliers of final demand are equal to the employment multipliers of output[27]. This results from the fact that the labour coefficients (the L matrix in (8)) are employment to output coefficients. Any shock in final demand is in fact translated into an output shock before its effect on employment is calculated.

3.5.2. Qualitative Employment Multipliers at the Level of 36 Products

We illustrate these issues by discussing the results of the employment multipliers at the level of 36 products. This is still only an intermediate level of detail, since the employment multipliers for 2000 have been calculated at the level of 147 products or homogenised IO industries. The 36 products in table 5 are represented by the letter and number of their CPA-product group[28]. A description of the product groups is listed below the table.

[25] In the case the activities could not be (directly) taken over by another domestic firm, intermediate supply to other industries would also be lost and would have to be replaced by imports.

[26] If the issue is the disappearance of a heterogeneous industry, instead of an activity, the expressions in (6) or (13) should be used to compute a new matrix of employment multipliers. (6) is used if one uses a product tot product input-output table, (13) for an industry to industry IO table based on industry technology.

[27] When multiplying the employment multiplier with total output in stead of only the output part destined for final demand, the employment effect becomes larger. It does not make sense to do this for the total economy, since then the indirect employment effect of final demand would be counted twice.

[28] The CPA is the European version of the Central Product Classification recommended by the United Nations. It is imposed for the product classifications in national accounts of EU countries.

Table 5 Cumulative employment share and qualitative Employment Multipliers for 36 Products in 2000 (workers/1 mln €)

	Final demand share (%)	Cumulative employment share (%)	Total employment multiplier (workers / 1 mln €)	Relative employment Multiplier	Men	Women	< 30 year	> 49 year	Primary + lower secundary	Tertiary education	Employees, full-time	Employees, part-time	Self-employed
A+B	0.66%	0.97%	17.8	1.41	11.7	6.1	3.5	5.5	9.1	2.5	4.6	2.5	10.8
C	0.17%	0.13%	8.8	1.84	6.7	2.1	2.0	1.8	3.4	2.1	6.6	1.0	1.2
DA	5.48%	5.29%	11.6	2.75	7.4	4.2	3.1	2.3	5.0	2.2	6.4	2.0	3.3
DB+DC	2.07%	1.80%	10.4	1.70	5.8	4.6	2.5	1.7	4.9	1.8	8.1	1.3	1.1
DD+DE	1.76%	1.32%	9.0	1.89	6.3	2.7	2.3	1.5	3.2	2.2	6.8	1.1	1.2
DF	2.32%	0.49%	2.5	6.70	1.7	0.8	0.6	0.5	0.8	0.8	1.7	0.4	0.4
DG	6.88%	3.15%	5.5	2.21	3.8	1.7	1.4	1.0	1.7	1.8	4.2	0.7	0.6
DH	1.18%	0.80%	8.2	1.68	6.0	2.2	2.2	1.2	3.0	1.8	6.6	0.9	0.7
DI	0.84%	0.66%	9.4	1.81	7.5	1.9	2.2	1.8	4.0	1.9	7.7	0.9	0.8
DJ	4.45%	2.67%	7.2	1.95	5.7	1.5	1.7	1.3	2.9	1.4	5.8	0.7	0.7
DK	2.85%	2.28%	9.6	1.87	7.5	2.1	2.5	1.7	3.5	2.2	7.7	1.0	0.9
DL	2.98%	1.98%	8.0	1.80	5.5	2.5	2.2	1.3	2.5	2.4	6.1	1.0	0.9
DM	5.71%	2.91%	6.1	2.08	4.8	1.3	1.6	0.9	2.5	1.1	4.9	0.7	0.5
DN	1.14%	0.87%	9.2	1.57	6.8	2.4	2.3	1.7	4.1	1.5	7.1	0.9	1.2
E	1.03%	0.46%	5.4	1.95	4.2	1.2	1.0	1.4	1.5	1.7	4.3	0.5	0.6
F	5.54%	6.22%	13.5	2.13	11.3	2.2	3.5	2.4	6.3	2.1	10.0	1.2	2.4
G50	2.15%	2.34%	13.1	1.60	9.4	3.7	3.6	2.4	4.9	2.7	8.0	1.8	3.3
G51	6.10%	6.02%	11.9	1.92	7.4	4.5	3.1	2.2	3.9	3.3	7.2	2.0	2.6
G52	3.75%	6.30%	20.2	1.39	9.1	11.1	5.7	3.7	7.4	3.9	8.5	5.7	6.0
H	2.20%	3.79%	20.7	1.43	10.6	10.1	7.2	3.3	9.0	3.0	7.5	7.2	6.1
I60AB	0.77%	1.06%	16.5	1.17	14.6	1.8	2.5	2.9	7.9	1.6	14.5	1.4	0.5
I60C	1.00%	0.85%	10.3	1.56	8.4	1.9	2.3	1.9	4.9	1.6	7.9	1.0	1.4
I61/62	1.05%	0.66%	7.6	3.51	4.9	2.6	2.2	1.2	2.2	2.3	5.0	1.4	1.2
I63	3.40%	2.76%	9.8	2.07	6.1	3.7	2.4	1.8	3.2	2.5	6.9	1.7	1.1
I64A	0.17%	0.30%	20.5	1.14	14.5	6.0	3.4	4.7	9.3	2.7	15.8	3.5	1.2

	Final demand share (%)	Cumulative employment share (%)	Total employment multiplier (workers / 1 mln €)	Relative employment Multiplier	Men	Women	< 30 year	> 49 year	Primary + lower secundary	Tertiary education	Employees, full-time	Employees, part-time	Self-employed
I64B	0.91%	0.66%	8.8	2.13	5.9	2.9	2.2	1.3	2.9	2.4	6.7	1.0	1.1
J	3.45%	2.93%	10.2	1.88	5.7	4.5	2.2	2.1	1.8	4.7	7.0	1.8	1.4
K70t	6.26%	0.90%	1.7	-	1.3	0.4	0.4	0.3	0.7	0.4	1.2	0.2	0.3
Kr7071	0.25%	0.17%	8.3	2.11	5.2	3.1	2.0	1.6	2.8	2.4	4.9	1.6	1.8
K7273	1.68%	1.74%	12.5	1.69	7.7	4.7	3.6	1.9	2.6	6.1	8.1	1.9	2.4
K74	2.93%	3.65%	15.0	1.44	9.7	5.2	3.2	3.4	3.5	6.5	5.5	1.7	7.7
L	5.56%	9.40%	20.3	1.11	11.1	9.2	3.4	4.2	6.6	5.4	15.4	4.5	0.4
M	4.64%	7.91%	20.5	1.05	7.3	13.2	3.6	4.9	2.1	15.7	13.8	6.5	0.2
N	6.13%	11.10%	21.8	1.23	6.7	15.1	5.0	3.5	5.0	10.2	9.8	7.9	4.2
O	2.28%	3.76%	19.8	1.35	9.3	10.6	5.0	4.1	6.3	5.3	9.5	5.1	5.2
P	0.22%	1.7%	92.9	1.00	15.7	77.2	9.2	4.1	62.0	2.3	1.6	91.4	0.0
Final demand	100%	100%	12.0	1.52	6.9	5.1	2.8	2.2	4.0	3.7	7.4	2.6	2.0

A+B Products of agriculture, hunting, forestry & fishing; C Products from mining and quarrying;

DA Food products, beverages & tobacco; DB+DC Textiles, leather & their products; DD+DE Wood, paper & printing services; DF Coke, refined petroleum products & nuclear fuel; DG Chemicals, chemical products & man-made fibers; DH Rubber & plastic products; DI Other non metallic mineral products; DJ Basic metals & fabricated metal products; DK Machinery & equipment n.e.c.; DL Electrical & optical equipment; DM Transport equipment; DN Other manufactured goods;

E Electrical energy, gas, steam & water; F Construction activities;

G50 Trade, maintenance & repair of motor vehicles & motorcycles, retail trade of automotive fuel; G51 Wholesale trade and commission trade services; G52 Retail trade & repair services; H Hotel & restaurant services;

I60AB Railway transportation services & other passenger land transportation services; I60C Freight transport services by road or pipelines; I61/62 Water & air transport services; I63 Supporting & auxiliary transport services, travel agency services; I64A Post and courier services; I64B Telecommunication services;

J Financial intermediation services; K70t Renting services involving own residential household property; Kr7071 Other real estate services and renting services of machinery, equipment & goods; K7273 Computer and related services, research and development services; K74 Other business services;

L Public administration & defense services, compulsory social security; M Education services;

N Health and social work services; O Other community, social and personal services; P Private households with employed persons;

The first column in table 5 gives the final demand shares. The second column gives the shares in cumulated employment. They can be obtained by multiplying each product's final demand share with the ratio of its total employment multiplier over the total employment multiplier of final demand. Column 4 gives the relative employment multiplier or the ratio of cumulated to direct employment. The next columns give the (absolute) employment multiplier for a specific type of workers. To highlight the huge differences in ordering depending on which type of indicator or (qualitative) multiplier is chosen, cells corresponding to the five largest values for each share or multiplier have been shaded.

First, compare the shares in final demand with those in cumulative employment. Like the final demand shares, the cumulative employment shares add up to 100% thus excluding any double counting. Despite this similarity, the ordering of both shares differs significantly. Of the top 5 products in the final demand ranking, only 1 remains in the top five of the cumulative employment ranking. Because of their high employment multiplier of 21.8, Health and social work services (N) see their final demand share of 6.1% increase to 11.1% of cumulated employment. The next places in the cumulative employment top 5 are taken by Public administration & defense services, compulsory social security (L), Education services (M), Retail trade & repair services (G52) and Construction activities (F).

The two manufacturing activities present in the top 5 for their final demand share, Transport equipment (DM) and Chemicals (DG), are not even in the top 10 activities for cumulative employment. Food products, beverages & tobacco (DA), which have the highest employment multiplier of manufacturing (11.6), maintain a high share of 5.3% in cumulative employment. The relatively high employment multiplier of Food products, beverages & tobacco (DA) is based on large indirect employment effects, as indicated by the high relative employment multiplier of 2.75. For being in manufacturing, this activity has a large multiplier of part-time and self employed workers, which could have been caused by its backwards linkages with agriculture.

Though interesting in this case, the relative employment multiplier has no predictive value for the cumulative employment share of an activity. It does not more than expressing the relative importance of indirect employment. In 9 out of 36 activities, the relative employment multiplier exceeds 2, indicating that the indirect employment generation is more important than the direct employment generation of final demand. With 6.7, Coke, refined petroleum & nuclear fuel (DF) has the highest relative employment multiplier, but its total employment multiplier of 2.5 is the second lowest. The lowest total employment multiplier (1.7) is for Renting services involving own residential household property (K70t). For this activity, no relative employment multiplier could be computed because no direct employment is attributed to it.

Because renting services have, with 6.26%, a large share in final demand, all product aggregates that include it are influenced by their low employment multiplier. Indeed, the other service sectors from J to K74 represented in table 5 all have a total employment multiplier larger than the 7.8 for Financial, real estate & business activities reported in tables 2 to 4. Despite their large final demand share, renting services only influence 0.9% of cumulated employment. Similarly the 2.32% final demand share of refined petroleum products & nuclear fuel falls back to a share of 0.49% in cumulated employment.

Another outlier is Private households with employed persons (P). This activity has a very high employment multiplier of 92.9 workers per 1 million euro spending. The qualitative multipliers offer more insight in this, since 91.4 of these 92.9 are part-time workers (see second last column). They consist of 62 low schooled workers, 2.3 tertiary schooled and (as can be obtained as a residual from table 5) 28.6 medium schooled workers. Consistent with these low schoolings levels, hourly wage costs in industry P were, with 8 euros, much lower than the average hourly wage cost of 20 euro for part-time workers. This can help explaining why final demand is translated in such a high employment[29]. With 1.7%, the cumulative employment share of household services better reflects the employer importance of private households then does their share in final demand spending.

The results in table 5 and the examples show that it could be erroneous to combine large fractions of final demand (like those in tables 2 to 4) with their aggregated employment multipliers to model the effect of structural changes in final demand. It is more appropriate to work at the product level of the imputed shock. For describing the employment use of final demand products, it is better to look at cumulative employment than at final demand shares. The former have the additional advantage that some of the unavoidable peculiarities of national accounting (like the treatment of imputed rents, but also that of interim workers and self employed administrators) loose much of their disturbing influence on the obtained shares.

Instead of discussing the qualitative employment multipliers given in table 5 directly, we invite the reader to find out some of their implications by computing alternative cumulative employment distributions. For each qualitative employment multiplier a cumulative employment distribution can be computed. For doing this, it suffices to multiply each products final demand share with the ratio of its multiplier over the final demand multiplier of the chosen labour type.

Thus, for example, one can show that while construction activities (F) have a share of 6.2% in cumulative employment, they have a share of 9.1% (=5.54 x (11.3 / 6.9)) in cumulative male employment. Similarly, Education (M) and Health and social work services (N) see their cumulative employment share of 7.9% and 11.1% increase to respectively 12% and 18.1% of cumulative female employment. With a share of 3.8% in total cumulative employment, Hotel and restaurant services (H) have a share of 5.7% in the employment of workers younger than 30 years and 5% of the low-skilled workers (having only completed primary or lower secondary education). On the other hand, final demand for Agriculture & fishing products (A+B) generates less than 1% of total cumulative employment, but 1.7% of the employment of workers over 50 years, 1.5 of the low-skilled and 3.6% of the self employed workers.

[29] Wages are more important for this activity since it has no intermediate demand. This is because cleaning products or insurance costs are treated as private consumption.

Sometimes the absolute employment multipliers are more telling than the cumulative employment shares. Final demand for Railway and other passenger land transportation (I60AB), Freight transport by road (I60C) and Post and courier services generates high male, low-skilled and Full-time employment, but except for Post and courier services, their female and part-time employment multiplier is much below the average.

One comment that could be given on table 5 is that it only gives information on the employment generation of final demand. What if an industry is hurt by a more general output shock, or how to use the multipliers for evaluating the indirect employment generation of a complete activity? Box 2 explains how the relative employment multipliers in table 5 can be used to estimate the indirect employment impact of shocks or to measure the cumulative employment impact of an economic activity.

Box 2: The use of the relative employment multiplier

Relative employment multipliers like those in table 5 can be used to estimate the indirect effects of a final demand shock hurting one of these industries. To do this, an estimate should be given of the initial jobs loss due to a drop in exports, consumption or investment, which could then be multiplied with the relative employment multiplier to find the cumulated employment effect.

If the initial shock also includes intermediate deliveries to other Belgian firms, the employment multipliers could still be used, but there could be an aggregation error, since within an industry the products destined for final demand and their employment multipliers might differ from those destined for intermediate consumption. If this is the case, the employment multipliers and the initial employment shocks should be confronted at a lower product level. Results at the lower product level could be aggregated using the direct employment shares as weights.

There is an additional problem if one uses relative employment multipliers for estimating the cumulated employment impact of an entire activity. The initial employment figure should only include employment that is directly linked to final demand or intermediate deliveries to other industries, and exclude the employment of suppliers or subcontractors operating exclusively within the industry, for the latter are already included in the multiplier.

4. Some applications of employment multipliers

In this section we introduce three applications of qualitative employment multipliers as a descriptive tool, or as the starting point for an impact evaluation. Section 4.1 illustrates the use of qualitative employment multipliers to show the employment generation of low-skilled workers. Section 4.2 presents the employment multipliers of ICT goods and services. Finally, section 4.3 presents employment multipliers for consumption, investments and exports.

4.1. Employment Multipliers for Low-skilled Workers

The method developed in this paper can be used to identify the activities with the highest cumulative employment shares as well as those with high employment multipliers for low-skilled workers. These are defined here as workers having completed only primary or lower secondary schooling.

From table 5, it can be derived that the final demand for 7 products is responsible for 50.6% of the cumulative employment of low-skilled. These activities are Public administration, defense services & compulsory social security (9.2%), Construction activities (8.8%), Health and social work services (7.7%), Retail trade & repair services (7%), Food products, beverages and tobacco (6.9%), Wholesale & commission trade services (6%) and Hotel & restaurant services (5%). These 7 activities are not only important for low-skilled, but represent 34.8% of final demand and generate 48.1% of total cumulated employment. In fact, 6 of these 7 activities are also present in the top 7 for total employment, where Hotel & restaurant services are replaced by Education services (see table 5).

A policy aimed at increasing low-skilled employment could take the form of stimulating final demand of the activities that employ most low-skilled workers. But because, at least at this still broad industry detail, the activities which generate most low-skilled employment are also those which generate most employed in general, this is not likely to be an efficient policy.

An alternative is to concentrate on the activities with the highest employment multipliers for low-skilled and to select these activities at the most detailed level of 147 products. Table 6 presents the absolute employment multiplier for low schooled (column [3]) and the cumulative employment shares for all and for low schooled workers (columns [4] and [5]) for a selection of 10 activities. For each activity, the table also gives its final demand share [8], its output share [9] and its share in the direct employment of all [6] and of low-skilled [7] workers.

The activities chosen are those with the highest absolute employment multiplier for low-skilled. Since the number of 10 is arbitrary, we give the results for Retail and repair services below the table. This activity has the largest employment multiplier for low-skilled outside these 10, but is less typical because of its larger size.

Table 6 Products with High Employment Multipliers for Low-Skilled Workers

[1] Nace / CPA	[2] Products (homogeneous industries)	[3] Low-skilled employment multiplier	[4] Share in cumulative employment all workers (fin. demand)	[5] Share in cumulative employment of low-skilled (fin. demand)	[6] Share in direct employment all workers (output)	[7] Share in direct employment of low-skilled (output)	[8] Final demand share (%)	[9] Output share (%)
01	Products of agriculture & hunting	9.2	0.9%	1.4%	2.2%	4.0%	0.6%	1.4%
02	Products of forestry & logging	10.1	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%
15.81+15.82	Bread, bakery products & biscuits	8.3	0.9%	1.2%	0.7%	1.0%	0.6%	0.4%
55.3-55.5	Food & beverage + canteen & catering services	9.5	3.2%	4.2%	3.0%	4.2%	1.8%	1.5%
60.21-60.23	Passenger land transport services other than railway [1]	9.1	0.5%	0.9%	0.6%	1.2%	0.4%	0.4%
64.1	Post and courier services	9.3	0.3%	0.4%	1.2%	1.7%	0.2%	0.5%
74.5	Labour recruitment & provision of personnel services	13.8	0.1%	0.1%	2.9%	3.8%	0.0%	0.7%
85.3	Social work services [1]	9.0	4.6%	4.1%	4.1%	3.5%	1.8%	1.1%
93	Washing and dry cleaning services, hairdressing & beauty services, funeral services, physical well being services other services n.e.c.	12.8	1.2%	1.3%	1.3%	1.6%	0.4%	0.4%
95	Private households with employed persons	62.0	1.7%	3.4%	1.7%	3.4%	0.2%	0.1%
	Total of selected activities	11.3	13.4%	17.1%	18.0%	24.5%	6.0%	6.5%
52	Retail trade & repair services	7.4	6.3%	7.0%	4.8%	5.4%	3.8%	2.5%
	Total economy (147 activities)	4.0	100%	100%	100%	100%	100%	100%

1 These two activities have not been shown at the most detailed level, where a distinction exists between the market and non market institutional sector. The employment multipliers of the market and non market sectors have been aggregated using the final demand product shares.

Table 6 can be read as follows. Final demand for the 10 activities, representing only 6% of total final demand, generates 13.4% of total employment and as much as 17.1% of the total employment of low-skilled. Thus, for favoring the employment of low-skilled by increasing final demand, it is more efficient to concentrate efforts on these 10 activities. This greater efficiency is also expressed by comparing their average low-skilled employment multiplier of 11.3 with the general low-skilled employment multiplier of 4.0.

By stimulating final demand for these activities not all possibilities for increasing employment of low-skilled are exhausted. As indicated by their low share in final demand compared to output, activities like Agriculture & hunting, Post and courier services and especially Labour recruitment & provision of personnel services are further away from final demand. These three activities in fact increase the (low-skilled) employment multiplier of their customers' activities.

In terms of their direct employment share, the 10 activities represent 24.5% of low-skilled employment. This is more than their 17.1% cumulated employment share of low-skilled. The direct employment share is computed by multiplying each activity's direct employment multiplier for low-skilled with its output and dividing this with the total employment of low-skilled[30]. Thus, like the cumulated employment shares, the direct employment shares add to 100% for the total economy, but the latter reflect the importance of production and not final demand.

For each activity, production or output is the sum of production for final and intermediate demand. For the whole economy, total output equals 158.5% of final demand. Thus, even if the 10 activities represent only 6.5% of the total output, the (euro) amount that corresponds to this exceeds considerably that for final demand.

Because employment is not the same as hours worked, or wages earned, employment multipliers do not necessarily tell the full story. Also our input-output multipliers for low-skilled labour do not take into account income effects, and might thus underestimate the impact of shocks. An overestimation might come from the possibilities of substitution (low-skilled workers being replaced by medium-skilled…) and supply restraints (if wages remain low compared to unemployment allowances the vacancies will not be filled…).

Still, the argument for stimulation activities with high employment multipliers for low-skilled is less theoretical then it may seem. In practice, final demand and the employment multipliers themselves for some of these activities have already been augmented by special employment programs and demand subsidies in Belgium.

Labour recruitment & provision of personnel services include Local Employment Agencies that engage unemployed. Once these persons work a sufficient number of hours, they are treated as

30 The direct employment multipliers for low-skilled are those given by equation (10). The calculation has to be done at the lowest level of 147 industries, since only there employment multipliers express both the effect of an output and that of a final demand shock.

"employed". But they continue to receive (a part of) their unemployment allowance, which is not included in wage costs. This increases both the final demand for and the employment multiplier of the provision of personnel services. Similarly, a more recent program of service vouchers can be expected to increase final demand for Labour recruitment & provision of personnel services[31]. Public passenger land transport services other than trains (i.e. busses and metro) have seen a large increase in their passengers and personnel thanks to a (subsidized) low price policy by regional and communal authorities in the period 2000-2005.

The direct employment shares of low-skilled given in table 6 are defined per product, and not per (heterogeneous) industry as known from the national accounts. Yet, for the 10 industries involved, there is little difference. The employment share of the industries corresponding to these 10 activities was 18% in 2000, which exactly equals the direct employment share of the corresponding activities in table 6. The 10 industries' share in total employment rose from 18% in 2000 to 18.1% in 2005. The employment share of low-skilled of the industries in the S matrix for 2000 was 24.8%, which is close to the 24.5% reported in table 6.

The global share in the low schooled employment of the 10 (heterogeneous) industries corresponding to the activities in table 6 rose from 24.8% to 26.2% in 2005. Much of this increase is due to the industry of Social work services, which saw its employment share of low-skilled increase from 3.6% in 2000 to 4.5% in 2005. This industry also increased its share in total employment from 4.1% in 2000 to 4.9% in 2005. The activity of Social work services is atypical among those in table 6 in the sense that it is the only one where the cumulative and direct employment shares for all workers exceed those for low-skilled workers. Thus these services are even more important for total employment than for low-skilled employment.

4.2. Employment Multipliers for ICT Goods and Services

Qualitative employment multipliers provide a link between products and the use of labour types. An economic field where this could be useful is the literature around the technology-skill-complementarity hypothesis. This hypothesis states that technology change has shifted labour demand in favour of skilled labour.

To test this hypothesis, Xiang (2005) proposed to find out whether new goods appear mostly in skilled-labour intensive industries. New goods are considered as a good proxy for technology, as they often embody it. He found that for the U.S. manufacturing sector in the late 1970s and 1980s the new goods average skilled-labour intensity exceeds the old goods by over 40%.

[31] These service vouchers, introduced in 2003, can be bought by households to pay for domestic services (like cleaning & dry cleaning) by low-skilled workers employed in recognized interim agencies. This way the state, that sells these vouchers at a price below their cost, subsidises the wages of domestic workers. The system was aimed at reducing informal employment by households, so that a substitution can be expected with employment in branch P. Yet the success of the system makes it likely that there has also been a net effect on employment.

To relate skills and new goods, the author calculated an average skilled labour intensity that takes into account the direct labour content. Because no use was made of IO-multipliers, differences in the skill content of indirect labour were omitted. Yet indirect labour demand for skilled labour is sometimes equally or more important than the direct demand for skilled labour.

Xiang's version of the skill-technology complementarity hypothesis links a more intensive use of skilled labour to the production of new goods[32]. We follow the same reasoning here and apply it to the production of ICT goods as well as ICT services. Thus we will use qualitative employment multipliers to find out if the production of ICT goods and services in Belgium is relatively more skill intensive and if it remains so if indirect labour use is taken into account.

Table 7 gives the employment multipliers and cumulative employment shares of ICT goods and services, as well as non ICT manufactured goods and non ICT services. A distinction is made between all workers and high-skilled workers. High-skilled workers are workers that have completed tertiary schooling. This is a rather broad measure of skilled workers, as it includes tertiary schooled of the short type. Like the OECD definitions applied by Biatour, Bryon and Kegels (2007) the ICT goods in table 7 include IT equipment and communication equipment. ICT services include telecommunications and computer & related services. The CPA codes that identify the products included in ICT goods and services are given below table 7.

Table 7 shows that the production of ICT goods involves more tertiary schooled labour than the production of other manufactured goods. This follows from the higher high-skilled labour employment multiplier (2.5 versus 1.7). The production of ICT services involves even more high-skilled workers (4.5), but this is still less than those used by non ICT services (5.3).

Still, with 40.3%, the share of high-skilled workers in cumulative employment in ICT services is higher than that in non ICT services (35.4%). The non ICT services in table 7 exclude low-skilled based construction activities, but include high-skilled services like education.

We conclude that Xiangs skill-complementarity hypothesis can be confirmed for ICT goods produced in Belgium both in absolute and relative terms. ICT services use less high-skilled labour than non ICT services, but a larger fraction of the employment generated by ICT services is high-skilled.

[32] More generally, and particularly for ICT, there can also be a complementarity between skilled labour and the use of new goods and services. This hypothesis can be tested using IO data, but without using employment multipliers. For an overview in Dutch or French, we refer to Dekkers and Kegels (2003).

Table 7 Employment multipliers and high-skilled worker employment shares of ICT goods and services.

[0] Products (homogeneous industries)	[1] Total employment multiplier	[2] Relative employment multiplier	[3] High-skilled employment multiplier	[4] Share of high-skilled in cumulative employment [3]*100/ [1]	[5] Share in cumulative employment all workers (fin. demand)	[6] Share in cumulative employment of high-skilled (fin. demand)	[7] Final demand share (%)	[8] Output share (%)
ICT goods[1]	7.4	1.91	2.5	33.8%	1.2%	1.3%	2.0%	1.5%
ICT services[2]	11.0	1.82	4.5	40.3%	2.0%	2.6%	2.1%	2.7%
Non ICT goods of manufacturing	7.8	2.09	1.7	22.0%	23.0%	16.3%	35.7%	31.3%
Non ICT services[3]	15.1	1.35	5.3	35.4%	66.0%	75.7%	52.8%	54.2%
Total economy (147 activities)	12.0	1.52	1.8	30.9%	100%	100%	100%	100%

1 ICT goods include IT equipment (CPA 300, 321,331, 332, 333) and Communications equipment (CPA 313,322,323). The IT equipment here includes CPA 331 (Medical and surgical equipment and orthopaedic appliances) because these could not be separated from 332 and 333. They are excluded from IT equipment by Biatour, Brion & Kegels (2007) following the OECD definition of IT equipment (November 2005). The IT communication equipment corresponds to that of these authors and the OECD.

2 ICT services include telecommunications (CPA 642) & computer and related activities (CPA 72). Wholesale of computers and of electronic and telecommunications part and equipment (5151 & 5152), as well as renting office machinery and equipment could not be isolated in the IO data.

3 Excluding construction activities, electricity, gas and water distribution.

In column [2] each activity's relative employment multiplier is given. For being services, ICT services have relatively strong backwards linkages. Its relative employment multiplier of 1.82 exceeds the non ICT services multiplier of 1.35, indicating a relatively larger indirect employment impact of the former. ICT services also have strong forward links. This is indicated by the fact that their output share exceeds their final demand share. This means that ICT services have a larger share in intermediate demand than in final demand.

Finally, table 7 gives the cumulative employment share (column [5]) and the final demand and output shares (columns [7] and [8]) of ICT and non ICT products. These figures show that the role of ICT production in the Belgian economy is limited. ICT goods represent 2.0% of final demand, 1.5% of output and only 1.2% of cumulative employment. Their share of high-skilled cumulative employment (column [6]) is 1.3%. ICT services represent 2.1% of final demand, 2.7% of output and 2% of cumulative employment. Their share in cumulative employment of high-skilled is 2.6%.

4.3. Employment Multipliers for Final Demand Components

Household and government consumption, investment and exports have a very different composition over products. Thus, the employment multipliers associated to them can be substantially different. Similarly, it is of interest to see how these final demand components differ in the use of low, medium and high-skilled labour[33].

Starting from the 147 input output products, the employment multipliers of the final demand components have been calculated by aggregating the multipliers, using the product shares in each final demand component as a weight. Thus, all differences in multipliers between the final demand components result exclusively from their differences in product composition. If the product detail is high enough, this IO based approach is defendable and more practical than setting up complex surveys asking firms to attribute their labour use to exports, other final demand components and domestic intermediate use.

It is useful to form an idea beforehand about differences that should be found between these employment multipliers. This is done in point 4.3.1. In point 4.3.2 and 4.3.3 the results for the total and qualitative employment multipliers are presented.

33 Of course final demand components can also be expected to differ in their labour use by other distinctions. Schaffer (2007) demonstrated that in terms of working hours, women have a smaller share in the employment generation by exports and investments in capital goods than in public & private consumption of services.

4.3.1. Expectations about employment multipliers per final demand component

We formulate some expectations based on the theory of comparative advantages, which have already been extensively tested with IO tables since Leontief's contribution on the subject[34].

We expect that all activities that face international competition use less of the scare production factors and more of the ones that are abundant in a country. Scarcity and abundance is relative to the international competitors. The more fierce this competition, the less scarce production factors will be used. Secondly, we expect that the components of final demand face different levels of international competition. Activities satisfying Government + NPISH[35] consumption can be expected to face least international competition[36], while exports are expected to face most competition. Production for household consumption and investment would face intermediate levels of international competition. In addition we distinguish between exports towards other EU countries and exports outside the EU, and assume that the latter face more fierce international competition. Thirdly, it is fair to assume that in Belgium, labour is a scarce production factor, whereas capital is an abundant one.

These hypotheses have direct implications for the total employment multipliers. Final demand components that face more international competition should have lower (absolute) cumulative employment multipliers. The use of cumulative employment multipliers is to be preferred over that of direct multipliers because the former also account for the indirect domestic labour use.

Finding a low employment multiplier for exports and a high one for government consumption is, on itself, no proof of the validity of the trade theory assumptions. All differences that can be found here are generated by composition differences over activities and these have different production functions. In all countries services, that are still less tradable than goods, could be expected to rely more on labour input, while manufactured goods rely more on capital. So, the different composition of exports and other final demand over goods and services could already produce the same result. To control for this, a distinction will be made between goods, construction activities and services.

Comparing the cumulated labour content of consumption, investment and exports is not what Leontief did when he formulated his famous paradox (see supra), but the difference is not very big. Since the labour and capital content of competitive imports is equal to their domestic production counterparts in Leontief's approach, the only difference between his and our approach

34 In 1953 Leontief formulated his Leontief paradox, revealing that in 1947, in contrast to the predictions of the by then established Heckscher-Ohlin theory, the US exports cumulatively used more labour and less capital than did its competitive imports (Duchin, 2004). Competitive imports are imports for which a domestic production exists. Their factor content is measured by taking that of the corresponding domestic productions as a proxy (assuming like HO that countries apply the same technology for equal products).

35 NPISH are Non-Profit Institutions Serving Households. The consumption pattern of these NPISH is composed of NPISH working costs (CPA 91), education and health services, R&D expenditures and cultural activities (CPA 92).

36 Services that typically make part of government consumption, like education, health care, public administration and defense are characterized by extremely low import and export levels. This is the case either because the physical proximity to users is needed, or because of language and political barriers to imports.

lies in the weighting of the employment multipliers. Leontief used competitive import shares, while we use consumption and investment shares[37]. In contrast to Leontief we also do not compute capital use here.

Our approach has the advantage that the full labour use in the economy is highlighted, while when comparing imports to exports one omits the labour use for domestic production which is exported nor imported[38]. This will have important consequences, as our results will demonstrate the importance of the labour use of government consumption expenditures.

With qualitative employment multipliers, it is possible to compare final demand components labour use per labour category. We only formulate expectations for the use of skilled or unskilled labour here[39]. Given the total employment, unskilled labour can be assumed to be scarce in Belgium relative to the EU average and particularly to non EU countries. If this is the case, its fraction in cumulated employment in exports, should be lower than that in other final demand components. If tertiary schooled are relatively abundant, the inverse should be true for these.

4.3.2. Results for total employment

Table 8 gives the direct, cumulative and relative employment multipliers by final demand component in 2000. Besides that, table 8 gives each components share in final demand and cumulated employment.

Exports, both within and outside the EU, have lower cumulative employment multipliers than products destined for private consumption and investments. Government +NPISH consumption have the highest cumulative employment multipliers. These differences are maintained when taking goods, services and construction activities[40] separately[41].

Indeed, while goods destined for household consumption and investment have a multiplier of 10.72 and 9.47, those destined for EU and non EU export have a multiplier of 7.55 and 7.06 respectively. With 11.87 and 11.92, the employment multipliers for exported services are lower then those for private consumption 13.21, government consumption 19.77 and investment 12.20.

Thus, it does not suffice to distinguish between goods, construction activities and services to explain the differences in employment multipliers between final demand components. It is also nice to see that the employment multiplier of exported goods outside the EU is, with 7.06, lower

37 See Wolff (2004), who tested and confirmed the existence of the Leontief Paradox using IO tables for the US up to 1996. Wolff's formula to compute the homogenised labour requirements of exports equals ours.

38 As soon as there are some imports or exports, they would not be omitted in the Leontief approach, but the weight of goods and services with little imports / exports would of course be very small.

39 Leontief and other authors tried to explain his paradox by referring to higher R&D, skill and human capital content of American workers (Duchin (2004), Wolff (2004)).

40 For construction activities no separate employment multipliers are shown for final demand components other than investments, because the corresponding final demand shares are too low for making comparisons.

41 With the exception of government +NPISH consumption expenditures on goods, which only represent 0.1% of final demand and consist mainly of refined petroleum & pharmaceutical products.

than that of 7.55 for the export of goods to other EU countries. For services, this is not the case.

Table 8 Employment multipliers and cumulative employment by final demand component, 2000

	Household consumption Expenditures	Government + NPISH1 consumption Expenditures	Investments + inventory changes	Exports within EU	Exports outside EU	Final demand
	P31/S14	P31/(S15+S13)	P5	P61/S21	P61/S22	
Final demand share[2]						
Goods	4.3%	0.1%[3]	2.2%	24.5%	7.4%	38.5%
Construction activities	0.1	0.0%	5.3%	0.1%	0.1%	5.5%
Services	23.8%	16.1%	2.7%	9.5%	3.8%	56.0%
All products	28.2%	16.2%	10.2%	34.1%	11.3%	100%
Direct employment multiplier						
Goods	4.97	3.09[3]	5.14	3.70	3.50	3.88
Construction activities			6.35			6.35
Services	9.13	17.36	6.82	6.79	6.77	10.82
All products	8.49	17.25	6.21	4.57	4.62	7.90
Cumulative employment multiplier						
Goods	10.72	6.80[3]	9.47	7.55	7.06	7.92
Construction activities			13.55			13.52
Services	13.21	19.77	12.20	11.87	11.92	14.73
All products	12.83	19.66	12.31	8.78	8.73	12.04
Relative employment multiplier (cumulative / direct)						
Goods	2.16	2.20[3]	1.84	2.04	2.01	2.04
Construction activities			2.13			2.13
Services	1.45	1.14	1.79	1.75	1.76	1.36
All products	1.51	1.14	1.98	1.92	1.89	1.52
Cumulative employment shares = (final demand share x cumulative employment multiplier)						
Goods	3.9%	0.1%[3]	1.7%	15.3%	4.3%	25.3%
Construction activities	0.1%	0.0%	5.9%	0.1%	0.0%	6.2%
Services	26.1%	26.4%	2.7%	9.4%	3.8%	68.5%
All products	30.1%	26.5%	10.4%	24.9%	8.2%	100%

1 NPISH are Non-Profit Institutions Serving Households. Their consumption pattern, involving Education, Health care, R&D, NPISH administration and Cultural activities, resembles more to that of government than household consumption.

2 Consistent with ESA 95 RULES on IO compilation, final demand is expressed in basic prices. This implies that product taxes like excise & vat are excluded, and that trade and transport margins on goods are allocated to distribution services. This explains the low final demand share of household consumption of goods.

3 Government and NPISH consumption of goods consists mainly of refined petroleum and pharmaceutical products. This explains their low employment multiplier (see table 5).

One of the most striking results of table 8 is the difference in the employment multiplier of government + NPISH expenditures on services (19.77) versus household consumption expenditures on services (13.21)[42]. This is due to the direct employment effects since the difference between household and government consumption of services in the direct employment multipliers ex-

42 A part of this difference is due to the presence of "renting services involving own residential property" in household consumption. These make up 6.26% of final demand and only 0.9% of cumulated employment (see table 5). They include fictive rents (4.6% of final demand) which are an estimation of the rents house owners pay to themselves for living in their own house. When the 6.26% renting services are left out, the multiplier of household consumption on services rises to 13.80. This is still much below that for government consumption.

ceeds that in the cumulative employment multipliers. This huge direct effect should not surprise because government consumption of services consists for the largest part of the payment of salaries. We will show further that most of this employment is related to Education and Health and social work services.

The relative employment multipliers reflect the differences in indirect employment generation. 100 workers directly employed in exporting services generate 75 or 76 workers indirectly, while only 45 and 14 workers are associated indirectly with 100 workers in household and government consumption of services. The relative employment multiplier is, with 1.98 highest for investments. This is due to the large share of construction activities in investment expenditures, which have a high relative employment multiplier (2.13).

The large differences in employment multipliers substantially shift the ordering of the final demand components when going from final demand to cumulative employment shares. With 34.1%, exports within the EU have the highest share in final demand. In cumulative employment, given below table 8, they are only ranked third, with 24.9%. They are now preceded by household and government + NPISH consumption with a cumulative employment share of respectively 30.1% and 26.5%. Similarly, the 11.3% final demand share of exports outside the EU falls back to an 8.2% of cumulative employment, where it is preceded by investments + inventory changes with a share of 10.4%. Due to their high employment multiplier, Government + NPISH service expenditures, with a share of only 16.1% in final demand, have a share of 26.4% in cumulative employment generation.

We conclude that cumulative employment multipliers differ significantly between final demand components. As predicted by our assumptions based on the comparative scarcity of labour (and abundance of capital) in Belgium, exports use less employment than investment and consumption by household or government. Thus, as far as total employment is concerned, no Leontief paradox shows up in the year 2000.

The shift in the cumulative employment multiplier from 13.2 to 19.8 when going from household to government consumption of services attracted our attention though, because it seems to be too large to be explained by trade theory alone. Due to its high employment multiplier, government + NPISH consumption expenditures, with a share of 16.2% in final demand, have a cumulative employment share of as much as 26.5%.

4.3.3. The results with qualitative employment data

Qualitative employment data can be used to analyze the large differences in employment multipliers more in depth. In table 9, each final demand component's cumulative employment has been broken down in 4 education levels and in part-time and full-time employment. The share of say, higher secondary schooled in cumulative employment equals their qualitative employment multiplier divided by the total employment multiplier of the final demand category. The latter was given in table 8.

Table 9 Composition of cumulative employment by final demand component over education levels and labour regime, shares 2000

	Household consumption Expenditures P31/S14	Government + NPISH consumption Expenditures P31/(S15+S13)	Investments + inventory changes P5	Exports within EU P61/S21	Exports outside EU P61/S22	Final demand
Distribution over formation levels						
Low-skilled: lower & lower secondary						
Goods	0.42	0.27	0.38	0.39	0.37	0.39
Construction activities			0.47			0.47
Services	0.35	0.23	0.28	0.31	0.30	0.29
All products	0.36	0.23	0.40	0.36	0.34	0.33
Medium-skilled : higher secondary						
Goods	0.38	0.35	0.40	0.39	0.38	0.39
Construction activities			0.38			0.38
Services	0.39	0.30	0.36	0.37	0.37	0.35
All products	0.39	0.30	0.38	0.38	0.38	0.36
High-skilled: tertiary short type						
Goods	0.10	0.17	0.11	0.11	0.12	0.11
Construction activities			0.08			0.08
Services	0.14	0.27	0.16	0.15	0.15	0.19
All products	0.13	0.27	0.11	0.12	0.13	0.16
High-skilled: tertiary long type + academic						
Goods	0.09	0.21	0.11	0.11	0.12	0.11
Construction activities			0.08			0.08
Services	0.12	0.20	0.19	0.17	0.18	0.16
All products	0.12	0.20	0.11	0.12	0.15	0.15
Share of part-time workers[1]						
All formation levels						
Goods	0.17	0.15	0.10	0.12	0.12	0.13
Construction activities			0.09			0.09
Services	0.30	0.29	0.15	0.15	0.15	0.26
All products	0.29	0.29	0.11	0.13	0.13	0.22
Tertiary schooled workers						
Goods	0.13	0.09	0.08	0.09	0.09	0.09
Construction activities			0.09			0.09
Services	0.19	0.24	0.09	0.09	0.08	0.19
All products	0.18	0.24	0.09	0.09	0.08	0.17

[1] Since only employees could be subdivided into Full-time and part-time workers, all self employed workers (that have this as a main activity) are considered as Full-time workers here.

First consider the results on the formation levels. Table 9 reflects the differences in the use of low, medium and high-skilled labour between goods, construction activities and services. Construction activities are based most on low and medium-skilled workers. As summarized by the last column, final demand for construction activities in 2000 was based for 47% on lower to lower secondary schooled workers, for 38% on higher secondary schooled workers and for only 8% each of tertiary schooled workers of the short or long type. Final demand for goods is less based on low-skilled workers, and also uses more tertiary schooled workers (22% instead of 16% for construction activities). Most tertiary schooled workers are used in the final demand for services (35%=19%+16%).

The overall differences between goods, services and construction activities are maintained within each final demand component and in fact reflect no more than common knowledge. As a consequence of the importance of construction activities among investments, this final demand component uses most low-skilled (40%) and least high-skilled (22%=11%+11%) labour.

Table 9 shows differences between final demand components in the use of skilled labour within the categories of goods, construction and services. These can be seen by comparing the figures on the same row. Both in the case of goods and services, investments and exports use less low-skilled and more high-skilled workers than does household consumption. This could support the assumption that tertiary schooled labour is abundant compared to other countries. Also in line with this view is that exports outside the EU use slightly more Tertiary long type + academic schooled workers than those within the EU, even when taking goods and services separately.

Table 9 shows that the final component which is least exposed to international competition, government + NPISH consumption expenditures, makes *most* use of both levels of tertiary schooled workers! Indeed, cumulative employment generated by government expenditures on services consists of only 23% low-skilled, 30% medium-skilled and as much as 47% of high-skilled workers (27% short type + 20% long type + academic).

When all products are taken together, the use of high-skilled labour by government + NPISH expenditures exceeds that of other final demand components dramatically. The 47% high-skilled labour use by government consumption expenditures falls to 28% in the case of exports outside the EU. Other final demand components use even less high-skilled labour.

Even if services are isolated, the differences in the use of tertiary schooled remain large. Most of the difference is situated in the group of tertiary short type workers though. If the definition of high-skilled would be restricted to long type +academic, and services are isolated, the shares of high-skilled in investments (19%) and in exports outside the EU (18%) would approach that in the government consumption (20%). The high use of tertiary schooled labour by government + NPISH expenditures on services is an important result that we want to study in more depth.

In the first place, it is interesting to look at the qualitative employment multipliers behind table 9. Table 10 gives the same cumulative employment multipliers and shares as table 8, except that now only workers with a tertiary schoolings level are included.

From table 8 we already know that government consumption expenditures on services have the highest employment multiplier. A final demand share of 16.1% was translated in a share of 26.4% of cumulated employment. Now table 10 shows that government expenditures on services alone are responsible for 40.2% of the employment of tertiary schooled workers!

Table 10 Employment multipliers and cumulative employment of tertiary schooled workers by final demand component, 2000

	Household consumption Expenditures	Government + NPISH consumption Expenditures	Investments + inventory changes	Exports within EU	Exports outside EU	Final demand
	P31/S14	P31/(S15+S13)	P5	P61/S21	P61/S22	
Direct employment multiplier of tertiary schooled workers						
Goods	0.81	1.46	0.93	0.72	0.78	0.76
Construction activities			0.60			0.60
Services	2.19	8.54	2.64	2.26	2.41	4.06
All products	1.97	8.48	1.21	1.15	1.33	2.60
Cumulative employment multiplier of tertiary schooled workers						
Goods	2.12	2.61	2.04	1.68	1.72	1.76
Construction activities			2.10			2.10
Services	3.36	9.30	4.35	3.81	3.98	5.23
All products	3.17	9.25	2.68	2.28	2.49	3.72
Relative employment multiplier (cumulative / direct)						
Goods	2.61	1.79	2.20	2.34	2.19	2.33
Construction activities			3.52			3.52
Services	1.53	1.09	1.65	1.68	1.65	1.29
All products	1.60	1.09	2.22	1.98	1.86	1.43
Cumulative employment shares = (final demand share x cumulative employment multiplier)						
Goods	2.5%	0.1%	1.2%	11.1%	3.4%	18.2%
Construction activities	0.0%	0.0%	3.0%	0.1%	0.0%	3.1%
Services	21.5%	40.2%	3.2%	9.7%	4.1%	78.6%
All products	24.0%	40.3%	7.3%	20.9%	7.5%	100%

This result is mainly due to direct employment generation. As the relative employment multiplier indicate, for 100 tertiary schooled directly working, only 9 tertiary schooled have been involved indirectly in the production for government consumption of services. This is a very low relative employment multiplier, particularly compared to those for goods and construction activities. For example, the relative employment multiplier for tertiary schooled of 3.52 for investment in construction implies that for each tertiary schooled worker directly employed, 2.5 additional tertiary schooled workers are needed indirectly in the production process[43].

If wages paid to tertiary schooled long type +academic and tertiary schooled short type workers differ[44], this could help explain the high employment multipliers for tertiary schooled workers in Government + NPISH consumption. Still the explanation would only be partial, since even among the tertiary schooled of the long type + academic, the cumulative employment share of Government + NPISH consumption of services amounts to 36.6%.

A further element of explanation is given below table 9. The all products and all workers share of part-time work for government + NPISH consumption equals 29%. This is high compared to the economy average of 22% but equal to the share of part-time work in household consump-

43 These 2.5 workers include workers of subcontractors operating within the construction industry.

44 Sadly, no wage data are available that differ between tertiary schooled of the short and long type + academic for the main services covered by government consumption.

tion services. Thus it does not explain the difference in both final demand components cumulative employment multipliers of table 8.

When tertiary schooled workers are isolated, the lowest part of table 9 reveals that 24% of their employment generated by the government consumption on services is part-time. This share is higher than the 19% share of part-timers among the tertiary schooled used for household consumption of services and definitely exceeds the mere 9% or 8% of part-time workers among the tertiary schooled employed through investment and exports of services.

At this point, one may wonder why we did not compute these and the previous multipliers for the number of hours worked instead of counting heads. Data limitations have prevented us from doing this so far[45], but in box 3 we explain why even in the presence of detailed data on hours worked, it remains important to understand differences in multipliers per head.

Box 3: Employment multipliers per head versus multipliers of hours worked

Our method for compiling employment multipliers per head can be applied to hours worked. It suffices to replace the matrix S with data on employed persons by a similar matrix with data on hours worked.

Yet, even when using multipliers by hours worked, one should continue to show distinctions such as those between part-time and full-time, and female or male employment. In a study based on the same data for employees, Van den Cruyce & Wera (2007) found that the hourly wages of part-time and full-time workers and female and male workers differ significantly in favor of full-time and male workers.

Thus, an economist that works with data on hours worked could wrongly think that he no longer has to look at the distinction between full-time and part-time or male and female workers to understand differences in the size of employment multipliers. He is likely to be wrong because the same final demand expenditure is more easily translated in the use of a higher labour volume (in hours) for worker types with lower hourly wages.

Given the great employment impact of government + NPISH consumption, it is interesting to have information on the distribution of this employment over different goods and services. In figure 1 the cumulative Government and NPISH consumption expenditures are distributed over activities. In figure 2 the same is done for tertiary schooled workers only. Thus, figure 1 gives the detail of the 26.5% cumulative employment share of Government + NPISH consumption expenditures in table 8, while figure 2 gives the same for the corresponding 40.3% of tertiary schooled workers in table 10.

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45 The FPB has compiled a series of hourly data for the period 1997-2005 comparable to national accounts and to the numbers per head used here. The series is limited to employees, though, and does not have the distinction between education levels. For a description and results of the full date base, see Van den Cruyce, Wera 2007.

Figure 1 : Cumulative Employment Shares of Government and NPISH Consumption by Product

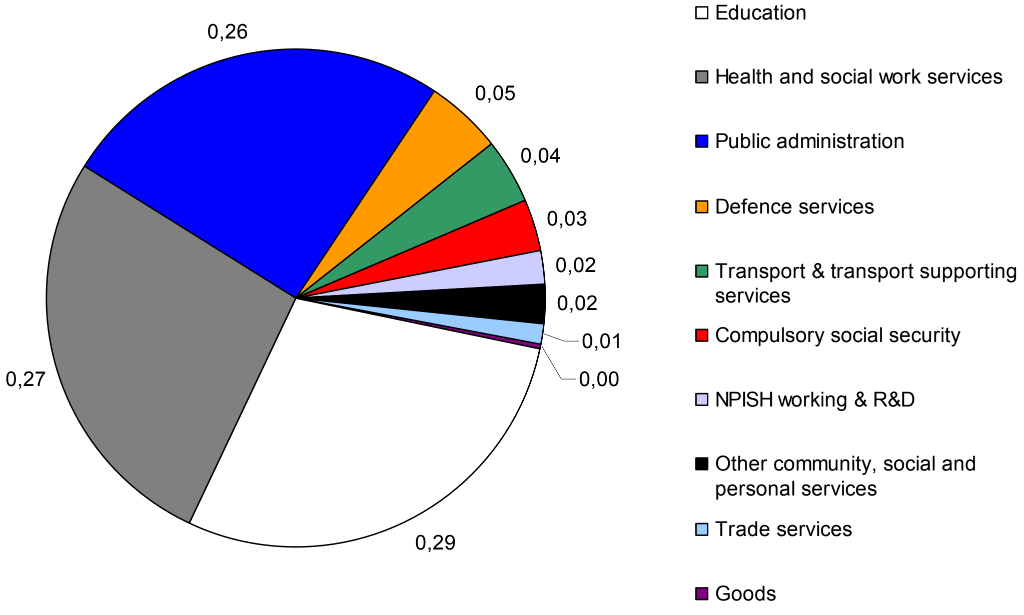
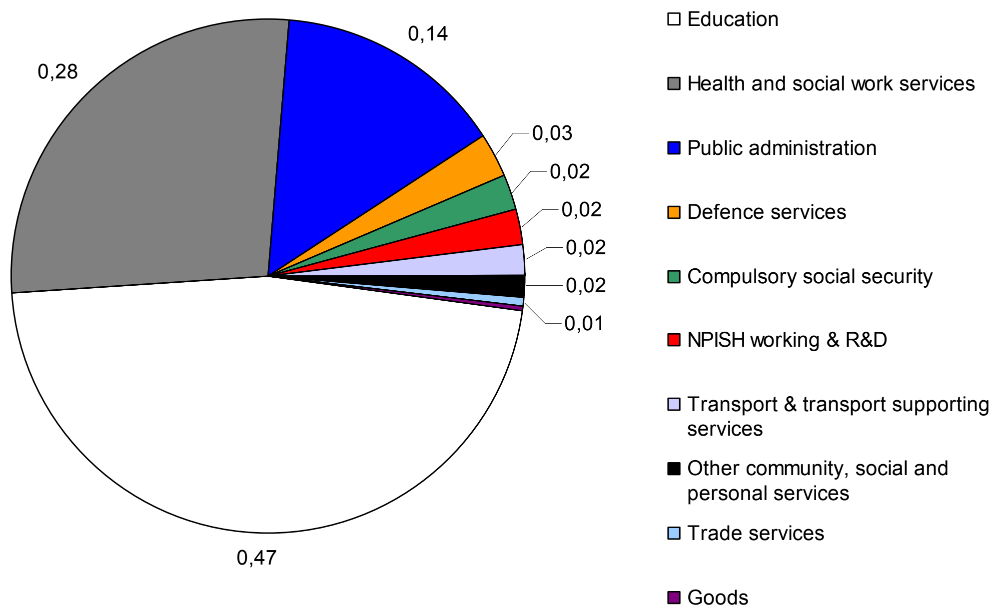


Figure 2 : Tertiary schooled Employment Shares of Government & NPISH Consumption by Product



Education is responsible for 29% of employment generation by government and NPISH consumption expenditures in 2000. Among the tertiary schooled, education is responsible for as much as 47% of employment generation by government and NPISH consumption. Education is followed by Health and social work services, responsible for 27% of total and 28% of tertiary schooled employment generation. Public administration only comes at the third place, with 26% of total employment generation and only 14% of tertiary schooled employment.

The major three services are followed at large distance by defense services, transport & transporting services, compulsory social security services, NPISH working & R&D, some smaller services and goods. The huge importance of Education and Health services in government and NPISH final consumption expenditures in employment generation are a major result.

According to ESA conventions, expenditures on Education and Health should be considered as individual consumption services along with expenditures on sport and recreation and Culture (ESA 95, §3.85). While the decision making about these expenditures is largely in the hands of individual residents, the figure reflects the large public expenditure share in Education and Health care services in Belgium.

In 2000 only 4.4% of total final consumption expenditures on Education are paid by Households. The rest are expenditures by government and NPISH that are behind the employment results here. The share of households in total final consumption for Health and social work services is 32.4%. The remaining 67.6% are behind the employment data in figures 1 and 2.

With 47%, almost half of the 40.3% share of government and NPISH final demand expenditures in the employment of tertiary schooled is explained by Education. As a result, 19% of all tertiary schooled are employed directly or indirectly through public Education expenditures. This reveals a public choice in favor of an extended education system. Indeed, even if many teachers are tertiary schooled of the short type[46], the education system in Belgium does use a lot of the high-skilled labour. To verify this claim, comparisons could be made with other countries using similar data.

[46] Education services were responsible for 53% of the cumulative employment of tertiary schooled of the short type generated by government + NPISH consumption in 2000. The use of workers with this formation level of Health care & social work and administration was 26% and 11% respectively.

5. Employment Multipliers for More Recent Years

Employment multipliers become more interesting if they can be computed for several years. This section gives the results for the employment multipliers based on an updated IO table for 2002. The structure of this section represents the steps needed to obtain detailed employment multipliers. For each step we indicate which tables are needed.

A question could be whether it is possible to compute qualitative employment multipliers in the absence of an input output table. This issue is too complex to be fully addressed here.

5.1. The Employment Data for 2002

As a first step, one needs detailed employment data similar to that for 2000, and comparable to national accounts. As a result of our effort for the period 1999-2005, these data are available[47].

Table 11 shows the employment types for non-homogenised industries. It is the equivalent of table 1, for the year 2002. Compared to the table for 2000, the employment structure over heterogeneous industries has already changed moderately in 2002.

[47] Our employment data are based on the version of the national accounts (INA) published in September 2006. For years prior to 2003 there have been no changes in the employment by industry figures in the publication of September 2007. Thus our results for 2000 and 2002 are still comparable with the latest version of national accounts.

Table 11 Employment by Type for Non Homogenised Industries, 2002 (shares)

Non homogenised industry:	Agriculture, forestry, fishing	Manufacturing	Mining, water & energy supply	Construction	Trade, repair, hotel & restaurant services	Transport, storage & communication	Financial, real estate & business activities	Public adm., defence education	Health & other services	Total
	A+B	D	C+E	F	G+H	I	J+K	L+M	N+O+P	
Men	0.70	0.76	0.84	0.93	0.52	0.76	0.59	0.43	0.29	0.57
Women	0.30	0.24	0.16	0.07	0.48	0.24	0.41	0.57	0.71	0.43
29 years or less	0.17	0.22	0.14	0.26	0.28	0.19	0.25	0.16	0.21	0.22
30-39 years	0.24	0.33	0.26	0.30	0.30	0.26	0.30	0.27	0.30	0.29
40-49 years	0.24	0.28	0.28	0.26	0.23	0.34	0.25	0.33	0.32	0.28
50-59 years	0.19	0.16	0.31	0.15	0.14	0.19	0.15	0.22	0.14	0.17
60 and older	0.17	0.02	0.01	0.03	0.04	0.02	0.05	0.02	0.03	0.03
Blue-collar, private	0.26	0.64	0.08	0.68	0.30	0.24	0.21	0.00	0.29	0.30
White-collar, private sector	0.02	0.32	0.55	0.12	0.47	0.19	0.45	0.02	0.36	0.30
Public sector	0.00	0.00	0.36	0.00	0.00	0.52	0.01	0.97	0.17	0.24
Self-employed	0.72	0.04	0.00	0.20	0.23	0.04	0.33	0.00	0.18	0.16
Primary/lower secondary	0.55	0.37	0.24	0.50	0.35	0.40	0.21	0.20	0.27	0.31
Upper secondary	0.37	0.42	0.44	0.41	0.46	0.43	0.33	0.29	0.33	0.37
Tertiary short type	0.06	0.11	0.18	0.05	0.11	0.10	0.20	0.31	0.22	0.17
Tertiary long Type + academic	0.02	0.10	0.15	0.04	0.08	0.07	0.26	0.21	0.18	0.15
Part-time workers	0.14	0.10	0.05	0.05	0.28	0.12	0.18	0.28	0.43	0.23
Company administrators	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.04
Interim workers	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.02
Workers (x1000)	89	638	29	238	722	293	758	726	650	4144
Share workers	0.022	0.154	0.071	0.058	0.174	0.071	0.183	0.175	0.157	1
Output (mln €)	7315	171090	11491	36394	83330	48448	122331	41926	39810	562135
Share of output	0.013	0.304	0.020	0.065	0.148	0.086	0.218	0.075	0.071	1

The most obvious overall changes are the lower shares of persons aged less than 30 years and 30-39 years, to the benefit of the workers aged 50-59 years and the 2% point drop in the share of primary/lower secondary schooled workers (from 33% to 31%) to the benefit of upper secondary and tertiary short type schoolings levels. With 15.4%, the employment share of the manufacturing branch is lower than in 2000 (16%). The output share of the manufacturing branch has dropped from 32.7% to 30.4% at current prices, which is quite considerable for a two years time period.

5.2. Final demand for domestic output in basic prices

Employment multipliers give the employment generation of final demand for domestic output. Final demand is a product vector, which (in expression (2)) is pre-multiplied by the Leontief inverse to obtain multipliers. Detailed product information on final demand can be found in a Use table. In the final demand part of that table, consumption, investment and exports are allocated over products. Following Eurostat rules, a Use table is produced annually with a delay of 3 years, thus the table produced at the end of 2007 is that for 2004.

However, the information in the Use table is insufficient. To be comparable to IO data, final demand for domestic output should be expressed in basic prices[48]. National accounts produce annual aggregates of consumption by households & government, investments and exports like those shown in table 8 and 9. But these totals and the expenditures in the Use table are expressed in purchaser prices[49]. Furthermore, they are not subdivided in an imported and a domestically produced part.

Final demand in purchaser prices is transformed in final demand for domestic output in basic prices by reducing it with the final demand parts of the following tables, prescribed by Eurostat regulations (ESA 1995).

1) a Use table of trade margins, transport margins and product taxes and subsidies

2) a Use table of imports

In Belgium, these tables are computed at the Federal Planning Bureau as a part of the compilation of an IO table. Thus, like the IO tables they are normally produced only every 5 years and with a 3 years delay, which brings along a serious timeliness handicap.

In the context of the EU Klems project, annual updates have been made of the above tables to provide Use tables for domestic production in basic prices for the years 2001, 2002 and 2003[50]. We continue with data for 2002, because the employment data for 2003 have not (yet) been made consistent with the latest version of national accounts (NBB, september 2007).

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48 Basic prices are the prices producers receive for their goods/ services. Output and import totals per industry, which are produced annually, with a delay of 1 year, are computed in basic prices.

49 Purchaser prices are the prices purchasers pay for goods. They include trade and transport margins as well as indirect taxes minus subsidies on products (with the exclusion of vat).

50 While consistent with the SUT tables of their year (2001, 2002 or 2003), the use tables of imports and trade and transport margins-tables are mechanic updates of the corresponding tables for 2000. For a description of the derivation of these tables, see Avonds, Hambye & Michel (2007).

5.3. Employment multipliers for 2002 and the use of an input output table

With the use table already expressed in basic prices, it was relatively easy to compute an input output table for domestic production for 2002[51]. Now all the tables needed for the compilation of qualitative employment multipliers in (8) are available, since the matrix of market shares D is generated by the Make matrix, which is a part of the Supply table.

Note that the final demand vector f^d does not directly make part of the expression (8). It is needed to aggregate employment multipliers. Also, only the use of a matrix of technical coefficients A^d —that is an IO table— guarantees that equation (2), and with it proposition 1, hold. Although the input-output table for 2002 is to some extent an update of the 2000 input-output table, it does reflect a series of changes in the basic data incorporated in national accounts, particularly with respect to final demand[52], as well as output and value added by industry.

Note that for computing the direct employment effects by equation (10), no input-output matrix is needed. For aggregating the direct effects by final demand product or component, a vector of final demand for domestic output in basic prices is needed, but direct effects could also be aggregated by output levels.

Table 12 shows the output & direct and cumulative employment multipliers for the year 2002. The rows [1] to [6] give results equivalent to those for 2000 in table 2. The total final demand employment multiplier has dropped from 12.04 in 2000 to 11.79 in 2002. In row [7], the % change with respect to the 2000 employment multiplier is given. For most of the 9 considered activities, the employment multipliers have decreased from 2000 to 2002. This result should not surprise, because final demand for both years have been expressed in current prices.

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51 With the exception of refining, product technology was assumed to hold for all activities. In contrast to a real IO year, no analysis was made of negatives in the original technical coefficient matrices. This usually gives rise to a feed back that improves the SUT, since most large negatives can be removed by correcting errors in the SUT.

52 At product level, new data are used for compiling consumption, investments, imports and exports.

Table 12 Output & Employment Multipliers by Final Demand Product, 2002 (workers/1 mln €)

Final demand category:	Prod. of agricul-ture, forestry, fishing	Prod. of manu-facturing	Prod. of Mining, water & electr. & gas	Cons-truction activities	Trade, repair, hotel and restaurant services	Transport, storage & communi-cation	Financial, real estate & business activities	Public adm., defense educa-tion	Health & other services	Total final demand [1]
[1] Total output multiplier (mln €)	*1.85*	1.61	1.51	2.12	1.79	1.70	1.51	1.21	1.50	**1.60**
[2] Employment multiplier	16.48	7.77	6.1	13.35	14.79	10.15	7.91	18.75	22.05	**11.79**
[3] Direct effect on employment	12.03	3.76	2.80	6.21	9.38	5.89	4.4	17.33	17.98	**7.76**
[4] Indirect effect on employment	4.45	4.01	3.30	7.13	5.41	4.26	3.5	1.42	4.07	**4.03**
[5] Relative em-ployment multiplier [5]=[2]/[3]	1.37	2.07	2.18	2.15	1.58	1.72	1.79	1.08	1.23	**1.52**
[6] % in final de-mand for domestic output in 2002	0.6%	36.0%	1.4%	5.4%	13.8%	7.0%	15.5%	10.9%	9.3%	**100%**
[6] % in cumulative employment	0.9%	23.7%	0.7%	6.1%	17.3%	6.1%	10.4%	17.3%	17.5%	**100%**
[7] % changes in employment multi-plier 2002-2000	-7.6%	0.3%	3.9%	-1.3%	-5.5%	-2.0%	2.0%	-8.2%	-4.5%	**-2.1%**
[8] % changes in relative employment multiplier 2002-2000	-3.0%	-0.5%	13.0%	0.8%	0.6%	-3.0%	-0.7%	0.2%	0.2%	**-0.3%**
[9] % price increase of final demand product 2002-2000	15.4%	-0.9%	8.1%	1.1%	1.8%	8.4%	2.5%	7.0%	6.2%	**2.4%**
[10] Employment mult. 2002 using relative employment mult. of 2000	17.00	7.81	5.40	13.24	14.69	10.46	7.96	18.71	22.02	**11.80**

[1] The total economy or average multiplier show the effect of a 1 million euro shock distributed over the final demand categories according tot their share in final demand for domestic output.

Price increases/decreases of final demand products can be expected to have a negative/positive influence on employment multipliers, since they are likely to have a larger impact on the denominator (valued in euro's) than the numerator (values in employment terms). Through rationalizations or expansions, price changes must influence employment at some point in time. Still, in a short time period (1 or 2 years) employment could be considered to be more linked to a volume measure of output. The national accounts estimate for the price increase of the 9 products and total final demand are given in row [9].

There is no one to one relation between a price increase of a final demand product and an employment multiplier decrease, but the comparison of rows [7] and [9] does reveal that in contrast to most other activities, manufactured goods, which saw a price decrease, saw a slight increase in their employment multiplier in the period 2000-2002. Between 2000 and 2002, total final demand had a price increase of 2.4% while the employment multiplier decreased by 2.1%.

Recently, a first series of SUT tables in constant prices of 2000 has been produced for Belgium. By compiling final demand in basic prices and an IO table in constant prices one could generate employment multipliers for 2002 that are "netted" of the influence of prices changes. In the future such an exercise can be performed knowing that constant price tables for Belgium have been computed by deflating current price tables in a rather mechanical way[53].

For impact studies it is disturbing that employment multipliers of previous years cannot be used readily. An alternative would be to look at *relative* employment multipliers. Relative employment multipliers equal the ratio of cumulated to direct labour. This ratio could be influenced by real structural changes like rationalizations, domestic outsourcing etc. but there is no direct link with input or output price changes.

Row [8] in table 12 shows the percentage change of the relative employment multiplier of 2002 with respect to 2000. In 4 cases, the relative employment multiplier has decreased, for 5 activities it has increased. With the overall change limited to -0.3%, the changes in the relative employment multipliers are also usually smaller than those in the absolute employment multipliers.

The absolute employment multipliers of 2002 could now be estimated by multiplying the direct effects on employment in row [3] with the relative employment multipliers of 2000. Row [10] shows the results of this exercise. The total final demand multiplier for 2002 is obtained by weighting the employment multiplier estimates with the 2002 final demand shares of their activities. As can be seen, the estimated total final demand employment multiplier of 11.80 is very close to that of 11.79 obtained by using an IO table in row [2].

This result, although nice, is not a sufficient proof of the virtues of this method. First, for individual activities, like products of mining, energy and water, the relative employment multiplier between both years can still differ visibly. As a result, the estimate for the absolute employment multiplier in 2002 also differs from the one obtained using an IO table.

Second, to calculate row [10], we have used the direct effects in row [3]. For calculating the direct effect at the level of 147 IO industries for 2002 no final demand shares are needed[54], but to obtain row [3], the direct employment multipliers have been aggregated using the 2002 product shares in final demand for domestic output in basic prices. Producing such final demand shares for recent years is, even when working in current prices, not a trivial step (as discussed in 5.2).

Thirdly, however small the difference in the total final demand employment multipliers of row [2] and row [10], the fact that they differ implies that proposition 1 no longer holds for the new set of employment multipliers. In other words: the cumulated employment no longer equals the actual employment total. This is particularly annoying in the case of qualitative employment multipliers, since this inequality would exist for every labour type.

53 For full detail about the compilation of these tables, see Avonds, Hambye, & Michel (2007)

54 Simply apply equation (10).

5.4. Some qualitative employment multipliers for 2002

Table 13 presents the cumulative employment use of various labour types for 9 activities in 2002. For each activity, the shares add to 1 per labour typology and are directly comparable with those in table 4.

Table 13 Cumulated Employment Use by Final Demand Product, 2002 (shares)

Final demand product:	Prod. of agricul-ture, forestry, fishing	Prod. of manufac turing	Prod. of Mining, water & electr. & gas	Con-struction activities	Trade, repair, hotel and restaurant services	Transport, storage & communi-cation	Financial, real estate & business activities	Public adm., defense education	Health & other services	Total final demand
Men	0.68	0.70	0.76	0.83	0.56	0.70	0.61	0.45	0.33	0.57
Direct	0.51	0.36	0.38	0.43	0.32	0.42	0.34	0.40	0.23	0.35
Indirect	0.17	0.34	0.38	0.40	0.24	0.28	0.28	0.05	0.10	0.22
Women	0.32	0.30	0.24	0.17	0.44	0.30	0.39	0.55	0.67	0.43
Direct	0.22	0.12	0.08	0.03	0.31	0.16	0.22	0.53	0.58	0.31
Indirect	0.10	0.17	0.16	0.13	0.13	0.14	0.17	0.03	0.09	0.12
29 year or less	0.18	0.24	0.19	0.25	0.27	0.21	0.22	0.17	0.21	0.22
30-39 year	0.25	0.31	0.28	0.30	0.30	0.27	0.30	0.27	0.30	0.29
40-49 year	0.24	0.27	0.28	0.27	0.24	0.31	0.27	0.33	0.32	0.28
50-59 year	0.18	0.16	0.22	0.16	0.14	0.18	0.17	0.21	0.14	0.17
60 and older	0.14	0.03	0.03	0.03	0.04	0.03	0.05	0.02	0.03	0.03
Blue-collar, private	0.27	0.49	0.24	0.57	0.32	0.25	0.15	0.02	0.30	0.30
White-collar, private	0.12	0.33	0.42	0.22	0.40	0.26	0.46	0.05	0.34	0.30
Public sector	0.02	0.03	0.20	0.04	0.04	0.39	0.07	0.91	0.19	0.24
Self-employed	0.59	0.14	0.13	0.17	0.25	0.10	0.31	0.02	0.18	0.16
Primary / lower secondary	0.49	0.36	0.29	0.43	0.35	0.36	0.21	0.20	0.28	0.31
Upper secondary	0.37	0.40	0.41	0.40	0.43	0.42	0.34	0.29	0.34	0.37
Tertiary short type	0.08	0.12	0.15	0.08	0.12	0.12	0.20	0.30	0.22	0.17
Tertiary long type + academic	0.06	0.12	0.15	0.08	0.10	0.11	0.25	0.21	0.17	0.15
Part-time employees	0.15	0.14	0.10	0.09	0.25	0.15	0.15	0.27	0.41	0.23
Administrators	0.01	0.03	0.05	0.02	0.04	0.03	0.18	0.00	0.01	0.04
Interim workers	0.01	0.05	0.02	0.02	0.02	0.02	0.03	0.00	0.01	0.02
Total multiplier	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

One can verify that the final column of table 13, expressing the employment used by total final demand in 2002, is equal to the total economy distribution in the employment data (table 11). Indeed, since these results are based on an IO table for 2002, proposition 1 continues to hold.

In part 5.1 we have already discussed the total economy changes. A comparison of table 13 with table 4 shows whether the qualitative changes differ between the large product groups. For all product groups there is a drop in the employment share of the primary or lower secondary schooled. With 3%, this drop is even more important in the production of manufactured goods than in general (2%). Thus, the fall in the share of low-skilled workers is not due to the lower final demand share of industrial goods, but rather to a reduced use of these workers in all branches including branches that use relatively much low-skilled labour.

The share of self-employed tends to fall. It does so in particular in the Trade, repair and hotel & restaurant branch, where the share of white and blue-collar employees increases. It is striking that in branches where the share of low-skilled workers decreases, the share of blue-collar workers remains constant, or even rises.

For all product groups there is an increase in the share of workers aged between 50 and 59 year, and a decrease in their share of workers younger than 30 years. Finally, the share of part-time workers rises moderately for all product groups.

Tables 14 and 15 give the employment multipliers and cumulative employment shares by final demand component, both for total employment and for tertiary schooled workers. They are updates of the tables 8 and 10. Since the relative employment multipliers and the cumulative employment shares are not directly influenced by price changes, they are more suitable for comparisons over time than the cumulative or direct employment multipliers.

Table 14 Employment multipliers and cumulative employment by final demand component, 2002

	Household consumption Expenditures	Government + NPISH[1] consumption Expenditures	Investments + inventory changes	Exports within EU	Exports outside EU	Final demand
	P31/S14	P31/(S15+S13)	P5	P61/S21	P61/S22	
Final demand share[2]						
Goods	4.3%	0.1%	1.8%	23.5%	7.0%	38.5%
Construction activities	0.1%	0.0%	5.1%	0.2%	0.1%	5.5%
Services	24.1%	17.4%	2.4%	9.5%	4.3%	56.0%
All products	28.5%	17.6%	9.3%	33.3%	11.3%	100%
Direct employment multiplier						
Goods	4.93	2.96	5.07	3.69	3.68	3.90
Construction activities			6.18			6.21
Services	9.12	16.17	6.80	6.61	7.17	10.59
All products	8.47	16.07	6.12	4.55	5.01	7.89
Cumulative employment multiplier						
Goods	10.70	7.09	9.37	7.50	7.23	7.92
Construction activities			13.34			13.35
Services	12.65	18.40	11.76	11.41	11.96	14.09
All products	12.36	18.32	12.16	8.66	9.05	11.78
Relative employment multiplier (cumulative / direct)						
Goods	2.17	2.40	1.85	2.03	1.97	2.03
Construction activities			2.16			2.15
Services	1.39	1.14	1.73	1.73	1.67	1.33
All products	1.46	1.14	1.98	1.91	1.81	1.49
Cumulative employment shares = (final demand share x cumulative employment multiplier)						
Goods	3.9%	0.1%[3]	1.4%	15.0%	4.3%	24.7%
Construction activities	0.1%	0.0%	5.8%	0.2%	0.1%	6.2%
Services	25.9%	27.2%	2.4%	9.2%	4.3%	69.1%
All products	29.9%	27.3%	9.6%	24.5%	8.7%	100%

1. NPISH are Non-Profit Institutions Serving Households.
2. Consistent with ESA 95 rules on IO compilation, final demand is expressed in basic prices.

Table 15 Employment multipliers and cumulative employment of tertiary schooled workers by final demand component, 2002

	Household consumption Expenditures	Government + NPISH consumption Expenditures	Investments + inventory changes	Exports within EU	Exports outside EU	Final demand
	P31/S14	P31/(S15+S13)	P5	P61/S21	P61/S22	
Direct employment multiplier of tertiary schooled workers						
Goods	0.87	1.36	1.00	0.78	0.58	0.82
Construction activities			0.59			0.60
Services	2.20	8.05	2.65	2.28	2.73	4.04
All products	2.00	8.00	1.20	1.21	1.59	2.67
Cumulative employment multiplier of tertiary schooled workers						
Goods	2.22	2.71	2.17	1.76	1.82	1.85
Construction activities			2.19			2.19
Services	3.37	8.87	4.34	3.83	4.41	5.23
All products	3.20	8.82	2.74	2.36	2.80	3.82
Relative employment multiplier (cumulative / direct)						
Goods	2.56	1.99	2.17	2.27	2.13	2.27
Construction activities			3.70			3.68
Services	1.53	1.10	1.63	1.68	1.62	1.29
All products	1.60	1.10	2.28	1.95	1.76	1.43
Cumulative employment shares = (final demand share x cumulative employment multiplier)						
Goods	2.5%	0.1%	1.0%	10.9%	3.3%	17.8%
Construction activities	0.0%	0.0%	2.9%	0.1%	0.0%	3.1%
Services	21.3%	40.5%	2.7%	9.6%	4.9%	79.1%
All products	23.9%	40.6%	6.7%	20.6%	8.3%	100%

Between 2000 and 2002 the cumulative employment share of government and NPISH consumption expenditures rose from 26.5% to 27.3%. This increase was not caused by an increase in the employment multiplier (that fell considerably from 19.66 to 18.32) but by an increase in the final demand share of government and NPISH consumption expenditures. These have increased from 16.2% to 17.6%.

While the final demand and cumulative employment shares of investments and exports to other EU countries have dropped between 2000 and 2002, the cumulative employment share of exports outside the EU has increased from 8.2% to 8.7%. The final demand share of exports of goods outside the EU dropped from 7.4% to 7.0%, but the employment effects of this were more than undone by an increase in the final demand share of exports of services outside the EU (from 3.8% to 4.3%).

Table 15 shows the employment use of tertiary schooled in 2002. Compared with table 10, one sees that government and NPISH consumption expenditures and exports outside the EU have increased their cumulative employment share of tertiary schooled from 40.3% to 40.6% and from 7.5% to 8.3% respectively at the expense of other final demand components' shares. Most of these changes are due to evolutions in services.

6. Conclusions

This paper introduces the notion of qualitative employment multipliers. These multipliers give the cumulative (direct + indirect) use of different types of workers by final demand product. Thus, for each final demand product, a set of employment multipliers by gender, age class, professional status, education level and other characteristics such as temporary work or part-time and full-time work was computed.

The compilation of qualitative employment multipliers of final demand can be done by using an input-output table, a make matrix and simple matrix algebra. In this approach, detailed employment data are homogenised using industry technology, while the intermediate inputs in the input-output table itself are homogenised by a methodology that rests mainly on commodity technology. We give several arguments why we think it is more problematic to homogenise detailed employment data with commodity technology but do not want to close that debate. Further research and comparison of results with homogenisation methods is desirable, particularly for providing consistent homogenised employment and wage data. This Working Paper should therefore be seen as a "work in progress".

The paper shows a large variety of results for total and qualitative employment multipliers based on the IO tables and employment data of 2000 and 2002.

The paper first demonstrates the descriptive virtues of employment multipliers in general. Employment multipliers better capture the employment content of a product than do employment data at the (heterogeneous) industry level. The latter do not only lack the indirect (domestic) labour inputs, they also give no exact direct effect, since the production of a good or service may be spread over several industries.

Employment multipliers can be expressed in absolute and relative terms. While absolute employment multipliers are a ratio of cumulated employment to final demand, relative employment multipliers are a ratio of cumulated to direct employment. Employment multipliers allow the compilation of cumulative employment shares, which summarize the labour use of a final demand product or component.

By specifying the types of workers used, qualitative employment multipliers enlarge the possibilities of such a descriptive application. They can also be used to qualify or explain observed differences in total employment multipliers.

A traditional example of the descriptive use of employment multipliers is the measurement of the employment generation of manufacturing. In 2000, the manufacturing industries represented only 16% of employment. Based on our employment multipliers for the same year, we find that the final demand for manufactured goods was, in fact, still responsible for 24.2% of cumulated (direct + indirect) employment[55]. The difference is explained partly by the higher final demand share of manufactured goods (compared to their output share) and partly by its relatively high indirect labour use. While for total final demand one worker directly employed is associated with the indirect employment of 0.52 workers, for manufactured goods one direct employment was associated with 1.08 indirect workers in 2000.

Despite the large indirect effects, the most striking finding for manufactured goods was their low absolute employment multiplier. In 2000, one million euro final demand spending on manufactured goods led to the cumulated employment of 7.7 workers, while for total final demand spending of one million euro led to the employment of 12 workers.

Qualitative employment analysis shows that final demand for manufactured goods, while responsible for 24% of total employment, generated as much as 30% of male employment and 28% of low-skilled (=primary or lower secondary schooled) employment but only 17% and 18% of female and high-skilled (=tertiary schooled) employment. Its particularly low share in part-time employment (14%) helps explain its low absolute employment multiplier.

The paper proposed three specific applications of qualitative employment multipliers.

In the first, qualitative employment multipliers are used to identify the final demand products that generate the most low-skilled employment. We found that 10 goods or services, representing only 6.3% of final demand were responsible for 17.1% of cumulated low-skilled employment. The share of these activities in direct employment of low-skilled workers was 25% in 2000. Thus, even if most low-skilled workers still work in other activities, stimulating demand for these activities could be an efficient way of increasing the employment of low-skilled workers.

The second application is in the context of the technology-skills literature. We confirm that the production of ICT goods and services uses relatively more tertiary schooled labour than other goods or services. This continues to hold if indirect labour use is taken into account. The importance for employment generation of final demand for ICT goods and services is limited though in Belgium. Final demand for ICT goods and ICT services is responsible for only 1.3% and 2.6% of the cumulative employment of tertiary schooled workers.

In the third application, the IO distinction between products is used to generate distinct employment multipliers for the major components of final demand. Thus we derived the employment multipliers of consumption expenditures by households and by government + NPISH, and those of investments and exports inside and outside the EU. The results were compared to expectations derived from trade theory, which assume that the final demand component that is most faced with international competition (exports) should use the least of the comparatively scarce production factor, which is taken to be labour.

55 This cumulated employment share fell to 23.7% in 2002.

The results confirm that Belgian exports generate less employment than consumption expenditure by household and investments even when goods, construction activities and services are considered separately. Exports, and particularly non EU exports, also use less low-skilled labour and use relatively more high-skilled labour than consumption expenditure by households and than investments.

The cumulative employment figures show that the absolute employment multiplier for government consumption expenditure exceeds by far that for household expenditure and investments. The huge employment multiplier for government consumption expenditure has translated its final demand share of 16.2% into a cumulative employment share of 26.5% in 2000.

When considering only the cumulative employment of tertiary schooled workers, the share of government consumption expenditures increases to 40.3%. 47% of these tertiary schooled jobs are generated by (government consumption expenses on) educational services. A further 28% are generated by health and social work services. The higher incidence of part-time work in the products concerned with government consumption expenditures can only explain a part of the employment multiplier differences with consumption by households or other final demand components.

Using an updated IO table for 2002, we were able to reproduce the results for 2000 for the year 2002. Comparing the results for both years, we formulated some ideas on the stability of employment multipliers and the possibilities for updating them. Because of their direct dependence on prices, absolute employment multipliers are less suited for comparisons over time. Relative employment multipliers and cumulative employment shares were found to be more stable over the considered (small) time period.

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