Regional Input–Output Models and the FLQ Formula: A Case Study of Finland

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Abstract

This paper examines the use of location quotients (LQs) in constructing regional input–output models. Its focus is on the augmented FLQ formula (AFLQ) proposed by Flegg and Webber, 2000, which takes regional specialization explicitly into account. In our case study, we examine data for 20 Finnish regions, ranging in size from very small to very large, in order to assess the relative performance of the AFLQ formula in estimating regional imports, total intermediate inputs and output multipliers, and to determine an appropriate value for the parameter δ used in this formula. In this assessment, we use the Finnish survey-based national and regional input–output tables for 1995, which identify 37 separate sectors, as a benchmark. The results show that, in contrast with the other LQ-based formulae examined, the AFLQ is able to produce adequate estimates of output multipliers in all regions. However, some variation is required in the value of δ across regions in order to obtain satisfactory estimates. The case study also reveals that the AFLQ and its predecessor, the FLQ, yield very similar results. This finding indicates that the inclusion of a measure of regional specialization in the AFLQ formula is not helpful in terms of generating superior results.

Key words: Regional input–output models Finland FLQ formula Location quotients Multipliers

INTRODUCTION

Regional analysts typically have inadequate regional data to construct input–output models directly and so are forced to resort to indirect methods of estimation. A common approach is to use the available national and regional sectoral employment figures to compute a set of *location quotients* (LQs). In its simplest form, an LQ expresses the ratio between the proportion of regional employment in a particular sector and the corresponding proportion of national employment in that sector. The LQs are used to adjust the national input–output table, so that it corresponds as far as possible to the industrial structure of the region under consideration. An LQ < 1 indicates that the supplying sector in question is underrepresented in the regional economy and so is assumed to be unable to meet all of the requirements of regional purchasing sectors. In such cases, the national input coefficient is scaled downwards by multiplying it by the LQ. At the same time, a corresponding allowance for 'imports' from other regions is created. The estimated regional input coefficients derived via this process can subsequently be refined on the basis of any additional information available.

Unfortunately, the conventional LQs available – most notably, the *simple* LQ (SLQ) and the *cross-industry* LQ (CILQ) – are known to yield greatly overstated regional sectoral multipliers. This occurs because these adjustment formulae tend to take insufficient account of interregional trade and hence are apt to understate regional propensities to import. In an effort to address this problem, Flegg *et al.*, 1995, proposed a new employment-based location quotient, the FLQ formula, which took regional size explicitly into account. They posited an inverse relationship between regional size and the propensity to import from other regions. This FLQ formula was subsequently refined by Flegg and Webber, 1997. A further refinement was proposed by Flegg and Webber, 2000; this aimed to capture the effect of regional specialization on the magnitude of regional input coefficients.

Empirical support for the FLQ formula was provided by a study of Scotland in 1989 by Flegg and Webber, 2000, and by one of a Finnish region in 1995 by Tohmo, 2004. In both cases, a survey-based regional input–output table was available to check the accuracy of the simulations and to provide a basis for estimating the value of an unknown parameter, δ. However, for the FLQ to be a useful addition to the regional analyst's toolbox, it is crucial that more guidance, based on an examination of a wider range of regions, is made available with regard to the appropriate value(s) of δ. This is the primary aim of the present study. We also aim to shed some further light on the role of regional specialization.

Our study makes use of the Finnish survey-based national and regional input–output tables for 1995, published by Statistics Finland, 2000. These tables identify 37 separate sectors. We examine data for 20 regions of different size, in order to assess the relative performance of various LQ-based adjustment formulae. These regions range in size from very small (0.5% of national output) to very large (29.7% of national output).

THE REGIONAL INPUT–OUTPUT MODEL

At the national level, we can define:

A to be an n × n matrix of interindustry technical coefficients,

y to be an n × 1 vector of final demands,

x to be an n × 1 vector of gross outputs,

I to be an n × n identity matrix,

where $\mathbf{A} = [a_{ij}]$. The simplest version of the input–output model is:

$$\mathbf{x} = \mathbf{Ax} + \mathbf{y} = (\mathbf{I} - \mathbf{A})^{-1}\mathbf{y} \tag{1}$$

where $(\mathbf{I} - \mathbf{A})^{-1} = [b_{ij}]$ is the Leontief inverse matrix.[1] The sum of each column of this matrix represents the multiplier for that sector. The problem facing the regional analyst is how to transform the national coefficient matrix, $\mathbf{A} = [a_{ij}]$, into a suitable regional coefficient matrix, $\mathbf{R} = [r_{ij}]$. Herein lies the role of the LQs.

Now consider the formula:

$$r_{ij} = t_{ij} \times a_{ij} \tag{2}$$

where r_{ij} is the regional input coefficient, t_{ij} is the regional *trading coefficient* and a_{ij} is the national input coefficient. r_{ij} measures the amount of regional input i needed to produce one unit of regional gross output j; it thus excludes any supplies of i 'imported' from other regions or obtained from abroad. t_{ij} measures the proportion of regional requirements of input i that can be satisfied by firms located within the region; hence, by definition, $0 \leq t_{ij} \leq 1$.

Using LQs, one can estimate the regional input coefficients via the formula:

$$\hat{r}_{ij} = LQ_{ij} \times a_{ij} \tag{3}$$

where LQ_{ij} is the analyst's preferred location quotient. However, this adjustment is only made in cases where $LQ_{ij} < 1$.

CHOOSING AN LQ

As noted above, the two most widely used LQs are the SLQ and the CILQ, defined as:

$$SLQ_i \equiv \frac{RE_i/TRE}{NE_i/TNE} \equiv \frac{RE_i}{NE_i} \times \frac{TNE}{TRE} \tag{4}$$

$$CILQ_{ij} \equiv \frac{SLQ_i}{SLQ_j} \equiv \frac{RE_i/NE_i}{RE_j/NE_j} \tag{5}$$

where RE_i denotes regional employment (or output) in supplying sector i and NE_i denotes the corresponding national figure. RE_j and NE_j are defined analogously for purchasing sector j. TRE and TNE are the respective regional and national totals. In addition, Round's semi-logarithmic LQ (Round, 1978) is sometimes used. This is defined as:

$$RLQ_{ij} \equiv \frac{SLQ_i}{\log_2(1+SLQ_j)} \tag{6}$$

In evaluating these alternative formulae, it is helpful to refer to the criteria proposed by Round, 1978. He suggested that any trading coefficient is likely to be a function of three variables in particular: (1) the relative size of the supplying sector i, (2) the relative size of the purchasing sector j, and (3) the relative size of the region. The first two factors are captured here by RE_i/NE_i and RE_j/NE_j, respectively, while the third is measured by the ratio TRE/TNE.

It is evident that the CILQ takes factors (1) and (2) explicitly into consideration, yet disregards (3), whereas the SLQ incorporates (1) and (3) but not (2). However, the SLQ allows for regional size in a manner that we would regard as counterintuitive: for a given RE_i/NE_i, the larger the region, the *larger* the allowance for imports from other regions. Whilst the RLQ allows for all three factors, TRE/TNE enters into the formula in an implicit and seemingly rather strange way.[2] There is also no obvious theoretical reason why the logarithmic transformation should be applied to SLQ_j rather than to SLQ_i.[3]

Flegg *et al.*, 1995, attempted to overcome these problems in their FLQ formula. In its refined form (Flegg and Webber, 1997), the FLQ is defined as:

$$FLQ_{ij} \equiv CILQ_{ij} \times \lambda^* \tag{7}$$

where:

$$\lambda^* = [\log_2(1 + TRE/TNE)]^\delta \tag{8}$$

and $0 \le \delta < 1$.[4]

Two aspects of the FLQ formula are worth emphasizing: its cross-industry foundations and the explicit role attributed to regional size. Thus, with the FLQ, the relative size of the regional purchasing and supplying sectors is taken into account when determining the adjustment for interregional trade, as is the relative size of the region.

A possible shortcoming of the FLQ formula was highlighted by McCann and Dewhurst, 1998, who argued that regional specialization may cause a rise in the magnitude of regional input coefficients, possibly causing them to surpass the corresponding national coefficients. In response to this criticism, Flegg and Webber, 2000, reformulating their formula by adding a specialization term, thereby giving rise to the following *augmented* FLQ:

$$AFLQ_{ij} \bullet CILQ_{ij} \times \bullet^{*} \times [\log_2(1 + SLQ_j)] \tag{9}$$

where the specialization term is applied only when $SLQ_j > 1$. The logic behind this refinement is that, other things being equal, increased sectoral specialization should raise the value of SLQ_j and hence raise the value of the $AFLQ_{ij}$. This, in turn, would lower the allowance for imports from other regions. This would make sense where the presence of a strong regional purchasing sector encouraged suppliers to locate close to the source of demand, resulting in greater intraregional sourcing of inputs.

Before examining the relative performance of these different LQ-based formulae, we need to examine the characteristics of the 20 Finnish regions.

FINNISH REGIONS

Table 1 and Figure 1 near here

Table 1 reveals some marked differences in the characteristics of the various regions, most notably in terms of their relative size. The location of each region is identified in Figure 1. Uusimaa is by far the largest region; it accounted for nearly 30% of Finnish national output in 1995. Uusimaa is the region where the central state administration is located, and it is also where firms maintain their headquarters, as well as being an important node of foreign trade. It has a high concentration of public sector jobs. Electronics manufacturing is a major industry in Uusimaa. Helsinki, the capital city of Finland, is also located within this region. At the opposite extreme, Ahvenanmaa is clearly the smallest Finnish region. It specializes in fishing and in services − especially transport − but it also has some manufacturing, the mainstay of which is the food industry.

The other 18 Finnish regions exhibit considerable diversity in terms of orientation. For instance, Satakunta, Pirkanmaa, Päijät-Häme, Kymenlaakso and Etelä-Karjala form a manufacturing belt with many manufacturing clusters. Also, in Varsinais-Suomi, Keski-Suomi, Pohjanmaa and Pohjois-Pohjanmaa, the regional industrial structure is characterized by manufacturing, and the most specialized industries are wood, metals, petroleum, machinery, transport equipment, rubber, and electronics and paper. By contrast, Itä-Uusimaa has only a few specialist manufacturing industries, most notably petroleum and chemicals. In the Kainuu region, agriculture, forestry and logging, and mining are more prominent than elsewhere. Manufacturing activity is quite low. The region's most specialist manufacturing industries are wood, along with medical and optical instruments. Kanta-Häme has many manufacturing industries that show above-average concentration; these include food, metals, textiles and furniture.

Extraction characterizes Etelä-Savo, Pohjois-Savo, Pohjois-Karjala, Etelä-Pohjanmaa, Keski-Pohjanmaa and Lappi, and manufacturing's share of employment is below the average for Finland. The specialist manufacturing industries in these regions are food, wood, furniture, textiles and leather. Some large-scale industry – largely paper, metals, chemicals, and rubber and plastic products – is also located in these regions. Keski-Pohjanmaa and Etelä-Pohjanmaa also have many small businesses.

Regional size can be measured in several different ways and the first four columns of Table 1 illustrate some of possibilities. The measures are obviously closely related, although it is noticeable how Uusimaa's pre-eminence is somewhat less pronounced when its relative size is measured in terms of population. The close relationship between the share of output and the share of employees is reassuring because the regional modeller typically has to use employment data as a proxy for regional output data, which are not normally available.[5]

Table 1 also displays some information on the degree of specialization in each region. When measured in terms of Herfindahl's index, *H*, for all industries, it is evident that Ahvenanmaa is the most specialized region in Finland. Using the same criterion, Uusimaa is the next most specialized region. However, as illustrated in Figure 2, there is not a great deal of variation in the value of *H* for the remaining regions. The table also reveals that, for most regions, manufacturing is more highly concentrated than are industries in general.

Figure 2 near here

Another way of attempting to capture the extent of sectoral specialization is by counting the number of sectors that are overrepresented in a regional economy, i.e. those with an SLQ > 1. Six regions stand out as being highly specialized inasmuch as they have 18 or more sectors (out of a possible 37) with an SLQ > 1. It is worth noting that four of these regions (Etelä-Savo, Pohjois-Savo, Pohjois-Karjala and Etelä-Pohjanmaa) are heavily involved in extraction. Of the remaining two, Kanta-Häme has many manufacturing sectors that show above-average concentration, whereas the focus in the Kainuu region is, as noted above, on agriculture, forestry and logging, and mining.

At the other extreme, there are two regions where only seven sectors have an SLQ > 1 and one region with only four SLQs above unity. Here it is worth noting that Etelä-Karjala and Kymenlaakso form part of the manufacturing belt mentioned above, whereas Itä-Uusimaa has only a few specialist manufacturing industries. Indeed, Table 1 shows that Itä-Uusimaa has a noticeably lower value of H in terms of manufacturing than is true for the other two regions.

Of course, merely counting the number of sectors that have an SLQ > 1 does not take any account of the extent to which such sectors are overrepresented in the regional economy, so this approach could be misleading. For instance, both Kainuu and Pohjois-Savo have 20 sectors with an SLQ > 1, yet the largest SLQ in Kainuu is 5.61, well above the maximum value of 2.84 in Pohjois-Savo.

The last column of Table 1 shows the number of cases (out of a maximum of $37^2 = 1369$) where $r_{ij} > a_{ij}$. As noted earlier, such instances are allowed for via the specialization term, $[\log_2(1 + SLQ_j)]$, in the augmented FLQ formula (9), which is applied only when $SLQ_j > 1$. What is a little surprising is that there is not a more obvious positive association between the last two columns. For instance, there are three regions in which 20 sectors have an SLQ > 1, yet these regions yield very different numbers of sectors with $r_{ij} > a_{ij}$. Across the regions, this number ranges from 149 (= 10.9%) for Etelä-Pohjanmaa to 312 (= 22.8%) for Uusimaa, with a mean of 197 (= 14.4%).[6]

Having outlined some characteristic features of Finnish regions, we can now consider how well different approaches perform in terms of their ability to estimate a region's propensity to import from other regions, its total intermediate inputs and its sectoral output multipliers. In its focus on the 'holistic' rather than 'partitive' accuracy of the regional tables, our approach is in the spirit of Jensen, 1980.

REGIONAL IMPORTS AND INTERMEDIATE INPUTS

Regional propensities to import

As a first step in the evaluation of alternative LQ-based adjustment formulae, we examine their relative success in estimating regional propensities to import products originating in other regions. In doing so, we use each formula to regionalize the survey-based national input–output table for 1995 (Statistics Finland, 2000). We then derive an estimate of the domestic import propensity for each region. Finally, we compare these LQ-based estimates with the survey-based estimates published by Statistics Finland.

Figure 3 near here

Figure 3 displays alternative LQ-based estimates of each region's propensity to import products produced in other Finnish regions, along with survey-based estimates for comparison. It is evident that the AFLQ (with $\delta = 0.2$) yields adequate values of these propensities for most regions. Even so, it is noticeable how the AFLQ (with $\delta = 0.2$) substantially overestimates the propensity to import in the four smallest regions, yet slightly underestimates this propensity in the largest region, Uusimaa. For the smallest regions, it appears that a lower value of δ is needed to provide satisfactory estimates; here $\delta = 0.1$ gives a very good fit. By contrast, for Uusimaa, a value of δ above 0.2 is needed to match the survey-based estimate.

In most cases, the SLQ and CILQ greatly overstate propensities to import and Figure 3 illustrates the point that much better estimates can be gained by using the AFLQ. This tendency of the SLQ and CILQ to underestimate interregional trade has been demonstrated in many other studies (Smith and Morrison, 1974; Harrigan *et al.*, 1980; Harris and Liu, 1998; Flegg and Webber, 2000). It is worth noting, however, that the SLQ does perform well in the smallest region, Ahvenanmaa, and no worse than the AFLQ (with $\delta = 0.2$) in the largest region, Uusimaa.

Regional total intermediate inputs

To shed some more light on the relative performance of the SLQ, CILQ and AFLQ, we examine how well they are able to estimate regional total intermediate inputs. The relevance of this is that the column sums of intermediate inputs are known to have a large effect on the magnitude of the sectoral output multipliers (Burford and Katz, 1981). Although we used several statistics to measure the degree of similarity between the simulated and survey-based total intermediate inputs, only the following statistic will be discussed here:

$$\mu_3 = (1/n)\,\Sigma_j\,|\hat{s}_j - s_j| \qquad (10)$$

where $\hat{s}_j$ is the column sum of the simulated input coefficients, s_j is the column sum of the survey-based coefficients and n = 37 is the number of sectors. We opted to use the mean absolute difference as our preferred measure in order to minimize the problem of positive and negative differences having a self-cancelling effect, which might give the spurious impression of an accurate simulation.[7]

Figure 4 near here

Figure 4 illustrates how well the alternative LQ-based methods perform in terms of estimating each region's total intermediate inputs, using the survey-based estimate as a benchmark. The AFLQ (with $\delta = 0.2$) again generates the most satisfactory results for most Finnish regions, although the results for Ahvenanmaa and Lappi are disappointing. For these regions, a lower value of δ is required to yield a satisfactory estimate.

In most cases, the SLQ and CILQ are the least successful of the four methods, even though the SLQ does produce good results for Ahvenanmaa and Uusimaa. This outcome is consistent with the findings for imports discussed earlier.

Table 2 near here

A similar picture emerges when the mean absolute differences are averaged over all 20 regions. Table 2 highlights the fact that the AFLQ (with $\delta = 0.2$) is, on average, far more successful than the SLQ and CILQ at estimating total intermediate inputs. The table also confirms the earlier impression that 0.2 is the best single value of δ. (The FLQ and row-based variant of the AFLQ are discussed later.)

Table 3 near here

A potential problem with the results displayed in Table 2 is that they take no account of differences in the relative size of the 20 Finnish regions (see Table 1). However, Table 3 reveals that weighting the mean absolute differences by regional shares of national output does not fundamentally alter the results, although it is true that most of the simulations appear to be slightly more accurate. This occurs because the somewhat atypical findings for the smallest regions have less impact when the values of μ_3 are weighted by regional size. It is also worth noting that $\delta = 0.25$ now yields the lowest mean error for the AFLQ, albeit only marginally so. The explanation for this outcome, as discussed later, is that the very smallest regions may need a value of δ rather lower than 0.2, whereas the largest regions may require the opposite.

REGIONAL OUTPUT MULTIPLIERS

Figure 5 near here

Figure 5 illustrates the comparative performance of the alternative LQ-based methods when they are called upon to estimate each region's output multipliers. The following statistic was used as the criterion:[8]

$$\nu_3 = (1/n)\,\Sigma_j\,|\,\hat{m}_j - m_j\,| \qquad (11)$$

where $\hat{m}_j$ is the LQ-based multiplier (column sum for sector j of the LQ-based Leontief inverse matrix), m_j is the corresponding survey-based multiplier and n = 37 is the number of sectors.

With minor exceptions, the results for multipliers are very similar to those obtained for total intermediate inputs. The AFLQ (with $\delta = 0.2$) once more produces the best results for most Finnish regions, although Ahvenanmaa is again problematic in the sense that a lower value of δ is evidently required.

When compared with the AFLQ (with $\delta = 0.2$), the SLQ and CILQ nearly always yield far less accurate estimates of sectoral output multipliers, although it is noticeable that the results from the SLQ and the AFLQ almost coincide in the case of Ahvenanmaa and Uusimaa.

Table 4 near here

Table 4 illustrates the findings for multipliers in a rather different way; this table records, for each method, the number of regions generating a mean absolute error within a given range. The table reveals considerable diversity in performance. For instance, in the case of the CILQ, the values of ν_3 are skewed towards the two highest ranges; indeed, for half of the regions, $\nu_3 = 0.211$ or more. The SLQ performs a little better than the CILQ but there are still fifteen regions in the two highest ranges. By contrast, the AFLQ (with $\delta = 0.2$) has no such extreme values; moreover, ten regions fall into the moderate range 0.071–0.090. Table 4 also shows that $\delta = 0.2$ yields much better results, on the whole, than either $\delta = 0.1$ or $\delta = 0.3$. It is worth noting, finally, that the FLQ yields rather similar results to the AFLQ when $\delta = 0.2$. This finding is explored later in the paper.

CHOOSING A VALUE FOR •

Table 5 near here

Choosing an appropriate value for • is crucial to the successful application of the AFLQ formula. Table 5 demonstrates the point that, for a given regional size, a bigger value for • entails a smaller value for the scalar $\lambda^* = [\log_2(1 + TRE/TNE)]^{\delta}$. As λ^* decreases, so too does the value of the AFLQ. Essentially, a higher value for • entails a bigger allowance for imports from other regions.

Table 6 near here

Table 6 shows how changes in the value of • affect the accuracy of the simulations for the regions as a whole. To facilitate comparisons with other studies, the following statistic was used as the criterion:

$$v_2 = (100/37)\,\Sigma_j\,(\hat{m}_j - m_j)/m_j \qquad (12)$$

Based this criterion, it is clear that • = 0.2 is the best single value for estimating sectoral multipliers. What is more, the mean error of –0.5% (representing a slight understatement) is very satisfactory, especially when compared with the outcomes for higher values of •. It also compares very favourably indeed with the results obtained for the SLQ and CILQ.[9]

It is worth noting, in passing, that the very poor results for the SLQ and CILQ confirm the findings of other researchers. For instance, in their classic study of data for Peterborough in 1968, Smith and Morrison, 1974, obtained mean errors for the SLQ and CILQ of 17.2% and 24.9%, respectively. However, the latter figure was reduced to 19.8% when the SLQ was used along the diagonal of the CILQ.[10] Harrigan *et al.*, 1980, using Scottish data for 1973, obtained a mean error for the SLQ of 25.0%. The corresponding figure for the CILQ was 20.0% but this was cut to 18.1% when the SLQ was used along the diagonal. Finally, Harris and Liu, 1998, using Scottish data for 1989, obtained a mean error for the SLQ of 14.5%.

Table 7 near here

Table 7 illustrates the impact on the accuracy of the simulations for individual regions of altering the value of •. What is most striking is that, for most regions, the optimal value of • lies fairly close to the modal value of 0.2. Indeed, the interval 0.2 ± 0.05 encompasses all but three cases and produces acceptable estimates of sectoral multipliers for most regions. There is, nonetheless, an indication that the very smallest regions may need • < 0.15, whereas the largest regions may require • > 0.25. Ahvenanmaa and Uusimaa are cases in point. Even so, when • = 0.3, it is noticeable that all outcomes are negative, which suggests that there is no basis for setting • > 0.3 in general. Likewise, apart from Ahvenanmaa, all outcomes are positive − many strikingly so − when • = 0.1, which indicates that it would not normally be appropriate to choose such a low value of •.

Calculations were also done using the mean absolute difference, formula (11) above. This is a more stringent criterion than the mean proportionate difference, formula (12), because negative and positive errors cannot offset each other to give the spurious impression of an accurate simulation. In fact, as shown in the Appendix, Table A1, these alternative measures of accuracy generated very similar distributions of regions by value of •.

THE AFLQ VERSUS THE FLQ

Figure 6 near here

One aim of this study has been to test whether the inclusion of a measure of regional specialization in the AFLQ formula is helpful in terms of producing more accurate simulations. However, Figure 6 shows that, with $\delta = 0.2$, the FLQ and AFLQ produce very similar results indeed with respect to multipliers, although the AFLQ does perform noticeably better in the smallest regions. How can we explain this similarity?

One possible explanation is that, on average across the 20 regions, only 14.4% of sectors have $r_{ij} > a_{ij}$. Thus a new formula designed to address the problem of $r_{ij} > a_{ij}$ is unlikely to yield dramatically improved results relative to one that does not admit of this possibility. Another possible explanation is that the specialization term $\log_2(1 + SLQ_j)$ in equation (9) is mis-specified in terms of its focus on the size of the purchasing sector j rather than on the size of the supplying sector i. This argument suggests that we should use $\log_2(1 + SLQ_i)$ instead.

Furthermore, there is a potential problem with using $\log_2(1 + SLQ_j)$ to capture the effects of greater specialization: a rise in SLQ_j will lower the denominator of the CILQ (recall that $CILQ_{ij} \equiv SLQ_i/SLQ_j$), which will tend to dampen the effects of the change in SLQ_j. However, contrary to expectations, using SLQ_i rather than SLQ_j produced slightly worse results. For instance, Table 2 records a minimum mean absolute error of 0.061 for the original (column-based) AFLQ, which is lower than any of the values for the row-based variant. A similar outcome emerges when, in Table 3, the results are weighted by size of region. In fact, no value of δ was identified for which the row-based AFLQ was superior.

Some additional information about the relative performance of the AFLQ and FLQ is presented in the Appendix, Tables A1 and A2. These tables, which are based on the mean absolute difference, reveal that there is no reason for opting for one formula rather than the other on the basis of their average performance across regions. However, a crucial difference highlighted in Table A2 is that, with the FLQ, the distribution of regions by value of δ is centred on $\delta = 0.15$ rather than on the 0.2 that characterizes the AFLQ.[11] Indeed, the interval 0.15 ± 0.05 produces acceptable estimates of sectoral multipliers for all but two regions. Even so, it should be noted that $\delta = 0.2$ provides acceptable estimates for ten of the thirteen largest regions. By contrast, $\delta = 0.1$ is clearly the best value for the three smallest regions.

OTHER CONSIDERATIONS

Table 8 near here

The above discussion suggests that regional specialization is not a very fruitful way of explaining why regional and national input coefficients might still differ, even after allowance has been made for regional size and for the relative size of purchasing and supplying sectors. Three alternative explanations are explored in Table 8, which shows the results of correlating the mean value of $r_{ij} - a_{ij}$ for each purchasing sector j in a given region, $d_j = (1/37)\,\Sigma_i\,(r_{ij} - a_{ij})$, with each of the following variables in turn:

- f_j, the regional minus the national share of foreign imports for sector j;
- w_j, the regional minus the national share of 'compensation of employees' for sector j;
- v_j, the regional minus the national share of 'other value added' for sector j.[12]

LQ-based approaches presuppose that regional and national propensities to import from abroad are identical, i.e. that $f_j = 0$ for all j. It is, therefore, reassuring that Table 8 identifies only one region where the divergence between regional and national input coefficients is significantly associated with differences in the propensity to import foreign goods. Moreover, this correlation is only just significant at the 10% level. On the whole, the correlation coefficients appear to be random, with a mean close to zero.

The results for compensation of employees and for other value added offer a striking contrast with those for foreign imports. Most noticeable is the fact that almost all of the correlations are negative, significantly so in several cases. There appears to be a general tendency for the relative size of regional input coefficients to vary inversely with the variables w_j and v_j. This negative relationship is what one might expect, although it does pose problems in the application of LQ-based approaches. The effect is, on average, somewhat stronger for other value added than for compensation of employees.

For purposes of discussion, let us assume that a simulation error of 2.5% or more is unacceptably large. Table 7 shows nine such cases when $\delta = 0.2$, four of overstatement and five of understatement. Unfortunately, it is difficult to discern a clear relationship between these simulation errors and the correlations. For instance, looking at the smallest regions, the multipliers in Keski-Pohjanmaa and Kainuu are understated, on average, by 4.8% and 5.0%, respectively, yet none of the three correlations is significant in Kainuu and only one is significant ($p = 0.039$) in Keski-Pohjanmaa. By contrast, two medium-sized regions, Päijät-Häme and Pohjanmaa, have modest simulation errors of 1.1%, despite the fact that each region has one highly significant correlation. In the larger regions, Satakunta and Pirkanmaa exhibit average overestimations of 4.8% and 5.9%, respectively, with no significant correlations, whereas Pohjois-Pohjanmaa produces a near-perfect simulation, notwithstanding a significant correlation ($p = 0.012$) for other value added.

Looking again at Tables 7 and 8, it does seem that some kind of regional size effect is present, such that the smallest regions may need δ to be 0.15 or less, whereas the largest regions are likely to require a value of 0.25 or more. This outcome cannot be explained in a systematic way by a divergence between regional and national propensities to import foreign goods or in terms of differences in the compensation of employees and other value added. Nevertheless, we do need to be cautious here because of regional peculiarities.

Consider the case of Ahvenanmaa. This region is interesting because using $\delta = 0.2$ causes its multipliers to be understated by 10.1% on average. This is a very large error indeed. Ahvenanmaa is, of course, atypical in terms of both its smallness and the fact that it is an island region. Table 8 also shows that both w_j ($p = 0.032$) and v_j ($p = 0.040$) have a statistically significant negative correlation with d_j. Thus, to some extent at least, the understatement of Ahvenanmaa's multipliers might be due to its atypicality in terms of compensation of employees and other value added. It is also worth noting that Herfindahl's index for all industries indicates that Ahvenanmaa is by far the most specialized region in Finland (see Table 1 and Figure 2).

Lappi is also somewhat anomalous, in that its multipliers are understated by 4.4% on average when $\delta = 0.2$ is assumed, yet this region has a considerably larger share of national output than Keski-Pohjanmaa and Kainuu. One possible explanation of this anomaly is that this sparsely populated northern region is surrounded on three sides by Norway, Sweden and Russia, and shares only one border with another Finnish region. Thus, on spatial grounds alone, one might expect Lappi to undertake less trade with other Finnish regions and hence be more self-sufficient. This, in turn, would give rise to larger regional input coefficients and hence multipliers, when compared with other regions of similar size in terms of share of national output. We did not anticipate that Lappi would engage in additional foreign trade as a consequence of its location and the near-zero correlation coefficient of –0.089 validates this supposition.

Turning now to the larger regions, the proposition that they need a higher value of δ is undermined by the fact that $\delta = 0.2$ works so well in Pohjois-Pohjanmaa. It is also not clear why these larger regions should need a higher value of δ but this may well be a technical issue related to the properties of the AFLQ formula: when $\delta = 0.2$, the value of the scalar λ^* may be too large (see Table 5), so that the allowance for interregional trade is too small.

In our earlier discussion of Finnish regions, we noted that some were characterized by manufacturing and others by extraction. However, there does not seem to be any obvious link between the accuracy of the simulations and the economic characteristics of regions. Keski-Pohjanmaa and Kainuu are cases in point: these regions have very different industrial structures, yet the simulation results are very similar. What is common to both is their relatively small and comparable shares of national output.

A final point worth noting is that LQ-based approaches require regional and national technology to be identical in terms of the proportions of the various inputs that are required to produce each unit of output. Any divergence between regional and national technology would obviously introduce errors into the simulations. Unfortunately, it was not possible to test this assumption of identical technology.

CONCLUSION

Regional analysts rarely have the necessary regional data to build input–output models directly and so are forced to resort to indirect methods of estimation. A common approach is to use the available national and regional sectoral employment figures to compute a set of location quotients (LQs). These LQs are then employed to adjust the national input coefficients, the a_{ij}, so as to derive estimates of regional input coefficients, the r_{ij}. In this paper, we have examined the relative performance of the LQ-based adjustment formula proposed by Flegg and Webber, 2000. This augmented FLQ formula – or AFLQ – takes the following factors explicitly into account:

1. The relative size of the supplying sector i and the purchasing sector j.
2. The relative size of the region.
3. Regional specialization.

The third factor is what distinguishes the AFLQ from its predecessor, the FLQ. A difficulty in applying the AFLQ and FLQ is the need to specify the value of an unknown parameter, δ. Some evidence on the required value of δ was presented for Scotland by Flegg and Webber, 2000,[13] and further light was shed on this issue by Tohmo, 2004, who examined data for the Keski-Pohjanmaa region in Finland. However, the generality of results obtained from a single region is always open to question, so the primary aim of the present study has been to provide more guidance, drawn from a detailed examination of a wide range of regions of different size, on the appropriate value(s) of δ.

In our case study, we examined data for 20 Finnish regions, ranging in size from 0.5% to 29.7% of national output. We used the Finnish survey-based national and regional input–output tables for 1995, which identify 37 separate sectors, as a benchmark to evaluate the performance of the AFLQ and other LQ-based adjustment formulae.

Our analysis revealed that the AFLQ was able to produce acceptable estimates of regional imports, total intermediate inputs and sectoral output multipliers, when judged in terms of the average outcome for each region. Several different statistical criteria were used to evaluate the findings. In general, the results obtained from the AFLQ were far superior to those from alternative LQ-based formulae such as the simple LQ (SLQ) and cross-industry LQ (CILQ).

However, the case study also revealed that the inclusion in the AFLQ of the specialization term $\log_2(1 + SLQ_j)$ did not, on the whole, yield better results. This outcome confirmed the findings of Flegg and Webber, 2000, with respect to Scotland. What is more, an attempt to improve the AFLQ formula by using $\log_2(1 + SLQ_i)$ as the specialization term produced slightly worse results.

The fact that the AFLQ and its predecessor, the FLQ, generated comparable results in terms of their average performance across regions suggests that it is immaterial which one of these adjustment formulae is used. On the other hand, Occam's principle provides a rationale for rejecting the complexity of the AFLQ in favour of the simplicity of the FLQ.

Whilst the AFLQ and FLQ produced similar results in terms of their ability to replicate survey-based data, they differed in terms of the required values of δ. For most regions, the optimal value of δ for the AFLQ was found to lie fairly close to 0.2. In fact, the interval 0.2 ± 0.05 encompassed all but three cases and produced satisfactory estimates of sectoral output multipliers for most regions. There was, nonetheless, an indication that the very smallest regions might need $\delta < 0.15$, whereas the largest regions might require $\delta > 0.25$.

For the FLQ, the distribution of regions by value of δ was centred on $\delta = 0.15$ rather than on 0.2. What is more, the interval $\delta = 0.15 \pm 0.05$ produced acceptable estimates of sectoral output multipliers for 18 of the 20 Finnish regions, including all but one of the biggest regions. Here it is worth noting that $\delta = 0.2$ gave the best results for ten of the thirteen largest regions. These regions had a share of national output of 3.0% or more. By contrast, $\delta = 0.1$ was clearly the best value for the three smallest regions, which had a share of national output of 1.3% or less.

A secondary aim of the case study was to ascertain why regional and national input coefficients might still differ, even after allowance had been made for regional size, for the relative size of purchasing and supplying sectors, and for regional specialization. To explore this issue, the mean value of $r_{ij} - a_{ij}$ for each purchasing sector j in a given region, d_j, was correlated, in turn, with each of the following variables:

1. f_j, the regional minus the national share of foreign imports for sector j;
2. w_j, the regional minus the national share of 'compensation of employees' for sector j;
3. v_j, the regional minus the national share of 'other value added' for sector j.

The correlation analysis suggested that f_j was not an important cause of deviations between regional and national input coefficients, although there appeared to be a general tendency for the relative size of regional input coefficients to vary inversely with the variables w_j and v_j. This effect was, on average, somewhat stronger for other value added than for compensation of employees.

These findings have implications for the use of LQ-based approaches such as the AFLQ and FLQ, which do not take into account any divergence between regional and national proportions of foreign imports, compensation of employees and other value added. Where a region is known to have, say, lower wage rates than the national average, one might expect a LQ-based formula to understate its input coefficients, other things being equal. However, we could not discern any relationship between the strength of the correlations mentioned above and the performance of the AFLQ and FLQ.

The results reported here are supportive of the use of the AFLQ and FLQ, yet it needs to be emphasized that such formulae can only be expected to generate a useful *initial* set of regional input coefficients. These initial coefficients would always need to be checked by the analyst on the basis of informed judgement, surveys of selected industries, etc. Here it would be wise to focus on the larger coefficients, since it is these that have the largest impact on the sectoral output multipliers.[14] It is also crucial that any regional peculiarities be taken into account.

In terms of future work, it would be interesting to explore the effects on the performance of the FLQ of relaxing the constraint that $FLQ_{ij} \leq 1$, which entails that $\hat{r}_{ij} \leq a_{ij}$. There are, in fact, several reasons why regional input coefficients might exceed the corresponding national coefficients and the focus in the AFLQ on regional specialization being the cause of $r_{ij} > a_{ij}$ could be too narrow a view.

Acknowledgements – We would like to thank Chris Webber for his helpful suggestions and Jeffery Round for clarification of certain aspects of his RLQ formula.

NOTES

1. See Miller and Blair, 1985, pp. 7–15, for a clear exposition of these basic concepts.
2. In a personal communication, Jeffery Round explained that his motivation in developing this formula was to devise a simple expression that allowed for all three factors, yet avoided the need to introduce an additional parameter. In addition, he wished to mediate between the SLQ and CILQ outcomes, in such a way that the SLQ, CILQ and RLQ all equalled unity when $SLQ_i = SLQ_j = 1$.
3. To illustrate how Round's formula works, consider two hypothetical regions, A and B, which account for 10% and 20% of national employment, respectively. In both cases, it is assumed that $RE_i/NE_i = 0.08$ and $RE_j/NE_j = 0.12$. The RLQ = 0.703 for A and 0.590 for B. This means that a larger allowance for regional imports would be made for B than for A, despite the fact that B is the larger region. Now suppose that we modified Round's formula (6) by re-expressing it as:

$$MRLQ_{ij} \equiv \frac{\log_2(1+SLQ_i)}{SLQ_j} \tag{13}$$

   The $MRLQ_{ij}$ = 0.707 for A but 0.809 for B, so that a larger allowance for regional imports would be made for the smaller region A than for the larger region B.
4. The logarithmic transformation in (8) ensures that •* → 1 as TRE → TNE.
5. Output has a correlation of 0.997 with employees, 0.998 with value added and 0.988 with population.
6. For a more detailed discussion of regional specialization and industrial concentration in Finland, see Tohmo, 2007, chapters 2–5. Also see Tohmo *et al.*, 2006.
7. The other statistics used were:

   $\mu_1 = (1/n)\Sigma_j(\hat{s}_j - s_j)$ $\mu_2 = (100/n)\Sigma_j(\hat{s}_j - s_j)/s_j$ $\mu_4 = (100/n)\Sigma_j|(\hat{s}_j - s_j)/s_j|$

   $\mu_5 = (1/n)\Sigma_j e_j(\hat{s}_j - s_j)$ $\mu_6 = (100/n)\Sigma_j e_j(\hat{s}_j - s_j)/s_j$ $\mu_7 = (1/n)\Sigma_j e_j|\hat{s}_j - s_j|$

   $\mu_8 = (100/n)\Sigma_j e_j|(\hat{s}_j - s_j)/s_j|$

   where n = 37 and e_j is the proportion of employment in purchasing sector j. The results from these alternative measures are available from the authors on request.
8. Other measures analogous to those listed in note 7 were also used; the results are available from the authors on request.
9. When the results are weighted by regional size, the AFLQ (with • = 0.2) yields a mean proportionate error of 1.3%. The corresponding figures for the SLQ and CILQ are 10.1% and 11.2%, respectively.
10. Note that $CILQ_{ii} = 1$ entails that $\hat{r}_{ij} = a_{ij}$. Using SLQ_i along the diagonal is a way of trying to capture the size of industry i. This procedure, first suggested by Smith and Morrison, 1974, has been followed in all calculations reported in this paper.
11. For a given SLQ_i, $CILQ_{ij}$ • SLQ_i/SLQ_j will vary inversely with the specialization term $\log_2(1 + SLQ_j)$ that is included in the AFLQ. This property will tend to dampen the impact of variations in SLQ_j. The AFLQ therefore requires a somewhat higher value of • than the FLQ to offset this tendency.

12. ‘Other value added’ is essentially a measure of profit or surplus. It equals ‘value added at basic prices’ *minus* ‘compensation of employees’ *plus* ‘subsidies on production’ *minus* ‘other taxes on production’. For example, for the agricultural sector in Keski-Pohjanmaa, 0.7566 = 0.5341 – 0.0789 + 0.3014 – 0.0000. *Source*: Statistics Finland, 2000, Regional accounts (data for 1995).

13. Scotland is, relatively speaking, comparable in size to Pirkanmaa and Varsinais-Suomi. Based on employment, TRE/TNE ≈ 0.085. Using the criterion $\mu_2 = (1/n)\,\Sigma_j\, w_j\,|\hat{r}_{ij} - r_{ij}|$, where w_j is the proportion of employment in purchasing sector j, Flegg and Webber, 2000, Table 4, report values for μ_2 (based on the original FLQ) of 0.00225 for $\delta = 0.1$, 0.00209 for $\delta = 0.2$ and 0.00196 for $\delta = 0.3$. The AFLQ produced values of 0.00237, 0.00219 and 0.00204, respectively.

14. Jensen and West (1980) show that more than fifty per cent of the smaller coefficients in an input–output table can be set equal to zero before a ten per cent error appears in the sectoral multipliers.

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APPENDIX

Table A1. *Mean absolute differences from survey for the AFLQ: sectoral output multipliers for 20 Finnish regions in 1995*

	Value of δ				
	0.1	0.15	0.2	0.25	0.3
Ahvenanmaa	**0.120**	0.123	0.152	0.177	0.201
Keski-Pohjanmaa	0.128	**0.082**	0.101	0.121	0.147
Kainuu	0.098	**0.085**	0.099	0.122	0.144
Etelä-Savo	0.099	0.064	**0.054**	0.068	0.093
Itä-Uusimaa	0.149	0.097	0.066	**0.054**	0.055
Pohjois-Karjala	0.144	0.101	0.091	**0.090**	0.105
Etelä-Pohjanmaa	0.237	0.143	**0.115**	0.119	0.136
Kanta-Häme	0.214	0.152	0.124	**0.116**	0.123
Etelä-Karjala	0.105	**0.076**	0.077	0.096	0.116
Päijät-Häme	0.121	0.091	**0.083**	0.085	0.102
Pohjanmaa	0.157	0.107	**0.085**	0.089	0.111
Lappi	0.118	**0.116**	0.122	0.138	0.156
Pohjois-Savo	0.153	0.091	**0.059**	0.071	0.101
Kymenlaakso	0.128	0.094	**0.079**	**0.079**	0.090
Keski-Suomi	0.130	0.091	**0.073**	0.077	0.098
Satakunta	0.200	0.125	0.082	**0.067**	0.073
Pohjois-Pohjanmaa	0.131	0.093	**0.082**	0.090	0.111
Pirkanmaa	0.180	0.124	0.085	0.065	**0.059**
Varsinais-Suomi	0.177	0.131	0.100	0.086	**0.083**
Uusimaa	0.104	0.088	0.076	**0.069**	0.070
Mean	0.145	0.094	**0.090**	0.104	0.109

Note: In this and in subsequent tables, minima (to three decimal places) are shown in bold.

Table A2. *Mean absolute differences from survey for the FLQ: sectoral output multipliers for 20 Finnish regions in 1995*

	Value of δ				
	0.1	0.15	0.2	0.25	0.3
Ahvenanmaa	**0.100**	0.133	0.166	0.193	0.213
Keski-Pohjanmaa	**0.085**	0.093	0.124	0.151	0.175
Kainuu	**0.099**	0.111	0.126	0.145	0.163
Etelä-Savo	0.081	**0.067**	0.072	0.090	0.110
Itä-Uusimaa	0.115	0.078	0.060	**0.056**	0.060
Pohjois-Karjala	0.113	**0.100**	0.102	0.111	0.128
Etelä-Pohjanmaa	**0.088**	0.094	0.117	0.139	0.161
Kanta-Häme	0.127	0.102	**0.100**	0.110	0.127
Etelä-Karjala	0.079	**0.068**	0.080	0.103	0.126
Päijät-Häme	0.107	**0.094**	**0.094**	0.103	0.119
Pohjanmaa	0.125	0.092	**0.090**	0.106	0.130
Lappi	**0.107**	0.115	0.131	0.150	0.170
Pohjois-Savo	0.089	0.074	**0.081**	0.109	0.135
Kymenlaakso	0.100	0.080	**0.075**	0.084	0.101
Keski-Suomi	0.103	0.080	**0.078**	0.092	0.113
Satakunta	0.108	0.069	**0.052**	0.059	0.076
Pohjois-Pohjanmaa	0.093	**0.076**	**0.076**	0.091	0.117
Pirkanmaa	0.138	0.099	0.072	0.061	**0.060**
Varsinais-Suomi	0.122	0.091	**0.075**	0.077	0.086
Uusimaa	0.095	0.091	**0.088**	**0.088**	0.093
Mean	0.104	**0.090**	0.093	0.106	0.123

Table 1. *Characteristics of Finnish regions in 1995*

Region	Value added (%)	Output (%)	Population (%)	Employees (%)	Herfindahl's index (1995)		SLQ > 1 (number of sectors)	$r_{ij} > a_{ij}$ (number of sectors)
					Manufacturing	All industries		
Ahvenanmaa	0.6	0.5	0.5	0.7	0.189	0.276	14	207
Keski-Pohjanmaa	1.1	1.2	1.4	1.3	0.157	0.088	15	208
Kainuu	1.5	1.3	1.9	1.6	0.162	0.080	20	231
Etelä-Savo	2.5	2.3	3.4	2.9	0.141	0.080	19	216
Itä-Uusimaa	1.7	2.5	1.7	1.6	0.110	0.067	4	155
Pohjois-Karjala	2.6	2.5	3.5	3.0	0.115	0.077	18	210
Etelä-Pohjanmaa	2.8	2.9	3.9	3.5	0.127	0.082	20	149
Kanta-Häme	2.8	3.0	3.2	3.1	0.119	0.072	18	220
Etelä-Karjala	2.9	3.2	2.7	2.5	0.207	0.091	7	154
Päijät-Häme	3.4	3.2	3.9	3.7	0.122	0.075	13	203
Pohjanmaa	3.4	3.5	3.4	3.4	0.114	0.071	12	156
Lappi	3.7	3.7	4.0	3.4	0.173	0.085	15	181
Pohjois-Savo	4.3	3.9	5.1	4.5	0.126	0.085	20	196
Kymenlaakso	3.9	4.4	3.8	3.7	0.230	0.096	7	150
Keski-Suomi	4.6	4.5	5.1	4.7	0.161	0.079	12	208
Satakunta	4.2	5.2	4.8	4.6	0.117	0.069	12	172
Pohjois-Pohjanmaa	6.0	6.0	7.0	6.1	0.168	0.083	13	249
Pirkanmaa	8.1	7.7	8.5	8.2	0.112	0.071	14	167
Varsinais-Suomi	8.4	8.9	8.5	8.9	0.122	0.075	11	204
Uusimaa	31.6	29.7	23.8	28.6	0.134	0.118	15	312
Mean					0.145	0.091	14	197

Source: Statistics Finland, 2000, Regional accounts

Table 2. *Mean absolute simulation errors by method: unweighted sums of intermediate inputs for 20 Finnish regions in 1995*

Method		Value of δ				
		0.1	0.15	0.2	0.25	0.3
SLQ	0.110					
CILQ	0.119					
FLQ		0.072	0.064	0.065	0.073	0.084
AFLQ		0.083	0.067	0.061	0.064	0.074
AFLQ (row-based)		0.095	0.075	0.066	0.064	0.071

Table 3. *Mean absolute simulation errors by method: weighted sums of intermediate inputs for 20 Finnish regions in 1995*

Method		Value of δ				
		0.1	0.15	0.2	0.25	0.3
SLQ	0.098					
CILQ	0.111					
FLQ		0.072	0.062	0.060	0.063	0.071
AFLQ		0.082	0.066	0.058	0.057	0.062
AFLQ (row-based)		0.094	0.076	0.065	0.060	0.062

Table 4. *Distribution of mean absolute simulation errors by method: sectoral output multipliers for 20 Finnish regions in 1995*

Mean absolute difference from survey-based multipliers	Number of regions					
	SLQ	CILQ	FLQ	AFLQ		
			$\delta = 0.2$	$\delta = 0.1$	$\delta = 0.2$	$\delta = 0.3$
0.000–0.050	-	-	-	-	-	-
0.051–0.070	-	-	2	-	3	3
0.071–0.090	1	-	10	7	10	3
0.091–0.120	-	1	4	8	4	8
0.121–0.060	4	3	3	3	3	5
0.161–0.210	7	6	1	2	-	1
0.211–	8	10	-	-	-	-

Table 5. *The behaviour of the function λ^* for 20 Finnish regions in 1995*

	TRE/TNE	Value of δ				
		0.1	0.15	0.2	0.25	0.3
Ahvenanmaa	0.005	0.614	0.481	0.377	0.296	0.232
Keski-Pohjanmaa	0.012	0.663	0.540	0.440	0.359	0.292
Kainuu	0.013	0.671	0.550	0.451	0.369	0.302
Etelä-Savo	0.023	0.709	0.597	0.503	0.423	0.357
Itä-Uusimaa	0.025	0.716	0.606	0.513	0.434	0.367
Pohjois-Karjala	0.025	0.717	0.607	0.514	0.435	0.368
Etelä-Pohjanmaa	0.029	0.726	0.619	0.527	0.449	0.383
Kanta-Häme	0.030	0.730	0.624	0.533	0.455	0.389
Etelä-Karjala	0.032	0.735	0.630	0.540	0.463	0.397
Päijät-Häme	0.032	0.735	0.630	0.540	0.463	0.397
Pohjanmaa	0.035	0.741	0.638	0.549	0.472	0.406
Lappi	0.037	0.745	0.643	0.555	0.479	0.413
Pohjois-Savo	0.039	0.749	0.648	0.561	0.485	0.420
Kymenlaakso	0.044	0.758	0.659	0.574	0.500	0.435
Keski-Suomi	0.045	0.759	0.661	0.576	0.501	0.437
Satakunta	0.052	0.769	0.675	0.592	0.519	0.456
Pohjois-Pohjanmaa	0.060	0.781	0.690	0.609	0.538	0.476
Pirkanmaa	0.077	0.800	0.715	0.640	0.572	0.512
Varsinais-Suomi	0.089	0.811	0.730	0.657	0.592	0.533
Uusimaa	0.297	0.907	0.863	0.822	0.782	0.745
Mean		0.742	0.640	0.554	0.479	0.416

Table 6. *Mean percentage differences from survey for different methods: sectoral output multipliers for 20 Finnish regions in 1995*

Method		Value of δ				
		0.1	0.15	0.2	0.25	0.3
SLQ	12.7					
CILQ	13.2					
FLQ		3.4	–0.5	–3.6	–6.1	–8.1
AFLQ		8.8	3.5	–0.5	–3.6	–6.2
AFLQ (row-based)		11.0	5.2	0.8	–2.6	–5.3

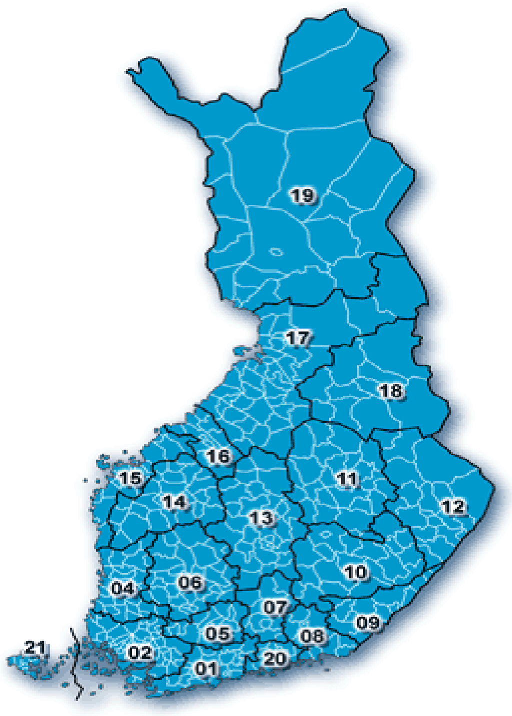
Table 7. *Mean percentage differences from survey for the AFLQ: sectoral output multipliers for 20 Finnish regions in 1995*

	Value of δ				
	0.1	0.15	0.2	0.25	0.3
Ahvenanmaa	**–1.297**	–6.486	–10.065	–12.629	–14.511
Keski-Pohjanmaa	6.773	**–0.075**	–4.775	–8.162	–10.683
Kainuu	3.955	**–1.231**	–5.042	–7.917	–10.124
Etelä-Savo	6.439	1.889	**–1.645**	–4.435	–6.662
Itä-Uusimaa	12.335	7.017	2.970	**–0.179**	–2.672
Pohjois-Karjala	9.748	4.176	**–0.078**	–3.394	–6.019
Etelä-Pohjanmaa	14.759	6.016	**0.256**	–3.862	–6.950
Kanta-Häme	13.587	6.750	**1.764**	–2.016	–4.957
Etelä-Karjala	6.641	**1.701**	–2.106	–5.104	–7.504
Päijät-Häme	7.318	2.624	**–1.078**	–4.040	–6.438
Pohjanmaa	8.841	3.216	**–1.112**	–4.514	–7.234
Lappi	3.884	**–0.820**	–4.449	–7.316	–9.621
Pohjois-Savo	10.145	4.304	**–0.181**	–3.705	–6.525
Kymenlaakso	8.309	3.543	**–0.199**	–3.196	–5.632
Keski-Suomi	7.866	3.223	**–0.466**	–3.445	–5.881
Satakunta	15.951	9.613	4.762	**0.943**	–2.127
Pohjois-Pohjanmaa	8.655	3.675	**–0.295**	–3.517	–6.168
Pirkanmaa	14.644	9.861	5.928	2.655	**–0.096**
Varsinais-Suomi	11.713	7.107	3.328	**0.184**	–2.461
Uusimaa	6.531	4.457	2.558	0.815	**–0.788**
Mean	8.840	3.528	**–0.496**	–3.642	–6.153

Table 8. *Possible determinants of deviations between regional and national input coefficients for 20 Finnish regions in 1995 (correlation coefficients)*

	Foreign import propensity	Compensation of employees	Other value added
Ahvenanmaa	0.247	–0.353**	–0.339**
Keski-Pohjanmaa	0.192	–0.340**	–0.220
Kainuu	–0.110	–0.262	–0.149
Etelä-Savo	–0.118	–0.409**	0.130
Itä-Uusimaa	0.111	–0.046	–0.127
Pohjois-Karjala	0.009	–0.170	–0.262
Etelä-Pohjanmaa	0.020	–0.390**	0.064
Kanta-Häme	–0.066	–0.261	–0.138
Etelä-Karjala	–0.116	–0.267	0.097
Päijät-Häme	0.108	0.203	–0.425***
Pohjanmaa	0.275*	–0.045	–0.556***
Lappi	–0.089	0.060	–0.276*
Pohjois-Savo	–0.032	–0.096	–0.061
Kymenlaakso	0.268	–0.104	–0.417**
Keski-Suomi	0.041	–0.008	–0.195
Satakunta	–0.082	–0.090	–0.138
Pohjois-Pohjanmaa	0.180	0.087	–0.408**
Pirkanmaa	–0.111	–0.111	0.070
Varsinais-Suomi	–0.076	–0.100	–0.283*
Uusimaa	–0.220	–0.264	–0.056
Mean	0.022	–0.148	–0.184

Note: ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively (two-tailed tests). The approximate critical values of *r* are 0.419, 0.325 and 0.275.



01= Uusimaa
02= Varsinais-Suomi
04= Satakunta
05= Kanta-Häme
06= Pirkanmaa
07= Päijät-Häme
08= Kymenlaakso
09= Etelä-Karjala
10= Etelä-Savo
11= Pohjois-Savo
12= Pohjois-Karjala
13= Keski-Suomi
14= Etelä-Pohjanmaa
15= Pohjanmaa
16= Keski-Pohjanmaa
17= Pohjois-Pohjanmaa
18= Kainuu
19= Lappi
20= Itä-Uusimaa
21= Ahvenanmaa

Figure 1. Finnish regions. Source: Statistics Finland

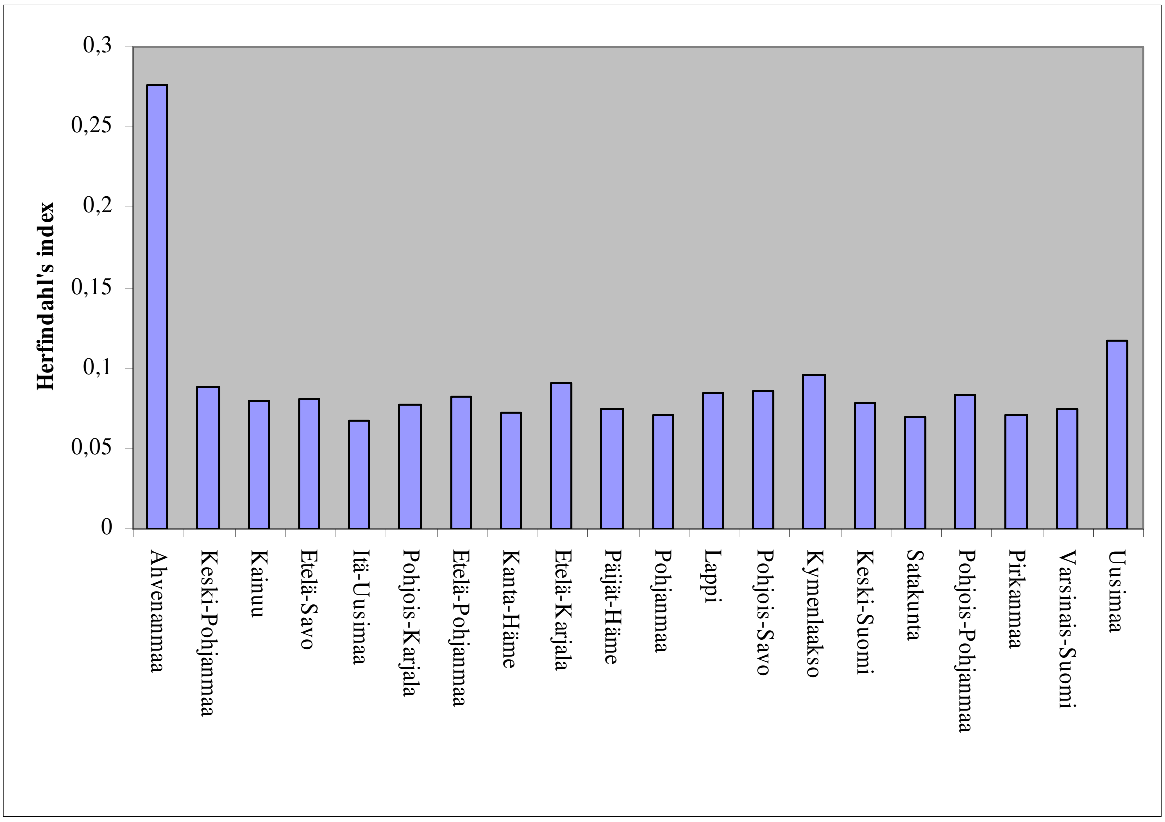


Figure 2. Herfindahl’s index (all industries) for Finnish regions in 1995

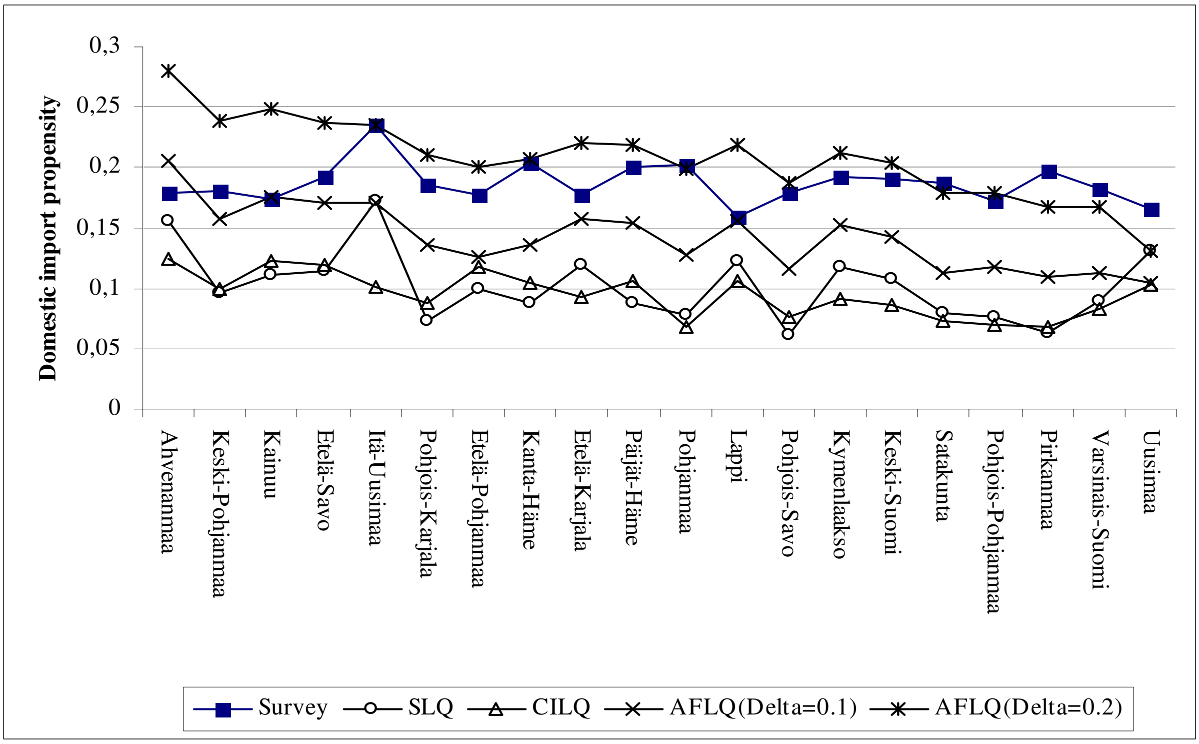


Figure 3. Estimates of domestic import propensities produced by the survey and by LQ-based methods

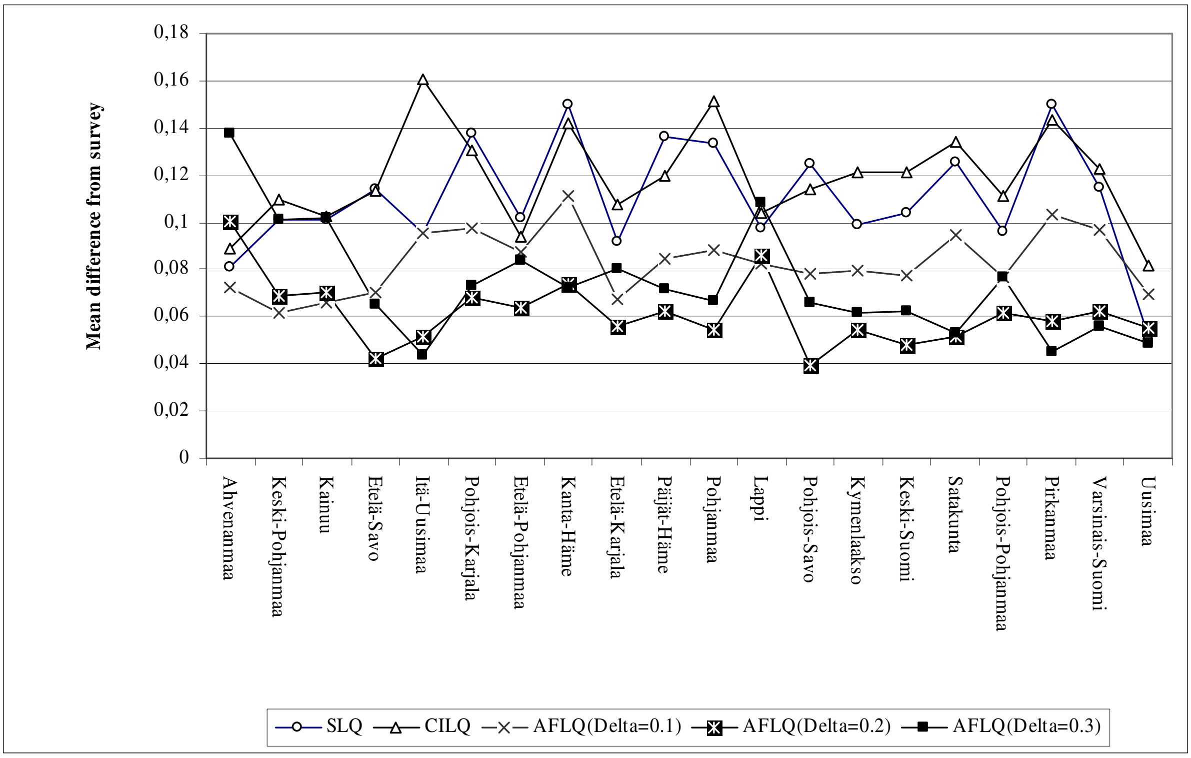


Figure 4. Estimates of regional total intermediate inputs produced by LQ-based methods: mean absolute difference from survey-based estimates

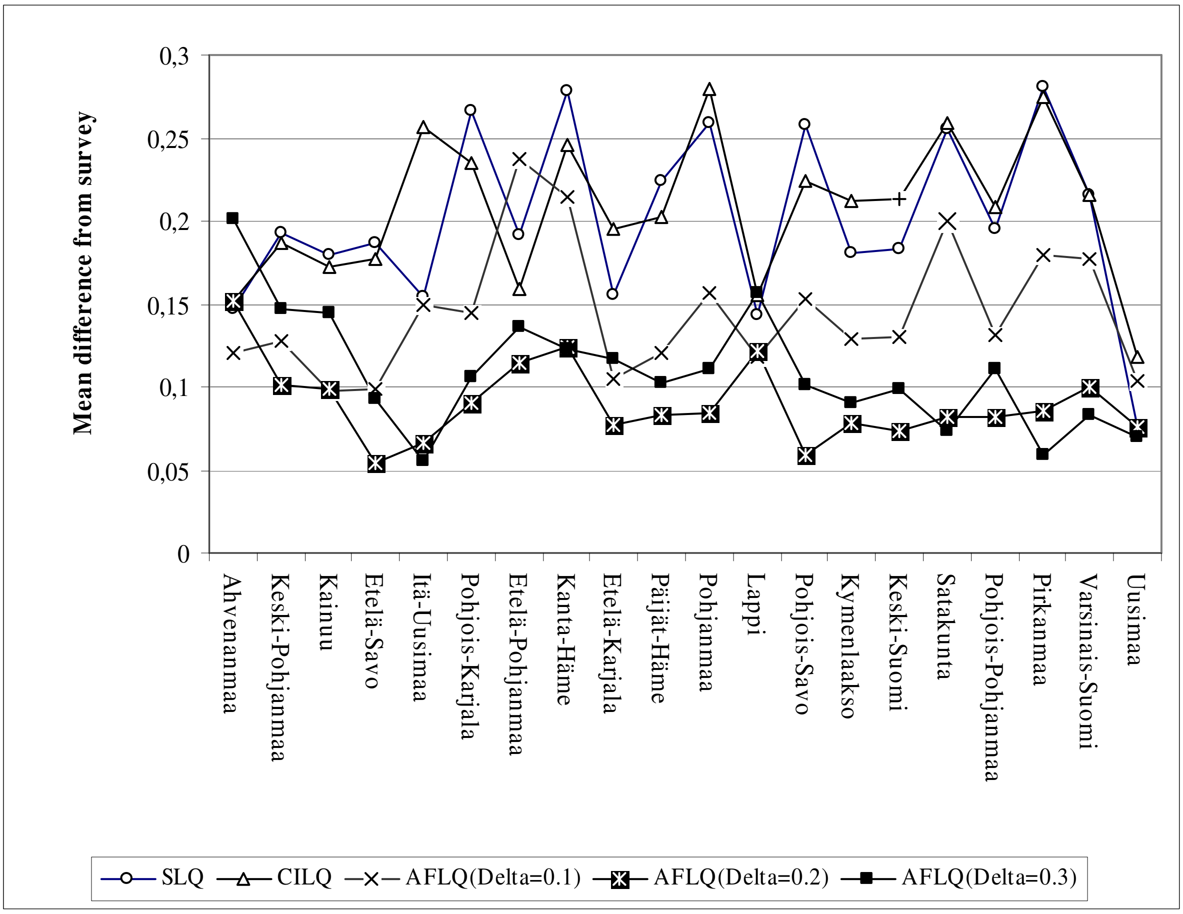


Figure 5. Regional multipliers produced by the LQ-based methods: mean absolute difference from survey-based estimates

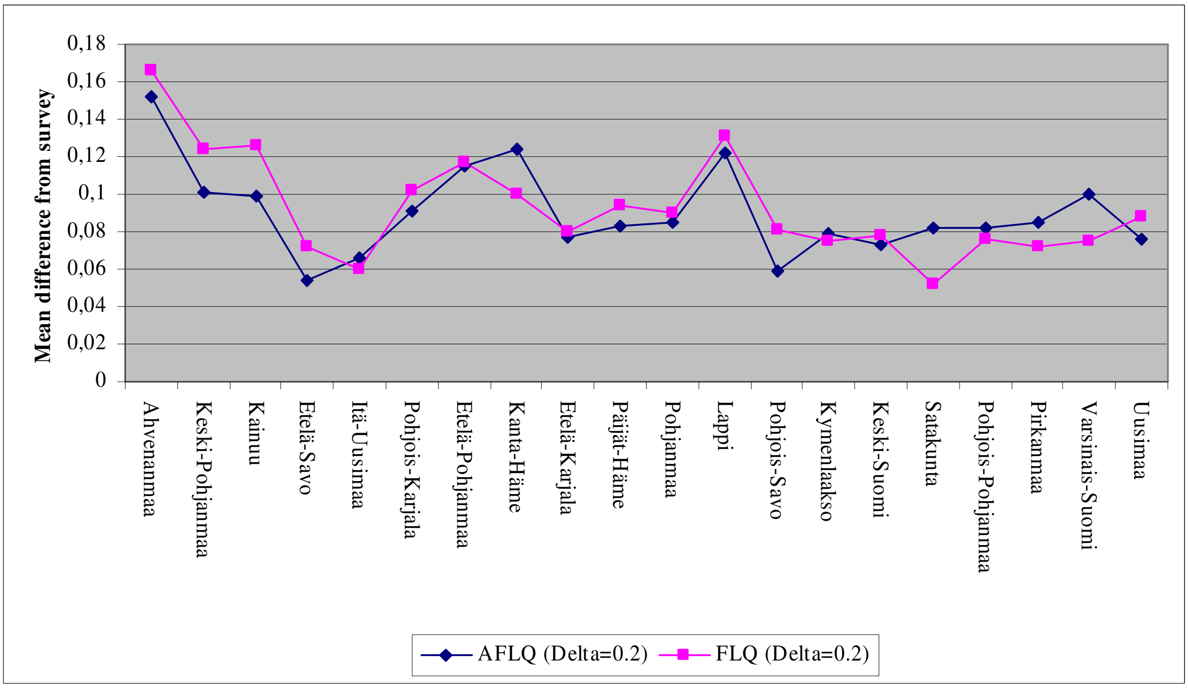


Figure 6. Regional multipliers produced by the AFLQ (δ=0.2) and FLQ (δ=0.2): mean absolute difference from survey-based estimates