REGIONAL ECONOMIC IMPACTS: NON-, SEMI- AND FULL-SURVEY METHODS APPLIED TO THE ENERGY DISTRIBUTION SECTOR IN THE NORTHERN NETHERLANDS

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Abstract *In 1995 the energy sector of the Northern part of the Netherlands was subject of an extensive study aimed at an estimate of its impact on the regional economy: its direct impacts and both its forward and backward linkages. The sector offered full bookkeeping information on input and output relations. First order indirect production impacts by sector and region could be measured precisely. Higher order impacts were estimated with the especially constructed 1990 5-region input-output table for the 4 Northern Dutch provinces. Thus, this study offers a unique opportunity to consider the various options to perform impact studies: by means of multipliers, by means of existing input-output information and by means of several levels of (full) survey information on the project at hand. Besides, it provided an opportunity to check the quality of existing regional input-output tables, with respect to the energy sector. Here we discuss the lessons of this research: were there significant differences and what do they mean for the application of semi-survey tables in general (sensitivity analysis), what was the contribution of the in dept search to the accuracy of the analysis. These questions will be answered in the paper.*

Keywords *Input-output analysis, Impact analysis, Energy sector, Forward linkages, The Netherlands.*

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1. INTRODUCTION

In the Netherlands, a strong tradition in the construction, updating and use of (inter)regional input-output tables has been built up. Oosterhaven (1980, p. 12) summarizes the development of Dutch regional input-output analysis up to the 1970's as running "from regional tables with only limited information used for primarily descriptive purposes towards ideal interregional tables mainly used for analytical purposes, such as estimates of economic impacts, experiments with programming models and building full forecasting models".

As opposed to the Dutch tables constructed in the 1970's and most tables constructed in the US (see Brucker, Hastings and Latham III, 1990), and Australia (see West, 1990), the Dutch (bi)regional tables of the 1980's are mainly based on surveys of *export* coefficients in stead of the usual approach via import coefficients or regional purchase coefficients (RPC's, see Stevens, Treyz and Lahr, 1989). This change in strategy is the outcome of several surveys that showed that firms have more and better data on the spatial destination of their outputs than they have on the spatial origin of their inputs, even more when they trade through wholesale firms and distribution centers, and especially when they trade with retail firms.

This new approach became more or less standardized in the Double-Entry Bi-Regional I-O Table construction method (the DEBRIOT-method). As a consequence of tackling the construction problem primarily from the output/sales side, DEBRIOT requires a 'regional sales table' along with either the well-known 'regional technology table' or a 'regional domestic purchase table'. To construct the regional (domestic) sales table, a non-survey method is proposed that uses a weighted average of the regional demand structure and the national sales structure. With both the auxilary regional purchase table and the auxilary regional sales table, the bi-regional character of the final I-O table can be used for consistency checks at the level of the individual *cells* of the table, whereas such checks only operate at the level of row totals in the more traditional methods (see Boomsma and Oosterhaven, 1992, for details).

In the area of impact studies, the Dutch experience also produced that are useful for a wider audience results, especially when forward linkages are concerned (see Oosterhaven, 1981 and 1988). Here we will concentrate on the effects of using survey versus non-survey data in impact studies. This is particularly important in practice, since quite often resources are insufficient for a full fledged survey-based impact study.

A related older Dutch study gives a flavour of the type of issues involved. In the context of a tourism impact study a mixed survey/non-survey type of single-region input-output table resulted from a survey into four tourist-specific sectors. The RPC's that related to the tourist sectors' inputs were also applied to the national input coefficients that were assumed to hold for the other regional sectors. A complete table resulted by putting the 4 survey and the 18 non-survey columns into one single table (see Spijker, 1985). A subsequent comparison of the resulting Type I multipliers with those from a more detailed semi-survey bi-regional table for Drenthe (FNEI, 1984), showed differences in the indirect part of the tourist sectors' multipliers of only 5-10%, whereas the differences in the indirect part of the 18 other multipliers ran from -50% to +65%, with outliers as large as +180%, +280% and +510% (Spijker, 1985).

We believe that these results show that both Bourque (1990) and Beemiller (1990) are right in their discussion in the *International Regional Science Review*: Bourque is right in his rejection of RIMS's non-survey alternative for the Washington State input-output table and Beemiller is right in his claim that combining direct information for the sectors of an impact study with a non-survey table produces sufficiently accurate estimates for most practical impact questions. But this assumes that survey data are available for the sector or project at hand, and that using non-survey data is limited to the input-output model.

Here we will investigate the opposite case, and concentrate on the size and type of errors made when non-survey data are used for the sector or project at hand. To this aim, we first discuss the set-up and the main results of a rather extensive survey-based impact study for the main energy distribution company in the Northern Netherlands (EDON). Aside from its rather detailed character, this study also shows an appropriate way to deal with the problem of forward linkages. After this, the results of a series of simulations will be shown and compared, ranging from a 'quick and dirty' method, via 'quick and non-dirty' -, 'semi-quick' - and 'semi-extensive' methods, to the results of the actually used, 'extensive' method.

2. THE EDON IMPACT STUDY

Practically all impact studies concentrate on the 'effects of' or the 'importance of' a certain branch of industry or a specific project. Seldom the question is asked and answered whether, from a model point of view, this sector or project might be considered as being exogenous or endogenous. Implicitly, most impact studies assume that the sector or project at hand is exogenous to the region, and continue the estimation of the impacts accordingly. However, when part of the sector or project is endogenous to the region at hand, this will lead to estimation errors, as will be shown in the next section.

But even more importantly, this leads to an unbalanced presentation of the importance of the sector or project at hand. In fact, when the traditional type of impact study would be done for all the sectors of an economy and the estimated impacts would be added, one would have to conclude that the economy at hand would be 2 to 3 times larger than its actual size. Or to be more precise: the 'estimated' size of the economy would be equal to its actual size multiplied by the (production or employment or income) weighted average size of its sectoral (production or employment or income) multipliers.

A more balanced presentation of the importance of a sector for a certain region, therefor, should start with a discussion of the dependence of the project on the economy of the region at hand. This is, in fact, the first question answered in the the EDON impact study (see Cras, et al. 1995, for details). As a consequence of this different approach, this study emphasises the *mutual* dependency of EDON and the regional economy, instead of the usual one-sided story of the region's dependence on the sector or project at hand.

Besides this, there is one more general point that is often neglected in impact studies. It relates to the type of research question that is being answered. In principle two basically different type of questions may be posed, each requiring a different modelling approach.

First, one might want to know which existing activities, and in how far these existing activities, are dependent on the *existence* of a certain sector or project. When using an (inter)regional input-output model, this question requires the use of *average* coefficients, both for intermediate demand and for consumption demand, along with the use of Type II income or employment multipliers (see Miller and Blair, 1985, for this type of multipliers). This is the traditional approach that is also used in the present study. Quite often, however, the results from such an impact study are (mis)used to answer the next kind of question.

For, second, one might want to know the size of the change in economic activities that is the result of a *change* in the sector at hand or that is the result of the *execution* of the project under study. For example, when the sector at hand increases its activities, supplying firms might need only a few more employees to satisfy the increase in intermediate demand. Or when the sector at hand reduces its activities, dismissed employees might experience only a little decline in income because of their entitlement to unemployment benefits. Hence, to answer this second type of question one needs to use *marginal* coefficients, along with Type III or IV multipliers (see Oosterhaven and Dewhurst, 1990, for further details on this type of impact model).

The present impact study answers the first type of question in three steps (see Cras, et al. 1995, for details). First, an extensive survey of sales, purchases and personel cost of the EDON company was made. Second, a 5-region impact model was constructed for the provinces Groningen, Friesland, Drenthe and Overijssel. These four provinces cover the two main regions of operation (the North and Overijssel) of the two constituant parts the EDON company. The fifth region comprises the aggregate of the remaining eight provinces of the Netherlands. Third, the results of the first two steps are combined in order to estimate the importance of EDON for the five regions at hand. This third step starts with the determination of the *forward* and the *direct* effects of EDON. Then the *backward* effects of both are determined with the impact model.

Here, we will discuss both the model and the main empirical results of this study.

The interregional *impact model* estimates the importance of any sector with respect to two impact variables, namely regional indirect income (i.e. gross value added at market prices, v_r) and regional indirect employment (w_r). This is done by multiplying indirect production (x_{ir}) with average income coefficients (c_{ir}) and average employment coefficients (e_{ir}) for 47 sectors (i) and 5 regions (r):

$$v_r = \sum_i c_{ir} x_{ir} \quad \text{and} \quad w_r = \sum_i e_{ir} x_{ir} \quad \text{for all } r \tag{1}$$

Since the EDON survey data relate to 1994, whereas the average input-output employment coefficients relate to 1990, the latter are updated for the 1990-1994 price development and labour productivity development, per sector, per region.

The indirect production is calculated from the demand of EDON and its employees per region of working s ($f_{ir,s}$), by means of the following equations:

$$x_{ir} = \sum_{js} a_{ir,js}\, x_{js} + \sum_{s} d_{ir,s} \left(\sum_{js'} b_{s,js'}\, x_{js'} \right) + \sum_{s} f_{ir,s} \qquad \text{for all i and r} \qquad (2)$$

The average intermediate input coefficients ($a_{ir,js}$) are derived from a 5-region input-output table for The Netherlands for 1990. This table was constructed from the existing bi-regional input-output tables for the provinces Groningen, Friesland, Drenthe and Overijssel for 1990 (Eding et al. 1995). The four 2x2 tables were telescoped into one single 5x5 table by means of the non-survey gravity method developed by Oosterhaven (1981, appendix; 1985).

The average consumption package coefficients ($d_{ir,s}$) indicate which part of the consumption expenditures of employees and dependents *living* in region s, is spent on goods and services produced in sector i in region r. They are directly derived from the above 5-region input-output table.

The average total consumption coefficients ($b_{s,js'}$) indicate the total amount of consumption expenditures of workers living in s and *working* in sector j in region s', per unit of production of j in s'. Note that these coefficients, in fact, result from the multiplication of commuting coefficients, disposable to gross income ratios, and unit labour income coefficients.

Most impact studies use (1)-(2), or simplifications thereof, without further consideration. However, when the impacts of the total production of a sector are estimated, and not just the impacts of its exogenous final output, (2) produces an over-estimation of the sector's real impact. This is the case because x_{ir} in (2) also includes (some of the) intermediate output and endogenous final output of the sector at hand, whereas these outputs are already included in the total production that was treated as exogenous. To prevent such *double-counting*, one has to put the rows with coefficients relating to the intermediate and endogenous final output of the sector at hand, equal to zero, which is mostly forgotten.

The equations (1) and (2) are easily put into matrix algebra, which gives the following solutions:

$$\mathbf{v} = \mathbf{C}\ (\mathbf{I} - \mathbf{A}^{\mathbf{edon}} - \mathbf{D}^{\mathbf{edon}} * \mathbf{B})^{-1}\ \mathbf{f} = \mathbf{C}\ \mathbf{L}^{\mathbf{edon}}\ \mathbf{f} \qquad (3)$$

$$\mathbf{w} = \mathbf{E}\ (\mathbf{I} - \mathbf{A}^{\mathbf{edon}} - \mathbf{D}^{\mathbf{edon}} * \mathbf{B})^{-1}\ \mathbf{f} = \mathbf{E}\ \mathbf{L}^{\mathbf{edon}}\ \mathbf{f} \qquad (4)$$

in which:

v and **w**	235-vectors with indirect income and indirect employment, per sector, per regio (235=47x5),
C and **E**	diagonal 235x235 matrices with average income and average employment coefficients, per sector, per region,
$\mathbf{A}^{\mathbf{edon}}$	235x235 matrix with average intermediate input coefficients, with the EDON-rows put equal to zero,
$\mathbf{D}^{\mathbf{edon}}$	235x5 matrix with average consumption package coefficients, with the EDON-rows put equal to zero,
B	5x235 matrix with total 'consumption from labour income' coefficients, per sector per region,
f	235-vector with the demand of EDON-companies and EDON-employees, as estimated by the survey.

Next, the importance of EDON for the economies of the five regions is determined by five types of impacts. Table 2.1 shows the aggregate results of the employment impacts.

First, the dependence of EDON on the regional economies needs to be determined. Being the main regional distribution company for natural gas and electricity, almost all output is sold in the four northern provinces. Within the Netherlands, price differences for *natural gas* are less than 10%, while the large industrial users are supplied directly by the national gas distribution company (Gasunie). Hence, for its regional natural gas sales, EDON is entirely dependent on the income growth of the region's inhabitants and on the growth of the region's firms. On these, it has no influence through its sales of natural gas. Hence, the companies forward natural gas linkages do not produce any employment impacts. Causality runs the other way around (cf. Oosterhaven, 1996).

The same holds for most of EDON's sales of *electricity*. But here, the situation is a little more complicated. With the 40 largest industrial users of electricity EDON has individual contracts, and with the other large users regional price differences of up to 30 % are noted. Hence, EDON potentially might attract firms to the region by means of favourable contracts. A detailed analysis of its individual energy-intensive users showed that three of them have contracts of such a nature that their presence in the region might be explained by these contracts. The firms at hand produce aluminium (Aldel) and magnesium (ESD) by means of electrolysis, and produce research services (Windtunnel), and are all highly dependent on the electricity price and other delivery conditions. In fact, these three firms alone purchase 5% of all sales of EDON. Consequently, EDON's own size will be *dependent on* the region's growth for at least the other 95% of its sales.

It was decided to consider the 5% to cause *forward* income and employment effects in the region, although it might almost as well be argued that other locational conditions, such as labour and the local availability of raw magnesium salts, or the availability of space and absence of congestion are dominant in the location/production decisions of these three firms. When these three firms are considered to depend solely on EDON, then this of course also applies for their backward linkages. The latter are estimated by applying the basic metal industry's multipliers from the 5-region impact model to the production levels of the three firms[2]. In this way a national total of 2100 jobs is estimated to be dependent on the sales of EDON.

Table 1. Aggregate employment impacts of EDON, number of jobs in 1994.

Type of effect/region	The North	Overijssel	Rest of NL	Total NL
Sales, forward and backward	1530	30	540	2100
Size of EDON, direct effect	1560	1730	0	3290

[2] In this case again, the rows with intermediate input coefficients and consumption package coefficients had to be put equal to zero (cf. Oosterhaven, 1988, figure 2).

Energy purchases, backward	610	220	720	1550
Other purchases, backward	1000	950	2300	4250
Wages and salaries, backward	420	280	340	1040
Total	5120	3210	3900	12230

Source: Cras, et al. 1995.

Second, the *direct* effect of EDON, with 95% of it being endogenous, was determined by the survey. In employment terms, EDON accounts for almost 3300 jobs, more than 1700 of which are found in the province of Overijssel, the region where the new headquarter of the two constituant parts is located.

Third, the direct *purchases of energy* by sector and region of origin are determined by means of the survey. The backward employment impact of these purchases is determined by (4), and amounts to 1550 jobs. The size of this impact surprised us a little, given the capital-intensive character of most producers of primary energy, but no obvious errors could be found.

Fourth, the direct other purchases related for 50% to purchases for *intermediate use* and for 50% to purchases for *investment purposes*. It proved to be impossible to separately estimate the sectoral and regional origins per category. Hence, the backward employment effect in Table 1 is based on the survey's sectoral and regional origin data for the total of all other purchases. In view of the volatility of the investment expenditures, a time series was used to check the representativeness of the EDON survey data for 1994. The backward employment impact of intermediate and investment demand amounts to 4250 national jobs, which is large and follows directly from the capital-intensive character of the energy distribution production process.

Finally, the *wages and salaries* of the 3290 employees of EDON lead to consumption expenditures and, according to (4), to a related backward employment impact of 1040 jobs in the Netherlands as a total.

The regional *employment multiplier* that follows from Table 1 is as large as 2.5 and the national multiplier amounts to as much as 3.7. When presented independently, this suggest that the energy distribution by EDON is extremely important for both regional and national employment. By first looking at the way in which this sector depends on other activities, this result can be put into a more proper perspective. Then it follows that energy distribution is primarily a service industry that goes up and down with the welfare of the region it serves, while only about 5% of its output may be considered exogenous to the region.

Moreover, being a rather capital-intensive industry with relatively little direct employment of its own, it is bound to have a relatively large multiplier whenever both forward and investment effects are included. When one only considers energy inputs, other intermediate inputs and consumption expenditures, the regional employment multiplier comes down to 1.6 and the national multiplier comes down to 2.1, which are both numbers that more commonly found in the literature (cf. Oosterhaven, 1981, ch. 5).

Next, we will turn to the question about the size of the errors made when the above impact study would have been done by means of non-survey methods instead of by means of the extensive survey into the company's records.

3. ALTERNATIVE METHODS FOR ESTIMATING IMPACTS

To keep the analysis simple, the 5-region impact model used in this section will exclude the consumption effect. Hence, in (3) and (4) $\mathbf{L}^{edon}$ excludes $\mathbf{D}^{edon}*\mathbf{B}$. And, just as in Table 1, only employment impacts will be shown. Finally, since (input-output) models are only used to estimate the indirect effects and not to estimate the direct impacts, only indirect effects will be compared and not the multipliers which include the direct effect as is usually done[3].

Impact studies can, in fact, be done using many different methods: ranging from quick and dirty methods, where only information on industrial output in conjunction with a set of general multipliers is used, to extensive methods, where a maximum amount of information in combination with an input-output model is used. In this paragraph different possibilities to do an impact study will be explored and the matching mathematical formulations will be specified. The EDON study is used as an example and for each method the resulting estimate of the total national employment impact will be presented. In section 3.6 these results will be compared further, both in terms of the regional distribution and in terms of the sectoral composition of the total indirect impact.

3.1. Quick and Dirty: the standard multiplier application

The first method can be described as the most simple type of impact study. The information needs for this method are minimal. The only requirements are: information on the (regional) production of the industry and a set of (regional) multipliers for the sector in gereral. In the EDON case study, the total output of EDON is simply known from the annual report (x^{edon}), while the geographical division of employment over the regions ($_{r}^{edon} = w_r^{edon} / w^{edon}$), also known from the annual report) may be used to derive a quick approximation of EDON's regional production, which is not know as such. This is a situation which is quite typical in

[3] When one compares multipliers and the percentage errors therein, one, in fact, underestimates the model's estimation errors. This usual practice may be one of the undue reasons for the continued faith in the input-output model.

standard impact studies. Mathematically, the non-zero cells of the 5-region vector **f** in (4) can then be calculated by:

$$f_{ir} \qquad {}^{edon}_{r} x^{edon} \qquad \text{with i = energy sector} \tag{5}$$

Next, **f** is pre-multiplied by a standard set of (employment) multipliers, which in our case result from the 5-region Leontief-inverse pre-multiplied by the updated employment coefficients, that is:

$$w \quad E\ (I\ \ A)^{1}\ A\ f \quad E\ (L\ \ I)\ f \tag{6}$$

The unity matrix **I** is substracted from the Leontief-inverse **L** to exclude the direct employment which is already known to be 3290 nationally (see Table 1).

The survey input for this method is limited to the total production value, Dfl 2.6 billion, and its estimated distribution over the five regions considered. The result of (5) and (6) is an estimated total indirect (national) employment of 4977 full time jobs.

3.2. Quick and Non-Dirty: excluding double counting

The above Dirty method has a major disadvantage: the impact on regional employment and income is estimated with a systematic upward bias. Because of multiplying the Leontief-matrix with total output instead of with exogenous final demand, indirect impacts on the production of the sector (EDON) itself, due to purchases of other sectors, are also included in the estimate of the indirect employment. To exclude this type of double counting, the Leontief-matrix in (6) needs to replaced with a matrix excluding the output row of EDON ($\mathbf{L}^{\mathbf{edon}}$). In a Non-Dirty Quick method (6) will thus be replaced by:

$$w \quad E\ (I \quad A^{edon})^{1}\ A^{edon}\ f \quad E\ (L^{edon} \quad I)\ f \tag{7}$$

The total indirect employment is then estimated with (5) and (7), and amounts to 4670 jobs compared to 4977 jobs in the previous estimate. Thus, in the EDON case, Dirty implies an upward bias of 6,6 % of the indirect impact. The size of the bias will largely depend on the relative size of the regional or national sales of the sector or company that is subject of analysis. The larger the size of the regional or national sales of the sector at hand, the more important is the correction for double counting.

3.3. Semi-Quick: using aggregate survey data

The above Non-Dirty method implicitly assumes the 5-region input-output table's column structures of the energy sector in the four regions at hand, to be the same as those of the four regional branches of EDON. This is of course not correct.

In this paragraph, we will investigate the possibilities to reduce the consequent estimation errors by means of the use of relatively easily accessible aggregate survey data. First, the effect of using survey data on total purchases[4] and total value value added will be studied. Second, the company's data on total energy purchases versus total other purchases[4] will be used. Third, as total energy inputs appear to be rather important, it will probably be worthwhile to substitute the detailed company data on the sectoral and regional origin of their energy purchases for the origins implicit in the 5-region table (RIOT). Recovering this last type of data from the company's record was not really Semi-Quick, but took far less time than the further subdivision of the other purchases[4], the consequences of which will be discussed in the next paragraph. The result of replacing the aggregate RIOT-data with aggregate EDON-data will be discussed in a stepwise fashion, such that the influence of each more detailed type of survey information can be identified sequentially.

3.3.1. Survey data on total intermediate input

The first step is based on generally available company information, for instance available from annual

[4] Nakijken of dat inderdaad inclusief de investeringsaankopen was.

reports, in addition to the previously used company information on total output (x^{edon}) and the distribution of direct employment over regions (^{edon}). It concern the aggregate share of value added (mainly wage cost and profits) and the complement aggregate share of total of all purschases in total output. For the further subdivision of all purchases[4] the intermediate input coefficients for the four[5] regional energy sectors from the 5-region table will be used. In formula:

$$f_{ir} \quad a_{ij}^{riot} / a_{j}^{riot} \quad a_{j}^{edon} \quad {}_{r}^{edon} \quad x^{edon} \qquad \text{with } j = \text{energy sector} \qquad (8)$$

The EDON share of total purchases in total output (a^{edon}) appears to be relatively large: 0.72 instead of the weighted average sectoral share (a_j^{riot}) of 0.51. Since **f** now represents intermediate demand instead of total output as in (5), the problem substracting the implicit estimate of direct employment is avoided. So, there is no more need to substract the unity matrix **I**. Therefor (7) needs to be replaced with:

$$w \quad E \; (I \quad A^{edon})^{1} \; f \quad E \; L^{edon} \; f \qquad (9)$$

The result of (8)-(9) leads to an indirect impact of 6564 jobs, instead of the former estimate of 4670. Using the non-survey RIOT-approximation of the total purchase by EDON thus resulted in an underestimation of the indirect employment with 39%.

3.3.2. Survey subdivision between energy and other inputs

A further refinement in this particular case is the distribution of total purchases over energy purchases and other purchases, viz.

$$f_{ir} \quad (a_{e\,j}^{riot} \;/\; {}_{e}a_{e\,j}^{riot})(\;{}_{e}a_{e\,j}^{edon}) \quad (a_{ne\,j}^{riot} \;/\; {}_{ne}a_{ne\,j}^{riot}) \qquad (10)$$

[5] Nog nakijken.

where: e = energy inputs, ne = other inputs, and j = energy sector.

The energy inputs appear to have a larger share of 0.89 in total intermediate inputs (${}_{e}a^{edon}_{e\ j}/a^{edon}_{j}$) than is implicated by the (regionally weighted) sectoral average (${}_{e}a^{riot}_{e\ j}/a^{riot}_{j}$) of 0.82, whereas the other purchases have a smaller opposite share of 0.11 instead of the average of 0.18 from the 5-region table. The subsequent substitution of (10) in (9) leads to a reduction of 26.6% of the estimated indirect employment impact of 6564 jobs to 5476 jobs here. The reason being that the energy inputs have a lower than labour intensity than the other inputs.

3.3.3. Semi-extensive: survey data on energy inputs

Since, the energy inputs represent the single most important purchases of EDON, a further investigation of these inputs seems the most logical next step. In the above step, energy inputs were treated as the average product of the utilities sector, i.e. the production and distribution of water, gas and electricity. The annual report of EDON gives more information about the type of energy that is bought, the location of the (few) suppliers, and the value of these purchases. Hence, the energy inputs in (10) may be replace with full survey information on the precise sector of origin ($a_{e.}$) and the precise region of origin (t_{er}) of these inputs, viz.

$$f_{er,js} \quad t^{edon}_{er,js} \; a^{edon}_{e\ ,js} \quad {}^{edon}_{es} \; x^{edon} \tag{12}$$

This additional information proved to be very important indeed, and leads to a reduction of 42.6% in the earlier estimated impact of 5476 jobs to 3145 jobs when full survey data on the energy inputs are used.

3.4. Extensive: using disaggregate survey data on other inputs

Finding survey data on energy inputs is relatively easy when an energy distribution company is at hand. Comparable improvements may be found in other impact studies when a few major inputs may be surveyed at relatively low cost. Surveying the host of other minor inputs will involve much more time. With a large company like EDON purchases are diverse, ranging from electrical equipment to office supplies, and they are purchased from a wide variety of suppliers. In actual extensive survey all these purchases have been assigned to a producing industry and a province of location. In particular deliveries by wholesalers ask for an extra step to identify the region of origin.

In this paragraph we will discuss the importance of such further desaggregation in two steps. First, the effect of using 'exact' information on the regional origin of the other inputs is discussed, and, second, the effect of having 'exact' information of the sectoral origin is discussed. In the EDON case both types of information were recovered from the companies internal purchase administration simultaneously, by assigning regions to the postal codes of the suppliers and by assigning industry codes to the companies at hand. The industry codes per company were obtained from outside statistical scources.[6] In the following, these two types of classifications will be used separately, despite their simultaneous derivation from EDON's purchase administation.

3.4.1. Survey data on regional origin

First, the technical coefficients for the non-energy inputs from the 5-region table (a^{riot}) are combined with the regional origin data from the survey (t^{edon}). Hence, the cells in vector **f** are calculated by:

$$f_{ne\ r,js} \quad t^{edon}_{ne\ r,js}\ a^{riot}_{ne\ ,js}\ x^{edon} \qquad (12)$$

The further empirical analysis will only discuss the improvement in the estimates of the employment impacts of these non-energy purchases. In fact, the new estimate of this impact appears to be rather close to the previous estimation: 1898 jobs in stead of 1895. In terms of improvement of the estimated total, the elaborate method thus does not pay off.

The regional distribution of these impact will be rather good as survey data are used (see table 4). The sectoral distribution, however, might still be off the mark, as is indeed the case (see Table 2). There we

[6] Nog in basis rapport nakijken.

compare the sectoral distribution of the impacts calculated with (9) and (12), with the impacts calculated with the data of the full survey data, in order to show the size of the errors made when non-survey technical coefficients are used.

Table 2. Sectoral distribution of indirect employment impacts, in %.

Sectors	based on RIOT data	based on EDON data	first order impact from EDON data
Agriculture	3	0	0
Mining	0	0	0
Manufacturing	18	25	26
Utilities	0	0	1
Construction	3	12	11
Trade	17	15	12
Transport	8	11	12
Business services	15	22	21
Other services	36	16	18

The table shows large differences over the whole range of sectors. The conclusion is inevitable that the RIOT information in this case does not lead to a reliable estimate concerning the sectoral distribution of the indirect impact, though the absolute size of the impacts could be estimated accurately. This large sectoral discrepancies imply a warning with respect to generalization of the latter fact. The accurate estimation of the total impact may be very coincidental.

Further, as an illustration, in the third column the first order employment impact of the non-energy purchases. The redistributional effect of higher order impacts is relatively small, at least compared to the first column. In other words, if a reliable estimate of the sectoral distribution of indirect impact is the main target of the analysis, in this case the availability of survey data contributes more than the availability of an input-output model.

3.4.2. Survey sectoral origin data

Next, the opposite combination of survey and non-survey data is investigated. The precise industry code distribution of the suppliers of EDON (a^{edon}) is combined with the trade coefficients of the energy sector from the 5-region table (t^{riot}), viz.

$$f_{ne\ r,js} \quad t^{riot}_{ne\ r,js}\ a^{edon}_{ne\ \ ,js}\ x^{edon} \qquad (13)$$

The total impact again is again quite close to the model in which only the energy inputs are surveyed. The simulation of substituting (13) into (9) gives an estimate of 1875 jobs as opposed to 1895 when the survey information on the postal codes is not used. Again the total hardly deviates, but since non-survey RIOT-data are used to estimate the regional distribution, the latter may still be wrong.

Tabel 3. Regional distribution of indirect employment impacts, in %.

Regions	based on IRIOT data	based on EDON data	First order impact from EDON data
Groningen	16	13	14
Friesland	18	3	2
Drenthe	7	10	11
Overijssel	22	24	26
Remaining NL	37	51	46

Table 3 show this to be the case. The reason is that EDON miports far more inputs from the remaining part of the Netherlands than the (regional total of the) utility sector. This results in smaller shares of impacts in all provinces but Overijssel. A relatively accurate impression of the regional distribution can be achieved by examination of the first order impacts. This leads to a similar conclusion as in the previous case: if a reliable estimate of the regional distribution of impacts is the main subject of analysis, in this particular case survey data are again more helpfull than an I-O model.

3.5. Conclusion: comparisons with the full survey estimate

Assuming that the model that uses all available survey is the most accurate description of reality, the preceeding models can be judged on accuracy in comparison with the 'ultimate model'. In Table 4 this is done with respect to the previously analysed criteria: the total employment impact, the sectoral distribution of the impact of the non-energy inputs, and the regional distribution of the non-energy inputs, respectively.

Clearly the quick methods lead to an overestimation of the total impact. This result, however, cannot be generalized. When other subsectors of the public utilities are subject of quick methods of impact assessment, underestimated impacts will be the result, assuming that the 5-region table as such is reliable. Another general feature is that estimating only first order indirect impacts lead to underestimates, but not to a really large extend (only -16.8%). Thus it seems to be more important to search for limited business information than to invest in building a full input-output table. When, however, a consumption function is included, as in (3)-(4), this conclusion will be valid to a lesser extend, due to a larger share of (higher order) indirect impacts in that case.

Table 4. Mean absolute percentage errors with respect to the full survey method.

Estimation Model	Total indirect impact		
Quick and Dirty	+60		
Quick and Non-Dirty	+50		
Semi-Quick: intermediate total	+111	Non-energy impacts only	Non-energy impacts only
Semi-Quick: energy/other inputs	+76	Distribution over 11 sectors	Distribution over 5 regions
Semi-Extensive: energy survey data	+1.2	48*	129
Extensive: postal codes only	1.3	55*	7
Extensive: industry codes only	0.5	1	160
Extensive: first order indirect impacts only	10	35*	24

* Excluding the extremely large error in the smallest sector.

In interpreting these results, it should be realized that not all conclusions are valid before more impact studies like this are analyzed in a similar fashion. Still some provisional conclusions may be drawn:

- impact assessments based on (interregional) multipliers only, is a most risky type of analysis,
- assuming homogeneity within sectors is also rather hazardous,
- aggregate information on the cost structure of the activity at hand already improves the quality of the estimate of total impact already considerably,
- full survey data are only usefull when one is interested in the sectoral distribution or the regional distribution of impacts.

When the size of the regional impacts is the policy issue, it may suffice to examine a bookkeeping system on the regional origin of the purchases only. Keeping track of all sectoral origins, may then be too much.

4. CONCLUDING REMARKS

First, the EDON impact study in general shows that it is important to ask the right questions before starting impact studies. The mutual dependence between companies, or more in general between economic activities and the rest of the regional economy, puts the so-called impacts of the particular activity in the right perspective. In this case, the EDON company is more dependent on the regional economy than the case is reversely. Only 5 % of its output can be considered to induce forward linkages, the rest can be considered as being dependent on endogenous regional demand. A consequent application of this rule leads in most cases to multipliers that are smaller than one. A *net* total assessment of the impact of regional activities than no longer will exceed the total value of regional income, or employment respectively.

Second, it is important to separate average and marginal linkages. In our EDON dependency question the relatively simple assessment of average linkages is sufficient. In case the EDON company would ask what would be the impact of a reduction or increase in sales in whatever shape, a more complicated analysis is required, taking marginal impacts into account, such as employment elasticities, impacts of unemployment etc.

A third important conclusion of this study regards the risks of a non-survey impact assessment. This regards both the level of total impact and the distribution over regions and sectors. In this particular case, total national impact could have been assessed accurately with a global analysis of aggregate company data. The details, however, can only be assessed with in depth analysis of the sectoral and regional origin of inputs. The errors can be divided roughly in (1) the lack of I-O table precision, and (2) in the lack of homogeneity within the sectors of the table.

In practice there exists a trade-off between the quality and price of an I-O table. This trade-off also influences the usability of a table. A full-survey table based model probably will require less information on the particular case of which the impact is to be assessed, assumed that the level of detail of the available table is sufficient to prevent large homogeneity errors. A semi-survey (or worse qualified) table will require more detailed information of the particular case, but this approach than also guarantees that the first order impact assessment is correct. And, as found in the case described here, the first order impact includes already 72 % of total indirect impacts. This confirms Beemiller's claim, as quoted in the introduction, and leads to the conclusion that for purposes of impact assessment it is better to invest in direct information for a particular case than in the ultimate quality of an I-O table.

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