Centre of Economic Scenario Analysis and Research

# Constructing Supply/Use Tables at the City Level

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The estimation methodology for regional SUTs at city level is based on the CHARM method as laid down in Kronenberg (2010) and Többen and Kronenberg (2015). The main steps of this method in order to arrive at a one-region supply/use table are:

(i) assuming the same technology at the regional level as on the national level (for the structure of domestic plus imported intermediate inputs per unit of total intermediate input)

(ii) applying industry level data for output (and/or value added) and aggregate data for population (size of the economy) and disposable income categories

(iii) estimating final demand components and cross hauling (exports and imports of the same good) given the data in (ii) and the national SUT data.

(iv) allocating imports across users and balancing of tables

The philosophy of the methodology is characterized by assuming similar technologies of production in the region as at the national level, especially at the sufficiently disaggregated level of goods and industries. The methodology is applied at the level of the NACE/CPA-classification of the last release of the WIOD database (64 goods and industries). At a more aggregate level that can lead to significant differences in total (domestic and imported) inputs per unit of output due to product-mix effects at the regional level. The difference between the general production technology at the city level and the national technology is completely determined by a different structure of output and value added, for which regional data are collected.

This assumption of similar technology applies to the structure of the intermediate input-part of the use matrix, more exactly the input of good *i* per unit of *total* intermediate input of industry *j*. The allocation of these total inputs to domestically produced and imported goods is in a second step the main difference between the national and the regional level. Like other non-survey methods (Flegg's Location Quotient, LQ), this methodology also states that the main difference between a regional and a national economy is its size. This diffrence in size leads to a higher degree of openness, i.e. a higher dependence on imports and exports of the regional economy. Aggregate variables that measure the size and are covered by the methodology are population and/or GDP or disposable income.

## 1. Data for production structures

Step (i) and (ii) as described above are carried out based on regional value added data as well as data from the national supply/use table. The ratio of gross value added by industries (vector **va**) to gross output (vector **q**) by industries from the national supply/use table is taken as the starting point for calculating **q** for the region. The relation va/q is directly applied to the va data for the region. Data for regional va are available for a large number of cities on a very aggregate industry classification at EUROSTAT. Thta needs to be complemented by information from national statistical offices in order to arrive at the detail of 64 industries and goods.

Gross output (**q**) and value added (**va**) by 64 industries are used to derive intermediate inputs by 64 industries (**m**) as the difference. This vector of intermediate inputs by industries **m** is multiplied with the nationsal use structure matrix for total (domestic and imported) intermediate inputs, $\mathbf{S}_M$ to yield the vector of total intermediate inputs (goods):

$$\mathbf{x}(i,j) = \mathbf{S}_M \, \mathbf{m}$$

The national use structure matrix of intermediate inputs, $\mathbf{S}_M$ is derived from the use matrix (absolute values) by dividing each element by the column sum and therefore has coulmn sum equal to unity. The transpose national supply matrix **V**' (output by industries and goods) is converted into the "product mix-matrix" **C** by dividing each element by the row sum. Matrix **C** therefore has row sum equal to unity and yields output by goods **q**(g), when it is multiplied by the vector of output by industries, **q**:

$$\mathbf{q}(g) = \mathbf{C} \, \mathbf{q}$$

The calculations lined out yield two vectors (**q**(g) and **x**(i,j)) of the regional commodity balance:

$$\mathbf{q}(g) + \mathbf{im}_f + \mathbf{im}_r = \mathbf{x}(i,j) + \mathbf{f}$$

For the full regionl commodity balance, the vectors of final demnad (comprising regional ($\mathbf{ex}_r$) and foreign ($\mathbf{ex}_f$) exports) as well as foreign ($\mathbf{im}_f$) and regional ($\mathbf{im}_r$) imports still need to be determined.

## 2. Data for the vectors of final demand

The vectors that define final demand have been estimated applying a varoety of methods and available data.

-*Private Consumption* The total of the private consumption *cp* vector is estimated by applying a function of income dependent savings ratios (from European estimations) to the regional *per capita*-income. From the estimation of consumption functions for different European countries (Salotti et al., 2015, based on household budget survey data), the difference between regional and national consumption structures ($\mathbf{w}_{cp}$) has been derived, based on the differences in regional *per capita*-income. Multiplying the vector of the budget shares of private consumption $\mathbf{w}_{cp}$ with total consumption *pc* yields the private consumption vector **cp** at the regional level:

$$\mathbf{cp} = \mathbf{w}_{cp} cp$$

-*Public Consumption* The gross output vector by industries **q** contains the values for the three sectors mainly producing for public consumption: public administration, education, health. It is assumed that the relationship between production and public consumption is the same at the regional as at the national level. The relationship is about more than 80% for public administration and health and for education. That determines one vector comprising these values for public administration, education and health and zeros otherwise. The other part of public consumption is – concerning its total sum – determined by applying the national public consumption per head relationship to the region. This total sum is then distributed across goods by apllying the national structure. Adding the vectors from both calculations yileds the vector of public consumption by goods, **cg**.

-*GFCF*

Regional accounts in some cases comprise vectors of GFCF (gross fixed capital formation) at industry-level, i.e. by investing industries. These data had to be complemented by estimations based on the relationship of capital formation per unit of value added from the national level. These resulting vectors of capital formation by industry *j* $\mathbf{cf}_j$ have been multiplied by the investment matrix $\mathbf{B}_{GFCF}$ derived from a matrix that links investment by industry (in absolute values) to investment by goods at the national level. The matrix $\mathbf{B}_{INV}$ has the dimension goods * industries and column sum equal to unity. The matrix multiplication yields capital formation by goods, $\mathbf{cf}_i$:

$$\mathbf{cf}_i = \mathbf{B}_{INV}\, \mathbf{cf}_j$$

The evctor of inventories and stock changes **st** has been estimated based on the relationship of inventories per unit of gross output from the national level.

In order to have a full commodity balance, the vectors of regional and foreign import and exports have still to be determined.

## 3. Regional trade data

The methodology applied here would in principle allow for a differntuiation of exports and imports to/from outside the country and to the rest of the country. Foreign trade of cities is in most cases not available. Therefore we limit the methodology to estimating total exports and imports of the region. The regional commodity balance can then be written as:

$$\mathbf{q}(g) + \mathbf{im} = \mathbf{x}(i,j) + \mathbf{cp} + \mathbf{cf} + \mathbf{cg} + \mathbf{st} + \mathbf{ex}$$

The parts of the commodity balance that have been estimated by the methods described in section 1 and 2 can be used to derive the trade balance (**ex** - **im**) as a residual. The trade balance **b** is the net result of exports and imports, and **v** can be defined as the total trade volume (**ex** + **im**). Taking the absolute value of the trade balance |**b**| and relating it to the trade volume gives a measure of cross-hauling: **v** - |**b**|. This measure indicates the magnitude of gross export and import flows that are realized for each commodity in relation to a certain trade balance. The logic of the CHARM method consists of relating this measure to the net output of each region (net of demand):

$$(\mathbf{v} - |\mathbf{b}|)/(\mathbf{q} - \mathbf{x}(i,j) - (\mathbf{f} - \mathbf{ex}))$$

Applying this measure of cross-hauling, exports **ex** are directly derived as **ex** = (**v** + **b**)/2 and imports **im** as the difference to the trade balance: **im** = (**ex** - **b**).

The methodology of the CHARM method has been challenged by Jackson (2014), especially in the context of multi-regional IO models, where the measure of cross-hauling resulting from foreign trade of regions is applied to interregional trade. The counter-argument by Többen and Kronenberg (2015) is that this measure of cross-hauling is basically a characteristic of a certain good. Therefore – in general – the method is the more justified, the more detail of good disaggregation is in the data.

## 4.Import matrices

The last step for splitting up the intermediate and final demand derived with the methods described in section 1 and 2 into domestic and imported products consists of applying the import share in total demand by good together with the degree of variety of this import share by good across users (across the row) to the use matrix. The vector of import shares by goods is defined as

$$\mathbf{im}/(\mathbf{x}(i,j) + \mathbf{f})$$

From the use tables of imports in national SUT one observes that this import share is not necessarily equal across the row, i.e. across intermediate and final users. The national tables serve for calculating the degree of deviation, $d(im\ (i,j))$, of the import share of good $i$ across users $j$:

$$d(im\ (i,j)) = im\ (i,j)/\ im\ (i)$$

This measure of deviation multiplies the estimated vector of import shares in order to derive user specific import shares by good to calculate the use table of imports for the city. This caculation is implemented by simulatneously enforcing the restriction of non-negative import flws ($im(i) \geq 0$).

## ***References***


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