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Analysis of business surveys data for a new estimation methodology of national accounts transport margins

Abstract: This paper presents an analysis of business surveys data to be used in a new estimation methodology of national accounts transport margins. The new methodology will consist in the following steps: business surveys analysis in relation to the transport margins estimation; business surveys data editing and imputation; matrix compilation. The paper will concentrate on the first two steps.

Keywords: national accounts, transport margins, business surveys, editing and imputation

Contents

1. Introduction[1]

This paper analyses the informative and qualitative contents of ISTAT structural business surveys to be used in a new estimation methodology of national accounts transport margins.

"The transport margin consists of all transportation costs that are included in the use of products at purchasers' prices but not in the basic prices of a manufacturers' output or in the trade margins of wholesale or retail traders.

The transport margin includes in particular:

⇒ Transport of goods from the place where it is manufactured to the place where the purchaser takes delivery of it in case the manufacturer pays a third party for the transport;

⇒ Transport of goods arranged in such a way that the purchaser has to pay separately for the transport costs even when the transport is done by the manufacturer or the wholesale or retail trader himself.

All other costs of transporting goods are not recorded as transport margins" (Eurostat, 1996).

The actual matrix construction of margins (Montella, 2000) is based on many statistical sources from the side of transport suppliers, that is, of enterprises that provide the transport service for transport type. The following paragraph explains the calculation method currently used to work out transport margins.

Transport statistical surveys are conducted every year by ISTAT and by several bodies working in the same sector. The latter, however, pursue sectorial goals; in addition to this, it is not easy to integrate data with other statistical sources since these have not been planned in a comparable framework of harmonized informative system of transport statistics. Besides that, the availability of estimates from the side of demand, as far as cost items are concerned, should produce an exhaustive estimation of costs

[1] The authors would like to thank Laura Peci, Istat, for the translation from Italian in English.

levels. It is known, in fact, that enterprises usually answer in a correct way for cost items.

The new methodology will consist instead in the following steps:

- economic analysis of surveys in relation to transport margins estimation;
- data editing, based on an economic and empirical data analysis, and imputation, based on the search of a "donor with least mixed distance";
- matrix compilation.

The paper will concentrate on the first two steps, as the matrix compilation method needs a further analysis of the results. Working out a matrix on the demand side will be based on using survey's per capita values and grossing them up to labour units[2], according to a methodology largely used for the estimation of economic aggregates (ISTAT, 2000). Such methodology, however, can only be applied to goods and services subject to transport costs thus excluding the agricultural sector. It is therefore necessary to integrate the new methodology of transport margins estimation with the current method; in this way it will be possible to obtain an exhaustive sectorial analysis (agriculture, industry and services). The new method will not substitute the old one so as to obtain a more detailed and accurate analysis.

2. Current method to calculate transport margins on transported goods

The present calculation method uses following statistical sources for different transport types:

⇒ Data published by the national railways;

these are used to quantify the national transport margin on goods freighted by rail, disaggregated by categories and goods types. They also enable to obtain more detailed information on the total demand trend of goods transported by rail and classified by single production unit[3]. Following variables are considered: transported goods in tons, ton-kilometre[4], goods traffic by traffic type. Data are processed using freighted goods, ton kilometres and the average income per ton-kilometre of transported goods (in Italian Liras)[5]; supplied traffic data are grouped into good types according to the traffic statistical nomenclature (NSTfs174) and disaggregated into 174 goods items.

⇒ Data collected by ISTAT through the sample survey on goods hauled by road; these are used to quantify the transport margin on these goods. The traffic of such goods is measured by loaded tons and by ton-kilometres and disaggregated into 24

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[2] In the National Account employment is measured in terms of "labour units" which reduce a series of "working positions" to approximately homogeneous units. These units characterise the measurement of the amount of work that contributes to the production process. The coefficient (full-time equivalent employment) has been calculated through the hours actually spent in working by a part-time worker and an employee (Istat, 1990; United Nations et al., 1993, chap 17).

[3] Ferrovie dello Stato S.p.A. Yearbooks 1992/96, edited by the statistical office of the Department for Strategy and Controlling, surveys on goods.

[4] "Ton-kilometre" is intended to be the product between transported weight and travelled route of the single goods parcel. The ton-kilometre value is considered to be the most appropriate measure unit since it does not show duplication.

[5] Ferrovie dello Stato "Historical series on the main indicators on the rail system evolution between 1905 and 1996", edited by the statistical office of the Department for Strategy and Controlling, Coordination, 1997.

goods types (NSTu24); the main variables showed by the survey related to goods transported on behalf of a third party and used in the present study are: transported tons, ton-kilometres, goods types according to the NSTu24 classification and the average kilometres[6] covered[7] by a vehicle during the week which is referred to. The average price[8], has been determined through fees[9] supplied by the Ministry of Transport and Navigation, section traffic control authority (M.C.T.C.).

⇒ ISTAT surveys on sea transport[10];

these are used to calculate coastal navigation transport margins. Navigation statistics points out loaded and unloaded goods at national level, wherever they come from or are shipped to. Goods are classified according to the statistical transport nomenclature (NSTu63 groups of goods[11]).

⇒ Data supplied by marine companies and published by "FINMARE";

these are utilised in order to determine the average price of coastal navigation transport of goods. The published data comprise: incomes, number of trips, travelled miles and loaded tons of the transported goods for each of the group companies. The implicit average medium prices related to tons of goods transported by coastal navigation are worked out through incomes deriving from the companies' activity.

As far as national air transport is concerned, the available sources proved to be exhaustive as to data on total transported goods. However, there is presently no specific information on national air transport of goods by goods types.

Single items classified by product or product groups that are related to the basic data listed before are structured into five statistical nomenclatures on transported goods. Each one is attributed to a different transport type and is linked to statistical nomenclatures on official traffic. Data on road transport are structured into 24 commodities groups as classified in NSTu24, sea transport data into 63 commodities items (see NSTu24), while lake and lagoon transport into 10 commodities items as classified in NSTu10. Data on air transport are aggregated into 11 commodities groups. Finally, data on rail transport are structured into 174 commodities groups (see NSTu174).

The aggregation degree of the adopted nomenclatures varies depending on the survey and the analytical detail of transported goods.

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[6] Average kilometres are intended to be the average amount of kilometres travelled by one ton of goods. They are therefore no real kilometres travelled by transport shipping clerks but a synthetic measure of one ton of goods trip length.

[7] Necessary to evaluate prices.

[8] Also see "*Alcune innovazioni sugli indici di prezzo dell'output dei servizi*" Maresca S. and Montella M.

[9] "*Le tariffe a forcella per l'autotrasporto di merci*", Gabriella Gamba- M.C.T.C. executive, I° issue July 1995, EGAF didattica S.r.l.

[10] For further studies on methodology see ISTAT, Services, "Le statistiche dei trasporti marittimi", Yearbooks, several years, Rome.

[11] NSTu293 consists in 293 product codes, aggregated into 52 goods items and 24 groups; ISTAT unit SCO surveys sea transport and disaggregates NSTu63 into 63 groups instead of 52 as foreseen by NSTu293; thus it supplies a more detailed analysis on specific products: one single product is subdivided into several items; for example, in NSTu293 brown coal and peat are a single item while in fact data supplied by the service on sea transport divided them into two products codes; this is the reason why NSTu293 has passed from 52 to 63 good types.

First it is necessary to harmonize each single statistical nomenclature with the official NSTu293 classification (EUROSTAT)[12] , being this last an important interpretation of the previously listed nomenclatures. Then data analysis by single transported item should be planned: when the available data are extremely disaggregated the analysis is in fact easier; in the opposite case NSTu293, which shows the highest disaggregation level of transported goods , is taken as a reference.

Once the analysis of the available information system have been carried out, the different statistical traffic nomenclatures for each transport type and NSTu293 are harmonized (see table 1). Finally, the analysis on each transported product is integrated with the attribution of the related economic activity (ATECO91) and production sector (101 sectors) (see table 2).).

Table 1 – Example of the harmonization between the five nomenclatures by transport types and the official traffic nomenclature (NSTu293)

NSTu293 product groupings*	**rail** NSTfs174	**maritime** NSTu63	**road** NSTu24	**air** 11 Codes	**lake** NSTu10
4-digit	3-digit	2-digit	2-digit	1-digit	2-digit
.....	.....	.....	.....	.....	.....
1221	83	12	6	1	–
1251	85	12	6	1	–
1281	79	12	6	1	–
1311	69	13	6	1	–
.....	.....	.....	.....	.....	.....

***1221**= *Beer*, **1251**= *Spirits* **1281**= *Soft drinks* **1311**=*Green coffee*.

Table 2 – Example of the harmonization between NSTu293, 4-digit product grouping and the 5-digit classification of economic activities producing transport margins (agriculture, industry and part of services). Aggregation to 101 production sectors.

NSTu293 4-digit product grouping	.....	**5-DIGIT ATECO 91 CLASSIFICATION** 15.51.1	15.86.0	15.91.0	15.96.0	.....
	.....	**AGGREGATION TO 101 PRODUCTION SECTORS** 10	8	13	13	
.....	.....	.....	.....	.....	.....	.....
1221		X				
1251			X			
1281				X		
1311					X	
.....	.....	.....	.....	.....	.....	.....

The end result of this extremely delicate phase is an harmonized table consisting in codes that can be crossed with each other. In this table there are eight columns related to the disaggregation of statistical nomenclatures diversified by transport type. The columns are linked to NSTu293, 5-digit ATECO 91 producing transport margins such as agriculture, industry and a part of services and the related 101 production sectors.

[12] The transport type determines the various disaggregation stages: from 2 to 4 digits for road transport, from 2 to 4 digit for sea, lake and lagoon transport, from 3 to 4 digits for rail transport. Thus all basic data are represented through the highest disaggregation level which is represented by the statistical nomenclature of the official traffic available in 4-digit product groupings (NSTu).

In order to complete the theoretical framework and to disaggregate the available basic data for the five transport modes, another column must be added: available national accounts labour units for 5-digit ATECO91[13].

The resulting 9 columns table is a valid tool to disaggregate commodities groupings by transport types, since these last are characterized by extremely aggregated data; moreover, the table is very important to make such data available, homogeneous and comparable to the 5-digit classification of economic activities and the 101 production sectors adopted by the National Accounts.

3. Working out of a transport margins matrix

According to the methodology explained in the previous paragraph, a basic evaluation of the four vectors[14] originating transport margins was carried out. The vectors correspond to the four production sectors of national accounts transport services mentioned before and are disaggregated according to the 101 production sectors classification[15]. In order to include the vectors into a matrix scheme (101 lines and 111 columns), it was necessary to have information as to the shares of economic sectors of goods subject to transport margins (intermediate employment, end consumptions, investments and exports).

The information obtained by the previously mentioned tables I/O (Input-Output) were used to solve this problem by classifying transport margins again through a transposition matrix[16], thus passing from 44 to 101 sectors.

On the basis of this new classification, the coefficients to distribute the margin total amount among the previously evaluated vectors on all column's lines were calculated. Finally, the shares used to balance National Accounts were worked out through the ratio between transport margins and the preliminary evaluation of underlying flows.

4. Economic analysis of the BAS and SMB surveys for transport margins estimation

The sources to be used for the new methodology include two structural business surveys conducted yearly by ISTAT: the exhaustive Survey on the Business Accounting System (BAS), on enterprises with 20 employees and over up to 1997 and with 100 employees and over from 1998, and the sampling Survey on Small and Middle Business (SMB), on enterprises with 1-19 employees up to 1997 and with 1-99 employees from 1998. These surveys consider the enterprise as a survey unit and the economic activity as an observation field (data on all economic activities are available for enterprises with 250 employees and over).

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[13] The choice of using labour units as reference parameter to disaggregate transport margins is determined by the acknowledgment of the accuracy and reliability of such economic variables.

[14] There are four vectors since transport on lakes and lagoons is included in sea transport according to the ATECO91 classification.

[15] Aggregated to 92 input-output table, 1992.

[16] Agresti, Moauro, "*Problemi di trascodifica nel sistema di Contabilità Nazionale"* Series documents n°14/1997, Rome.

Surveys' analysis and use are carried out starting from micro-data on each company.

As a matter of fact, the use of micro-data out of statistical and administrative sources to estimate economic aggregates in an input-output table framework is one of Italian National Accounts main feature. It should be stressed that sources are integrated - where possible - to improve both their quality and their informative contents (ISTAT, 2000). As a consequence, survey data editing and imputation processes are used after having been optimized, according to the needs of NA aggregates compilations (Calzaroni, Puggioni, 1998). These editing and imputation applications by the Italian NA are not generalized but designed to provide good results in a panel analysis contest. There are indeed some points of contact with some existing general editing and imputation systems (Eurostat, 1999) but editing specification, outliers detection, errors localization and the imputation used in the NA process are custom-made.

Companies account data are usually divided into:

A) Production value.
B) Production costs.
C) Income and financial costs.
D) Financial activities value adjustment.
E) Income and extra costs.

Production costs included in the economic accounts of a company can be divided into:

- costs for raw, subsidiary, consumption and commodities materials;
- costs for services;
- costs for enjoyment of other companies' goods, etc.

In the costs for raw, subsidiary, consumption and commodities materials, transport costs for purchases of raw materials are indicated as "*transport costs on purchases";* since these are incorporated in the purchase invoice, they are included by the company in purchase costs of raw materials; consequently, according to SEC95, these costs do not form any transport margin. In the costs for services, instead, the company sustains costs for transports of purchases (if not debited in billing by raw materials and commodities suppliers as just said) and for transports of sales.

It is comforting that transport costs on purchases are reported in the field of services, since these costs have been sustained for the transport of commodities for third companies with separate billing, as defined by SEC95. This means that costs are estimated by demand (companies that make use of the transport service).

The items in the questionnaire of the BAS survey selected are:

- COMMODITIES TRANSPORT (**12203**);
- OTHER TRANSPORTS (**12204**).

Big companies include transport costs of commodities in field n. 12203; field n. 12204 reports other transport costs paid to third companies for transport services after Value Added Tax (VAT) (above all as far as transport of persons, unload material, etc are concerned).

The only available item in the questionnaire of the SMB survey is:

- COMMODITIES TRANSPORT (**12203**).

Item 12203 reports the total cost of commodities transport and of other transports.

The goal is to calculate transport costs that only burden on commodities bought by companies.

5. Data analysis and edit specification

Empirical evidence says that about 90% of item 12203 value in the SMB survey is to attribute to commodity transport costs. In fact, its per capita value in 1996 amounts to 10.2 millions of Italian liras (ITL), while for big companies the per capita value commodities transport costs amounts to 8.9 millions of ITL and the per capita value of other transports costs amounts to 1.4 millions of ITL. This confirms the little weight that other transports costs show if compared with commodities transport costs.

According to 1996 BAS survey, 23,484 enterprises out of 30,521 declared transport costs for commodities and for other transports. Commodities transport costs amounted to 27,045 millions of ITL of Italians liras, while costs for other transports were equal to 4,238 millions of ITL. These values seem to introduce an underestimation of commodities transport costs if compared to currently calculated estimates referring to a set of comparable enterprises (20 and more employees and same coverage for economic activity). This would confirm the assumption that the 7,037 enterprises reporting in the questionnaire no transport costs for commodities and for other transports (both items resulted with void values) in fact omitted the real value of these costs.

In order to verify this assumption following edit rules were defined:

1) In the first place, all companies belonging to an economic field that does not envisage commodities transport costs due to its nature were excluded.
2) In the second place, the consistency of the variables "commodities transport costs", "sale of products manufactured by the company" (**11101**), and "sale of commodities bought in proper and reselled without transformation" (**11102**) was analysed for enterprises that declared no costs. If these variables were equal to void values, the void value for transport costs was considered void: this set of companies was therefore excluded from margins calculation, since it would not make sense to attribute them any transport costs for nonexistent commodities. Differently, the void value for transport costs was not considered valid. Although 3,000 enterprises out of 7,037 resulted consistent with the hypothesis of transport costs being different from zero, they declared the contrary.

There are different reasons for the missing value for transport costs, such as:

1) in the first place, transport costs were integrated in the item "costs for other services", since companies very often do not dispose on information disaggregated by cost type; in fact, the analysis of SMB survey data shows overestimated costs for other services, probably due to the inclusion of additional costs for services;
2) in the second place, companies did not declare transport costs to third companies because they only sustained transport costs for purchases, which burden directly the purchasing of raw materials without a separate billing (see previous paragraph);
3) finally, enterprises did not declare transport costs intentionally.

The selected records were considered affected by error.

Since a not negligible number of companies omitted to underline transport costs, although they have an activity where handlings of commodities is possible, it was considered necessary to carry out an imputation process with the goal to impute a more consistent value.

6. Data imputation

The search for a solution for non-response units was extremely important by analysing data; as mentioned in the previous paragraph, non-response units were spotted by considering some variables that are believed to be strictly linked to the observed variable: when to a void value of the observed variable correspond non void values of the related variables we are in the presence of a non response unit.

For the considered years (1995-1998), the non-response rate for transport costs was very high (on average 17% for the BSA survey and 33% for the SMB survey); in order to have a more complete information, it was decided to reconstruct the missing information through an automatic imputation method based on the search of a "donor with least mixed distance" (Abbate, 1997). The method is based on the concept of nearness among two statistical units and its goal is to select the closest valid unit to the failed edit record, so as to obtain the missing information. The nearness between two different statistical units is calculated through an opportune function of distance; the choice of this distance depends upon both subjective considerations and the information features. The first goal was, then, to select those items in the survey questionnaire that expressed the level of nearness between two enterprises in the observed values. Of course, these fields do not need imputation and are called matching variables. In order to get a more reliable reconstruction of missing data and to relieve the computational aspects, and after having identified matching variables, enterprises were gathered into homogeneous clusters in comparison to the values of two other items (stratification variables): for each enterprise to be imputed, potential donors were those that passed the edits and reported the same value for stratification variables.

Supposing that matching variables were grouped under *m*, the distance was the following:

$$D_{i,j} = \sum_{k=1}^{m} | X_{k,i} - X_{k,j} | p_k \qquad 1.1$$

Where $X_{k,i}$, $X_{k,j}$ were the values for matching variables for the enterprises *i* and *j* and p_k the weight given to their difference in absolute value .

Particular attention was paid to the choice of the weight p_k

If *s* was the number of layers, the adopted procedure for the calculation of p_k was given by the following formula:

$$p_k = | \bar{c}_k - \sigma_{\bar{c}_k} | \qquad 1.2$$

where $\bar{c}_k = E(c_{k,i})$ was the mean of the correlation coefficients $c_{k,i}$ i = 1,2, s of matching variables X_k for each layer i, while $\sigma_{\bar{c}_k}$ was the standard deviation calculated on these coefficients. The value of the coefficients was used as discriminating in order to decide if, in reference to a particular survey, a matching variable had to be considered or not in the calculation of the distance: a minimum threshold of 0.2 for each coefficient was set. The imputation method was developed in SAS-IML language. 56 matching variables were considered for the BAS survey and 46 for the SMB survey. In both surveys three stratification variables (economic activity, geographical area, size of the company) were considered, determining a split of population into 54 subgroups.

For example, in 1996, data imputation for big companies involved that the mean value of commodities transport costs per capita decreased from 10.4 millions of ITL to 10.2 millions of ITL.

7. Conclusions and future works

After a first analysis, results showed that the business surveys data editing and imputation method proposed can produce an apparently plausible estimation of transport costs which is consistent with estimates produced through the current method, based on sources that analyse the phenomenon from the supplier side. However, a next step will consist in a more detailed evaluation of consistency and in the comparison of the two estimates, also including the problem of the unit non-response. The availability of estimates from the demand side, as far as cost items are concerned, should produce, in fact, an exhaustive estimation of costs levels. It is known, in fact, that companies usually answer in a correct way for cost items.

The matrix compilation by demand will be founded on the use of per capita surveys values for economic activity and on their amounts carried over to the population target of National Accounts by full-time equivalent labour units (FTEs), in accordance with a methodology largely used for the estimation of economic aggregates (ISTAT, 2000).

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