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Statistical Approaches to Estimate Sectoral Economic Aggregates

Antonio Frenda [1,*] **and Sergio Scippacercola** [2]

[1] National Institute of Statistics (Italy), Pegaso Telematic University.
[2] Department of Economics, Management, Institutions, University of Naples Federico II, Italy, ORCID: 0000-0003-4416-5838, tel. +3981675010

Abstract. In the near future, the statistical estimation of the value added of leading business groups in Europe and of large complex units could become a source for the preliminary estimates of GDP at a European level, or be used for the further development of existing indicators of European growth. However, it is often challenging to produce such data, because in standard accounting formats the distinction between national and foreign activities is not always requested. The following case studies explain how it is possible to solve some of the problems that arise when trying to calculate group accounts that are useful for establishing aggregate statistical indicators, starting from the accounts of the individual companies and branches. (Continued in page 448)

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*Corresponding Author : Antonio Frenda (frenda@istat.it)
: Sergio.Scippacerco

Full Abstract. In the near future, the statistical estimation of the value added of leading business groups in Europe and of large complex units could become a source for the preliminary estimates of GDP at a European level, or be used for the further development of existing indicators of European growth. However, it is often challenging to produce such data, because in standard accounting formats the distinction between national and foreign activities is not always requested. The following case studies explain how it is possible to solve some of the problems that arise when trying to calculate group accounts that are useful for establishing aggregate statistical indicators, starting from the accounts of the individual companies and branches. The chosen solution method depends on the availability of data concerning foreign production (in particular for enterprises involved in the construction field and those operating in Internet), accounting criteria used in certain countries, and vertical integration: when some of these are unavailable, it may result in a particular method being chosen over another. As highlighted in the European System of Accounts in Eurostat (2010), the centre of predominant economic interest of an enterprise indicates that a location exists where this unit engages in economic activities and transactions on a significant scale within a country's economic territory. Some statistical, fiscal and administrative sources are outlined that can be used to sketch the domestic economic performance of the main enterprises carrying out activities abroad. The paper provides robust statistical methods regarding the utilization of such sources.

Résumé (FRENCH) Dans un proche avenir, l'estimation statistique de la valeur ajoutée des principaux groupes d'entreprises en Europe et des grandes unités complexes pourrait devenir une source pour les estimations préliminaires du PIB au niveau européen ou être utilisée pour l'améliorartion des indicateurs existants de la performance de la croissance européenne. Cependant, il est souvent difficile de produire de telles données, car dans les formats de comptabilité standard, la distinction entre activités nationales et étrangères n'est pas toujours demandée. Les études de cas suivantes expliquent comment il est possible de résoudre certains des problèmes qui se posent lorsqu'il s'agit de calculer des comptes de groupe utiles à l'établissement d'indicateurs statistiques globaux, à partir des comptes des entreprises et des succursales. La solution retenue dépend de la disponibilité des données relatives à la production étrangère (notamment pour les entreprises du secteur de la construction et celles opérant sur Internet), des critères comptables appliqués dans certains pays et de l'intégration verticale : lorsque certaines d'entre elles sont indisponibles, faire en sorte qu'une méthode particulière soit choisie sur une autre. Comme souligné dans le Système européen de comptes dans Eurostat (2010), le centre d'intérêt économique prédominant d'une entreprise indique qu'il existe un endroit où cette unité exerce des activités et des transactions économiques de grande ampleur sur le territoire économique d'un pays. Certaines sources statistiques, fiscales et administratives peuvent être utilisées pour esquisser la performance économique nationale des principales entreprises menant des activités à l'étranger. Le document fournit des méthodes statistiques robustes concernant l'utilisation de telles sources.

1. Introduction

The globalisation phenomenon affecting the world economy changes some of the conditions relative to the production of business statistics, since the underlying economic activities are often multinational, while statistics are bound to national boundaries.

The key aspects for capturing elements relating to globalisation include: 1. international activities of enterprise groups; 2. outsourcing of activities; 3. foreign direct investments.

To track such elements, information can be obtained by "profiling ", defined in the Eurostat Business Registers Recommendations Manual as follows: "a method to analyse the legal, operational and accounting structure of an enterprise group at national and world level, in order to establish the statistical units within that group, their links, and the most efficient structures for the collection of statistical data "(annex 3.1, paragraph 19.9).

The Council Regulation (EEC) No 696/93 on Statistical Units defines an Enterprise Group (EG) as "an association of enterprises bound together by legal and/or financial links. A group of enterprises can have more than one decision-making centre, especially for policy on production, sales and profits. It may centralise certain aspects of financial management and taxation. It constitutes an economic entity which is empowered to make choices, particularly concerning the unit it comprises ".

A group is a synthetic picture of many enterprises that are linked to others. A multinational enterprise group (MNE) is defined as an enterprise group composed of at least two enterprises or legal units located in different countries.

In order to create an EuroGroups Register containing the global structure of the European economy, Eurostat must collect the most accurate information on EG from the national statistical business registers: in Article 11 of the business registers, Regulation 177/2008 outlines the necessary data exchange between the national business registers and Eurostat.

The BR Regulation (EC) No 177/2008 of the European Parliament establishing a common framework for business registers for statistical purposes states that: "A multinational enterprise group shall mean an enterprise group which has at least two enterprises or legal units located in different countries ".

The statistical estimation of the value added for the leading business groups in Europe and large complex units (multinational, foreign branches) could in the near future become a source for the preliminary estimates of GDP at European level, or be used for further development of existing forecasting indicators of European annual growth (Fornengo *and* Rullani (1982); Fortis (2009); Codogno

(2008)).

There are three main legal forms by which an enterprise can settle abroad: the
representative office, the permanent establishment (or branch), and/or a new
company. In the latter case, enterprises can opt for a corporation, a joint venture or
a partnership, with different methodologies of calculation for economic variables.
At the European level, there is a small number of foreign-controlled enterprises,
but their contributions to economic performance are high in terms of turnover,
value added, and employment.

Sources useful for Structural Business Statistics (SBS) that can be used to analyse
globalisation include:

(a) statistics showing the impact of foreign-controlled enterprises and branches
on the European economy;

(a) information relative to exports of business services to residents in other
Member States or outside of the EU;

(a) information on trans-border purchases and deliveries of services;

(a) consolidated balance sheet accounts and fiscal sources (Frenda (2004)).

The reason why both enterprises and legal units are mentioned is that branches
that do not constitute separate legal units and are dependent on foreign enterprises
are deemed quasi-enterprises for business register purposes.

A branch is neither a representative office nor another company - it is a permanent
establishment.

As the phenomenon of enterprise groups started to become established, the need
to provide third parties with more information on the prospects of the groups'
future development grew, as well as the need to provide further information on
their organization and on the results of their own activities.

For these reasons, the legislator provides for a document that can meet the
cognitive needs of third parties connected to a group, namely *the consolidated
balance sheet.*

There is a vast difference between the *group's consolidated balance sheet* and the
category of the *integrated accounts* (Mella (1985); Marshall (1890)).

The former takes the system of values for a single company as a point of reference
(even though it consists of several related economic units), while the latter refers
to the process of aggregation (thus representing a pure sum) of several accounts

for various companies, which are associated by sector, company and/or area.

As a matter of principle, flows and stocks between constituent units within subsectors or sectors should not be consolidated, however, *consolidated accounts* may be built up for complementary presentations, analyses, and estimations (Mayer *and* Ottaviano (2007); Brancati *and al.* (2010); Bennett *and al.* (2008)).

In ESA (2010) (European System of Accounts), a way to subdivide the economy is to describe processes of production by grouping local kind-of-activity units (local KAUs) into industries based on their type of activity.

An activity is characterised by an input of products, a production process and an output of products. When an institutional unit contains more than one local KAU, as in the case of complex statistical units, the output of the institutional unit can be defined as the sum of the outputs of its component local KAUs, including outputs delivered between the component local KAUs (ESA 3.15).

A contribution of this work is to propose some statistical approaches to attain group accounts that are useful for establishing sectorial economic indicators, starting from the accounts of the individual units included in an aggregate of institutional units.

In Amante *and al.* (2016), some of the main national enterprise groups were singled out for application of the intensive activity profiling activity (ESSnet (2014)); with the full involvement of the enterprise group (by visits) and we follow their approach in order to contribute to the ongoing debate on statistical units at the European level.

The following case studies explain some of the problems that arise when trying to attain group accounts that are useful for establishing economic indicators, starting from the accounts of individual companies included in a group of companies.

In particular the following four cases, established on the basis of determined hypotheses, describe the statistical consolidation methods used to pass from the company to the aggregated whole to be analysed (Casciano *and al.* (2010); Grillo *and* Silva (1991)).

It is important to underline that the chosen solution method depends on the availability of certain information (such as intra-group exchanges, the accounting criteria used in certain countries, and vertical and horizontal integration).

In cases where some of this data is not available, one particular method may be chosen over another (Jacquemin and de Jong (1977)).

Statistical consolidation of Multinational enterprise groups may become an approach to building GDP forecasting sources for national economies in the Euro Area.

Therefore, a large sample of complex units (e.g. groups) can be used to estimate a proxy of the added sectorial value for the main economic sectors.

In this vein, one might hypothesise that the enterprise group NACE code is to be identified by the highest number of employees working in a specific sub-sector with respect to the considered aggregate.

In Section 2, based upon determined hypotheses, the statistical methods used to pass from the company to the *national aggregated whole* are described, in order to analyse the impact of an aggregation of simple units (a large complex unit) on added value and fixed capital formation.

In Sections 3 and, the impact of foreign activities and sectorial intra-group exchanges on a group's economic performance is outlined.

2. Integrating legal units

Local Kind-of-Activity Units are the key building block for analysis. Table 1 (page 462) highlights some of the statistical unit definitions s comprised in Regulation EEC $696/93$ for a relatively simple case in which the activities are all performed in the same country.

By contrast, in **Table 2 (page 462**) we consider a single legal entity having substantial operations in two or more territories (e.g. for branches and multi-territory enterprises).

In order to analyse an *aggregate of complex units* (Table 2, page 462), which may be considered as an enterprise group with controlled companies and foreign branches, the approach set forth in Table 1 (page 462) can be re-applied.

The columns represent the n economic activities of the m branches comprising the *aggregate of complex units,* and the rows illustrate the various kinds of activity units (KAU) of each of the m branches.

With the information about the *value added* for each unit being available, each cell would contain one of the individual KAUs, showing one of each of the m

branch/legal units in the marginal row, along with the *value added* of each of the n economic activities in which the group operates in the marginal column.

The grand-total will contain the value added of the *aggregate of complex units* (Calzaroni *and* Pascarella (1998)).

Two legal units are said to be *vertically integrated* if they are within the same statistical enterprise group with one consuming the total output of the other.

For example, the output of a legal unit engaged in printing could go entirely to a legal unit engaged in bookbinding.

If two or more legal units in the same enterprise group are vertically integrated, they may be considered as not acting independently.

In cases where one unit is completely dependent upon another for its sales, it loses autonomy. In practice, it is assumed that the legal units are managed together as one business, and should therefore be combined to form one enterprise.

Two legal units are said to be *horizontally integrated* if they are within the same statistical enterprise group, carry out similar or complementary activities, and are managed as one business.

If two (or more) legal units are horizontally integrated, they cannot be considered to act autonomously. Thus, the legal units should be combined to form a single enterprise.

An instance of such horizontal integration is given by the absorption of a company that operates in the field of household appliances and produces washing machines and dishwashers by a firm that produces refrigerators and operates in the same sector.

This case covers several legal units carrying out a high number of production phases in a certain production chain. In this situation, we need to evaluate the existence of costs and benefits connected to intra-group sales (Depoutot (2003)), because of the existence of vertically integrated companies.

The presence of vertical integration does not imply the presence of shareholdings between the companies that make up the production chain, and consequently the aggregated whole (Dervieux (2002)).

Vertical integration can indeed take place through fusion, a share raid, a long-term delivery contract, or any other technical form (all those forms that can lead to de facto control) (Brancati *and al.* (2010); European Commission (2010)).

Let us consider an ABC group (in other words, an aggregate consisting of Companies A, B and C), with Companies B and C vertically integrated and working only for Company A (whose only suppliers are the two integrated companies).

We can hypothesise that information on vertical and horizontal integration are obtained by intensive profiling.

Case I – Consolidation of balance – sheet accounts in cases of vertical integration

The *value added* (VA) of an enterprise is obtained by subtracting the amount of intermediate goods and services (BSI) purchased and used in the production process from the production value (PV) of each enterprise:

$$VA = PV - BSI.$$

The variables *value added and fixed capital formation* for the aggregate was obtained by adding the values of each economic sector.

On the other hand, the total sale proceeds (Table 3, page 462) correspond to the proceeds of company A (10000), while the total *cost of purchased goods and services* (800) corresponds to the sum of the costs of the vertically integrated companies $(700 + 100)$[1].

In fact, the costs of A (2500) corresponds to the sale proceeds of B and C (1700+800). Thus, when carrying out consolidation, the intra-group costs and the proceeds are avoided, without affecting the total sum of the value added (which is obtained through a simple sum of the companies' value added).

In order to generalise, vertically integrated k *companies* are considered, and so the calculation of the group values can be formalised by following the criteria defined as *consolidation with vertical integration* (Fimiani *and* Frenda (2004)), in the following way:

Total Value Added $= \sum_{i=1,k} VA_i$ where VA_i indicates the value added for the $i-th$ company in the chain, with $i = 1, ..., k$;

Total Fixed Capital Formation $= \sum_{i=1,k} FCF_i$ where FCF_i indicates the fixed capital formation for the $i-th$ company in the chain, with $i = 1, ..., k$;

Total sale proceeds $= R_K$ where R_K indicates the sale proceeds of the $k-th$ company that sells the finished product on the market;

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[1] In fact, the automobile industry integrates the upstream sectors, and registers earnings deriving from the final market sales to consumers in its accounts

Total cost of purchased goods and services $= \sum_{i=1,k-1} C_i$ where C_i indicates the costs for goods and services for the $i-th$ vertically integrated company, with $i = 1, ..., k-1$.

However, data on vertical integration and intra-group exchanges can actually be obtained by intensive profiling of a specific group sample involved in the experiment.

Case II – Pure aggregation of balance-sheet accounts in cases of horizontal integration

Let us suppose an aggregate consisting of Companies A, B and C, where Companies B and C are not vertically integrated: A has a 100% shareholding in B and C.

The aggregated totals can be established by simply adding the economic items to the accounts relating to the individual units in the aggregated companies (Table 4, page 463).

Case III – Consolidation with proportional integration

This deals with a case in which the group head holds less than 100% of the shares and there are no vertical integration relationships.

In this case, the proportional integration method can be used. This method provides for each item in the accounts being entered into the consolidated accounts at the sum corresponding to the proportion of shares held by the group.

It therefore only highlights the value of the group's shareholding in the subsidiary and not the overall global value of the controlled company (Montrone (2000)).
This case supposes that the Company A holds a share of 80% in Company B and 60% in Company C (Table **?**

Method of proportional aggregation. The consolidated value added, fixed capital formation, sale proceeds and costs of purchased goods and services are given by the sum of the respective variables of Company A, plus 80% of Company B's variables and 60% of Company C's variables. When considering k *companies*, the calculation of the group values can be carried out using a criterion we define as proportional consolidation of accounts, as follows :

Total value added $= \sum_{i=1,k} p_i VA_i$ where VA_i indicates the value added for the $i-th$ company of the aggregate, and p_i[2] the relative weight, with $i = 1, ..., k$;

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[2] For the group head, Company A, the weight is obviously always equal to one. This is also true for the weight for the total sale proceeds and the total cost of purchased goods and services.

Total Gross Fixed Capital Formation $= \sum_{i=1,k} p_i GFCF_i$ where $GFCF_i$ indicates the gross fixed capital formation for the $i-th$ company of the aggregate, and p_i[3] the relative weight, with $i = 1, ..., k$;

Total sale proceeds $= \sum_{i=1,k} p_i R_i$ where R_i indicates the sale proceeds of the $i-th$ company, and p_i the relative weight, with $i = 1, ..., k$;

Total cost of purchased goods and services $= \sum_{i=1,k} p_i C_i$ where C_i indicates the costs for the goods and services of the $i-th$ company, and p_i the relative weight, with $i = 1, ..., k$.

3. Depurating a legal unit from foreign branch activities

Units that constitute the economy of a country and whose flows and stocks are recorded in the ESA (2010) are those that are resident: an institutional unit is resident in a country when it has its centre of predominant economic interest located within the economic territory of that country.

Centre of predominant economic interest indicates that a location exists within the economic territory of a country where a unit engages in economic activities and transactions on a significant scale, either indefinitely or over a finite but long period (a year or more).

Enterprises are usually connected to only one single economy. A separate institutional unit is identified for statistical purposes where a single legal entity has substantial operations in two or more territories (e.g. for branches and multi-territory enterprises).

In such cases, the export of construction services thus remains a small part related to exports that do not constitute gross fixed capital formation, and include repairs and routine maintenance (Codogno (2008); ISTAT 2010; ISTAT 2008).

European Regulation (number $696/93$) for Statistical Units states that *the enterprise is the smaller combination of legal units that is an organizational unit producing goods or services*[4], *which benefits from a certain degree of autonomy in decision making, especially for the allocation of its current resources. An enterprise carries out one or more activities at one or more locations.* It underlines a relevant difference between the concept of a legal unit (a physical or juridical subject with rights and duties) and the statistical unit enterprise (a unit producing goods or services and

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[3] For the group head, Company A, the weight is obviously always equal to one. This is also true for the weight for the total sale proceeds and the total cost of purchased goods and services.

[4] A legal unit may be purely administrative (fiscal) or may not yet carry out a productive activity, despite the fact that it is legally recognised or it may have ceased activities without legally declaring such.

is autonomous in decision-making).

This distinction is necessary due to the existence of both foreign branches, and of units that are not autonomous organisational units producing goods or services despite the fact that they are legally recognised from both administrative and juridical viewpoints.

ESA (2010) (Eurostat, 2013) in 2.09 (b) states that "when the activity is carried on for less than a year, the activity remains part of the activities of the producer institutional unit and no separate institutional unit is recognised ".

Under ESA (2010), the activity in such cases will be, recorded as output of the home country rather than of the construction unit's temporary country of residence, and this matter affects GDP.

Consider an example: a construction site unit wholly owned by a company in Country A, existing in Country B and engaged in constructing an industrial building.

Any profits deriving from the activity will be remitted back to A. Suppose that local materials used are 50, and local labour employed is 100.

Employees of the parent working temporarily in Country B earn wages and salaries 200, which will be paid directly to their Country of residence A.

The value of the building is 500 and recognised as GFCF (gross fixed capital formation) (Table 7, page 464).

The added value produced by the parent company's branch in Country B is equal to 450: the sum of operating surplus and wages. In the table below the case of a work carried out for *less than one year* is considered (Table 8, page 464).

The added value produced by the parent company's branch operating in Country B increases the GDP of Country A: added value produced is equal to 450 (the sum of operating surplus and wages).

The following statistical, fiscal and administrative sources can be used to outline the main enterprises carrying out activity abroad and to separate (purify) national production from foreign activity, but are not useful for the estimation of national (or European) gross domestic product: Balance sheet accounts, consolidated or not; Inward and outward Fats statistical survey; Fiscal data (e.g. IRAP for Italian enterprises); Social Security Database.

In Italy, EMENS is the database containing declarations that Italian companies must submit to Social Security for each employee. Emens declarations are the means by which salary data and information necessary for the computation of

social security contributions for each employee are collected.

The idea may be explained by considering an example with Enterprise A carrying out construction activity through its branches abroad in year x. Since we do not know whether the activity is carried out for more or less than 12 months, we must decide how to depurate production.

The proposed approach is one that chooses the source producing the higher percentage of national production (or the lower percentage of foreign production, which is the same).

By so doing we can hypothesise that production over a period less than 12 months remains in the parent company's national added value and will not be eliminated. In Table 6 (page 463), IRAP data source (influenced by fiscal deduction and based on the number of employees both home and abroad) allow one to obtain higher national production, and the total production in Structural Business Statistics Survey could therefore be depurated by 40% of foreign production: the same linear depuration can be made for intermediate consumption.

4. A real application relative to the Italian economy: the integrated approach

The structure conduct performance approach defines vertical integration as one of the elements of industrial structure, and indicates the quantity that an individual company/industry realises in the later stages of production and distribution of a product.

Among the examples of vertical integration, we may consider aviation companies that integrate upstream maintenance activities and supply aircraft, and the construction industry, where large enterprises use smaller subcontracted enterprises (Rey *and al.* (2008)).

The family of indices that we want to consider here is the one using the Supply and Use Tables, outlining a market dependent sector, namely other sectors producing inputs and intermediate goods and services, through the indices that measure the incidence of the branches on the target sectors.

The limits of these measures regard the degree of geographical and sectorial aggregation of these tables. The transfer prices of goods throughout the various stages of the production process could then diverge from market prices (Del Gatto *and al.* (2005)).

To identify the existence of sectorial vertical integration, we may use the classic approach with the Adelman Index[5] (Anitori *and al.* (2010)), which is the ratio between value added (VA) and value of production (turnover could also be considered as a proxy of the production).

It can range from 0, where the company has purely one mediation, buys the product from the outside and sells it, in which case the external costs cover almost all the revenues and added value is very low, up to 1, which is the extreme case where an organisation produces the whole input and turns it into output by reselling it on the market.

In such cases, the external costs are minimal and the added value (De Novellis *and* Nardozzi (2009)) is approximately equal to the total turnover (Crandall (1968); Confindustria (2010)).

The Adelman Ratio will be compared in Table 9 with an approach following ESA (2010) (see Section 3), to estimate foreign production; in particular, the value of the activities carried out abroad can be eliminated from the production and cost values of resident enterprises in different ways:

$a)$ Accurate attribution of cost and revenue levels taken from the yearly balance sheet accounts and corresponding explanatory notes;

$b)$ Use of a linear reduction coefficient for enterprise revenues and costs, when the annual statements did not show accurate data;

$c)$ A proportional method, i.e. applying different reduction rates to costs and revenues, when making the hypothesis that a part of the intermediate costs regards domestic suppliers.

By using a proportional method, we will calculate a ratio between domestic added value and domestic value of production.

We also propose an innovative approach by calculating *the effective vertical integration ratio* (EVI):

$$EVI = VA_t/(TP_t - FP_t - INTRA_t) \tag{1}$$

where VA_t is the added value of the t sector, TP_t is the total sectorial production, FP_t the foreign production of domestic enterprises, $INTRA_t$ is the percentage of intermediate consumption produced by the t economic sector as input for the same t sector.

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[5] Another measure not used in this paper is represented by the ratio of gross fixed capital formation with value of production.

To summarise, the sectorial value of production must be the one generated by third sectors using similar principles to case I (Section 2 of this work), applied to a sectorial aggregate and using specific criteria for depurating value of production (ISAE (2009); Colacurcio *and al.* (2010)), and not what individual companies in the same sector have achieved by working together.

Furthermore, total production must also be depurated from foreign production (and should also include internal production of foreign companies), as ESA (2010) explains (see Section 3).

The infra-group profits and losses must be eliminated. Profits and losses deriving from operations among enterprises included in the consolidating area (and related to some values comprised in the sectorial assets) should be eliminated, since our approach requires an economic and financial representation of a sole entity (Cecchi (2002); Quintieri (2007); Pulsoni (2000); Montrone (2000)).

In the following, we show an application for the Italian economy. In this simulation of a real case, we compare classic and EVI approaches for estimating vertical integration in Construction, Telecommunication and Transport sectors as estimated in National Accounts (De Novellis *and* Nardozzi (2009)).

5. Some final conclusions

The paper provides robust statistical methods for utilization of the sources used to separate national production from foreign activity, by applying the recent European System of Accounts 2010.

Moreover, a simulation of an artificial multi-country economy made of firms having complex business units allows experimental detection of potential advantages for each chosen method: the solution method to be chosen depends on the availability of certain information (such as on intra-group exchanges), data concerning foreign production, accounting criteria used in certain countries, and vertical integration.

By using the two different approaches shown in Table 9 (page 465), we show that intra-sector exchanges have a positive impact on vertical integration for Construction and Telecommunication, unlike foreign production.

We observe that the vertical integration estimate difference between the two sectors is lower by using the effective ratio (EVI) than by using the classic approach.

In practice, by considering intra sector exchanges and foreign production that is imputed on production and added value with a nonlinear approach (therefore considering that a percentage of intermediate consumption related to foreign

production will regard domestic economy).

By using EVI approach, we also observe quite a high ratio of vertical integration for the Construction sector, near to that of the entire Italian economy.

This can be considered as the approach that is able to consider the rules established in ESA (2010) and national accounting tables, by estimating performance of each economic sector through reducing the impact of other external movements.

For transport sectors (air and sea), we do not observe a significant impact of foreign production and intermediate consumption on vertical integration.

In conclusion, we can single out the main strengths of the paper. We suggest a strategy of consolidation methods, flexible enough to cover a wide range of actually recurring conditions.

The dynamic trajectory of utilizing new business data sources, whose importance will grow over time with digitalisation and internationalisation, is better delineated.

Another strength of the paper is the potential use of the conceptual and accounting categories developed in the papers, not only from empirical data but also from data generated by artificial economies and agent-based models of international supply and value chains.

Warning : The views expressed in the article are those of the author and do not involve the responsibility of ISTAT.

Table 1. Representing Local KAU

Parts of the company	Economic Activities (NACE - Rev.2)						
	Activity 1	Activity 2	...	Activity j	...	Activity n	Total
Offices	$LKAU_{11}$	...	...	$LKAU_{1j}$	...	$LKAU_{1n}$	$Local\ Unit_1$
Establishment	...	...	...	...	...	...	$Local\ Unit_2$
...							...
Sales showroom	$LKAU_{m1}$	...	...	$LKAU_{mj}$	...	$LKAU_{mn}$	$Local\ Unit_m$

Table 2. Representing a Complex Unit

Branch	Economic activities (NACE–Rev.2)			V.A. per branch/legal units
	Activity 1	Activity j	Activity n	
Branch 1	KAU_{11}	KAU_{1j}	KAU_{1n}	...
Branch i	KAU_{i1}	KAU_{ij}	KAU_{in}	...
Branch m	KAU_{m1}	KAU_{mj}	...	...
Legal unit 1	KAU_{11}	KAU_{1j}	KAU_{1n}	...
...				...
Legal unit m	KAU_{m1}	KAU_{mj}	KAU_{mn}	...
V.A. per economic activity sector	...	...	...	V.A. of the complex unit

Table 3. Cases of vertical integration

	Vertically integrated companies			
	COMPANY A	COMPANY B	COMPANY C	Total*
Value added[6]	7.500	1.000	700	9.200
Sale proceeds	10.000	1.700	800	10.000
Cost of purchased goods and services	2.500	700	100	800
Fixed Capital Formation	20.000	10.000	5.000	35.000

Table 4. Case of consolidation with horizontal integration

	Vertically integrated companies			
	COMPANY A	COMPANY B	COMPANY C	Total
Value added	7.500	1.000	700	9.200
Sale proceeds	10.000	1.900	1.000	12.900
Cost of purchased goods and services	2.500	900	100	3.500
Fixed Capital Formation	20.000	10.000	5.000	35.000

Table 5. Case of consolidation with proportional integration

	Vertically integrated companies			
	COMPANY A	COMPANY B	COMPANY C	Total *
Value added	7.500	1.000	900	8.840
Sale proceeds	10.000	1.900	1.000	12.120
Cost of purchased goods and services	2.500	900	100	3.280
Fixed Capital Formation	20.000	10.000	5.000	31.000

Table 6. Percentage of data concerning domestic activities for an Enterprise X

	% Domestic Social Contribution	% Domestic Production
Balance sheet accounts		40%
IRAP data	55%	
EMENS data		60%

Table 7. Work carried out by parent company in country B for more than 1 year

Uses	Country B	Resources	Country B
Materials	50	Output	500
Services			
Wages and Salaries	300		
Operating surplus	150		
Total Uses	500	Total Resources	500.

Table 8. Work carried out by parent company in Country B for less than 1 year

Uses	Country A	Resources	Country A
Materials	50	Output	500
Services			
Wages and Salaries	300		
Operating surplus	150		
Total Uses	500	Total Resources	500.

A. Frenda and S. Scippacercola, African Journal of Applied Statistics, Vol. 5 (2), 2018, pages 447 – 467.

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Table 9. Comparing Construction, Telecommunication and Transport vertical integration for the year 2011 in Italy : *Our Elaboration and Estimates on data from Balance Sheet Accounts, IRAP and ISTAT Supply and Use Tables*

Performance indicators	Construction Sector	Telecommunication	Transport [7]
(Classic Approach) Added Value/Production	0.33	0.51	0.23
Foreign production	2.5%	...	1%
Foreign Intermediate Consumption	1.25%	...	0.5%
(ESA 2010 approach) Domestic Added value/Domestic Production	0.32	0.51	0.22
Intra-sector exchanges	28.6%	3.8%	0.2%
EVI ratio	0.45	0.56	0.22

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