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Input-Output Models and Derived Indicators: A Critical Review

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Abstract

Input-Output literature can be characterized as complicated and chaotic. The complications concern the nomenclature of concepts for the derived indices from the multipliers' models, their mathematical expressions and computable applications. The terminologies' inconsistencies often end up to a deviation between the description for these indices and their actual computation, or/and to a misunderstanding as for their usefulness and outcomes. The aim of the paper is to help the readers to face the weaknesses in the literature. In this way, the paper provide an overview with a critical look to the constructed multipliers' matrices and their derived indicators from the I-O models, and elaborate the causes for the scrutinized confusions. The paper proposes both terminological and computational adjustments and differentiated approaches for the models and their indices, in order to ameliorate their capabilities and to exploit their peculiarities for the developmental patterns. Alternative interpretative ways and applicable expansions are suggested.

Keywords: Leontief's and Ghosh's models; initial effects; linkages' indices; multipliers; elasticities; size-indicators.

JEL classification: C18, C31, C67, F43, O21.

1. INTRODUCTION

The combination of theoretical ideas, their mathematical expressions and the empirical applications, the record and the interchange of differentiated views, the arguments, the proposals, the modifications and the trials for improvements, the collaboration among the

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scientists through agreements and disagreements, all of them constitute the pylons for the scientific progress and none scientific progress could exist without them. The correct, the less-correct, even and the erroneous, are necessary in this intellectual procedure, since on a point in which someone can comprehend and distinguish something important, wrong or right, maybe someone else can see something else, and vice-versa. A conclusion that something is correct cannot be extracted without a previous touch with the fallacious, or out of an empirical control for the theoretical ideas in an evolutionary process, but even in this case "the correct" may be something relevant. Under this vein, the record of various views is always preferable to be supported and published to the reading public, so that this to have the last assessment, at least to the degree that everyone serves a common scope: the scientific progress.

Wassily Leontief (1906-1999) devised the empirical dimension of the mathematical model of input-output (I-O) analysis (Leontief, 1936), based on the idea of Francois Quesnay (1694-1774) for the *"Tableau Economique"* (1758) and on the scientific contribution *"Elements d' Economie Politique Pure"* (1874) of Leon Walras (1834-1910) for the theory of general equilibrium. Leontief's contribution to the economic science achieved to attach to the theory usability and applicability and to open a range framework for the developmental analysis through a system of three matrices (Amsden, 1995; Bjerkholt, 1995; Dorfman, 1995; Duchin, 1995; Lian and Haimes, 2006; Phillips, 1955; Zhang, 2001). From the formal publication of Leontief's work in 1936 until to nowadays, the I-O analysis has provoked revolution at the collection, the record and the arrangement of statistical data of national accounts (Augusztinovics, 1995).

During the time, various models are developed as alternatives or expansions of traditional I-O analysis, starting from the seminal Leontief's syllogism, into the framework of growing planning (Oosterhaven and Stelder, 2002). The exploitation of information from these models has permitted to the policy-makers to have today at their hands, a variety of indicators for their developmental patterns (Bekhet, 2011). The indices constitute the heart of all the versions of primary model (Guerra and Sancho, 2012; Dietzenbacher *et al.*, 2013). However, the indicators are not all the same suitable for any kind of planning (short-run or long-run), presenting advantages and disadvantages (Sonis *et al.*, 1995). Their combination and their utilization must be done by presuppositions and delving at their roots at first, trying to understand their peculiarities (Sonis *et al.*, 1995; Kolokontes *et al.*, 2018). The reason is that, among the indicators that have been proposed in the literature are met for example tendentious indices. Moreover, some of them are unsuitable for their generating scope, by default, while others have problems as for their compatibility or/and comparability. There are indices more sensitive or less sensitive to the open or closed schemes of models, indicators that are appropriate only for a combinative use together with other indices, and so forth (Kolokontes *et al.*, 2008; Kolokontes *et al.*, 2018).

Furthermore, a jumble is remarked in the literature, as for the conceptual enunciation and the computable application of various indices (Sonis *et al.*, 1995). In some cases the perplexities and the imprecisions concern exclusively the used notations for the indices and this can be considered something rational. However, in other cases are recorded more serious confusions, due to the following nomenclature for the concepts, their mathematical expressions and their calculations.

For instance, the erroneous use for the terms of "direct" and "initial" effects which is observed in the literature, it is capable to mislead the comprehension and the application of various indicators. A consequence from these terminological inexactitudes is that, in the

action there are cases in which the computations' syllogisms are not follow the descriptive definitions for the indices, or to put it somewhat differently, the description for an index does not match to its actual computation, due to the fact that the users have done (at the better case) the correct computations, following a fallacious description. This is a problem that, of course, differs from the case in which someone has done erroneous computations, while the substratum as for the indices' determination is correct. However, the literature must not make difficult the comprehension of indices for their users and sometimes must be more descriptive and explicit. In any case, when for example the computable definition for an index uses the term "direct" meaning "initial" effects, then it is probably to misguide the non-insider or initiate readers. The more experienced scholars, researchers and policy-makers often consider the problem as known, although the fact that for an initiate researcher is difficult for him/her to find a paper in which are collected paradigms that can help him/her do not ends up lost in the terminological confusions of literature. Moreover the deterministic errors can mislead the more experienced scholars, researchers and policy-makers too, and this is something that is extracted from the published papers. The terminological inconsistencies make difficult the correct and the deeper comprehension of indices' peculiarities, and this is a significant problem that is met in the action.

As for the notations, it is much easier for someone to be lost between the using variations. Against to this, in this paper has been used a descriptive notation, just for the explicit distinction and the comprehension of concepts and not necessarily as a proposal for a widely adoption.

This paper is an ambitious attempt to provide an overview with a critical look on the obtained multipliers' matrices and their derived indicators from the I-O models. Paradigms for terms from the literature that confuse the new readers are collected and underlined, proving from the one hand the terminologies' inconsistencies, and aiming from the other hand to help the new readers to face the weaknesses in the literature. In this way, the paper tries to scratch the surface and to elaborate the causes for the scrutinized confusions and discrepancies. The paper proposes both terminological and computational adjustments and differentiated approaches for the models and their indices in order to ameliorate their capabilities and to exploit their peculiarities. Alternative interpretative ways and applicable expansions are suggested in conformity with the indices' weights. In any case, this paper aims to constitute a helpful conceptual guide for the initiate readers, and to tease the curiosity of scholars, researchers and policy-makers opening differentiated paths for more empirical studies on the proposed expansions or others. Furthermore, the paper wants to encourage the new researchers to develop and express their ideas stressing that all the proposals have something to offer, even if they do not fully correct, since no one is infallible and nobody knows from where, from whom and when the next interesting idea will be emerged.

In the following sections, firstly is presented the quantitative and the price-oriented approaches from the Leontief's model, with the linkages' indices that can be revealed from them, as well as the Ghosh's (1958) approach. Continuing, the expansions of models that have been constructed based on other agents than the output (e.g. employment, income, etc.), with their generated indicators, are commented. A debate for the double-countings that are generated during the operation of models follows. The sections with the critical review of conceptual determinations, the planning-tools' explications, the analysis of size-indicators and the alternative choices for the policy-makers, fulfill the paper, in the framework of

developmental analysis. The terms into the *"parenthesis with italics"* are originated from the literature, while the terms in "parenthesis without italics" are stemmed from this paper.

2. THE LEONTIEF'S MODEL AND THE LINKAGES INDICATORS

The traditional Leontief's I-O model represents a static, into the time, snapshot for the cross-sectoral balance, or for the sectoral coherence, in an economy (Bekhet, 2012; Eiser and Roberts, 2002; Kelly, 2015; Leontief, 1951; Rickman, 2002; Valadkhani, 2003). Into a timespan, changes are happened that lead to a new photo for the balance of productive circuit (Kelly, 2015; Lopes and Neder, 2017). Since the driving-force in this model is the final demand, its interpretative causality is headed from the exogenous initial changes-stimuli on the final demand for a sector's i output, to the endogenous produced direct and indirect intermediate changes on all the sectoral outputs (de Mesnard, 2004; Dietzenbacher, 2002; Miller and Blair, 2009, pp. 2-3, 10-26; Rickman, 2002; Sancho, 2013). This *"demand-driven approach"* is also met in the literature as *"inputs approach"* due to the fact that its conceptual and computable architecture is relied on the sectoral production's functions, scilicet on the required purchases of primary and secondary inputs for the sectoral productive processes (de Mesnard, 2004; Dietzenbacher, 2002; Eiser and Roberts, 2002; Miller and Blair, 2009, pp. 10-26). The *"direct"* and the *"total requirements matrices"* which are the pylons in this model, they are also referred in the literature as *"direct inputs matrix, direct inputs coefficients matrix, technical coefficients matrix, technological matrix, direct purchases matrix, direct linkages matrix"* and as *"Leontief's inverse, inputs inverse, interdependence coefficients matrix, direct and indirect purchases matrix and output multiplier matrix"*, respectively (Chuenchum *et al.*, 2018; Ciobanu *et al.*, 2004; Dietzenbacher, 2002; Eiser and Roberts, 2002; Freytag and Fricke, 2017; Jensen *et al.*, 1979, pp. 20-22; Jones, 1976; Kelly, 2015; Kelly *et al.*, 2016; Miller and Blair, 2009, pp. 16-18, 23; Sancho, 2013; Temurshoev and Oosterhaven, 2014; Yotopoulos and Nugent, 1973). The fact that an *"inputs approach"* yields *"output multipliers"* must not provoke confusion to the readers. The conventional Leontief's model operates as a quantity model and is subjected to borderline restrictions like as, the perfectly price-elastic supply without supply constraints and with constant returns of scale into the linear production's functions of columns of direct requirements matrix, that indicates fixed proportions for the inputs-purchases per sector, or else stable inputs coefficients (Dietzenbacher, 2002; Eiser and Roberts, 2002; Freytag and Fricke, 2017; Jensen *et al.*, 1979; Kelly, 2015; Müller-Hansen *et al.*, 2017; Oosterhaven *et al.*, 2001; Tadayuki, 2008, pp. 66-69; Valadkhani, 2003; Zhang, 2001). Moreover, in a model like this, the industries of economy are price-takers with competitive behavior, and none sector has the power to impose the prices of sectoral outputs, that have zeroes elasticities (Rey, 2000; Sancho, 2013; Kelly, 2015; Müller-Hansen *et al.*, 2017). The absence of technological changes and the absence of imports and exports' substitution complete the restrictions of static approach (Jensen *et al.*, 1979, p. 24; Oosterhaven *et al.*, 2001; Dietzenbacher, 2002; Sancho, 2013).

The direct requirements matrix A^L is derived from the transaction matrix Z^T. The superscripts "L" and "T" denote the provenance of direct requirement matrix from the Leontief's approach, and the total of a magnitude (total transactions' matrix in this case), respectively. The matrix Z^T is constituted from four quadrants (Valadkhani, 2003;

Chuenchum *et al.*, 2018). The first quadrant (Z) depicts the endogenous intermediate transactions $(Z \subset Z^T)$, the second the per sector sales to the final demand $(Y \subset Z^T)$, the third the primary inputs that are purchased per sector $(V \subset Z^T)$, and the forth $(\subset Z^T)$ the transactions among the components of final demand (e.g. households or government) and the components of primary inputs (e.g. labor). As it is obviously, terms in the literature like as for example the Dietzenbacher (2005) term *"matrix of intermediate deliveries"* or the Oosterhaven *et al.* (2001) term *"intermediate sales matrix"* are referred to the endogenous intermediate transactions indicating the first quadrant Z of matrix Z^T, although the fact that these terms are nearest to a horizontal consideration rather than to a bilateral description. The rows' summations from the first and the second quartile yields the sectoral outputs, and the same outcomes are obtained by the columns' summation of the first and the third quartile, per sector.

The elements of the direct requirements matrix $A^L = [a_{ji}^L] = [Z_{ji} / X_i]$ are the intermediate transactions coefficients for the endogenous intermediate purchases of secondary inputs from each one sector and in the literature are met as *"intermediate inputs coefficients", "direct requirements coefficients", "direct purchases coefficients", "direct linkages coefficients", "direct inputs coefficients" and "technical coefficient of production"*. With matrix algebra: $A^L = Z < X >^{-1}$ (de Mesnard, 2004; Dietzenbacher, 2005; Leontief, 1936; Miller and Blair, 2009, pp. 16, 21; Sancho, 2012, 2013; Yotopoulos and Nugent, 1973). Hence, the endogenous transactions, or the *"endogenous intermediate demand"* (Oosterhaven *et al.*, 2001) as absolute magnitudes are obtained as: $Z = A^L < X >$, in which: $X = [X_i]$ is the vector of sectoral outputs, the symbol "<>" denotes a vector's conversion to a diagonal matrix and $< X >^{-1}$ is the inverse of diagonal matrix $< X >$. The total sectoral outputs are obtained either adding the elements of rows: $X = Zi + Y = A^L < X > i + Y$ in which: $Y = [Y_i]$ is the vector of final demand and i indicates a vector with all its elements to be equal to one; or adding the elements of columns: $X' = i'Z + V' = i'A^L < X > + V'$, in which: $V = [V_i]$ is the vector of primary inputs or else the value added vector and the tones indicates row-vectors (de Mesnard, 2004; Dietzenbacher, 2005; Kelly, 2015; Leontief, 1936; Miller and Blair, 2009, pp. 3, 13; Sancho, 2012, 2013; Tadayuki, 2008, pp. 40-54).

From the division of elements V_i from the vector V with the sectoral outputs X_i are obtained the *"primary inputs coefficients"* or else the *"value added (technical) coefficients"* per sector (Dietzenbacher, 2002, Sancho, 2013). Adding per each one column the coefficients of primary and secondary inputs from the first and the third quadrant the result must be equal to one (=1) and reflects the unitary monetary sectoral productive cost (including the percentage of profit), and the coefficients of primary and secondary inputs are the stable percentage partitions for each one kind of inputs in the formation of this unitary cost. Consequently, a first observation is that the primary and the secondary inputs coefficients are smaller than one (<1) and obviously in the matrix A cannot be existed coefficients bigger than one (>1), as for example is recorded at the element a_{12} of the

matrix A^L that has been used from Sancho Sancho (2012). A second observation is that this property of Leontief's approach is associated with the columns' sums, only. Adding the coefficients of rows from the first and the second quadrant the sum is not equal to one. The basic reason for this is that, in a backward consideration like as the describing via the production's functions, the columns' summations must be equal to one because reflect the unitary monetary value of each sectoral output, whereas the rows' summations reflect the accumulated formed forward intermediate interactions that are concentrated on a specific sectoral output from the first effects' round.

Due to the creating productive activities at the rest of sectors in the economy since the equilibrium adjustments are internalized into the sectoral outputs, a one unit (=1) monetary value-change on a sector's i output disperses a bigger than one (>1) total impact to the economy's output as a whole, including the initial effect. This impact can be assessed adding the elements of columns from the Leontief's inverse matrix, videlicet aggregating with the direct impacts, the indirect impacts from the sequential after from the first, rounds of effects, and the initial effect as well (Miller and Blair, 2009, pp. 20-27; Sancho, 2012). The total (initial, direct and indirect) requirements matrix is defined as: $X = A^L X + Y \Rightarrow X - A^L X = Y \Rightarrow (I - A^L)X = Y \Rightarrow X = (I - A^L)^{-1} Y$. These sums are called in the literature sectoral *"output multipliers"* or sectoral *"backward linkages indicators (BLs')"* and express the purchasers view or else the view of dispersed spillovers to the rest of economy (Bekhet, 2011; Cai and Leung, 2004; Chuenchum *et al.*, 2018; Dietzenbacher, 2002; Freytag and Fricke, 2017; Hirschman, 1958, pp. 100-107; Miller and Blair, 2009, pp. 245, 555-558; Tadayuki, 2008, pp. 40-54, 85-87; Temurshoev and Oosterhaven, 2014; Yotopoulos and Nugent, 1973). Adding the elements of each one row of Leontief's inverse can be accumulated the total potential effects' that are concentrated on a sector's i output, from the rest sectors of economy. These sums are called in the literature as *"forward linkages indicators (FLs')"* and express the sellers view or else the view of concentrated impacts in a specific sector (Cai and Leung, 2004; Dietzenbacher, 2002; Hirschman, 1958, pp. 100-107; Miller and Blair, 2009, pp. 555-558; Tadayuki, 2008, pp. 40-54, 85-87; Yotopoulos and Nugent, 1973).

Since the derived from the Leontief's inverse BLs' and the FLs' measure the total (initial, direct and indirect) impacts, is preferable to be referred with their full names as *"total backward linkages indicators (TBLs')"* and *"total forward linkages indicators (TFLs')"*, so as do not be confused with the corresponding *"direct backward linkages indicators (DBLs')"* and *"direct forward linkages indicators (DFLs')"* that can be derived from the columns' and the rows' sums of direct requirements matrix and measure only the direct dispersed or concentrated effects, respectively. Chronologically, the DBLs' and the TBLs' indices are firstly met computable as part of other indices in Chenery and Watanabe (1958), concerning only the case of output (ODBLs' and OTBLs') and without a distinct enunciation. Two years earlier, Rasmussen in his Ph.D. thesis *"Studies in Inter-sectoral Relations"* had already presented the *"summary measures of the inverse matrix"*, scilicet his weighted linkages indicators, aiming to order sectors under the criterion of their contribution for the configuration of total magnitudes in an economy (Rasmussen, 1956, pp. 133-138; Kelly *et al.*, 2016). Conceptually, the OTBLs' indices have been entered in the literature from Hirschman, adding the role of indirect effects in the framework of his "unbalanced

growth theory" for the detection of key-sectors in an economy (Cella, 1984; Cuello *et al.*, 1992; Hirschman, 1958; Ivanova, 2014; Yotopoulos and Nugent, 1973).

In any case, a sector either can actively to disperse impulses to other sectors (backward approach) or can passively to concentrate impulses from the other sectors (forward approach). The linkages indicators, independently from their practical correctness or not, have diachronically been used from the policy-makers as tools for the derivation of sectoral rankings, the determination of key-sectors and the policy-planning (Sonis *et al.*, 1995; Ivanova, 2014). The idea for the detection of key-sectors that can operate as *"intustrie motrice"* for the whole economy had been founded by Perroux, from 1955. Preparative to be concerned a sector important as a "key-sector" *("propulsive industry"*) for the growth of economy as a whole, necessitates a combination of high interrelated effects (Hirschman, 1958) with a capability for autonomous (sectoral) impulses' generation (Perroux, 1955; Clements and Rossi, 1991; Bekhet, 2012; Cuello *et al.*, 1992; Ivanova, 2014; Oosterhaven, 2004). The priorities enactment means that have been examined the sectoral interdependencies, from the rest of economy and to the rest of economy, as a two-sided (backward and forward) and not only as an one-sided phenomenon (Oosterhaven and Stelder, 2002; Oosterhaven, 2004). The question if "the hen makes the egg or the egg makes the hen" must not be existed in the process for the determination of developmental priorities. This means that, it is necessary to know both the significance that have a sector as for its potential capability to diffuse impacts to the rest of economy and its importance as an effects-receiver from the other sectors. Together with the backward effects, the forward effects must be taken into account (Cai and Leung, 2004). The matter is how to estimate the forward effects.

Although the FLs' of Leontief's inverse have been used in empirical studies in the literature, these indices are problematic from their basis (Hirschman, 1958; Freytag and Fricke, 2017). Bayers (1976) had pointed out that the estimation of FLs' based on the *"purchases coefficients"* from the "stimulated by the final demand, backward consideration of Leontief's quantitative inverse" is fallacious and he proposed the usage of *"sales coefficients"* from the "stimulated by the primary inputs *("final supply")*, backward consideration of Leontief's quantitative inverse". Cai and Leung (2004) accept that the derivation of BLs' and FLs' from a common "stimulated by the final demand, backward consideration of Leontief's quantitative inverse" is erroneous and they turn round their attention on the derivation of FLs' from the Ghosh model. The literature has been veered to the choice of Ghosh's model after from the considerations of Augusztinovics (1970) and Jones (1976). However, the Ghosh's model, as it is represented in the follows, is a price-model that can be utilized for other scopes. The usage of Ghosh's model as a one-sided "forward consideration of Leontief's quantitative inverse" is false, due to the fact that none of all these modes is one-sided. From the aforementioned, it is obviously that an adjustment is needed. But where is the problem and how to tackle it?

The root of the problem is found at the fact that, the summation of rows' coefficients from the first and the second quadrant of Leontief's approach are differed than one (≠1). Since the problem begins from the level of matrix of direct inputs coefficients (coefficients of first quadrant in the demand approach), this paper propose that it will be good to explore the outcomes after from an adjustment of these elements, so as the sums of each row's coefficients from the first and the second quadrant to become equal to one (=1). If the sum of a row's j coefficients, from the first and the second quadrant, is: $Q_j \neq 1$ at the inception; and supposing

that the adjusted ("adj", in next symbols) row's j sum will be: $Q_j^{adj} = 1$; then the coefficients a_{ji} of j's row of direct requirements matrix must be adjusted as: $a_{ji}^{adj} = (a_{ji} Q_j^{adj}) / Q_j$ $= a_{ji} / Q_j$ and the final demand's coefficients of second quartile can be modified with the same logic. After from this proposed adjustments the rows' elements, i.e. the individual forward coefficients, acquire the property to be a part from an equal to a one unit (=1) sum per each one row, something that in the non-adjustment situation was a trait of individual backward coefficients of columns' elements. In this case, the interpretation for the individual forward coefficients and the final demand's coefficients is that, they yield the percentage proportion of each element into the distribution's function of each one sector i, when its distributional output is equal to one (=1). The corresponding total adjusted inverse matrix: $X = (I - A^{L(adj)})^{-1} Y$, can be derived using the adjusted direct requirements matrix $A^{L(adj)}$. The per row's elements of adjusted Leontief's inverse will be the concentrated effects on the sector's i output, through to its intermediate distributional interactions for the support of sectoral outputs' configuration in the rest sectors of economy. This adjusted approach will be the same unsuitable for the appraisal of BLs' indicators, as was the non-adjusted conventional approach for the calculation of FLs' indices. Theoretically, from the adjusted approach could be derived improved estimations for the FLs' indicators. Hence, if someone want to compare backward and forward sectoral linkages' indices, then the choice to use two different schemes of Leontief's inverse, the conventional one: $(I - A^L)^{-1}$ for the derivation of BLs', and the adjusted spin-off: $(I - A^{L(adj)})^{-1}$ for the derivation of FLs', so as to be succeeded the compatibility and the comparability of measurements of BLs' and FLs', it must be examined. The compatibility and the comparability of indices must be a necessary presupposition, for instance for their division, in cases like as the proposed from Dietzenbacher (2005) comparative ratio between the backward and the forward effects. In the next sections are recorded references to this adjusted approach.

In a quantitative Leontief's model (=*"demand-pull quantity model"*, according to the terminology of Kelly, 2015) the monetary value of each sectoral output is exclusively depended on the quantitative changes of used intermediate and primary inputs, that are combined under the locked proportions of production's functions per sector (Dietzenbacher, 2002, 2001). The nominal prices for the purchasing inputs and the selling outputs are considered constant (Dietzenbacher, 2002), something that in a short-term period of time (in which the table Z^T is referred) could be acceptable (Jensen *et al.*, 1979), and which implies constant relative prices among the sectoral inputs (primary and intermediate) and between to them and the corresponding outputs, too. Due to the fact that the quantitative Leontief's model is based on the consequences from a primary stimulus on the final demand for the output of a sector's i, is underlined that this stimulus is a one unit monetary change, meaning a value-change on the final demand for the sector's i output. Supposing that the prices for all the outputs are stable and equal to one (=1), each value-change on a sectoral final demand reflects a quantity change (Sancho, 2013). Hence, saying that the model is relied on the unit of value of output, this unitary value could be equal to a quantity like as a half of a kilo of an agricultural product, either a number of killowatt-hours or the 0.00….01 of a specific kind of a car.

If the prices in model are stopped to consider stable and instead of them the constant parameters are the quantities of inputs and outputs, then alters the model from a quantitative to a price-model. Miller and Blair (2009, pp. 41-54) and Dietzenbacher (1997, 2002) have presented the way with which a quantitative Leontief's model is modified to a price-oriented one. At this case, the value-changes of sectoral purchases for inputs indicate corresponding value-changes for the sectoral productive cost, scilicet for the sectoral prices (Baumol and Wolff, 1994; Dietzenbacher, 2001; Temurshoev and Oosterhaven, 2014). Hence, a price-oriented model is an inflationary-pressures model. This model can yield the percentage changes on the nominal sectoral prices which are stemmed from an initial change that is registered to a sector's i productive cost and which is originated from a value-change on the inputs' purchases of sector i (e.g. due to a change on the payments for the labor inputs or on the taxes-payments for the government's services or on the interests of capital or on the rental payments for used land or on the profit's margins for the entrepreneurship or on the imports value, and so forth), regarding stable both the quantities of sectoral inputs and outputs.

Each static quantitative or price-oriented model consist an ex post snapshot into the time (Eiser and Roberts, 2002; Kelly, 2015; Leontief, 1951; Lopes and Neder, 2017; Valadkhani, 2003). The transactions among the sectors of economy, during a given period of time, are recorded (with the same way that are registered the transactions that have an individual enterprise), and then they are accumulated until the end of the observed period for their final configuration (as the annual economic result for an individual enterprise) (Eiser and Roberts, 2002; Kelly, 2015). The final situation is a "new ex post photo" that corresponds to a new general equilibrium of economy (like as the financial statement for an enterprise). For any new ex post photo, the corresponding previous photo has been converted to a description for the antecedent balance, videlicet has been converted to a description of previous internal sectoral coherence of economy (Ciobanu *et al.*, 2004; Kelly, 2015; Lopes and Neder, 2017). In order to be examined the changes between two different photos (two different general equilibriums) during the time, the *"causative matrices technique"* have been devised (Ciobanu *et al.*, 2004; de Mesnard, 1990, 1997, 2000; Jackson *et al.*, 1990; Plane and Rogerson, 1986; Rogerson and Plane, 1984), and modified by the *"double-causative model"* of Jackson *et al.* (1990) and the *"de Mesnard's (2000) bi-causative matrices technique"*. These techniques, basically, have been used in order to investigate the structural and technical-technological changes (Bekhet, 2012) in the framework of economy's evolution over the time. Hence, these techniques are very important for an ex post critical observation on the outcomes of an ex ante decided developmental programme, as for their consequences on the sectoral inputs and outputs due to the technical-technological progress on the one hand, as well as due to the attempt for structural re-formation on the other. Moreover and on the contrast, these techniques are even useful for the evaluation of consequences from negative suddenly changes (crisis or disasters) on the sectoral technology and on the economy's structure. The *"dynamic inoperability I-O model"* has been contributed by Lian and Haimes (2006) in this field. Kelly (2015) has handed in an interesting review on this topic as for the measurements of consequences from the vulnerability of physical infrastructure, the economy's resilience and its recoverability, the strengths and the weaknesses of used models.

The Leontief's model has constituted the fount to construct many others scientific acceptable spin-offs during the time (Cardenete and Sancho, 2012). Some of them are trials to marry the I-O models with the econometric methodology, so as to develop linear or non-

linear models capable to capture with a "cinematic way" the diachronic-dynamic dimension of economic advancement (Zhang, 2001; Lopes and Neder, 2017). The necessary presupposition for the transition from a "photo-static" to a "cinematic-dynamic" model is the break-down of counterfactual restrictions of static model. Despite of the criticism on these restrictions, the static model survives into the time thanks to their unquestionable usefulness for the impacts' analysis and the forecastings in the framework of policy-planning (Baumol and Wolff, 1994; Eiser and Roberts, 2002; Miller and Blair, 2009, p. 243; Rickman, 2002). Beyond of them, other approaches have been focused on differentiated variants of original model in order to take from it information under another view and the much-debated among to them is the alternative proposal of Ghosh's model (1958).

3. THE INFLATIONARY-PRESSURES' MODEL OF GHOSH

The Ghosh's model is a *"supply-driven model"* (or else, a *"supply-side model"*: Miller and Blair, 2009, pp. 543-555), an *"output approach"* (terminology that has been adopted in the literature in order to confront this model to the terminology for the Leontief's model), according to its conceptual and computable architecture that is relied on the intermediate and final sales of outputs (Augusztinovics, 1970; Cai and Leung, 2004; Eiser and Roberts, 2002; Ghosh, 1958; Gruver, 1989; Kelly *et al.*, 2016; Miller and Blair, 2009). In contradiction to the Leontief's model, the counterfactual restrictions of Ghosh's supply-driven model are the perfectly price-inelastic supply via the linear allocation's functions of rows of *"direct allocations matrix"* (or else, *"direct outputs matrix"*) and the fixed proportions of selling per sector outputs, or else the stable outputs (or allocation) coefficients, in combination with a perfectly elastic demand for the primary inputs and the sectoral outputs (Augusztinovics, 1970; Eiser and Roberts, 2002; Kelly, 2015; Oosterhaven, 2017; Oosterhaven *et al.*, 2001). The interpretative causality of *"Ghosh's"* or *"supply"* or *"outputs"* approach, begins from an exogenous stimulus-change on a sector's i primary-inputs which is equivalent to a net change on a sector's i value-added and ends up to changes on the value of all the affected sectoral total sales through the endogenous sectoral outputs' interactions.

The Ghosh's model does not follow the logic that the supply must be adjusted to the demand and for this reason it has been impugned and considered unsuitable to provide plausible causal quantitative interpretations (Cai and Leung, 2004; Cella, 1984; de Mesnard, 2002a, 2004, 2009; Dietzenbacher, 1997, 2001; Gruver, 1989; Oosterhaven, 1988, 1989, 2017; Oosterhaven *et al.*, 2001). The model handles the primary inputs as exogenous independent variables (Kelly, 2015), supposing changes on the supply-value that generate changes on the demand-value, and this contrary approach does not answer to a comparative market (Sancho, 2013). Specifically, in this model an initial stimulus is originated from a change on the primary inputs instead to a change on the final demand (Temurshoev and Oosterhaven, 2014; Kelly, 2015), but in real without to be certain the consumption of any extra sectoral output from the components of final demand (scilicet without to be the demand the driving force). Thereafter, from their starting-point, the changes on the value of sectoral outputs are inflationary-changes that are entirely transited to consumers, owing to a change on a sector's i primary cost with unchangeable the quantities of used primary and secondary inputs per sector (Dietzenbacher, 1997, 2002, 2001).

de Mesnard (2002a) has remarked the incompatible between the coefficients of the Ghosh's and the Leontief's model. The *"intermediate output coefficients"*: $A^G=[a_{ji}^G]=[Z_{ji}/X_j]$ are the elements of "*direct output coefficients matrix"* A^G of Ghosh's approach, in which the superscript "G" denotes the origin of derived matrix from the Ghosh's model. With matrix algebra: $Z=<X>A^G \Rightarrow A^G=<X>^{-1}Z$ $\Rightarrow A^G=<X>^{-1}A^L<X>$ and the product $<X>A^G$ constitutes the *"endogenous intermediate sales or the endogenous intermediate supply of sectoral outputs"* (Oosterhaven *et al.*, 2001; Guerra and Sancho, 2010). The per sector total output are obtained either adding per columns: $X'=i'Z+V'=i'<X>A^G+V'$, or adding per rows: $X=Zi+Y=<X>A^Gi+Y$, and the Ghosh's inverse matrix is: $(I-A^G)^{-1}$, because: $X'=X'A^G+V'$ $\Rightarrow X'-X'A^G=V' \Rightarrow X'(I-A^G)=V' \Rightarrow X'=V'(I-A^G)^{-1}$ and moreover: $(I-A^G)^{-1}=$ $<X>^{-1}(I-A^L)^{-1}<X>$ (Augusztinovics, 1970; de Mesnard, 2002a, 2004, 2009; Dietzenbacher, 2002; Ghosh, 1958; Guerra and Sancho, 2010; Jones, 1976; Kelly, 2015; Miller and Blair, 2009; Temurshoev and Oosterhaven, 2014).

Dividing per sector, the driven outputs to the components of final demand, with the corresponding total sectoral outputs, are derived the sectoral *"final output coefficients"* (Augusztinovics, 1970; Dietzenbacher, 2002), or else the "final supply coefficients", videlicet the per sector coefficients of supplying-outputs to the final demand (a concept in contrast to the *"final demand coefficients"* of Leontief's approach). By default, on the contrary to the Leontief's conventional approach, in Ghosh's approach aggregating per row the direct output coefficients ("direct intermediate supply coefficients") with the final output coefficients ("final supply coefficients") the result must be equal to one (=1). This property of Ghosh's approach is associated with the rows' sums, only. Adding the coefficients of columns from the first and the third quadrant the sectoral sums are not equal to one (≠1).

Leading researchers of the I-Os' field, Oosterhaven (1988, 1996, 2017), Oosterhaven *et al.* (2001), Dietzebacher (1997, 2002) and de Mesnard (2002a), have agreed that the conventional shape of Ghosh's model is a price-model. This implies that each increase on the values of primary inputs does not productive but only inflationary. Oosterhaven (1996) and Oosterhaven *et al.* (2001) have characterized the model as *"demand pull-price model"* and Miller and Blair (2009, pp. 543-555) and Dietzenbacher (1997) has proved that the handling of Leontief's model as a price-model (=*"cost-push price model"*, according to the terminology of Oosterhaven *et al.*, 2001) interpretatively resembles to the prices' effects of Ghosh's model (=*"supply-push price model",* according to Kelly's term, 2015).

The elements of "direct inflationary-pressures' coefficients matrix" A^G represent the direct prices' effects from the first round of effects, which are stemmed after from an initial inflationary change on the value of primary inputs. The elements of Ghosh's inverse denote the total prices' effects (as "total inflationary-pressures' coefficients") taking into consideration the transiting cost of sequential round-by-round effects. Beginning from the Ghosh's model, the Leontief's price-model can be derived following the syllogism:

$$(X^G)'=V'(I-A^G)^{-1} \Rightarrow (X^G)'(I-A^G)=V'(I-A^G)^{-1}(I-A^G)$$

$$\Rightarrow (X^G)'-(X^G)'A^G=V' \Rightarrow (X^G)'=(X^G)'A^G+V' \Rightarrow (X^G)'=$$

$$(X^G)'< X^L >^{-1} A^L < X^L > +V'$$

$$\Rightarrow P'< X^L >= P'< X^L >< X^L >^{-1} A^L < X^L > +V' \Rightarrow P'< X^L > = P'A^L < X^L > +V'$$

$$\Rightarrow P'< X^L >< X^L >^{-1} = P'A^L < X^L >< X^L >^{-1} +V'< X^L >^{-1}$$

$$\Rightarrow P' = P'A^L +V'< X^L >^{-1} \Rightarrow P' - P'A^L = V'< X^L >^{-1} \Rightarrow P'(I - A^L) = V'< X^L >^{-1}$$

$$\Rightarrow (I - A^L)'P = V'< X^L >^{-1} \Rightarrow [I - (A^L)']P = V'< X^L >^{-1}$$

$$\Rightarrow [I - (A^L)'][I - (A^L)']^{-1} P = [I - (A^L)']^{-1} V'< X^L >^{-1} \Rightarrow P = [I - (A^L)']^{-1} V'< X^L >^{-1},$$

in which P denotes the vector of formed *"prices' coefficients"*, through the suitable formed of total impacts that are emerged after from the initial stimulus: $[I - (A^L)']^{-1} V'$. The X^G is the ex post vector of sectoral outputs, meaning that this includes the impacts from the prices' changes, and the X^L is the vector of sectoral outputs at the inception of the process without the influence of prices' changes.

Consequently, using the Leontief's price-oriented model, at a first stage can be obtained the percentage changes on the sectoral prices from an initial change on the sectoral productive cost, due to a change of sectoral purchases of primary inputs, while at a second stage can be multiplied the vector of coefficients of sectoral prices with the starting vector of sectoral outputs. The product PX^L is equivalent to the ex post derived vector X^G of Ghosh's model, after from a value-change on a sector's i primary inputs. Hence, between the models is recorded an ex-ante to ex-post connection. The Ghosh's supply-driven model as an inflationary-pressures model, its expansions, prospects and moreover the interpretations of indicators that are derived from it, all these are remain "open topics" in the literature, especially as for the *"final output coefficients"* of Augusztinovics (1970) and Dietzenbacher (2002). Therefore, interest for a further empirical analysis as for their usefulness presents the derived of Ghosh's model *"direct output-to-output elasticities"* and *"direct and indirect output-to-output elasticities"* of Dietzenbacher (2005), if they are supposed as a tool for the sectoral inflation's approach, since from their presentation these indices have not been clarified with accuracy as for their usefulness.

According to the above, adding the elements of each one row of Ghosh's inverse can be accumulated the "total average potential dispersion of prices' effects", reflecting on the value-outputs of the rest sectors of economy, owing to an equal to a one monetary unit value-change on a sector's i primary inputs as an initial effect (Cai and Leung, 2004; Oosterhaven, 2017). Videlicet, these magnitudes measure the sectoral potential pressure to the economy's inflation. It will be very interesting an approach of Ghosh's model supposing reduced prices for the primary inputs. Under these circumstances can be checked the consequences on the values of sectoral outputs, through the productive circuit, due to the decreases in prices of primary inputs (e.g. on the payments of taxes). If these decreases shrink the values of sectoral outputs, then the economy will prompt to a more competitive productive cost supposing that the per price's profit-margin for the entrepreneurship remains constant in each sector. Combining the Leontief's quantitative-model and the Ghosh's price-model into a cyclical ex-ante-to-ex-post consideration, then the benefits from the improved competitiveness (e.g. from the trading-balance of economy) could be studied.

For the dispersed impacts of rows' sums of Ghosh's inverse, in the literature has been used the term *"sectoral input multipliers"* (Miller and Blair, 2009; Temurshoev and Oosterhaven, 2014; Freytag and Fricke, 2017) in contrast to the term *"sectoral output multipliers"* that has been used for the dispersed impacts of columns' sums of Leontief's inverse, but the term is abstruse and confuses the readers. The input multipliers, as "forward linkages prices' indicators" in essence, which are derived from the output's inverse of Ghosh's price-model, must not be confused with the "quantitative-forward indicators" that are revealed from the quantitative output's inverse of Leontief, something that it seems to be happened in the literature diachronically, for instance from Jones (1976) until to more recent empirical studies like as these of Temurshoev and Oosterhaven (2014); and Freytag and Fricke (2017).

From the other hand, adding the elements of each one column of Ghosh's inverse can be accumulated the total potential concentration of impacts on the sector's i price, since its value-output has been changed (initially, directly and indirectly), because of value-changes on the primary inputs at all the sectors of economy. Hence, these magnitudes measure the potential sectoral concentration of price-effects, the "potential sectoral inflation". For example, when the price of imported petroleum is changed, then the values of primary inputs probably for all the sectors are affected. Due to the change on primary inputs as prices' changes, the values of intermediate inputs (that previously was sectoral outputs) will be change too, but without to have been changed their quantities or their stable proportions (coefficients) in the price model. The aforementioned sums as "backward linkages prices' indicators" that are emerged from the Ghosh's price-model must not be confused with the "quantitative-backward indicators" that are obtained from the quantitative Leontief's inverse. Hence, the columns from the quantitative Leontief's inverse and the rows from the Ghosh's price-inverse measure and indicate impacts dispersion, whereas the rows of the first and the columns of the latter denote impacts' concentration and need the proposed above adjustment. This means that the "backward linkages prices' indicators" of conventional Ghosh's model must be adjusted follows the same logic that have been used for the adjustment of FLs' of conventional Leontief's inverse, via an analogous adjusted model with this that have been proposed earlier in this paper.

Obviously, in real situations, the changes of sectoral outputs are happened both due to the quantitative-changes and the prices' changes, and this means that the reality is put on between the two extreme models, the Leontief's quantity and the Ghosh's price-model (Oosterhaven *et al.*, 2001). However, each one of them is recognized as a methodological sound tool that can be used to serve variant purposes in the predictions' framework. In this article has been done with a critical vein, just only a briefly mention on Ghosh's model, in order to compare it with the Leontief's model, so as the reader to be capable to imagine the possible expansions for anything that is written in continue, reflecting them on it. Cardenete and Sancho (2012) have remarked that these models are the seminal concepts for any other relevant approach, in order to be constructed multipliers matrices which will be capable to provide the data for the comparison of sectoral impacts. Due to the fact that for the sake of brevity the rest of paper focused on Leontief's approach, the application of superscripts "L" and "G" is stopped here. However, under the view of dispersed and concentrated price-cost in the framework of inflationary-pressures indices, with an appropriate process many of the following can be found application and in a Ghosh's price-model.

4. THE EXPANSIONS OF LINKAGES INDICATORS AND THE CONCEPTS OF "NET" AND "GROSS" EFFECTS

Except from the multiplicative effects on the output that are revealed from the direct and the total requirements matrices, during the time and until to nowadays, through the proposals for the indicators' progress, others ad hoc per kind matrices have been constructed for the estimation of coefficients for the direct and total multiplicative impacts on factors like as the employment, the income, the carbon dioxide emissions, and so forth. It is useful to be clarified for the continue that generally the total effects reflect the aggregation of initial (In), direct (D) and indirect (Ir) effect (E) for anyone measured kind "S" of effects (InDIrSE=STBL), in which the consideration S can indicate either the output (InDIrOE=OTBL), or the employment (InDIrEE=ETBL), or the income (InDIrWE=WTBL, where the W denotes the wages and salaries), or whatever else "S" kind of effects. The generalization of "S" kind of effects is adopted for brevity's sake. For the derivation of SDBLs' and STBLs' indices, the appropriate direct and total requirements matrices (M) per category "S" (SDM, STM) must be constructed.

In order to be estimated the direct and basically the indirect spillovers that are happened in a productive network after from an exogenous stimulus, the I-O models are constructed so that to realize the round by round effects in it (Miller and Blair, 2009, pp. 31-34). The round, after round, after round repercussions, until the productive circuit to reach to its new general equilibrium, generate the total impacts on each one sectoral output into the economy, aggregating the initial plus the direct and plus the indirect coefficients and their effects. These total impacts are stemmed from the inborn "intra-sectoral initial trend for effects generation", in combination with the sectoral production's functions. The first round of effects generates the direct impacts and the direct coefficients via the production's function for a specific sector. From all the sequential round of effects are generated the indirect impacts and the indirect coefficients due to the interaction among the productions' functions from all the sectors in the productive circuit. Hence, after from an exogenous stimulus, changes are contemporaneously caused on sectoral outputs of all the sectors, through a primary change that has been happened on a specific sector from which the obtained feedbacks continue the process of round by round effects.

The former illustration of round by round process makes easier the comprehension of concepts of *"net and gross effects"* according to Sancho's used terminology (Augusztinovics, 1970; Dietzenbacher *et al.*, 2013; Sancho, 2012, 2013). The initial exogenous stimulus of change on the sector's i final demand, which is equivalent with a change on the value of the sector's i output, constitute the *"net extra output"* for this sector or else the *"net effect"* (Dietzenbacher, 2002; Dietzenbacher *et al.*, 2013; Sancho, 2013). The *"total gross effects"* is a concept that is defined accumulating the initial change on the sector's i output (that is accrued from an exogenous initial stimulus on a component of its final demand), with the dispersed changes on all the other sectoral outputs that are emerged from the endogenous intermediate sectoral interplays of sector i, that are happened in order to sustain its initial change (Cardenete *et al.*, 2017; Dietzenbacher, 2002; Dietzenbacher *et al.*, 2013; Milana, 1985; Sancho, 2012, 2013). This is the background of gross outcomes' generation after from an isolated net (initial) exogenous stimulus, that it establishes a *"net-to-gross multiplier mapping"* (Sancho's terminology in Dietzenbacher *et al.*, 2013).

From the concept of *"total gross effects"* can be revealed and assigned the concept of "truncated gross effects", if the initial change on the sector's i output from its equivalent final demand's change is subtracted from the "total" magnitude. Ab initio, the coefficients of total requirements' matrices are gross impacts coefficients that include the net stimuli per sector. The "truncated gross impacts' coefficients" are obtained subtracting the net stimuli, videlicet the net effects, from the corresponding total gross impacts coefficients. So, the "truncated gross coefficients" are referred only to the direct and indirect effects without the initial stimuli. The "truncated gross impacts" constitute the basis for a number of indicators that will be presented in continue. In the case of output, the "net effect" is synonym to the "initial exogenous stimulus", according to the above. For any other kind "S" of effects must be defined "the corresponding initial stimulus" that will take the role of "extra net per kind S effect" (like as "the extra net employment", "the extra net income", etc.). This corresponding initial stimulus in the case of any other kind "S" of effects, except of output, is the "intra-sectoral initial trend for effects generation" that obviously is not tantamount to the initial exogenous stimulus on the sectoral final demand or else on the sector's i output. The purport of the "intra-sectoral initial trend for effects generation" is explicated later.

5. DOUBLE-COUNTING AND RELEVANT PRECISION

Another topic relevant to the description of round by round effects is the double-countings that are provoked from the aggregation of gross sectoral outputs. At a first step must be clarified that the gross output is calculated adding the sectoral outputs for the whole of economy (X^T), as: $X^T = \sum_{i=1}^{n} X_i$. At this point is remarked that when an open model is converted to a corresponding closed model removing the columns and the rows of the second and the third quadrant into the model (Miller and Blair, 2009, pp. 34-41) with their corresponding transactions of forth quadrant, then the enhanced closed model has a form m *x* m (m>n) and the gross output for the whole of economy is configured as: $X^T = \sum_{i=1}^{m} X_i > \sum_{i=1}^{n} X_i$. Returning to the open model, the total (from all the sectors) value of sales to final demand $\sum_{i=1}^{n} Y_i$ (*"net total expenditure"*) is the *"total net output"* of economy and the total value of used primary inputs for the productive scopes of economy $\sum_{i=1}^{n} V_i$ is the equivalent *"net income"* (Sancho, 2013). When each one of these magnitudes is summed with the total intermediate inter-sectoral sales or purchases, then the result is the total gross output (X^T) of economy (Milana, 1985). In a completely closed model in which is internalized all the components from the second and the third quadrant, by definition, the concepts net output and net income for each one sector separately and for their total too, are disappeared as concepts, and the only magnitudes that remains are gross.

The total gross output (X^T) of economy, by default, includes double-countings because of the fact that any transaction for a pair of sectors is both a backward effect for the

one sector and a forward effect for the other, since each one of the individual elements from a total requirements matrix (b_{ji}) denotes an individual multiplier for a pair of sectors, a purchaser-sector and a seller-sector (Augusztinovics, 1970; Yotopoulos and Nugent, 1973). In essence, the columns' elements are "individual backward-to-forward indices", while the corresponding rows' elements are "individual forward-to-backward indices", due to the twofold purport of any transaction.

After from the above, it must be explicit that any model generates, regenerates and finally multiplies endogenous inter-sectoral effects through the direct and indirect coefficients (a_{ji}, b_{ji}) and so has intrinsic the propensity to engender double-countings and overestimations. The double-countings are emanated from the coefficients of total requirements and more specifically from the indirect repercussions and not from the starting stimuli themselves or from the direct effects.

Although the TBLs' and TFLs' indicators have traditionally been used in order to emerge the key-sectors for an economy, however these indices present a number of weaknesses. In the previous section had already been emphasized the structural computable weakness of FLs' from the conventional Leontief's model and the corresponding weakness of BLs' from the conventional Ghosh's model, escorting with a theoretical proposal for the encounter of problem and the amelioration of their compatibility and comparability. At this point becomes discernible the weakness of total linkages' indicators as for the overestimation of importance of each one sector into the productive network regarding to its capability to generate or to concentrate multiplicative effects, because of the nature of these indices as gross coefficients that estimate potential capabilities. The "potential" is the one cause for the overestimation of capabilities of sectors, especially of small sectors, since the sectoral relative sizes are ignored. The potential impacts constitute misleading evaluations of actual impacts that each one sector is indeed capable to disperse or to concentrate in real time. Consequently, these indices measure the potential sectoral multiplicative impacts that one sector is able to disperse or to concentrate due to its input-output interdependencies with the other sectors of economy, without to take into consideration the given per sector relative size which affects the effects that a sector can disperse or concentrate. Schultz (1977) had detected the high measurements of TBLs' and TFLs' indicators, and he had advocated that without supplementary information for the relative sectoral size, these indices are inadequate to determine the key-sectors of economy. The "gross" of magnitudes constitute the other cause for the overestimation of capabilities of sectors, since it points out the double-countings in the measurements. This point was the target of Oosterhaven and Stelder (2002) criticism when they had underlined that the sectoral outputs' summation (either in an open model: $\sum_{i=1}^{n} X_i$, or in a closed model: $\sum_{i=1}^{m} X_i$, m>n) includes the descriptive above double (or even more than double) countings. Another one significant weakness of linkages indicators which is revealed from their empirical results is that these indices have the propensity to bias in favor of some sectors and against to others, as it is commented in a next section comprehensively.

Consequently, the individual elements of models provide information for the multipliers' coefficients for each one pair between two sectors; the sectoral potential effects include double-countings; and the potential effects from all the sectors simultaneously exaggerate the overestimations because of the accumulation of sectoral double-countings. For instance, a

column's summation from a total requirements matrix of a static demand-driven model expresses a maximum potential dynamic for a sector. The maximum capability for sectoral impacts dispersion can be evaluated from an open model, and from each one constructed closed model that are gradually shaped, transiting as endogenous to them the components from the final demand and from the primary inputs (Bekhet, 2011). The deviations among these maximum measurements from model to model create a fluctuated maximum range. Ultimately, for any sector exists a fluctuated maximum breadth of potential effects that could generate to the rest of economy (or could concentrate from the rest of economy), according to the model's definition (open or closed and how enhanced). These maximum levels of measurements just only express promising spillovers and are not the real repercussions that could be indeed generated from a sector. Hence, it is not realistic to be awaited that an economy could achieve all the maximum sectoral potential levels of effects at the same time. The first reason for this is that each one sectoral level for promising potential effects is ideal, but for many cases in action these promising potentialities are pent into the restrictive relative size of each one sector. The second reason is the twofold nature of transactions which involves double or even more than double-countings. The most interesting point in the study of Oosterhaven and Stelder (2002) must be regarded the produced deduction that in real dynamic situations and supposing restricted productive resources, the unbalanced growth, even if it follows a general pattern, leads some sectors to the enlargement, some sectors to an immobility and the rest sectors to a shrinking. This means that in real dynamic situations when some sectors verge on their potential multiplicative effects, then some others diverge from their promising capabilities, and this means an opportunity cost in terms of social welfare among the alternative growing scenarios.

At this point it is necessary to remember that from their nature, multipliers like as the TBLs' and TFLs' indices are constructed to measure multiplying effects, either vertically or horizontally and their scope is just this, without to distinguish if and when these effects can be summed or not. It is rational that when the multiplicative effects of all the sectors are simultaneously summed, a corollary is that are generated double and more than double-countings and overestimations. Also, it is rational that cannot be summed backward and forward effects, because a summation like this bring about conceptual disjointedness. Cella (1984) and Dietzenbacher and Van Der Linden (1997) have expressed the view that the use only of TBLs' or only of TFLs' indicators cannot determine the key-sectors into the economy. The original *"Hypothetical Extraction Method, (HEM)"* from Paelnick *et al.* (1965) (as cited in Temurshoev, 2010), Strassert (1968) and Schultz (1977) had been constructed to measure the loss for the whole economy, when a sector is eliminated from the productive circuit (Cai and Leung, 2004; Temurshoev, 2010; Temurshoev and Oosterhaven, 2014). Essentially, this is a "Hypothetical Elimination Method". A spin-off approach of HEM is the *"loss of the industry"* or else the *"shut-down of industry"* (Valadkhani, 2003), while someone can find *"normalized (complete and partial) HE linkages"* in Temurshoev and Oosterhaven (2014). The HEM (complete or partial), despite of the criticism that could gather at its feedback framework, provide a general view (correct or less correct) for the sectors of economy, although not for all (Valadkhani, 2003). However, HEM's expansions-modifications and spin-offs, for instance by the proposals of Cella (1984), Clements (1990), Clements and Rossi (1991), Sonis *et al.* (1995) (e.g. the *"pure linkages indices",* by Sonis *et al.*, 1995), summing in essence TBLs' and TFLs', in any case enlarge the double and more than double-countings problem, and furthermore ignores the compatibility problem of

forward measurements before from their adjustment. The summations of BLs' with the FLs', i.e. the summations of dispersed and concentrated effects, albeit the fact that they are registered as "improvements" in the literature (e.g.: Cella, 1984; Clements, 1990; Clements and Rossi, 1991; Sonis *et al.*, 1995), seem to be without sense, since the purport of dispersed from a sector effects to the rest of economy is differed from the purport of concentrated effects into this sector from the rest of economy (Eiser and Roberts, 2002; Cai and Leung, 2004). From the above are emerged the inference that from the linkages' indicators can be obtained information for the potential capabilities, but these indicators are not suitable to predict with precision the growing effects on each one sectoral output separately, as well as the economy-wide multiplicative impacts that are caused from all the sectors. And of course, if this is a problematic situation in the case of response to a primary exogenous stimulus of only one sector (backward approach), it is a much more problematic situation in the case of response to primary exogenous stimuli both for all the sectors of economy (forward approach). So, the question is how to be determined the key sectors for the present welfare or the propulsive sectors for its future perspective, and what indicators must be chosen and used in a framework like this. Many indices have been constructed for this scope. Each one of them has advantages and disadvantages, but the coexistence of some of them can ameliorate the planning process. The next sections present them elaborating their conceptual architecture, the confusions in the literature and stressing their peculiarities.

6. CONCEPTUAL AND COMPUTABLE ELABORATIONS OF PLANNING TOOLS

In the literature, traditionally and erroneously, is recorded a conceptual complication between the terms "direct" and "initial" effect, which is capable to mislead their comprehension. A consequence that is revealed from these terminological inexactitudes is the fact that in the action someone can meet cases in which the computational syllogisms do not follow the descriptive definitions for the indices, or to put it somewhat differently, the description for an index does not match to its actual computation, due to the fact that the users have done (at the better case) the correct computations, following a fallacious description. This is a problem that, of course, differs from the case in which someone has done erroneous computations, while the substratum as for the indices' determination is correct. However, the literature must not make difficult the comprehension of indices for their users and sometimes must be more descriptive and explicit.

In any case, when for example the computable definition for an index uses the term "direct" meaning "initial" effects, then it is probably to misguide the non-insider or initiate readers. The more experienced scholars, researchers and policy-makers often consider the problem as known, although the fact that for an initiate researcher is difficult for him/her to find a paper in which are collected paradigms that can help him/her do not ends up lost in the terminological confusions of literature. Moreover the deterministic errors can mislead the more experienced scholars, researchers and policy-makers too, and this is something that is extracted from the published papers. The terminological inconsistencies make difficult the correct and the deeper comprehension of indices' peculiarities, and this is a significant problem that is met in the action.

Very often cited works, of wide-acceptable authors and researchers present this conceptual problem (Jensen *et al.*, 1979, pp. 20-24, Oosterhaven *et al.*, 2001; Oosterhaven

and Stelder, 2002; Dietzenbacher, 2002, 2005), despite of the fact that West and Jensen had pointed out it from 1980. However, from then until to nowadays, the conceptual confusion as regards the purports of initial and direct effects is continued and expanded. Taking paradigms from the literature, Ciobanu *et al.* (2004), for example, have used the terms *"direct and indirect employment effect"* and *"direct and indirect income effect"*, in which they have tacitly included the initial effects. For another instance, Milana (1985), Dietzenbacher (2002) and Kelly *et al.* (2016) systematically omit the concept of *"initial effect"* from the accumulative concept of *"total effects"*. The total effects are referred as *"direct and indirect effects"* instead of their full expression of *"initial, direct and indirect effects"*. The same practice is followed in Miller and Blair (1985, pp. 102, 114-115; 2009, pp. 244, 258) too, but in their case the used terminology is more confused. Miller and Blair have called as *"simple output multipliers"* (1985, p. 103; 2009, p. 245) the OTBLs' indicators that are derived from an open model, as *"total output multipliers"* (1985, p. 105; 2009, p. 247) the enhanced OTBLs' indices from a closed model, as *"simple household income multipliers"* (1985, p. 106; 2009, p. 251), the WTBLs' indicators from an open model, as *"total household income multipliers"* (1985, p. 106; 2009, p. 251) the enhanced WTBLs' indices from a closed model, as *"simple household employment multipliers"* (1985, p. 111) the ETBLs' indicators, as *"total household employment multipliers"* (1985, p. 112) the enhanced ETBLs' indices, and so forth, while the corresponding direct indices (ODBLs, WDBLs', EDBLs') are not defined. Moreover, they called *"household inputs coefficients"* (1985, p. 105; 2009, p. 250) and *"monetary labor inputs coefficients"* (1985, p. 111), the "intra-sectoral initial trend for income effects", and even they called *"physical labor inputs coefficients"* (1985, p. 111) the "intra-sectoral initial trend for employment effects". Temurshoev and Oosterhaven (2014) have called the traditional BLs' as *"non-normalized total backward linkages"* and the type I multipliers as *"normalized total backward linkages"*.

These paradigms are just only a small sample from the general confusion in the literature. However, the initial effect is not something negligible and constitutes a noteworthy part of total multiplicative effects, when the initial effect does not omit from an index in conformity with its architectural construction. The initial effect is the multiplicative impact that must be happened in the productive circuit for the sustainability of exogenous impulse. The elimination of initial effect and the isolation of direct and indirect effects fulfill the purport of "truncated total effects". In the framework of paradigms for the contradictions and the imprecisions that are met in the literature, Baumol and Wolff (1994), Oosterhaven and Stelder (2002), Dietzenbacher (2005), Temurshoev (2010), Temurshoev and Oosterhaven (2014), Kelly *et al.* (2016), among many others, have called the "intra-sectoral initial trend for effects" (see below: $<S><X>^{-1}$) as *"direct effects or direct coefficients"*, although the direct effects and coefficients are clearly something else (see below: $<S><X>^{-1}A$). Of course, all these authors know very well and have in their mind exactly what they mean, but however their used nomenclature either bring about a fallacious and misguiding sense in the mind of non-insider or initiate readers, scholars and researchers, or does not help for a deeper comprehension of indices peculiarities, or both of them. There are two basic reasons for this confusion.

The first reason is come from the construction of direct requirements matrix (A) as it has been described in previous, in connection with the primary inputs coefficients of third quadrant. It has been clear that the *"primary inputs coefficients"* are not direct effects and are not included in the open shape of direct requirements matrix. For instance, from the

division of wages and salaries (households' income: W_i) of sector i with its output: $InWE_i = (W_i / X_i)$ is calculated the "intra-sectoral initial (In) trend for income (or wages and salaries, W) effects (E) generation". For the sake of generality, any division under the form: $InSE_i = (S_i / X_i)$ calculates the "intra-sectoral initial trend for effects generation of kind S". The computation of "InSE matrix" for each one of the sectors of economy (i=1,2,…,n) is: $<InSE> = <S><X>^{-1}$, and this implies: $<S> = <InSE><X>$. In any case these magnitudes constitute intra-sectoral initial reactions per kind "S", that are connected with the initial exogenous stimuli that are happened on the final demand (or else on the sectoral output). This means that when a closed model with an enhanced matrix A, with respect for example to households' consumption and income (or/and whatever else components from the second and the third quartile of Z), is used, then the main part of enhanced matrix includes, the twofold purport, a_{ji} elements of direct effects coefficients, while the enhanced rows include the individual per sector "intra-sectoral initial trends for effects generation per category S" which are not direct effects and this is the first reason of conceptual confusions. The direct effects that can be generated on a kind "S" of estimated impacts ["S" = income (I), employment (E), or whatever else, except of the output (O)] after from an exogenous stimulus are assessed creating the appropriate per kind "S" direct requirements matrices (SDM) that are differed from the conventional direct requirements matrix (A) that outright expresses only the output effects, as it will be clear in the passages below.

The second reason of conceptual confusion is concentrated on the fact that there is not recorded an explicit distinction between the concepts: *"initial exogenous stimulus"* and "intra-sectoral initial trend for effects generation". As a first step it must be brought out that generally the initial effects just indicate the offset-point for the effects' measurements. An initial effect could be:

(1) An exogenous change on a sectoral final demand (Y_j), like as it is happened in the classic approach of model in which the final demand for each one sector is an exogenous variable, or even in the *"mixed exogenous-endogenous variables approach"* (see: Eiser and Roberts, 2002; Miller and Blair, 1985, pp. 325-339; 2009, pp. 621-639) especially for these sectoral cases in which the final demand's changes constitutes the initial exogenous stimulus.

(2) An exogenous change straightforward on a sector's output (X_j), something that it is happened when the sectoral outputs are concerned as exogenous variables, or even in *the "mixed exogenous-endogenous variables approach"* (see: Eiser and Roberts, 2002; Miller and Blair, 1985, pp. 325-339; 2009, pp. 621-639) but only for these sectoral cases in which the changes on the sectoral outputs constitute the initial exogenous stimulus.

(3) Also, the initial effect could be the net sectoral propensity for impacts generation on a category "S" (employment, income, emissions or whatever else) and in a case like this reflects the "intra-sectoral initial trend for effects generation".

In a traditional Leontief's model that is focused on output's effects, by default, the changes are originated from the sectoral final demand that is regarded as the initial exogenous stimulus and are transferred on the sector's output as an equivalent intra-sectoral initial trend specifically for output's effects generation. This is translated as an equal to a one unit change on the sector's i output $(dX_i = 1)$, as a response to the corresponding unitary change of final demand for this sector's output $(dY_i = 1)$. This means that in the conventional consideration of Leontief's model, at the stimuli level, there is a primary one

to one balance $(dX_i = dYi = 1)$ between the changes on the sector's i final demand and on the sector's i output, which reflects the "net stimulus-effect" on the sector's i output that is come from the "net stimulus-change on the sectoral final demand" (with the exception of the completely closed model in which the concept "net" is absent into the model, as mentioned earlier). Three observations must be reffered as for this balance.

The first of the three observations is that this balance is combined only with the outputs' effects. It must be underlined that when an I-O model is used for the measurement of DBLs' and TBLs', the "initial exogenous stimulus" is identical to the "intra-sectoral initial trend for effects generation" only in the case of measurements of output's (O) effects (ODBLs', OTBLs'). In contrast, in any other case (employment: EDBLs' and ETBLs', income: WDBLs' and WTBLs', etc.) these two concepts and magnitudes are not in consonance. Using an I-O model in order to estimate SDBLs' and STBLs' indicators for other categories of effects (e.g. employment, income, etc.), except of output, the above descriptive balance $(dX_i = dYi = 1)$ is interconnected with smaller than one "net employment, net income, or net whatever else, intra-sectoral effects" $(InSE_i < 1)$. This is happened due to the fact that in these cases another one step intervenes in the process and the "net effect on the sectoral output" is transferred to the "intra-sectoral initial trend for effects generation of any other kind "S" of effects" via the division: $S_i / X_i = InSE_i$, which is smaller than one (<1) by definition. Thereafter, for the measurements of multiplicative effects on output (O), the sectoral ODBLs' and the OTBLs' are calculated by the columns' sums of conventional direct and total requirements matrices respectively, scilicet:

$$ODBL_i = \sum_{j=1}^{n} a_{ji} \quad \text{and} \quad OTBL_i = \sum_{j=1}^{n} b_{ji} \ ,$$

whereas from the other hand the dispersed sectoral direct and total (=initial, direct and indirect) multiplicative effects for any other kind "S", to the whole economy, are measured via the sums:

$$SDBL_i = \sum_{j=1}^{n} a_{ji} InSE_j \quad \text{and} \quad STBL_i = \sum_{j=1}^{n} b_{ji} InSE_j \ .$$

The direct and total requirements matrices for the estimation of categories "S" of effects, are:

$$SDM = < S \rtimes X >^{-1} A = < InSE > A$$

and: $$STM = < S \rtimes X >^{-1} (I - A)^{-1} = < InSE > (I - A)^{-1} = < InSE > B \ ,$$

with the corresponding vectors of direct and total [initial (In), direct (D), indirect (Ir)] backward (B) linkages (L) effects (E) of kind "S" to be:

$$SDBL = DBSE = i'(SDM) = i' < InSE > A = i' < S \rtimes X >^{-1} A$$

and: $$STBL = InDIrBSE = i'(STM) = i' < InSE > (I - A)^{-1} = i' < S \rtimes X >^{-1} (I - A)^{-1} \ .$$

The elements of STM are: $b_{ji} InSE_j$, and for the main diagonal: $b_{ii} InSE_i$ (or: $b_{jj} InSE_j$).

Especially for the case of output, these matrices and vectors take correspondingly the form:

$$ODM = <S \succ\prec X>^{-1} A = <X \succ\prec X>^{-1} A = A \ ,$$

$$OTM = <S \succ\prec X>^{-1} (I-A)^{-1} = <X \succ\prec X>^{-1} (I-A)^{-1} = (I-A)^{-1} = B \ ,$$

$$ODBL' = DBOE' = i'A \ \text{ and } \ OTBL' = InDIrBOE' = i'(I-A)^{-1} = i'B \ .$$

The vector of "truncated (Tr) total effect" (only direct plus indirect effects without the initial intra-sectoral effect), is defined as:

$$STrTBL' = DIrBSE' = InDIrBSE' - InSE' = i'(STM) - i' < InSE > \ ,$$

and for each one sector is:

$$STrTBL_i = DIrBSE_i = InDIrBSE_i - InSE_i = \sum_{j=1}^{n} b_{ji} InSE_j - InSE_i \ ,$$

while for the case of output, due to the fact that: $< InOE \succ = I$:

$$OTrTBL' = DIrBOE' = InDIrBOE' - InOE' = i'(I-A)^{-1} - i' < InOE \succ = i'(I-A)^{-1} - i'$$

$$\text{and: } OTrTBL_i = DIrBOE_i = InDIrBOE_i - 1 = \sum_{j=1}^{n} b_{ji} - 1 \ .$$

As for the isolation of indirect effect:

$$SIrBL' = IrBSE' = InDIrBSE' - DBSE' - InSE' = i'(STM) - i'(SDM) - i' < InSE > \ ,$$

$$\text{and: } IrBSE_i = InDIrBSE_i - DBSE_i - InSE_i = \sum_{j=1}^{n} b_{ji} InSE_j - \sum_{j=1}^{n} a_{ji} InSE_j - InSE_i$$

The isolated intra-industry initial, direct and indirect effect is:

$$s_{jj} = b_{jj} InSE_j \ \text{ (or: } s_{ii} = b_{ii} InSE_i \text{),}$$

with the truncated intra-industry direct and indirect (without the initial) multiplicative effect to be:

$$(s_{jj} - InSE_j) = (b_{jj} InSE_j - InSE_j) \quad [\text{or: } (s_{ii} - InSE_i) = (b_{ii} InSE_i - InSE_i) \ ] \ .$$

Especially for the case of output, the intra-sectoral initial, direct and indirect effect is: b_{jj} (or: b_{ii}), with the truncated intra-sectoral direct and indirect (without the initial) multiplicative effect to be:

$$(b_{jj} InOE_j - InOE_j) = (b_{jj} - 1) \ [\text{or: } (b_{ii} InOE_i - InOE_i) = (b_{ii} - 1) \ ] \ .$$

Under this vein can also be defined the, concentrated specifically on a sector j, forward (F) effects with the analogous manner, based on the sectoral measurements:

$$SDFL_j = \sum_{i=1}^{n} a_{ji} InSE_j \ \text{ and } \ STFL_j = \sum_{i=1}^{n} b_{ji} InSE_j \ .$$

Using the data of modified A^{adj} and $(I-A^{adj})^{-1}$ matrices, theoretically, can be estimated the adjusted forward (F) linkages effects via the adjusted matrices (SDM^{adj} and STM^{adj}) and this approach must be controlled by empirical studies. At this point is stressed that in the matrix algebra, a matrix pre-multiplication with a vector i' produces the columns' sums that are needed for the measurements of backward effects, while a matrix post-multiplication with a vector i produces the rows' sums that are needed for the forward effects. For instance:

$$STFL = InDIrFSE = (STM^{adj})i =< InSE > (I-A^{adj})^{-1} i =< S >< X >^{-1} (I-A^{adj})^{-1} i .$$

In order to move to one (=1) the intra-sectoral initial trend for generation of any other category "S" of effects, videlicet in order to becomes the division $S_i / X_i = InSE_i$ from less than one $(InSE_i < 1)$ to be equal to one $(InSE_i = 1)$, then the presupposition for this transition is: $[(S_i / X_i)dX_i] = [(S_i / X_i)dY_i] = 1$ with $S_i < X_i$ and compulsory $dX_i = dY_i > 1$, instead of $dX_i = dY_i = 1$. The reformation of $InSE_i$ from less than one (<1) to a reformed measurement that will be equal to one (=1) necessarily implies the reformation (r=reformed, in the notation below) of primary measurements of $DIrBSE_i$ and $InDIrBSE_i$ to the analogous level via the equations:

$$rDIrBSE_i = DIrBSE_i / InSE_i ,$$

which essentially is the *"truncated type I multiplier"* of sector i for the factor "S" ($t.I - TrSM_i$, hereafter)

and:

$$rInDIrBSE_i = InDIrBSE_i / InSE_i ,$$

which essentially is the (total) *"type I multiplier"* of sector i for the factor "S" ($t.I - SM_i$, hereafter) so as to be:

$$rInDIrBSE_i - rDIrBSE_i = rInSE_i = 1 .$$

As vectors:

$$rInDIrBSE' = DIrBSE'(i' < InSE >)^{-1} ,$$

which is the general form of vector for the truncated type I multipliers ($t.I - TrSM$), for any kind "S" of effects,

and:

$rInDIrBSE' = InDIrBSE'(i' < InSE >)^{-1}$, which is the general form of vector for the (total) type I multipliers ($t.I - SM$), for any kind "S" of effects.

As a matter of fact, these are the presuppositions for the transition from the BLs' indices to the type I multipliers (t.I-Ms') of Jensen *et al.* (1979), since by definition the t.I-Ms' measure the multiplicative impacts on a parameter "S" that are generated to the economy as a whole due to a unitary initial change exactly on this factor "S" (=intra-sectoral initial trend of factor "S":: $rInSE_i = 1$).

In the case of output, the t.I-OMs' are identified to OTBLs' indices, because of the equations:

$$[(X_i / X_i)dX_i] = [(X_i / X_i)dY_i] = 1, \text{ owing to } dX_i = dY_i = 1,$$

$$\text{and: } [(X_i / X_i)dX_i] = [(dX_i / dX_i)dX_i] = [(dX_i / dY_i)dY_i] = (dX_i / dY_i) = (dX_i / dX_i) = (X_i / X_i) = 1,$$

in contrast with the case of any other factor "S" for which be in force that: $t.I - SM_i \neq STBL_i$ (videlicet, the magnitude of a type I "S-kind" multiplier (SM) for the sector i is differ from its corresponding BL's measurement) and this is the explanation of why the t.I-Ms' and the BLs' indicators provide differentiated sectoral rankings, with the exception of output's case. The vector of t.I-Ms' for any kind "S" (t.I-SMs') of effects are determined as:

$$SM = i' < S \gg X >^{-1} (I - A)^{-1} (i' < S \gg X >^{-1})^{-1} = i' < InSE > (I - A)^{-1} (i' < InSE >)^{-1}$$

$$= i'(STM)(i' < InSE >)^{-1} = InDIrBSE'(i' < InSE >)^{-1} = rInDIrBSE'$$

and this mean that the sectoral t.I-SMs' are:

$$SM_i = (InDIrBSE_i / InSE_i) / rInSE_i = rInDIrBSE_i / rInSE_i$$

$$= r(\sum_{j=1}^{n} b_{ji} InSE_j) / rInSE_i = r(\sum_{j=1}^{n} b_{ji} InSE_j) / 1 = r \sum_{j=1}^{n} b_{ji} InSE_j \ .$$

and hence the vector of truncated sectoral t.I-SMs' is:

$$TrSM' = rDIrBSE' = DIrBSE'(i' < InSE >)^{-1} = [i'(STM) - i' < InSE >](i' < InSE >)^{-1}$$

$$= [i' < S \gg X >^{-1} (I - A)^{-1} - i' < InSE >](i' < InSE >)^{-1}$$

and the truncated sectoral t.I-SMs' are:

$$TrSM_i = rDIrBSE_i / rInSE_i = (rInDIrBSE_i - rInSE_i) / rInSE_i$$

$$= [r(\sum_{j=1}^{n} b_{ji} InSE_j) - rInSE_i] / rInSE_i = [r(\sum_{j=1}^{n} b_{ji} InSE_j) - 1] / 1 = r(\sum_{j=1}^{n} b_{ji} InSE_j) - 1 \ .$$

Especially at the case of output, the truncated type I multipliers following the equations:

$$TrOM = [i' < X \gg X >^{-1} (I - A)^{-1} - i'I](i'I)^{-1} = i'[(I - A)^{-1} - I]$$

$$\text{and: } TrOM_i = \sum_{j=1}^{n} b_{ji} - 1 = DIrBOE_i = OTrTBL_i \ .$$

In literature exists studies, like as in Ciobanu *et al.* (2004), in which for example the *"type I output or employment or income multipliers"* had been referred as *"output or employment or income multipliers"*. The omission of *"type I"* from the nomenclature is misleading for the reader, since in the literature the terms *"output or employment or income multipliers"* are usually used as synonyms to the linkages indicators. In a conceptual confusion like this, a reader could comprehend that the used indices are *"type I output or employment or income multipliers"* only by the results (Tadayuki, 2008, pp. 59-66), but of course this is very difficult for the initiate and unsuspecting readers, scholars and researchers. More specifically, with the exception of output's case, the corresponding BLs' for any other kind "S" of effects (employment, income, etc.) will be less than one (<1),

while the original (non-truncated) type I multipliers are greater than one (>1). Especially, in the case of truncated t.I-Ms' their distinction is inconspicuous.

The truncated OTBLs' provide the same sectoral rankings with the non-truncated OTBLs', since from each-other sectoral subtractions, the outcomes shrink the multiplicative effects per sector with the same number (-1):

$$DIrBOE_i = InDIrBOE_i - InOE_i = \sum_{j=1}^{n} b_{ji} - 1 \ .$$

However, for any other kind "S" of truncated measured linkages' indices, due to the equation:

$$DIrBSE_i = InDIrBSE_i - InSE_i ,$$

is deduced that the truncated sectoral linkages' indicators are not derived subtracting the same number from each one of their total magnitudes, but subtracting a different number in any case, since any:

$$InSE_i \neq InSE_j \text{, for } i \neq j \text{, when } i, j = 1,2,\ldots,n \ ,$$

and in these cases the derived sectoral rankings are different from the corresponding rankings of non-truncated indices (with the exception of output).

In contrast, the truncated t.I-Ms' reveal the same sectoral rankings with the conventional non-truncated t.I-Ms', not only in the case of output but moreover and for any other measured kind "S" of impacts, since by default, their denominators have already been reformed and moved to one: $rInSE_i = 1$ and each numerator has been reformed to:

$$rDIrBSE_i = rInDIrBSE_i - rInSE_i = r\sum_{j=1}^{n} b_{ji} InSE_j - 1 \ ,$$

something that indicates that from the reformed sectoral indices are subtracted the same magnitudes: $rInSE = 1$.

After from the aforementioned, it must be clear that, the BLs' produce inequitable results in favor of the sectors in which the intra-industry initial effects constitute a noteworthy part of their total multiplicative impacts, while the type I multipliers are focused exactly on the part of direct and indirect effects considering the initial effect causally neutral, supposing all the intra-sectoral initial trends for the effects' generation to be equal to one.

As for the difference between the type I and the Type II multipliers, this is that the latter are based on the enhanced matrices of a closed model yielding bigger measurements since the endogenous sectors are more. Applying the proposal for the adjusted matrices A^{adj} and $(I - A^{adj})^{-1}$, the adapted data will be suitable for the calculation of forward type I multipliers that would have the compatibility to be compared with the backward type I multipliers.

The second observation, regarding to the mentioned earlier balance $(dX_i = dYi = 1)$, concerns the "net-to-net" relation that exists between the initial exogenous stimulus of change on the sectoral final demand and the corresponding intra-sectoral initial trend specifically for the output's generation. This *"net-to-net multiplier mapping"* (following the Feran Sancho's terminology in Dietzenbacher *et al.*, 2013), means that, in the case of a non-

completely closed static demand-driven model, the "net-to-net" response is met into the interrelation between the initial exogenous stimulus and the intra-sectoral initial trend for the output's generation. This one-to-one balance of net-to-net output's response does not include more multiplicative effects and expresses only the initial stimulus. Since this initial stimulus begin to create multiplicative effects into the productive circuit through the interplay of sectoral production's functions, the net result (the net intra-sectoral initial trend for output generation) is multiplied and become a gross result through the round by round effects that are registered in it. Beyond of the fact that a non-completely closed model is constructed to describe a "net-to-gross" relation between the stimuli and the outcomes, it is possible someone to imagine a "net-to-net multiplier mapping", as the case in which the output's outcome must be equal to the primary exogenous stimulus and this will resemble as a segmentation and a (re)distribution of initial net effect without further generated multiplicative impacts (Sancho, 2013), something that violates the constructed scope of direct and total requirements matrices. Under this vein, a first deduction is that the intrinsic double countings of gross measurements of model are necessary for its usefulness, and therefore a second deduction is that a completely closed model is a "gross-to-gross multiplier mapping" by definition.

Although that the scope of conventional model is not to provide "net-to-net" or "gross-to-gross" measurements, as it is underlined by Feran Sancho in Dietzenbacher *et al.* (2013), however a third observation, regarding to the mentioned earlier balance $(dX_i = dYi = 1)$, can be emerged analyzing the consequences from the movement of initial exogenous starting-point, from a change on a sectoral final demand to a straightforward change on a sector's output. An interesting and comprehensive presentation for this transition has been provided by de Mesnard (2002b) who has elaborated what happened in the process of multiplicative effects when the initial exogenous stimulus is recorded as a straightforward change on a sector's output. Following the causality of traditional Leontief path as for the interconnection between the initial change on a sector's output and on the final demand $(dX_i = dYi = 1)$, de Mesnard (2002b) has exhibited the conclusion that supposing the sector's output as the offset-basis of initial effect, this is like to disappear the phase of initial change on the final demand (=and its repercussion on the intra-sectoral initial propensity for sector's output, $InOE = 1$) and this conduct the process to begin right from the phase of first round of effects. Consequently, instead to the traditional way in which the initial exogenous change is registered on the final demand:

$$X = (I - A)^{-1}Y \Rightarrow dX = (I - A)^{-1}dY = \sum_{k=0}^{\infty} A^k dY = (I + A + A^2 + \ldots)dY \ ,$$

when the initial exogenous stimulus is transferred straightforward on the sector's output, then the rest of process is:

$$dX = \sum_{k=0}^{\infty} A^{k+1} dX^e = (\sum_{k=0}^{\infty} A^k)(AdX^e) = [(I + A + A^2 + \ldots)A]dX^e = [(I - A)^{-1}A]dX^e \ ,$$

in which dX^e expresses the exogenous (superscript: e) defined vector of sectoral outputs that bring about the direct and indirect multiplicative effects of matrix: $(I - A)^{-1}A$ (de Mesnard, 2002b). In point of fact, de Mesnard recommends that if one wants to examine the multiplicative consequences that are generated from the initial changes on the sectoral

outputs, then these changes must be multiplied with the reformed indicators of product: $(I-A)^{-1}A$. The product $(I-A)^{-1}A$ measures only the direct and indirect effects, without the initial effect, since:

$$(I-A)^{-1}-I=(I-A)^{-1}-[(I-A)^{-1}(I-A)]=(I-A)^{-1}[I-(I-A)]=(I-A)^{-1}A\ .$$

The vector of new sectoral outputs is configured as:

$$X^{new}=[(I-A)^{-1}A]dX^{e}=[(I-A)^{-1}-I]dX^{e}\ .$$

Here, it is noted that Sancho (2012) has called the subtraction $[(I-A)^{-1}-I]$ as *"total intermediate inputs requirements"* meaning the changes that must be happened endogenous on the intermediate inputs of economy in order to be sustainable the initial one unit change on the sector's i output (Cardenete *et al.*, 2017), versus to the $(I-A)^{-1}$ consideration for which he has used the term *"total output requirements"* according to the conventional terminology.

Following de Mesnard's approach someone can ascertain that, generally, when for the factors "S" are isolated the direct and indirect effects, the BLs' take the form:

$$DIrBSE'=InDIrBSE'-InSE'\ ,$$

and as it has been determined in the previous, these measurements are the truncated total effects $(STrTBL)$, scilicet the rest effects without the initial effect, while particularly for the case of output this index is found as:

$$OTrTBL'=DIrBOE'=InDIrBOE'-InOE'=InDIrBOE'-I\ .$$

Inferentially, de Mesnard's indices are an elegant approach to the intermediate endogenous mechanism of model, for the measurement of multiplicative round-by-round direct and indirect effects that are caused to the rest of economy from a one unit value-change on a sector's output, when this sector decides to increase its output, of ones own accord. Then, the initial stimulus is originated from a change on the sector's output instead to come from a change on its final demand, and the exogenous change of sector's output is considered the injection for the endogenous (intermediate) round-by-round effects on total output (Sancho, 2013; Cardenete *et al.*, 2017). Although the fact that, for the de Mesnard's indicators have been used (from others) in the literature the term *"de Mesnard's net multipliers"*, however these indices are unambiguously gross multipliers since are exactly focused on the intermediate round-by-round direct and indirect effects. Oosterhaven (2004) has criticized the *"de Mesnard's net multipliers"* saying that they do not solve the double-countings of endogenous intermediate connectedness, but de Mesnard's approach did not aim to create net multipliers. De Mesnard's approach, using truncated linkages' indices, is focused to explain what multipliers could be multiplied straightforward with the sectoral outputs, instead to them that are used for multiplication with the sectoral final demand. Hence, despite of the fact that the initial exogenous effect is supposed to be happened on the sector's output, if its reflection on the ignored sectoral final demand (dY_i) is taken into account again, then these measurements are come back to: $(I-A)^{-1}$ and b_{jj}, instead to

the: $[(I-A)^{-1}-1]$ and $b_{jj}-1$, due to the fact that the conventional causal balance remains in force in any case: $dX_i = dYi = 1$.

The basic causal one-to-one balance of a model between the initial exogenous change on the final demand and its correspondence on the sector's output $(dX_i = dY_i = 1)$, also remains in the Dietzenbacher (2005) proposal for the percentage initial exogenous change on the sectoral output. For the matter, according to Dietzenbacher (2005) paradigm, an one percent (1%) increase on the sector's i output: $X_i = 7000$, is corresponded to a 70 units initial increase on the sector's i output, or else this is a net equivalent to a 70 units initial increase on the sectoral final demand of conventional approach $(dX_i = dYi)$. So, in this approach the only point that has been changed in comparison to the traditional path is the percentage express for the initial effect at its offset-point.

Consequently, looking at the backward, the approaches of Dietzenbacher (2005) and de Mesnard (2002b) keep the model's causality. Essentially, these approaches in an open model remain net-to-gross and only in a completely closed model are converted to gross-to-gross. Moreover both of them are appropriate for a completely closed model in which all the components of final demand are endogenous in it. However, an industry's decision to increase suddenly its output does not follow the rational causality that exists when a sector response to its final demand's changes, since this decision in advance presuppose the knowledge for the absorption of new extra output both via the endogenous intermediate demand and the internal and external final demand. Someone can find in the literature more approaches that are handled the sectoral outputs as exogenous initial starting-points (Cai and Leung, 2004).

The use of sector's i output, as the initial exogenous starting-point, has been researched in the literature in order to be covered the fictitious and erroneous needs of practitioners who want a tool to multiply suitable reformed indicators straightforward with the sectors' output. However, when a total coefficients' matrix $(I-A)^{-1}$ is multiplied with a matrix of direct coefficients A, then although that the coefficients of the matrix $(I-A)^{-1}A = [(I-A)^{-1} - I]$ are smaller than those into the matrix $(I-A)^{-1}$, they do not exclude their double-countings. The view that the multiplication of suitable reformed indicators with the sectoral outputs will remedy the double-countings distortion, basically remains an illusion. In the antecedent sections, it has been brought out that the "precision" in I-O models is something relevant. The inherent model's propensity to produce double or more than double-countings that are included in the conventional total indices, or/and in the truncated total indicators too, is only one of the reasons. The multiplication of conventional-causality indicators with the sectoral outputs hyper-multiply the inherent double-countings from the indirect round-by-round effects of productive circuit, in anyway. Even though the above approaches do not solve the intrinsic problem of double-countings, someone could find them interesting since they provide an alternative exploitation of information, expanding the theoretical paths.

If someone insists to require a "quasi-gross-to-gross" approach in a non-conventional open model, then he/she must be look at Miller and Blair (2009, pp. 621-639). The truncated BLs' and t.I-Ms' indicators must not be confused with the *"output-to-output multipliers"* of Miller and Blair (2009, p. 625). In Miller and Blair (M-B, henceforth) approach, the b_{jj}

intra-industry effects have been standardized to be equal to one: $b^{*}_{jj}=1$. This create an "homogenous sectoral base" from which is disappeared any differentiated (≠1) intra-sectoral effect. Hence, the process begins from a common unitary intra-sectoral level, so as the indicators to be kept detached from the total intra-sectoral (initial, direct and indirect) differences of multiplicative effects. Thereafter, the sectoral BLs' and t.I-Ms' indicators can loud and clear to provide results which remain unaffected from the intra-sectoral differentiations and strictly based on the sectoral direct and indirect spillovers. For this scope, the individual elements of total requirements matrix are reformed as:

$$b^{*}_{ji}=(b_{ji}/b_{ii})=(dX_j/dY_i)/(dX_i/dY_i)=(dX_j/dX_i)$$

$$\text{and: } dX_j=b^{*}_{ji}dX_i \ ,$$

while for the diagonal elements be valid the:

$$b^{*}_{jj}=(b_{jj}/b_{jj})=1 \ .$$

The outcome is a normalized Leontief's inverse matrix: $[(I-A)^{-1}]^{*}=B^{*}$, with the appropriate shape for a gross-to-gross approach: $X^{*}=B^{*}X^{e}$, with X^{e} to be the independent (exogenous) sectoral output (Miller and Blair, 2009, p. 625; Sancho, 2012). The more interesting point in this proposal is the attempt for the "clear isolation" of calculated impacts from the differentiated intra-sectoral effects. However the crucial point that must be examined through empirical studies, comparing the derived indicators' results and the sectoral rankings with the outcomes from the others approaches, is the fact that the division b_{ji}/b_{ii} does not modify only the elements on the diagonal of matrix, but also shrinks each one of the rest elements that are out of the main diagonal. An automatous consequence that can be supposed is that will be exaggerated the shrinking of derived indicators, while a basic question is how the per sector differentiated denominators $(b_{ii}\neq b_{jj},\forall i\neq j)$ will affect the indices' measurements and the sectoral rankings. The out of the main diagonal elements of normalized Leontief's inverse matrix of M-B are coincided to the corresponding elements of Szyrmer's "total flows' approach", while the difference between these two approaches is that the elements on the main diagonal of M-B are all equal to one (Miller and Blair, 2009; Oosterhaven, 2017; Sancho, 2012; Szyrmer, 1992; Temurshoev and Oosterhaven, 2014). Temurshoev and Oosterhaven (2014) had exhibited a connection among the Miller and Blair's *"output-to-output multipliers"*, the Szyrmer's *"total flow multipliers"*, and the *"complete and partial* (truncated) *hypothetical extraction linkages*". In the spirit of HEM, Cai and Leung (2004) proposed *"supply-driven Leontief's and Ghosh's indices (LSD, GSD)"* with the sectoral output to be the offset-point for their stimulation, in a trial to improve the Dietzenbacher (1997) *"absolute backward and forward linkage measures"* and the *"pure backward and forward linkage measures"* by Sonis *et al.* (1995). It must be underlined that in Cai and Leung (2004) terminology, the term *"supply-driven model"* is not coincided to Ghosh's model, but they indicate the origin of stimulation from the sectoral outputs' changes, instead to the final demand's changes or to the primary inputs' changes.

Someone can meet in the literature the concepts "gross" and "net" effects with an absolute different substance, than their senses in the previous. For instance, Acharya and

Hazari (1971) used the concepts "gross" and "net" effects to distinguish the indicators that are derived from the conventional Leontief's inverse matrix, from those that can be obtained from a *"domestic inverse matrix"*. They baptized "gross" the multiplicative impacts of Leontief's inverse matrix because their measurements include the consequences of imports' effects, and they have constructed the *"domestic inverse matrix"* as more appropriate for the derivation of "net" multiplicative impacts, subtracting from this matrix the imports' effects, claiming that their matrix is a more suitable approach when someone want to study the productive circuit of less developed countries (LDCs') in order to build a developmental strategic pattern. Jones (1976) and Alauddin (1986) have adopted these concepts, trying to expand them. The linkages' indices from the domestic inverse matrix focus on the domestic capabilities of productive structure. A planning that is based on these indices does not permit the progress of economy. The economy is circumvallated into its restrictive productive limits. In contrast, the derived indicators from the conventional Leontief's inverse matrix can exhibit the avenues wherein the growing patterns must be swiveled for the reformation of existed economic structure to a more efficient scheme for the social prosperity (Lopes and Neder, 2017). Beverelli *et al.* (2016) and Meng *et al.* (2017) have pointed out that, into the subnational level, the strong inter-industrial and interregional linkages among the firms improve the domestic productivity, due to the exploitation of comparative advantages and specializations. Improving the sectoral and regional domestic specializations and the competitiveness of domestic firms, as a consequence the country's participation in the global supply and in the value added chains can be enhanced via the collaborations with firms of other countries in the framework of global functional and spatial fragmentation of production (Romero *et al.*, 2009; Puttanapong, 2016; Meng *et al.*, 2017). This situation implies intraregional effects from the interregional or/and international trade flows and spillovers, which are oriented into or/and out from the national borders (Meng and Qu, 2008; Meng *et al.*, 2017).

Closing this section, in the framework of conceptual inconsistencies into the literature, it must be brought out that Bayers (1976) and Cardenete *et al.* (2017), both of them have used the term *"supply multipliers"* under another purport, comparing for example with the usage of same term from Miller and Blair (1985, 2009). Moreover, as concern the conceptual part, it must be referred that Dietzenbacher (2002) has rejected the M-B terminologies: *"output or demand multipliers"* for the BLs' of Leontief's inverse matrix and *"input or supply multipliers"* for the FLs' of Ghosh's inverse matrix, proposing instead of them, the terms: *"backward output multipliers"* for the BLs' of Leontief's inverse and *"forward output multipliers"* for the FLs' of Ghosh's inverse. Both of these terminologies (Dietzenbacher's, as well as Miller and Blair's) seem to be adopted and used from Temurshoev and Oosterhaven (2014). However all these terminological approaches are very limitative, since both the Leontief's and Ghosh's models can provide "backward-to-forward" and "forward-to-backward" multiplicative measurements under their suitable management, as it has been illustrated earlier.

7. THE "SIZE-INDICATORS"

Oosterhaven and Stelder (2002) (O-S, henceforth) did not underline the inherent propensity for double-countings into the round-by-round effects of model. They had discerned the double-countings that were produced when the practitioners instead to multiply the

conventional impacts' indicators with the sectoral final demand, multiplied them straightforward with the sectoral outputs. O-S have pointed out that this misuse practice uses the sectoral outputs as *"size-indicators"* in order to be taken into consideration the relative sectoral sizes. However, as it is elaborated below, the sectoral outputs themselves are unsuitable to operate as *"size-indicators"*. Such practices are an accessional corroboration that the "precision" is something relevant in I-O analysis as for the estimation of absolute magnitudes for the sectoral outputs after from an exogenous initial stimulus, since it is depended on the used indices and from their handling (Milana, 1985). Due to the aforementioned practitioners' trend, Dietzenbacher (2005) has stressed that if the practitioners want to multiply with this way, the researchers must construct the suitable tools, since any index can answer to specific questions (Sonis *et al.*, 1995). Sancho (2013) seems to disagree with the Dietzenbacher's opinion, as for the practitioners' satisfactory, saying that a bad habit is better to be stopped instead to be faced with half-measures. O-S (2002) were the first that had tried to propose suitable differentiated indicators to this way, using differentiated weights. However, after from the criticism on their indicators, Oosterhaven (2017) had advocated to be halted the proliferation of indicators, something that is discrepant. This is much more discrepant and likes with an elimination of others aspects, given that in Temurshoev and Oosterhaven (2014) had proposed another one index, the *"Temurshoev-Oosterhaven net forward"* reflection of *"O-S net (backward) multipliers"* (2002).

The construction of more and more tools must be always desirable for the scientific progress (Sonis *et al.*, 1995) and can't be confused with their comprehension or with their posterior empirical proved weaknesses and capabilities. However, the first step must be the comprehension of existed tools that are already found at the policy's makers disposal and the examination of their capabilities and peculiarities, so as to be understandable what needs these tools can cover, and what cannot, their advantages and disadvantages, and then to construct indeed usable new tools (Sonis *et al.*, 1995). The fallacious use of existed indicators and the erroneous interpretations of sectoral rankings from the policy's planners probably conceal tendentiousness into the planning through pressures from the governmental factors. The electoral promises, the pressures on the governments from the labor syndicates and the employer unions, the multinational companies, the supranational-international organizations, or/and even the personal benefits, are all crucial factors that restrict the free and independent decision-making (Müller-Hansen *et al.*, 2017). From another view, the bad use of indices is possible to be emanated from the fact that the technology converts the practitioners to computers' operators who do not plunge into the advantages and disadvantages of used indicators (Lopes and Neder, 2017).

In the previous sections have been presented approaches registered in the literature aiming to satisfy the discerned (from O-S) practitioners' habit, for the multiplication of impacts' indicators straightforward with the sectoral outputs. de Mesnard (2002b) and Dietzenbacher (2005) approaches are corollaries from their criticisms to O-S (2002) proposal for the *"net multipliers"*. O-S, earlier in 2002, had suggested a new form for the impacts' indicators in order to solve the problem of double-countings that they had discerned to be happened from the practitioners' misuse, naming their indices *"type I and II net total multipliers"* (Oosterhaven and Stelder, 2002; Oosterhaven, 2004, 2007, 2017). Into the framework of conceptual confusions in the literature, later, in 2014, instead of the term *"type I net total multipliers"*, Temurshoev and Oosterhaven have preferred for the same index the term *"net backward linkage"*. The targeting of O-S, on the t.I-Ms' indices, is distinct from

their approach at the employment case, since in the case of output the t.-I Ms' and the BLs' are in consonance. Scrutinizing someone the *"O-S net multipliers"* can ascertain that this attempt is nearest to the concept of "truncated t.I-Ms"" (scilicet, without the initial effect in their numerators). Precisely, the *"O-S net multipliers"* are "gross truncated and weighted t.I.-Ms"" and this means that they are not "net" but "gross" multipliers based on a net-to-gross causality and they are standardized via an explicit weight.

The practitioners' habit to use the sectoral outputs as *"size-indicators"* in order to take into account the relative sectoral sizes is unorthodox. The multiplication of impacts' indicators (BLs' or t.I-Ms') with the absolute numbers, either of sectoral final demand (Y_i), or of sectoral output (X_i), does not operate as a correct weight. A multiplication like this just enlarges the level of multiplicative effects as absolute magnitudes and only with a relevant precision (Milana, 1985). Furthermore, both the sectoral final demand (Y_i) and the sectoral output (X_i), are parts from bigger summations that denotes the total final demand (Y^T) or the total sectoral output (X^T) of economy, so as if someone wants to compare and classify sectors taking into consideration their relative sizes into the economy, then he/she multiply these impacts' indicators with ratios that are appropriate to measure the participation of each one sector into the total measures of economy, like as the fractions: (Yi/Y^T) and (X_i/X^T).

The ratio: $Y_i/Y^T = Y_i/\sum_{i=1}^{n} Y_i$, firstly had been worked from Hazari (1970), while the weight: $X_i/X^T = X_i/\sum_{i=1}^{n} X_i$ had been suggested from Long (1970). These ratios are weights for the relative sectoral size into the economy and reform the multiplicative effects that are revealed via the impacts' indicators and their sectoral rankings (Cuello *et al.*, 1992). In action, these weights shrink the potential sectoral multiplicative effects to more realistic levels, according to the sectoral relevant sizes, creating a category of "shrinking and correctional orderings' weighted indices". In this category can also be classified the weight: $Y_i/X^T = Y_i/\sum_{i=1}^{n} X_i$, of Mattas and Shrestha (1991).

Each one of these ratios has the feature that is harmonized with the static demand-driven Leontief's model. On the contrary, the weight Y_i/X_i that O-S have suggested in order to take into account the relative sectoral size (Oosterhaven, 2004, 2007; Oosterhaven *et al.*, 2001; Oosterhaven and Stelder, 2002), does not have this characteristic. O-S (2002) ratio: Y_i/X_i, is a weight in which both the numerator and the denominator are altered and fluctuated. De Mesnard (2002b, 2004, 2007a, 2007b) and Sancho (2013) have detected the unstable of O-S (2002) weight. This changeability is a common feature for all the ratios that have the form: Y_i/S_i, e.g.: Y_i/E_i, Y_i/W_i, $Y_i/CO2_i$ and so forth. This means that the O-S weight is not appropriate for a static model, but it could be more suitable and interesting for dynamic approaches. Through another approach, the static I-O models usually portray a transient situation of economy's equilibrium (Kelly, 2015), without a demand capable to lead to a full employment of labor and a full exploitation of capital assets, in which each one

sector can increase its primary inputs at fixed (short-run) prices without to need to abstract inputs from anyone else sector (Valadkhani, 2003; Godley and Lavoie, 2007; Müller-Hansen *et al.*, 2017). In contrast, the O-S (2002) ratio describes a situation in which the increase on a sectoral total output implies a decrease on the total outputs of other sectors, something that it is matches to a situation with a full exploitation of primary factors. However, the full or almost full utilization of productive factors is always a description for a situation nearest to the ideal long-term aims through a dynamic evolution. The static I-O models hide this substitution's opportunity cost (Valadkhani, 2003).

In any case the "shrinking and correctional orderings' weighted indices" must not be confused with the "comparative orderings' weighted indices". The latter group includes indices that do not aim to shrink the potential sectoral effects, but have as a unique scope to order the sectors of economy comparing their ability for impacts' generation with a weighted visualized sectoral average for the whole economy. Such indicators are the weighted indices of Rasmussen (1956) and Diamond (1975), the Heimler (1991) index for the "*degree of vertical integration"*, or even the Dietzenbacher (2005) fraction for the comparison of forward and backward sectoral effects per each one sector, separately. However, these indices, in essence, are not indeed multipliers due to the fact that nothing multiply.

Dietzenbacher (2005) fraction that it has been presented as an alternative exploitation and interpretation of *"O-S net multipliers"*, can compare the backward and the forward effects of a sector (as numerators, denominators, and vice-versa), with gravity center the one (1), in order to discern if a sector i is more important as a purchaser or as a seller sector into the economy. This ratio seems to be more an idea to construct an index, which will be capable to compare the dispersed (backward) with the concentrated (forward) sectoral effects, instead of this that O-S (2002) had in their minds when they proposed their *"net multipliers"*. However, it is purely arbitrary to be regarded as more important for the economy those sectors that have more noteworthy backward than forward effects (or the opposite), despite of the fact that the majority of the studies are focused only on the part of backward effects, due to the mentioned in the antecedent sections interpretative peculiarities and computable difficulties of forward indicators. In point of fact, the developmental planning must exploit both the backward and the forward indicators, but this implies double work, more time and more finicky and meticulous analysis, if someone decides to use a combination of conventional way with the adjusted option.

The Dietzenbacher (2005) ratio could be utilized for descriptive scopes, as to share the sectors into three groups: 1) a first group with the purchasers sectors (with the backward greater than the forward impacts), 2) a second group with the sellers sectors (with the forward greater than the backward impacts) and 3) a third group with sectors that keep a balanced role as purchasers and sellers (when the ratio is near to one). However, as it had already been remarked, in the conventional model, the indices of total forward effects have the weakness that they are originated from direct coefficients and final demand's coefficients, with sums different from the one ($\neq 1$) per row. This implies that the total effects of numerators and denominators of Dietzenbacher (2005) ratio are not endowed with the appropriate compatibility for their comparability, at their offset definition. In order to be confronted this problem, the adjustment of rows' coefficients, so as to be obtained sums equal to one (=1), must be applied.

Coming back to the group of "shrinking and correctional orderings' weighted indices", a particular mention must be done to elasticities indicators of Mattas and Shrestha (1991, M-

S hereafter). The elasticity is a tool that can be used either weighted or non-weighted for the measurement of multiplicative effects. For instance, the intra-sectoral output elasticity for a sector i is (Sancho, 2013):

$$(dX_i / X_i)/(dY_i / Y_i) = (dX_i / dY_i)(Y_i / X_i) = b_{ii}(Y_i / X_i)$$

and of course:

$$[(b_{ii}Y_i) / \sum_{j=1}^{n} b_{ji}Y_j] < 1 \ .$$

The intra-sectoral output elasticity $b_{ii}(Y_i / X_i)$ has been called from M-S (1991) as *"direct output elasticity (DOE)"*, but this term has the problem which has been detected in previous as for the use of term "direct". The ratio $b_{ii}(Y_i / X_i)$ is just an internalized weighted intra-sectoral total (initial, direct and indirect) effect, since the intra-sectoral total effect b_{ii} is multiplied with the weight: (Y_i / X_i), in which the Y_i and X_i are ex ante (stable) magnitudes (and this is the basic difference comparing with the dynamic fluctuating Y_i and X_i magnitudes of O-S ratio). Due to its definition, an elasticity index depicts the weighted percentage change of sector's i output due to the percentage change on its final demand. Hence, the: Y_i / X_i , is a ratio that is revealed from the definition of elasticity's index itself.

Generalizing the product $b_{ii}(Y_i / X_i)$ to a form $\sum_{j=1}^{n} b_{ji}(Y_i / X^T)$ is created the concept of *"output elasticity (OE)"* that measures the multiplicative effects that are dispersed from a sector i to the economy's output as a percentage, due to an initial unitary percentage change on its final demand and taking into consideration its relative size. In order to be captured the relative size of a sector into the economy, M-S (1991) have applied the weight: $Y_i / X^T = Y_i / \sum_{i=1}^{n} X_i$, as part of elasticity's index. The peculiarity for this weight is that yields a sectoral final demand (Y_i) as a proportion of total output of economy (X^T) and due to its denominator this ratio trend to shrink excessively the estimated multiplicative impacts. Using for instance a weight like the: $Y_i / Y^T = Y_i / \sum_{i=1}^{n} Y_i$, in which $Y^T < X^T$ at the point of denominator, or even a weight like the: $X_i / X^T = X_i / \sum_{i=1}^{n} X_i$, in which $X_i > Y_i$ at the point of numerator, the ratios' percentages will be bigger and the same will be happened to the magnitudes of obtained elasticities. This is an observation that can also be studied and interpreted using empirical results. Hence, for any kind "S" of effects, the cross-sectoral elasticities' indicators (like those of M-S) can be calculated as:

$$SE_i = [[\sum_{j=1}^{n} b_{ji}(S_j / X_i)]/(S_i / X_i)](Y_i / X^T) \ .$$

The "S" kind of elasticity (employment elasticity, income elasticity, etc.) represents the percentage change of parameter "S" (e.g. employment) into the economy that is generated from a one percent (1%) change on the parameter "S" of i sector (which is expressed based on its output and is weighted with the expression of its final demand to the total output of economy).

In the numerator of elasticity's type, if the parameter S_i replace the parameter S_j, then the above type is not the cross-sectoral elasticity's index. Instead of it, a weighted type I (forward) multiplier is created with a weight: Y_i / X^T. Returning to the paradigms about the confusions into the literature, Valadkhani (2003) had calculated an index that he thought that was the employment elasticity of Mattas and Shrestha (1991), without to be. Valadkhani (2003) index was an ETBL index that was weighted by a ratio: Y_i / E. However, the interesting point is met at the denominator of his weight that was specifically focused on on the measured kind of employment (E). The Valadkhani's index marked as more important for the employment's growth, those sectors that already had a notable relative size into the economy's employment, according to their employees' percentage. Another one observation is that the exclusive concentration of developmental planning on sectors like these, can partially tackle the unemployment into the short-to-medium-run level, but does not create the substratum for the medium-to-long-run improvement. For applications with the elasticities indicators, among others, the reader can see: Ciobanu *et al.* (2004), Loizou *et al.* (2015), Kolokontes *et al.* (2008; 2018).

The weighted-indices using size-weights are affected from the relative size of each one sector (Valadkhani, 2003; Kolokontes *et al.*, 2008; Kolokontes *et al.*, 2018) overriding and putting on the background the sectoral promising potentials. This means that the BLs' and the t.I-Ms' are affected when they are multiplied with the size-indicators, due to the fact that their weights shrink their potential sectoral multiplicative effects and modify the sectoral classifications. Kolokontes *et al.* (2018) have elaborated that the breakdowns from the non-weighted impacts' indicators show the sectoral dynamics via their promising spillovers. Supposing that the sectors of economy will be enlarged, these potential capabilities can gradually be materialized. The developmental expansion for all the sectors of economy is a progress, once. A developmental expansion following a suitable structural reformation is a progress, twice. The Hirschman's unbalanced growth gave emphasis on the more promising sectors. This must not be confused with a unilateral sectoral hydrocephalism. The rankings of weighted impacts' indicators reveal as more important for the growing planning those sectors that are already capable to actualize their multiplicative effects due to their size. The policy-makers must be careful do not lead the productive circuit to a unilateral sectoral hydrocephalism relied only on the weighted, by size-indicators, impacts' indices, and simultaneously they must care to remedy the existed structural distortions opening new prospects for sectors that deserve more attention, as capable to ameliorate the social prosperity via the correctional and hopeful reformation of productive network for the present and the next generations (Ivanova, 2014; Lopes and Neder, 2017; Müller-Hansen *et al.*, 2017; Kolokontes *et al.*, 2008; Kolokontes *et al.*, 2018). The coexistence of weighted and non-weighted indicators facilitates the growing planning for the present phase of economy and for a future perspective (Humavindu and Stage, 2013; Kolokontes *et al.*, 2008; Kolokontes *et al.*, 2018; Sonis *et al.*, 1995). The necessary presupposition is the policy-makers to delve at the roots of

indices in order to understand their peculiarities, their advantages and disadvantages, instead to applied them as computers' operators (Lopes and Neder, 2017).

Thereafter, the weights are not panacea and must be used with attention. For instance, taking a marginal supposal that a sector i has zero sales to the final demand $(Y_i = 0)$ (Milana, 1985), automatous each index that uses a weight with the final demand as numerator will become zero. This means that the sector will present zero multiplicative effects, although it is possible this sector to be very important underpinning and supporting the productive circuit, intermediate and endogenous. Another one observation as for the weight that have as a numerator the final demand (Y_i) and as a denominator the total output of economy (X^T) is that closing an I-O model then the denominator is enlarged due to the additional effects from the interactions that are come from the new endogenous elements. In this case, the weight trends to shrink the weighted-index (scilicet the multiplivative effects that will be already enlarged due to the close form of the used model). Hence, any weighted-index that uses for its weight as numerator the final demand (Y_i) must be faced with carefulness because of its propensity to propose as *"intustrie motrice"* these sectors that are kept noteworthy sales to the final demand, against to those sectors that are kept significant intermediate purchases and sales as pylons for the productive circuit (Milana, 1985). From the other hand, any weighted-index that uses as denominator in its weight, the total output of economy (X^T), automatous uses double-countings. Especially, the weight that have the form: $X_i / X^T = X_i / \sum_{i=1}^{n} X_i$ (Long, 1970) constitute "the compatibility of double-countings" according to its numerator and denominator. In any case someone can create differentiated indices via the generalization of Hazari (1970) and Long (1970) formulae as: $S_i / S^T = S_i / \sum_{i=1}^{n} S_i$,and then can apply these weights on the variant indices comparing the derived results.

Closing this section, it is underlined that the role of policy-makers is to choose and combine the appropriate indicators (Bayers, 1976; Temurshoev and Oosterhaven, 2014) according to their desirable and predominant target, so as from the one hand to register the sectors with the most important potential impulses as for the different kind of effects (e.g. output, income, employment, etc.) for a medium-to-long-term planning, while from the other hand to take into consideration the given relative size of each one sector in the framework of a short-to-medium-term "transitive planning" (Sonis *et al.*, 1995). Especially, the care of transitive planning must be to put the productive circuit to a correct developmental track (Baumol and Wolff, 1994), so as gradually to become more realistic the potential sectoral impulses into the perpetual optimization procedure for the social welfare (Lopes and Neder, 2017; Müller-Hansen *et al.*, 2017). The sectoral attractiveness for the private investments' funds (Kolokontes *et al.*, 2018), the estimation for the operational levels for each one sector as concerns the limits of their sectoral productive capabilities (Miller and Blair, 1985, p. 104), the natural sources and the environmental regulations and externalities (Müller-Hansen *et al.*, 2017), the educational policy, the infrastructures (Kelly, 2015; Kelly *et al.*, 2016), the private and the public budgets' restrictions and the opportunity cost of *"expenditures substitution's effects"* from the reallocation of public expenditures among the sectors or from changes on the taxes-policies (Cardenete *et al.*, 2017; Guerra and Sancho, 2012; Oosterhaven, 2017;

Temurshoev and Oosterhaven, 2014), the social satisfactory and the happiness, are also parameters that deserve attention. The heuristic feedbacks, the inferences and the conscious choices among alternative options and actions are parts into this cognitive process of decision-making (Weber, 1978; Gigerenzer and Gaissmaier, 2011).

8. CONCLUSIONS

Studying the narration of previous sections someone can find a concentration of nomenclature terms that are used in the I-O analysis, both with paradigms about their terminological inconsistencies in the literature. The concept of "intra-sectoral initial trend for effects generation" is entered in order to explain the terminological inexactitudes. Elaborations and comments as for the derivation of multipliers' matrices and the indicators' tools are provided, through a concentrating process, step-by-step. The effects of size-indicators have been analyzed. An adjustment for the I-O models, in order to be obtained from them, compatible and comparable, forward-to-backward and backward-to-forward indices, is published for the paper needs, at a theoretical level for the moment.

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