Accounting for International Trade in Value Added: Some Comments on the OECD-WTO Project

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Abstract

In the global economy of today, what you "do," the activities a firm or a country is involved in matters more for growth and employment than what you "sell," the final product. Global value added chains (GVCs) allow firms and countries to "do" the part of the process they are best at. They affect countries' competitiveness and patterns of trade and investment.

In response to this new reality OECD and WTO have joined forces, and launched a common statistics project of the "OECD-WTO Trade in Value Added (TiVA) Database." The database links national input-output tables with bilateral trade data to develop inter-country input-output tables that provide a wide range of indicators on GVCs. The proposed paper reviews the report that sets out the main evidence and policy implications of this work, and points out some consequences which follow from this new empirical research for traditional economic theory of international relations. The observed rapid rise of production fragmentation established within a new global division of labor has impacts on national growth, jobs and productivity which cannot be handled within the old theoretical framework, alone.

1. Introduction

"Interconnected Economies. Benefitting from global value chains" is the telling title of the synthesis report of an OECD work to which an unusually large staff of the organisation has jointly, and one can say, successfully, contributed. The title is instructive as it has been chosen on purpose, supposedly. We are not speaking of the one "global economy", anymore, because there is no such thing, and what we actually observe is not fusion, but "interconnection" of existing economies, and those are given, and essentially defined as being of "national" character. OECD is an international organisation founded by its member states in order to provide a forum where national governments can work together to share experiences and seek solutions to common problems. In this function it sets standards and promotes policies on a wide range of things leading governmental action and laws. Its work is open and worth being studied and evaluated not only by member states, but also by their citizens, because it is their life such action is aimed at, eventually. The new fact to which to pay attention is modern economies are "interconnected", they establish "global value chains", and the questions is how to "benefit" from the new reality.

This is not the place for a comprehensive evaluation of that outstanding project. The focus is put on one particular issue, only, which is the role foreign exchange rates play in determining national value added, at an international level. The OECD report is characterized

by a complete absence of considerations concerning that role. It proceeds and argues as if exchange rates were non-influential, or, if they were, they were fixed, so as if one operated within a world being endowed with an overarching and stable global currency serving as an unequivocal unit of measurement of any national value added. Whether to call this a serious deficiency, or not, is a matter of point of view. A large part of the report is based on business administration literature, a field where foreign exchange rates are recognized and treated as exogenous parameters, which are important to deal with, but their management is not part of ordinary business operations, being similar in this respect, to wage rates or tax obligations. So from the business administration point of view the omission is natural. In economics proper, however, while it is true that most foreign trade theory abstracts from exchange rate variation, governmental action on the economy cannot succeed without regard to the rate of foreign exchange. Some consequences of that disregard are pointed out, not from a policy, but from a pure statistical measurement point of view, and taking the additional step of going from nominal to real exchange rates is suggested as the proper remedy. Independent of that lacuna, inherited from business administration and theoretical economics, the report contains a valuable empirical message for these theories. In outlining the chances and risks of multinational organization of production the report elucidates the additional management leverage gained vis-a-vis legislation of national governments through internationalization, and concerning economic theory it concludes that the classical paradigm of comparative advantage of international trade is now being replaced by the ordinary search for absolute advantage. The latter of these two issues will be addressed and discussed here.

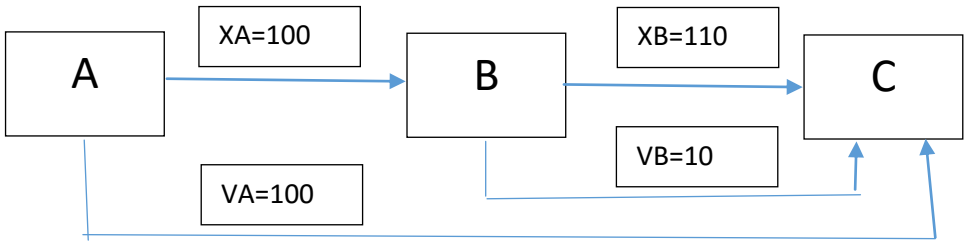
2. Compiling value-added chains

The “interconnection” of national economies is described and studied by observing flows of exports and imports, the constituents of international trade, traditionally. They are recorded in the balance of payment every country prepares in order to determine and to control its position in international finance. A negative balance of trade expresses a need to acquire international finance through further transactions of either income or credit, a positive balance of trade indicates a surplus of foreign financial assets acquired through trade. The economic picture drawn out in this way is complete as long as any production of goods and services traded is completely contained within one and the same country: The wine exported to England is completely produced in Portugal, and the wool traded in exchange is fully of English origin – the classical example of the theory of trade. With the arrival of multinational corporations the classical paradigm is no longer pertinent, today. As production stages and technologies have become internationally mobile companies disperse their operations across the world; goods, and increasingly services, contain inputs sourced from many countries. Intermediate inputs such as parts and components are produced in one country and then exported to other countries for further production or assembly in final products: cotton grown in the United States is exported to China to be manufactured into a T-shirt, which is returned to the United States for imprinting with logos and graphics for wholesaling and retail sales; sometimes, the used T-shirt is exported to Tanzania for resale or is shredded as furniture padding. The sequential stages in the value-added chain are

typically performed in the location best suited to the activity. Countries are now part of a process of vertical specialisation, a vertical division of labour in which countries specialise in specific stages and tasks of the value-added chain. “This is a departure from the long-established view of comparative advantage as concerning specific goods or industries.” (OECD 2013, p. 16) Multinational enterprises undertake different stages of production in different countries, with the location of the stages depending on the cost of the factors of production that are used intensively. A simple example illustrates the phenomenon (figure 1).

Country A exports USD 100 of goods (XA), produced entirely in A, to country B, which further processes them before exporting them to country C (XB) where they are finally consumed. B adds value of USD 10 to the goods and so exports USD 110 to C. Conventional figures of trade show total exports and imports of USD 210 but only USD 110 of value-added has been generated in their production. The aim of the trade in value-added approach is to identify the different national origins of the value added contained in a product.

Figure 1: A simple schematic for trade in value added



Source: OECD 2013

Input-output tables reveal the relationship between the use of a good, - intermediate or final – and its production. They can therefore be used to estimate the foreign value-added contained in an imported good which again is an input into production of some other good. OECD and the WTO have joined forces, for the purpose, to produce an input-output data base containing a coherent set of supply and use tables for every country of the world.

Figure 2 exhibits the basic structure of an input-output table of two countries, as a simplified example. Each country A and B has two industries where it does not matter whether they are the same, or not, between them; the distinction by origin is sufficient to separate the industries. The first quadrant z_{ij} figure 2 registers intermediate consumption of products where i,j = 1 or 2 denotes consumption of domestic goods of country A in country A, and i,j =3,4 denotes the same for country B (the diagonal submatrices). Mixed indices i,j =1,2 for rows and i,j = 3,4 for columns (off-diagonal submatrices) describe exports of country A for intermediate consumption in country B, and vice versa. Final use f_{ij} (II. Quadrant) is also distinguished by industry i and country j as is the III. Quadrant y_{ij} of primary inputs and value added.

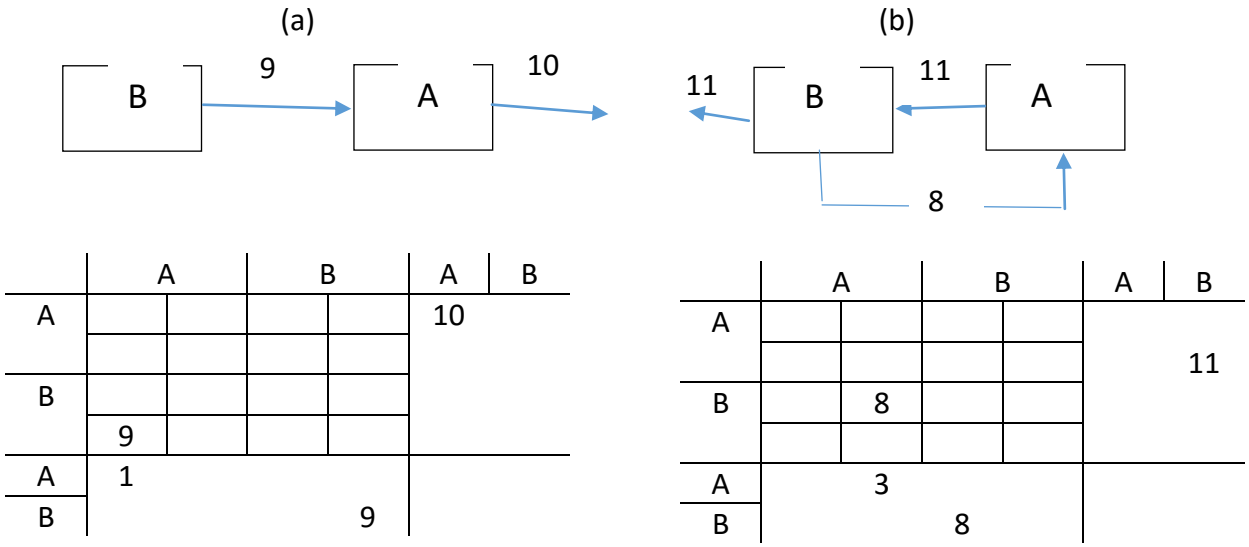
Figure 2: **Structure of a bi-regional input-output table**

	Intermediate consumption	Final use

		Region A Industry 1	2	Region B Industry 3	4	A	B
Region A	Industry 1	z_{ij}				f_{ij}	
	Industry 2						
Region B	Industry 3						
	Industry 4						
Value added	Region A	y_{ij}					
	Region B						

The next figure 3 tabulates two typical examples of interconnecting economies. Rows denote receivables (exports), columns denote payables (imports) of an account. In figure 3a an amount 10 of final use of product 1 in region A is traced back directly to an input of 9 of good 4 produced in region B and a value added of 1 in region A. The first is traced back further by its corresponding column to a value added of 9 generated in region B. This is the same case as the one described in figure 1. Figure 3b shows a more complex and more interesting case. A value of 11 of product 2 is consumed in region B. It is decomposable into a value of intermediate consumption of 8, that good being imported from B, and own value added in region A of 3. The export from B generates a value added of 8 there. In other words, final use in B is related to value added in B, mostly, in spite of the significant amount of foreign trade involved.

Figure 3 Two forms of interconnection: value increasing (a) and looping (b)



The mathematical apparatus applied in order to reveal the existing interconnection of economies is not explained well in the OECD publication. The pertinent chapter resembles more a computer program written for internal communication than an explanation directed to an external public. A brief, and therefore superficial, sketch of the method is produced here, for substitution.

It is a well-known feature of input-output methodology that it enables to map a given vector *f* of final use into the vector space of primary inputs *v*, by means of the famous Leontief inverse $(I - A)^{-1}$ where *A* is a matrix of input coefficients, and *x* is the corresponding gross output (Miller, Blair 2009, p. 53),

$$f \longrightarrow x \longrightarrow v.$$

In a system where there is only one (column) vector of final use and one (row) vector of primary input you have

(1) $$e' f = v' e$$

under the condition that column sums *s* (inputs) are equal to row sums *u* (outputs); *e'* = (1, 1, 1,…) is the summation vector In the two-region case, formulas are more complex and best explained by means of a small example (table 1):

Table 1: Example of a two-region economy

		A		B		A	B	Sum
(Z)		I1	I2	I3	I4	fA	fB	u
A	I1	1	1	2	3	3	2	12
A	I2	2	0	1	3	1	2	9
B	I3	1	3	0	2	2	3	11
B	I4	3	2	1	2	1	2	11
VA		5	3	0	0			8
VB		0	0	7	1			8
Sum (s)		12	9	11	11	7	9	

You calculate total output *u* according to equation 2*,*

(2) $$u = Ze + f_A + f_B$$

and total input vector *s* by equation 3,

(3) $$s' = e'Z + y_A + y_B$$

You have

(4) $$u = s$$

which is assured by defining value added y as the balance between output and secondary inputs in equation 3 together with equations 2 and 4.

Table 2: Aggregated goods and services account

Output produced in:	Used in A	Used in B	Total supply
Country A	8	13	21
Country B	12	10	22
Total use	20	23	

Trade balance of country A: 13 – 12 = 1

The matrix *A* of input coefficients is given by

(5) $$A = \{a_{ij}\} = \left\{\frac{z_{ij}}{u_j}\right\} = \begin{pmatrix} 0{,}083 & 0{,}111 & 0{,}182 & 0{,}273 \\ 0{,}167 & 0 & 0{,}091 & 0{,}273 \\ 0{,}083 & 0{,}333 & 0 & 0{,}182 \\ 0{,}250 & 0{,}222 & 0{,}091 & 0{,}182 \end{pmatrix}$$

from the figures of the example. Coefficients of value added are defined by equations (6),

(6)
$$g'_A = \{g_{1j}\} = \left\{\frac{y_{Aj}}{u_j}\right\} = (0{,}417 \quad 0{,}333 \quad 0 \quad 0)$$
$$g'_B = \{g_{2j}\} = \left\{\frac{y_{Bj}}{u_j}\right\} = (0 \quad 0 \quad 0{,}636 \quad 0{,}091)$$

It follows from equations (2), (3), and (5) that

(7) $$e' A + g'_A + g'_B = e'$$

so that

(8) $$g'_A + g'_B = e'(I - A)\,.$$

The Leontief inverse helps find output vectors x_A and x_B corresponding to final use vectors of each region f_A and f_B,

(9)
$$x_A = (I - A)^{-1} f_A$$
$$x_B = (I - A)^{-1} f_B$$

It follows from equation (8) that

(10)
$$(g'_A + g'_B)x_A = e'(I - A)(I - A)^{-1} f_A = e'\, f_A$$
$$(g'_A + g'_B)x_B = e'(I - A)(I - A)^{-1} f_B = e'\, f_B$$

Total value added contained in final use of products in region A can be divided into two shares, one coming from region A itself ($g'_A x_A$), one from region B $(g'_B x_B)$; the same holds for region B, a result which may be summarised in table 2, with figures from the example. The row of county A sums to 8, which is the value added generated in region A, and it sums to 8 for region B as well. The columns, however, sum to 7 for region A, which is the value added consumed there, meaning that 1 unit is exported to region B, increasing consumed value added from 8 units produced to 9. The off-diagonal figures indicate exports and imports of value added.

(11) Table 3: Mapping final use of products into value added generated

Value added generated in:	Value added consumed in region		Total value added generated
	A	B	
Region A	$g'_A x_A$ 3,7	$g'_A x_B$ 4,3	8
Region B	$g'_B x_A$ 3,3	$g'_B x_B$ 4,7	8
Total value added consumed	7	9	

3. The rate of foreign exchange

The example treated above table has been called “bi-regional,” meaning that two geographic regions situated within one and the same economy are being studied. And indeed, this has been the beginning of dealing with different territories, in input-output analysis. Going one step further, and applying the same technique to the relationship between different national economies requires not only more empirical effort, which has been generously been provided now by OECD, but it also introduces an additional variable into the model. A national economy is distinguished from a regional one by the fact that it runs and manages its own currency. A national currency serves three purposes. It is the general means of payment, above all; it must by a reliable store of value in order to fulfil that requirement, and it is the one and only measure of economic value. It is that last function which changes the picture drawn out in section 2. When each region in section 2 is interpreted as a nation, each running its own currency, different from the others, there is no unique and natural measure of value in which to express the common accounts. There is a new problem with which to deal is not a simple matter.

Common practice is two pick one national currency arbitrarily, and to transform the other currencies into it on the basis of rates established at foreign exchange markets; and that practice has been followed in the OECD study as well. But it is, so I argue, only a superficial solution. Any sound economic accounting requires the definition of a measure of value which is homogeneous throughout its realm of application. A standard, and essential, assumption of national accounting is that a unit of the national currency carries the same economic value independently of on what and where it is spent, within the economy. That is assumption is violated, obviously, when dealing with two different currencies, joined by a volatile exchange rate.

In economic modelling, the difficulty may be assumed away by postulating that the rate of exchange is set at a point where the purchasing power of the one currency equals the purchasing power of the other. That “purchasing power parity theorem” is admissible in models, for reason of simplicity, of course. The economic mechanisms envisaged behind the parity theorem is the following: Customers have free access to all markets in both countries. If the rate of exchange makes buying in one country appear cheaper than in the other, customers will shift their purchases there, and demand more of that country’s currency. Its rate of exchange will rise, as a result and make the commodities appear more expensive, as a result. Equilibrium of the exchange rate will be attained when the purchasing power of the two currencies is at par. In other words, the rate of foreign exchange is fully determined by the forces of supply and demand on national commodity markets, in this model. It is the assumption followed in all MRIO tables produced so far, including the new construction of global value-added chains.

Convenient as it appears the assumption is counterfactual, nevertheless. The fact is that only a few percent of the daily turn-over of foreign exchange serve the purpose of paying for international commodity trade. Trade does not have the leverage, at all, to influence and regulate the exchange rate. The opposite is rather true, a small variation in the underlying

exchange rate will have an enormous effect on some accounting constructs especially those which are compiled as a balance between two large figures, such as value added, which is defined as the balance of output and intermediate consumption. Table 3 assumes a 10 percent devaluation of the $B. The accounts are expressed in currency A. The effect on the resulting figures of value added is much larger than 10 percent, not so much in country A where the vector changes from (5.0; 3.0) to (5.7; 3.6) as in country B where a vector (7.0; 1.0) is modified to (7.1, 0.5). The balance of trade grows from 1.0 to 2.3.

Table 4 **Bi-national input-output table, variation of the exchange rate**

$A=1,1$B

		A		B		A	B	sum
		I1	I2	I3	I4			
A	I1	1	1	2.2	3.3	3	2.2	12.7
	I2	2	0	1.1	3.3	1	2.2	9.6
B	I3	1	3	0	2.2	2	3.3	11.5
	I4	3	2	1.1	2.2	1	2.2	11.5
		5.7	3.6	0	0			9.3
		0	0	7.1	0.5			7.6
sum		12.7	9.6	11.5	11.5	7	9.9	

Balance of trade = 2.3

The cause of revaluation may have nothing to do with conditions of production or consumption. It may simply have been triggered by a rise of positive international expectations about investment in country B. And, yet, this appears as if actual production has changed, a wrong implication, in this case. Table 4 shows the modification made to table 2, as a result of the shift in exchange rates. All value added figures vary significantly although no modification of production has taken place. The shift expresses only a movement of price levels.

Table 4 Mapping final use of products into value added generated after a 10 percent devaluation of currency B

Value added generated in:	Value added consumed in region A	B	Total value added generated
Region A	$g'_A x_A$ 4.05	$g'_A x_B$ 5.25	9.3
Region B	$g'_B x_A$ 2.95	$g'_B x_B$ 4.65	7.6
Total value added	7	9.9	

consumed			

The resulting balance of product trade, and thus of value added, grows from 1 to 2.3, it more than doubles in response to a 10 percent variation of the exchange rate. And how quick is a variation. It needs not even a modification of any of the parameters defining the relationship between the two countries. If the currency of a third country is chosen as unit of account, a change of the exchange rate with it of one country affects the measurement of its values in respect to the other country whose exchange rate with the base country remains stable. Rate of exchange are also highly volatile. One takes a particular day for specifying the rates, such as the 1st of January every year. Change that date for another one in the same year and you will have different values in your accounts. Last, but not least, the OECD has already recognised the inadequacy of rates of foreign exchange for measuring and comparing production of different nations, itself. It is so impressive, I quote it in full length:

”Why not to use exchange rates to make international comparisons of GDP? Before PPPs became available, exchange rates were used to make international comparisons of GDP. This was partly because there was no alternative, but the use of exchange rates was also underpinned by the theory of purchasing power parity in international economics. In its simplest form, the theory suggests that national price levels converted to a common currency using exchange rates should be equal. Arbitrage will ensure that the price of an individual good will be the same in all countries in which it is traded - the *law of one price*. Thus, when the individual goods are taken together, there will be high correlation in general price levels – at least in the medium and long term. The two principle assumptions underlying the theory are that the demand and supply for currency is driven entirely by international trade and that all goods (and services) are internationally tradable.

In reality, the supply and demand for currencies are influenced principally by factors such as currency speculation, interest rates, government intervention and capital flows between countries and not by the currency requirements of international trade. Furthermore, many goods and services, such as buildings, all government services and most market services, are not traded internationally. In other words, the two principle assumptions underlying the theory do not hold: exchange rates do not reflect the relative purchasing powers of currencies in their national markets. Hence, while exchange rates provide GDPs that are expressed in the same currency unit, they do not provide GDPs that are valued at the same price level. The GDPs remain valued at national price levels and, as a result, they reflect not only differences in the volumes produced in the countries being compared, but also differences in the price levels of these countries.

One consequence of this is that exchange rate converted GDPs are usually misleading on the relative sizes of economies. Price levels are typically higher in high-income countries than they are in low-income countries. If no account is taken of this when converting the GDPs of countries to a common currency, then the size of high-income countries will be overstated and the size of low income countries will be understated. Exchange rate converted GDPs do not take account of the price level differences between countries and therefore overstate the size of economies with relatively high price levels and understate the

size of economies with relatively low price levels. **It is for this reason that exchange rates should not be used to make international comparisons of GDP.**" (OECD, Eurostat 2012, p.15, emphasis added)

If that argument applies to measurement of GDP it applies to value added, at equal measure. There is no way out, value added chains constructed on the base of market exchange rates alone are misleading. They should, rather, be in line with purchasing power parities in order to have one and the same price level, and so define a geographically homogeneous and consistent unit of value measurement, for every country involved. How to attain such a construct is briefly recalled in the next section. You go from nominal to what is defined as "real effective exchange rates", in the theory of international trade (Rübel 2002, p.57).

4. Establishing real exchange rates

If nominal change rates as they are read on markets of foreign exchange are inadequate to measure and compare value added the question is how to find real exchange rates which serve that purpose in a better way. The term "real" means, in this context, not "actual" – the actual exchange rate is always the nominal one – but an exchange rate measured against a specific basket of goods and services ("res", "thing" in Latin), usually the commodity basket of private consumption expenditure. That basket is employed for measuring real income as opposed to nominal income of a person or a nation, and it may equally well be applied to comparing Income between nations. Such an International Comparison Project (ICP) project has originally been initiated by Pennsylvania University, and it is now carried on by the major international organisations. Its theory is based on the so-called Geary-Khami index (Balk 2008, p.45).

International comparison of national accounts figures is undertaken in three steps. First, one chooses one country as the base country for the envisaged comparison. This is the United States, by tradition. All economic data are then expressed in currency of the base country, applying ordinary rates of foreign exchange. In the second step, price data on individual commodity items are aggregated to yield purchasing power parities (PPPs) for basic headings, which is the lowest level of disaggregation at which expenditure shares and weights are available. The third stage involves aggregation of basic heading parities to aggregates of gross domestic product. PPPs of basic headings are defined so as to measure how much local currency is needed to buy as much as the currency in the base country. Actually the PPP-index is a compound of three well-known economic variables, the domestic price p^d of a good selected as price representative ("potato"), for the whole of its commodity group, the corresponding foreign price p^f and the exchange rate e ruling between the two countries:

(11) $$ppp = \frac{p_d\left[€ / piece\right]}{p_f\left[\$ / piece\right]} \times e\left[\$ / €\right]$$

It is a dimensionless variable, and corresponds to what is otherwise known as the "real exchange rate," at the aggregate level of international trade. Underlying any compilation of aggregate purchasing power parities is the assumption that one unit of an individual product represents the same economic value, independent of where, and when, it is produced, or to whom it is sold (or what the underlying preference functions are) all over the world, and at any time. This fundamental axiom of all price comparison is sometimes paraphrased in the trivial statement: "A

potato is a potato". The difficulties of making this assumption come to true in a global context are almost overwhelming to one who dares dive into the "technical notes" of the OECD explaining the compilation process. Nevertheless, once the hypothesis is accepted, and the data have been prepared, accordingly, it makes sense to speak of a "world price" as an analytical means for comparing national prices, eliminating the effect of varying exchange rates on product comparison, and to search for a way to statistically determine such price. The procedure requires each country to provide a set of national annual prices for a selection of representative and comparable products chosen from a common basket of goods and services that covers the whole range of final expenditure on GDP and a detailed breakdown of final expenditure on GDP according to a common classification.

Let v_i^j [national currency units] be the value of an aggregate product flow *i* in GDP of country *j* (basic heading). It is denominated, initially, in the currency of country *j* as this is the currency in which its accounts are naturally compiled. Since different national currencies cannot be added national values are transformed into currency of one country, the United States, traditionally. For every product heading *i* the dimensionless index of purchasing power parity ppp_i^j is established in the International Comparison Project, measured at current exchange rates between countries. It is then possible to derive, as a complement, a ppp-adjusted value q_i^j which measures how much product the flow v_i^j contains in relation to similar expenditures in other countries,

(12) $$q_i^j = \frac{e^j v_i^j}{ppp_i^j} \ [\$] \ .$$

When the data required by equations 11 and 12 have been established at the elementary level of every product group their aggregation is performed by means of the following homogeneous system of linear equations where Latin letters stand for given data, and Greek letters for unknowns:

$$\pi_i \sum_j q_i^j - \sum_j \varepsilon^j e^j v_i^j = 0 \ , \ i = 1,... \ [\$]$$

(13)

$$\sum_i \pi_i q_i^j - \varepsilon^j e^j \sum_i v_i^j = 0 \ , \ j = 1,... [\$]$$

In equations 13, π_i is a dimensionless index which tells how the price of product i must be modified in order to function as a world average ("world price index"). Variable ε^j is also a dimensionless number, which may be called "parity factor". Multiplying the actual exchange rate e^j with it defines an (artificial) conversion rate of purchasing power parity between national currencies. Its meaning is similar to what is called "real exchange rate", or more precisely "real effective exchange rate" in international trade, except the latter is determined from the point of view of each country, individually, while the "parity exchange rate" here is formed within a globally coherent system. The "parity exchange rate" answers the question of what exchange rates must prevail at given GDPs, in the world, in order to have every national currency acquire the same purchasing power abroad as it has at home. Equations 13 form a homogeneous system

of linearly dependent equations. It is a Geary-Khamis (GK) system such as is being in use by the United Nations.

Notwithstanding higher index-theoretical claims of exactness and superiority, the rationale supporting this system of equations is self-explaining, and straight-forward. An average world price (first equation in system 13) is calculated by dividing world volume of a product, formed by adding up all national volumes q_i^j, into their total value where the conversion of national currencies into an international measurement unit has been performed on the basis of purchasing power parity (ε^j). These rates of conversion, themselves, are determined by dividing national GDPs valued in national prices (v_i^j) and exchange rates into the same GDPs valued at world prices π_i^j (second equations in system 13). World price is thus a weighted average of national prices, and international purchasing power of national currencies is compared on the basis of national GDPs. Both of these stipulations are in conformity with customary rules of national accounting.

Equations 13 form a homogeneous system of as many linear equations as there are unknowns, *m* world prices, plus *n* real exchange rates. The equations are linearly dependent and do not fully determine the solution. To do so you add an equation of normalisation, such as

(14) $$\varepsilon_{\$} = 1 .$$

That convention, however, introduces an asymmetry into the system which is innocuous for comparing at a given point of time, but counterproductive when it comes to including the time dimension and construct figures which are coherent over time (Reich 2013). A better rule of normalisation is

(15) $$\sum_{i=1}^{m}\sum_{j=1}^{n} \pi_i q_i^j = \sum_{j}^{n}\sum_{i=1}^{m} \varepsilon^j e^j v_i^j = \sum_{j}^{n}\sum_{i=1}^{m} e^j v_i^j .$$

That normalisation transforms nominal exchange rates into real exchange rates creating a homogenous price level, and unit of measurement, between the countries without affecting the actual overall value of world GDP. The compiled world prices are what is a called a “shadow price” in operations research which means it is not actually observed but derived from observation as a means of analysis of the underlying economic situation.

For applying the theory to our exampled let purchasing power parities of country B vis-a-vis country A be given by

(16) $$ppp_i = \begin{pmatrix} 1.5 \\ 0.5 \\ 0.8 \\ 0.9 \end{pmatrix} .$$

The resulting volumes q_i are then determined (equation 2) as

(17) $$q_i = \begin{pmatrix} 1.333 \\ 4.0 \\ 3.25 \\ 2.222 \end{pmatrix}.$$

The Geary-Khamis equations are

$$\begin{aligned} (3+1.333)\pi_1 &= 3\varepsilon^1 + 2\varepsilon^2 \\ (1+4)\pi_2 &= 1\varepsilon^1 + 2\varepsilon^2 \\ (2+3.25)\pi_3 &= 2\varepsilon^1 + 3\varepsilon^2 \\ (1+2.222)\pi_4 &= 1\varepsilon^1 + 2\varepsilon^2 \end{aligned}$$

(18)

$$\begin{aligned} (3\pi_1 + 1\pi_2 + 2\pi_3 + 1\pi_4) &= 7\varepsilon^1 \\ (2\pi_1 + 2\pi_2 + 3\pi_3 + 2\pi_4) &= 9\varepsilon^2 \end{aligned}$$

$$7\varepsilon^1 + 9\varepsilon^2 = 16$$

and their solution is

(19) $$\pi = \begin{pmatrix} 1.140 \\ 0.605 \\ 0.872 \\ 0.938 \end{pmatrix}$$

and

(20) $$\varepsilon = \begin{pmatrix} 0.958 \\ 1.033 \end{pmatrix}.$$

Equation (20) says that currency of country A is lightly overvalued at the foreign exchange in respect to its internal purchasing power; its price level is high, and the opposite is true, naturally in the 2-country case, for its partner. The world prices indicated by equation (19) say that product volumes compiled at exchange rates according to equation (17) a priced too low for the first product and those of the other three are too high.

For the ten-percent revaluation of currency B assumed in table 4 the result are

(21) $$\pi = \begin{pmatrix} 1.204 \\ 0.639 \\ 0.921 \\ 0.991 \end{pmatrix}$$

and

(22) $$\varepsilon = \begin{pmatrix} 1.012 \\ 0.992 \end{pmatrix}$$

New world prices (21) are exactly proportional to the old ones, having increased by 5.63 percent, an amount which equals the nominal growth of total world product from 16.0 to 16.9 A$ caused by the revaluation of currency B. It is now currency which is undervalued at foreign exchange. A shift of exchange rate is correctly measured as a mere change in world price level without effect on the resulting volume of world product.

5. Lessons for international trade

Global value added chains as such are not new, but their extension is, and connected with the increasing role multinational enterprises have adopted in organising international trade. Owing to their organisation and capital structure multinational enterprises are leading actors in global value added chains, and they dominate the trade pattern. 1% of companies account for 40% of aggregate exports in Europe, for example (OECD 2013, p.21). So there is a historical change going on which "challenges the way we look at the global economy" (OECD 2013, p. 3) and it has triggered debate on its impact on national economies, both in terms of economic policy, and economic theory. One conclusion has already been mentioned. The long established view of comparative advantage as an appropriate model of international trade is no longer universally valid.

The concept of "comparative" advantage, as is well known, stands in opposition to "absolute" advantage, as a driver of trade. It explains why it makes sense for a high cost country to trade with a low cost country, for both of them, even if both products are more expensive in the first than in the latter. The argument is based on the concept of opportunity cost. If the opportunity costs of switching from one product to the other are different between the two countries both may gain from performing that switch in opposite directions. Employment in one product is increased at the expense of the other product and the surplus exported. The model stresses to components of trade, there are two industries existing in both countries production of which may be balanced against each other, and production is contained within the countries. It is only the final product that is open for trade. Both elements of that model are discarded in the new development. Industries are no longer sub-national and contained within their home country, but they are international, operating as a decision unit which overarches and overcomes national boundaries. As companies disperse their operations across the world their products contain inputs sourced from many countries. Intermediate inputs such as parts and components are produced in one country and then exported to other countries for further production or assembly in final products. The sequential stages in the value-added chain are typically performed in the location best suited to the activity. And this location is sourced world-wide. A decision to a certain part of the value-added chain in one country does not imply any comparison of some other process or industry as being traded as compensation, but simply whether or not it is advantageous over production of the same type at any other place of the world. "Competitive" advantage is the term

the management literature has created for the process, and this is nothing other than what is called “absolute” advantage in economics. So even if the OECD report itself wavers between different schools of thought, some arguing that the increasing importance of global value-added chains challenge our thinking, others even consider that the principle of comparative advantage remains valid (p. 31) sober analysis cannot deny that essential premises of the comparative advantage model are missing in the new era of competitive international sourcing of stages of production.

The conclusion is the present process of globalisation has various effects: positive as well as negative. “The visible negative short-term effects (e.g. employment losses) typically receive the most attention from the media and the public, as they are easily measured; longer-term indirect benefits are much harder to calculate. Short-term costs are often transitory or one-off in nature while long term gains are frequently lasting. However, the gains from globalisation only indirectly benefit the people whose jobs are lost.”(OECD 2013, p.31) This is a sensible assessment, in itself, but clearly not in support of the comparative advantage paradigm.

Having dealt with the topic of “Measuring traded in value added”, (OECD 2013, chapter 2) one can address the “Implications of global value added chains for trade policy” (chapter 3). Here again a step further of analysis may be warranted over what has very well been treated, in the report. It is evident, in thinking through the notion of value-added chain, that “despite low nominal rates, tariffs can add up to significant trade costs when goods cross borders many times.” (OECD 2013, p. 111) The effect is known from other, domestic indirect taxation, which has finally lead to introducing the value-added tax. Customs procedures at the border and technical standards also play a role in nations’ competition for participation in a value-added chain. Finally “reaping the full benefits of participation in a global value-added chain requires liberalisation of domestic services markets…when they are more restrictive than necessary fort meeting legitimate regulatory policy objectives.” (OECD 2013, p. 111)

One topic has not been addressed, and is missing all through the report. There is a difference between value added generated and value added distributed as is well known from the system of national accounts. The effort put into a certain production is measured by the first, the benefit in income attained, by the second. One of the mechanisms determining the latter are the terms of trade ruling between trading countries, and partially determined by the rate at which their mutual currencies are exchanged. A rise in terms of trade indicates a favourable, a fall an unfavourable development in that respect. A country’s terms of international trade are defined as follows:

$$t.o.t. = e[\$/€]\frac{p_{ex}[€]}{p_{im}[\$]}, \tag{23}$$

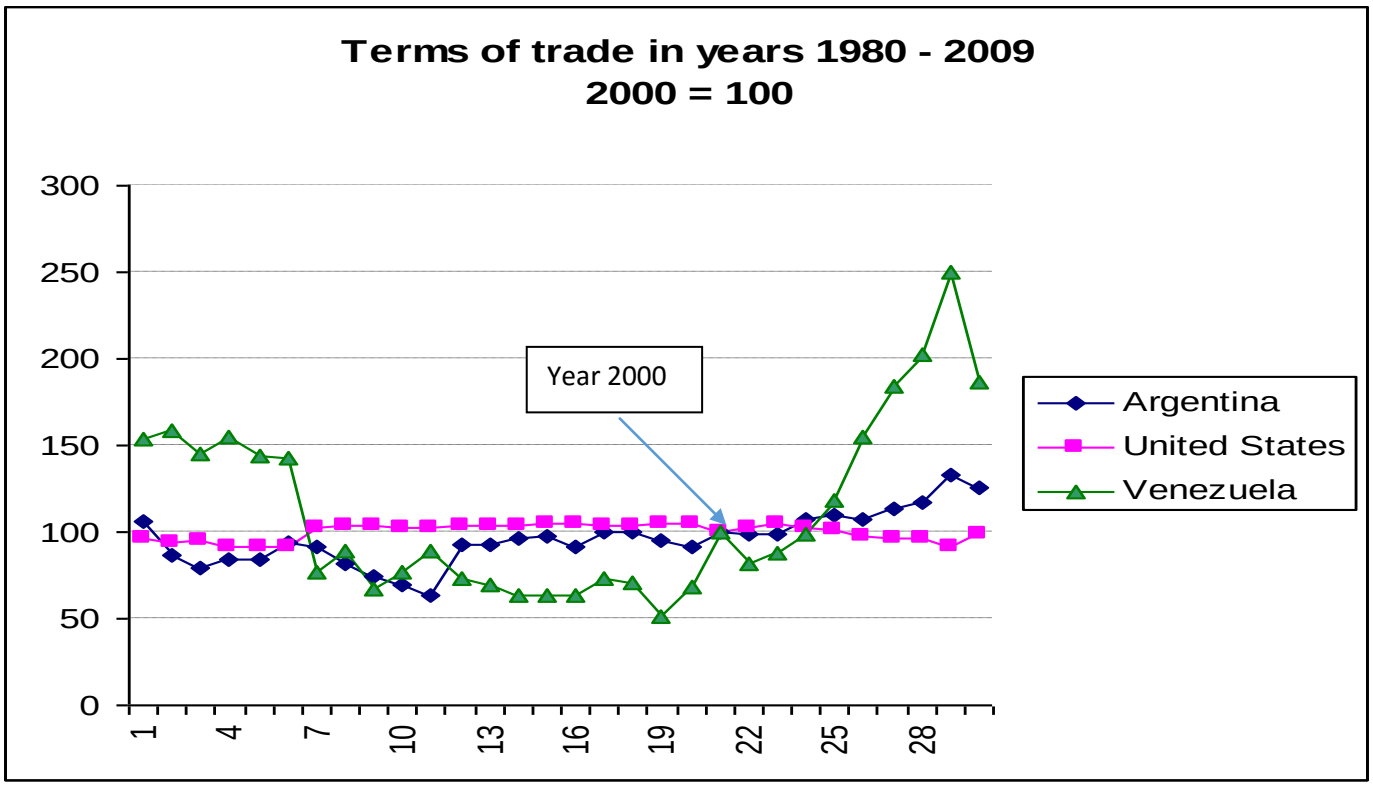
where p_{ex} and p_{im} denote the price indexes of exports and imports, respectively, and e is the rate at which foreign currency is exchanged against its domestic counterpart. Terms of trade are hence governed by two kinds of variables, prices determined at

product markets, and rates of foreign exchange determined at financial markets. I am interested in the latter. With one third of global exports being performed as internal transaction of multinational enterprises export and import prices are no longer formed by market forces, alone, but increasingly they represent internal accounting constructs of multinational enterprises designed to separate income earned from income generated and to allocate the latter to low-tax countries. The resulting effect on terms of trade becomes interesting when, as in the case before, you add the real to the nominal perspective of value measurement.

It follows from definition (23) that terms of trade are high, or "favourable" for a country when its exchange rate *e* is high. A revaluation of national currency increases the advantage a country enjoys in international trade in that it is able to buy more imports for its exports. The opposite, a trading disadvantage, follows from devaluation. This does not contradict the fact that for reasons of competition an unfavourable exchange rate may be preferable, and even necessary, in order to enter an international market. But, once participation is assured earning a high price is always advantageous against earning a low one, just like in any other business. An advantage in terms of trade for one partner in trade implies, by nature of the bilateral business relationship, a disadvantage for the other. The question hence arises: is there, in this situation of conflict, an equilibrium, i.e. an exchange rate ε which makes that gains of trade are divided equally between partners, so that advantage and disadvantage balance on either side? The answer is positive. Such an equilibrium point can be defined and established by means of the statistical tool of purchasing power parities (PPPs), as I want to show in the following. PPPs are employed only for measuring GDP of nations, at present, but they may be usefully be applied to a wider range of purposes.

Figure 4 shows an example of terms of trade development over the period 1980 – 2009 for three countries, Argentina, United States, Venezuela. It shows how variation of terms of trade may differ very much between countries. Venezuela is one extreme, because of its heavy dependency on oil exports, Argentina's variation is smaller with a slight improvement over the years, and terms of trade of the Unites States appear as rather stable, an effect of the enormous size of their economy, perhaps. Most interesting in our context here is year 2000. In that year, terms of trade appear as being equal for all four countries, namely 100. But are they really equal?

Figure 4: Commodity terms of trade of three selected countries



The informed reader knows, of course, that that "equality" is an artefact, the year at which the time series meet to apparent equality being fixed arbitrarily, in that terms of trade are set at 100 for all countries, at a certain year, and that "base year" is picked simply because it has a round number. Choice of a different base year would generate a different "equality". Figure 4 insinuates, for example, that terms of trade of Venezuela lie some-times below, and some-times above, those of the United States. Imagine that not year 2000, but year 2008 be chosen as base year, and the time series of Venezuela would lie below the United States for over the whole period observed. There is no absolute scale established at which to compare terms of trade, only their movement in one or the other direction is captured, in present statistics. There is a degree of freedom, in other words, in these statistics which calls for being closed be a reasonable and useful complement. Terms of trade described in figure 4 are observed at current exchange rates, a natural choice as these form the rate at which actual foreign trade takes place. For analytical purposes, however, it is permissible to add to that recording of facts a compilation of real exchange rates which are defined on a theoretical basis, in order to interpret the observed situation. Real values correct nominal values of trade for difference in purchasing power of the underlying currency, or, what is the same thing, for the difference in the general price level of countries. Method and implication of that technique have already been described above, they have proved useful, even inevitable, in international comparison of national GDPs, and the same extension can be tried for

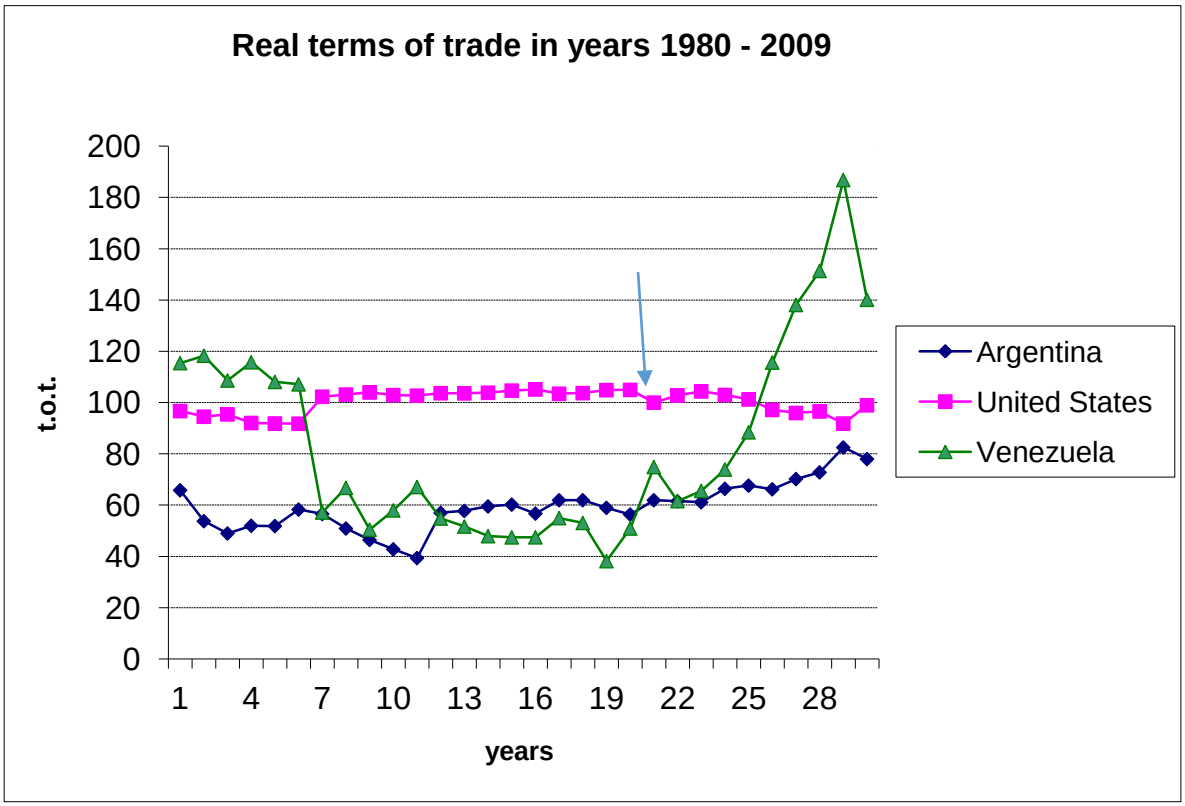
the terms at which national products are internationally exchanged. The proposal, therefore, concerning value-added chains is to compile balances of trade not only in nominal but also in real terms; equation (23) may thus be supplemented by equation

(24) $$t.o.t._{real} = \varepsilon\, e[\$/€]\frac{p_{ex}[€]}{p_{im}[\$]}.$$

In words, real terms of trade are distinguished from their nominal, actual counterparts by the fact that they are adjusted for differences in national price levels. The operation assures that all production is measured with one and the same, homogeneous unit of account. Actual nominal terms of trade are advantageous for a country when its real exchange ε is smaller than 1, and disadvantageous when it is larger without corresponding effects on real value added. High terms of trade, implying an international overvaluation mean that domestic production is valued higher than its foreign counterpart, and the opposite holds when they are low. Terms of trade are equal when the real exchange rate equals 1. In that case price levels at home and abroad are equal and aggregates can be added without inconsistency. The artificial unit of account, created that way expresses the same purchasing power in all countries observed.

Figure 5 shows the result of that transformation from nominal to real exchange rates, compiled in an approximate way by using the ratio of national GDP in real terms (PPP-GDP) to GDP in nominal terms as an approximation of the real exchange rate (Reich2007). The resulting real terms of trade of the United States lie constantly above those of Argentina and Venezuela, except for years 2000 plus because of Venezuela's particular dependence on the oil price in. The graph reflects the general experience not only of economists, but of every tourist traveling abroad from a weak currency country to one with a strong currency, as he notices how much more, or much less, he is able to buys with his national funds when having crossed the currency border.

Figure 5: Real terms of trade of three selected countries



Source: Reich (2007)

6. Conclusion

The project of studying the structural pattern of "Interconnected Economies" initiated and carried out by OECD has pursued an ambitious goal, and attained it with success. The empirical base for research on the global economy has been significantly broadened, if not established for the first time, setting out the main evidence and policy implications for trade policy, investment policies, innovations policies, and framework and structural policies that affect how, and to what extent, countries whether industrialised, emerging, or developing can benefit from, or may be challenged by, participation in global value added chains. Pointing out the prominence of large multinational enterprises in driving the process of international fragmentation of production it joins the technique of input-output analysis, known and applied to economic analysis on the national level, mainly, to statistics of international trade, creating a new and considerably broader base empirical for theoretical analysis of that process.

These comments address a specific point, which has not been dealt with in the report, but appears to be a logical next step. The value of an international trade depends on two variables, national prices and,- that is its mark of distinction from national trade, - international rates of foreign exchange. In contrast to national prices which are formed on national product markets operating within the realm of a well-defined and homogeneous national currency as unit of measurement rates of foreign exchange result from the working of financial markets dealing with property assets rather than labour products. Hence they introduce an unwarranted bias when used as a measure of value

and may mislead if interpreted as resulting from national conditions of production. By joining the results of this project to the somewhat older project of establishing international purchasing power parities, it is possible, however, to separate the effect of currency exchange rates from the effect of conditions of production reflected in national prices, and thus to deepen and clarify the analysis of value added-chains. A brief and sketchy exposition of how to attempt such a complement, and what additional insights may be expected from it, has been carried out in the paper.

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