



Value Added and Factors in Trade:

A Comprehensive Approach

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Value Added and Factors in Trade: A Comprehensive Approach [☆]

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Abstract

Based on recent approaches measuring the factor content of trade when intermediates are traded this paper provides an approach to decompose the value added and factor (capital, high, medium and low educated labor) content of trade into foreign and domestic components. This adds to the literature by simultaneously considering both exports and imports allowing a focus on the patterns and changes of net trade and its components and generalizes the commonly applied vertical specialization measures based on exports only. It is further pointed out that a country's trade balance in terms of value added content equals its trade balance in gross trade. Empirically, results of the proposed decomposition based on the recently compiled World Input-Output Database (WIOD) covering 40 countries and 35 industries over the period 1995-2009 are presented. The domestic value added content of exports tends to decrease over time, increasing again in the crisis. Splitting up by production factors, emerging economies tend to export relatively more capital and import labor in value terms, with the opposite pattern found for advanced economies. Splitting up labor by educational attainment the expected pattern of the advanced countries being relatively stronger net exporters of high-educated labor as compared to low-educated labor in value terms emerges. This provides a distinct view on the structure of trade deficits and surpluses across countries based on its factor content. Finally, it is shown that the role of services is more important than would be suggested by conventional trade statistics due to the value added created in service sectors for production of manufacturing exports.

JEL: F1, F15, F19

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1. Introduction

The flows of value added rather than goods across countries has become an increasingly debated topic due to the rapid integration of production processes and the further inclusion of countries in this interna-

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tionalization process. Though this process has been ongoing for quite some time there have been rapid integration processes in the world economy taking place over the last decade or so. In the 1990s this was due to the creation of the North American Free Trade Agreement (NAFTA) involving the US, Canada and Mexico and the integration of formerly communist countries with Western EU countries which started after the transformational recession in these countries and led to the accession of some countries into the European Union in 2004. Further, large emerging economies such as Brazil, Russia, India and China (and Indonesia and South Africa to a lesser extent) became important players on world markets at least in particular industries. This implied an increase in overall trade flows in the world economy with increasing shares of imports and exports between these newly integrating countries and the developed world. This integration of trade flows in the world economy was further accompanied by increasing foreign direct investment activities. One particular feature of this integration process was the integration of production structures in the sense that firms offshore activities to other countries to exploit cost advantages in particular stages of production. This integration of production processes has been theoretically analyzed under different headings including 'fragmentation', 'slicing up the value chain', 'outsourcing' and 'offshoring' or the 'second unbundling' and recent contributions emphasizing 'trade in tasks'.

From an empirical point of view there is still the challenge to properly measure this ongoing integration of production processes and its consequences for trade flows. The literature ranges from particular case studies for products like the Barbie doll (Tempest, 1996), the iPod (Linden et al., 2009; Varian, 2007), computers (Kraemer and Dedrick, 2002), or the Nokia N95 (Ali-Yrkkoö, 2010) or more complex products like cars (Baldwin, 2009) or airplanes (Grossman and Rossi-Hansberg, 2008), to studies of trade patterns in particular products such as 'parts and components' and overall trade in intermediates versus trade in final goods (Miroudot et al., 2009; Stehrer et al., 2011) and a number of studies focusing on the magnitude and changes of 'vertical specialization' patterns. In the European context the changes in the international structure of production are discussed from a multi-disciplinary point of view in Faust et al. (2004). This book also provides a number of case studies at the level of industries (the automobile industry, the electronics industry, and the apparel industry). Other recent studies focus on measuring trade in value added between countries thus trying to measure how much of value added created in the production process in one country is exported thus 'netting out' the value already embodied in imported products and the extent of 'vertical specialization' or 'vertical integration' (Hummels et al., 2001; Daudin et al., 2011; Johnson and Noguera, 2012; Koopman et al., 2010), with an overview of these approaches provided by Meng and Yamano (2010).¹ Related to these are papers on the measurement of trade in value added, examples including (examples including Escaith, 2008; Maurer and Degain, 2010; Timmer et al., 2012). Further there are a number of papers with a focus on the Asian production and trade network (recent examples include Meng and Inomata, 2009; Hiratsuka and Uchida, 2010; Yamano et al., 2010; Dean et al., 2011).

In the international trade literature this issue has been addressed in a similar way though having a different focus when measuring the factor content of trade flows. The seminal contribution in this respect was that of Vanek (1968) and the so called Heckscher-Ohlin-Vanek model.² In this model the perspective switches from that on trade in goods to trade in factors of production embodied in the goods traded. Empirically, this goes back even earlier to the important contribution of Leontief (Leontief, 1953) which triggered a number of subsequent studies focusing on the 'Leontief paradox'. Only recently have there been successful attempts to solve this 'paradox' by allowing for (Hicks neutral) technology differences across countries (Trefler, 1993). One particular concern in these contributions was to properly account for trade in intermediate products, an issue which has been the focus of some recent contributions including those of

¹See also Meng et al. (2011) for a decomposition of vertical specialization measures.

²For a recent overview see (Baldwin, 2008).

Davis and Weinstein (2001), Reimer (2006), and Trefler and Zhu (2010), though this issue was considered earlier by Deardorff (1982) and Staiger (1986).

The starting point of this paper are these recent papers focusing on the factor content of trade when accounting for intermediates trade and in particular the contribution of Trefler and Zhu (2010) where a 'Vanek-consistent' measure of the factor content of trade is proposed. Based on this approach we introduce an alternative approach to decompose trade flows in value added and its components capital and labor, (differentiated by educational attainment categories) and relate these to recent approaches of measuring vertical specialization patterns (Hummels et al., 2001; Daudin et al., 2011; Johnson and Noguera, 2012; Koopman et al., 2010). Our approach can be aligned with the measures of vertical specialization proposed in these studies which will be discussed below. We add to this literature by simultaneously looking at both exports and imports of the value added content of trade. The proposed framework allows us to show that a country's value added content of net trade equals its net exports in gross trade which aligns this approach to national accounting. On top of that, data allow us to further break down the figures of value added content of trade in to the components of value added. In particular, we split value added (in value terms) into capital and labor income. Labor income can be further split into high, medium and low educated income by ISCED categories, respectively.

The paper proceeds as follows. In Section 2 we introduce our method of decomposing trade in value added. Section 3 provides a short overview of the recently compiled world input output database (WIOD) database used and presents selected results of this approach. Section 4 concludes and points towards further avenues of research.

2. Measuring value added and factors in trade

In this section we introduce our approach to decompose trade flows into its value added components. The same approach is also used to further to split up these flows into value added components. There is already a wide literature on the measurement of vertical specialization, value added chains and trade in value added (see e.g. Hummels et al., 2001; Johnson and Noguera, 2012; Daudin et al., 2011; Koopman et al., 2010; Timmer et al., 2012).

Often this literature focuses on measuring the vertical integration of production processes focusing on exports and thus leaving out the aspect that all countries are also important importers of intermediates and the existence of two-way trade in intermediates as outlined above.³ On the other hand, the literature focusing on the effects of offshoring on labor markets (employment and wages) and other variables such as productivity often focus on the import side only. In this paper we therefore aim at including both sides of trade to measure the extent of exports, imports and net trade in value added and its relative importance across countries' trading patterns. The WIOD database (see below) further allows us to follow the respective trends over time and to further decompose value added flows into its components.

Another strand of literature which is related to the issue of trade in value added and vertical specialization focuses on trade in factors and is often motivated by the Heckscher-Ohlin-Vanek theorem with the further complication when trade in intermediates has to be accounted for (see Deardorff (1982) and Staiger (1986) for early contributions and Reimer (2006) and Trefler and Zhu (2010) for more recent ones). The approach suggested here is motivated by a recent paper on trade in factors, Trefler and Zhu (2010), which focuses on the correct (or 'Vanek consistent' way) of calculating the factor content of trade with trade in intermediates. We apply a similar method of calculating the factor content with two modifications. First, we

³The literature focuses on the 'import content of exports'; using supply-driven IO models allows one to also calculate the 'export content of imports' (see for example Meng and Yamano, 2010).

apply this approach using value added shares in gross output and capital and labor income shares in gross output rather than physical input coefficients upon which most of the papers focusing on trade in factors is based. In essence, we therefore not only allow for cross-country and cross-industry differences in direct and indirect input coefficients but also for differences in factor rewards.⁴ Second, we decompose the resulting measure into several categories which are outlined below in detail. In particular, this latter aspect links this paper to other approaches of measuring vertical integration and the value added content of trade.

2.1. A comprehensive approach

The starting point for the analysis are indicators of the share of value added in gross output denoted by a vector \mathbf{v} , the Leontief inverse of the global input-output matrix, $\mathbf{L} = (\mathbf{I} - \mathbf{A})^{-1}$ with \mathbf{A} denoting the coefficients matrix, and the flows of exports and imports of goods between countries denoted by \mathbf{t} . For simplicity we first discuss our approach for the case of three countries without an industry dimension. Further, we discuss net trade in value added from the viewpoint of country 1 without any loss in generality. In this special case the vector of value added coefficients becomes $\mathbf{v}' = (v^1, v^2, v^3)$, the Leontief-inverse is of dimension 3×3 and the trade vector is written as $\mathbf{t} = (x^{1*}, -x^{21}, -x^{31})$ where $x^{1*} = \sum_{p,p \neq 1} x^{1p}$ denotes exports of country 1 to all countries and x^{r1} denotes exports of country r to 1, i.e. imports of country 1. These imports are included as negative terms which results in the value added content of net trade for country 1, i.e. $t_V = \mathbf{v}'\mathbf{L}\mathbf{t}$. For the decomposition procedure however we need the individual entries of the matrix capturing exports and imports of country 1 which is achieved by a diagonalization of the value added coefficients and trade vector which results in the following exposition:

$$\mathbf{T}_V^1 = \begin{pmatrix} v^1 & 0 & 0 \\ 0 & v^2 & 0 \\ 0 & 0 & v^3 \end{pmatrix} \begin{pmatrix} l^{11} & l^{12} & l^{13} \\ l^{21} & l^{22} & l^{23} \\ l^{31} & l^{32} & l^{33} \end{pmatrix} \begin{pmatrix} x^{1*} & 0 & 0 \\ 0 & -x^{21} & 0 \\ 0 & 0 & -x^{31} \end{pmatrix} = \begin{pmatrix} v^1 l^{11} x^{1*} & -v^1 l^{12} x^{21} & -v^1 l^{13} x^{31} \\ v^2 l^{21} x^{1*} & -v^2 l^{22} x^{21} & -v^2 l^{23} x^{31} \\ v^3 l^{31} x^{1*} & -v^3 l^{32} x^{21} & -v^3 l^{33} x^{31} \end{pmatrix}$$

The first matrix contains the value added coefficients of the three countries, the second matrix denotes the elements of the Leontief inverse from the global input-output matrix and the last matrix contains exports of country 1 and imports of country 1 from the other countries which are included as negative values. Summing up this matrix over rows and columns therefore gives a measure of net trade in value added for country 1. It is informative to discuss the entries in the matrix separately. This will also document the decomposition of value added exports and imports in its various forms.

- *Exports*: The first column in matrix \mathbf{T}_V^1 describes value added contained in the exports of country 1.
 - * *Domestic value added content of exports*: The first entry, $v^1 l^{11} x^{1*}$, denotes the direct and indirect value added content of country 1's exports to all other countries.
 - * *Foreign value added content of exports*: The production of these exports also requires inputs from other countries. For production of these inputs - used to produce exports of country 1 - value added in the other countries is created. This is captured by the remaining terms in the first column by partner country, i.e. $\sum_{p (p \neq 1)} v^p l^{p1} x^{1*}$. Note, that this is added to country 1's value added content of exports, though value added is created in the other countries.
- *Imports*: The other columns capture the value added content of country 1's imports.
 - * *Foreign value added content of bilateral imports*: The imports of country 1 from 2 embody value added from country 2. Thus the second term in the second column captures country 2's value

⁴This can later be decomposed into the effects of changes in productivity, factor rewards and trade patterns by splitting ratios over gross output into factor rewards and physical input coefficients, i.e. to disentangle quantity and factor price effects.

added embodied in country 1’s imports from country 2. Similarly, the third entry in the third column captures country 3’s value added embodied in imports from country 3. Generally, the elements of the diagonal in the import block contain the partner country’s value added content of bilateral imports, $\sum_p (p \neq 1) v^p l^{pp} x^{p1}$.

* *Re-Imports*: Imports of country 1 from 2 can also require inputs from country 1 itself. Therefore, the first element in the second column captures country 1’s value added embodied in imports from country 2; analogously for the third term in the first row. Total re-imports of value added are therefore $\sum_p (p \neq 1) v^1 l^{1p} x^{p1}$.

* *Foreign multilateral value added content of imports*: Country 1’s imports from country 2 also require inputs from other countries. Thus, for example, the entry in row three of the second column captures country 3’s value added embodied in country 1’s imports from country 2. An analogous interpretation holds for the entry in the second of the third column. Thus, the total amount of these imports is given by $\sum_{p,q (p \neq q; p,q \neq 1)} v^q l^{qp} x^{p1}$.

Analogous interpretations would also hold for countries 2 and 3 and, more generally, for N countries. To disentangle these five components of net value added trade for country 1 it is convenient to rewrite the sum of the equation in the following way:

$$t_V^1 = \underbrace{v^1 l^{11} x^{1*}}_{\text{Domestic}} + \underbrace{\sum_{p (p \neq 1)} v^p l^{p1} x^{1*}}_{\text{Foreign}} - \left(\underbrace{\sum_{p (p \neq 1)} v^p l^{pp} x^{p1}}_{\text{Bilateral}} + \underbrace{\sum_{p (p \neq 1)} v^1 l^{1p} x^{p1}}_{\text{Re-imports}} + \underbrace{\sum_{p,q (p \neq q; p,q \neq 1)} v^q l^{qp} x^{p1}}_{\text{Multilateral}} \right) \quad (1)$$

Value added content of exports Value added content of imports

There is a close relationship between this measure and other measures in vertical specialization that already exist in the literature. Koopman et al. (2010) disentangles the measures as proposed by Hummels et al. (2001), Johnson and Noguera (2012) and Daudin et al. (2011) and provides an explicit derivation of the VS1 measure as proposed by Hummels et al. (2001). Relying on these results we can interpret the five terms in the above equation accordingly: The first term is country 1’s domestic value added contained in its exports. The second is the ‘true’ VS1 measure capturing the (value added) import content of exports (see Hummels et al., 2001; Koopman et al., 2010). The third term is the bilateral value added content of country 1’s imports from the other countries. The fourth term captures the re-imported value added which is similar to the VS1*1 measure as proposed in the literature (see Daudin et al., 2011; Koopman et al., 2010). Finally, the last term is the value added content of imports through third countries which is therefore the sum of the VS1^p measures (see Hummels et al., 2001; Koopman et al., 2010, for details).

Extending the above framework to many sectors requires only some slight modifications in the dimensionality of the matrices involved. Let N denote the number of countries and G the number of industries. $\mathbf{T}_V^r = \hat{\mathbf{v}}' \mathbf{L} \hat{\mathbf{t}}^r \mathbf{v}$ is now a $NG \times 1$ matrix, the Leontief inverse \mathbf{L} is of dimension $NG \times NG$ and \mathbf{t}^r is of dimension $NG \times 1$ with sector specific information on exports to all countries and imports from individual countries. Calculations can then be performed in exactly the same way as indicated above, summing up over industries additionally.⁵ To derive country specific results one first has to add up block-wise. Thus the algebra has to be rewritten in the following way with $\mathbf{R} = \mathbf{I} \otimes \mathbf{t}$ and $\mathbf{S} = \mathbf{R}'$ denoting summation matrices where \mathbf{I} is the identity matrix of dimension $N \times N$, and \mathbf{t} denotes a vector of ones of dimension $G \times 1$ and \otimes denotes the Kronecker product. Matrix \mathbf{R} is therefore of dimension $NG \times N$. Pre- and post-multiplying the industry specific matrix \mathbf{T}_V^r which is of dimension $NG \times NG$ by \mathbf{S} and \mathbf{R} respectively, results in a matrix of dimension $N \times N$ which has the same interpretation as above (having however incorporated industry-specific interrelations).

⁵This will further allow us to provide industry or industry-group specific results.

2.2. Value added content of trade and the trade balance of gross trade

This approach allows for the consideration of the relationship between a country's trade balance in gross and in terms of value added content. Based on the framework introduced above it can easily be shown that a country's net trade in value added terms equals net trade from gross exports and imports (for a further discussion of this see Stehrer, 2012). Intuitively it is clear that total exports in the value added of a country must be imported by another country (as all exports of goods must be imported somewhere else). As trade in goods is traced back to primary factor inputs and rewards and the coefficients of direct and indirect value added creation in a closed system is equal to one the trade deficit of a country equals the deficit measured in value added. Thus, this equality is a consequence of national accounting identities in a closed system of world trade. Further, as we view trade deficits from the viewpoint of individual countries we consider exports and imports as a form of final (exogenous) demand.

From an algebraic point of view this can be shown in a straightforward manner. The vector of value added, which we will denote by \mathbf{y} , can be expressed in the following way from which value added coefficients can easily be derived. Value added is gross output minus intermediate inputs, $\mathbf{y} = \mathbf{q} - \hat{\mathbf{q}}\mathbf{A}'\boldsymbol{\iota}$. Expressed in relation to gross output this yields

$$\hat{\mathbf{q}}^{-1}\mathbf{y} = \mathbf{v} = \hat{\mathbf{q}}^{-1}\mathbf{q} - \hat{\mathbf{q}}^{-1}\hat{\mathbf{q}}\mathbf{A}'\boldsymbol{\iota} = \boldsymbol{\iota} - \mathbf{A}'\boldsymbol{\iota}$$

and therefore $\mathbf{v}' = \boldsymbol{\iota}'(\mathbf{I} - \mathbf{A})$. Inserting into our equation for measuring net value added content of trade we get

$$t_V^{\text{net}} = \mathbf{v}'(\mathbf{I} - \mathbf{A})^{-1}\mathbf{t} = \boldsymbol{\iota}'(\mathbf{I} - \mathbf{A})(\mathbf{I} - \mathbf{A})^{-1}\mathbf{t} = \boldsymbol{\iota}'\mathbf{t} = t^{\text{net}}$$

i.e. net trade in terms of value added content equals net trade in gross terms. Similarly one can show (by using trade vectors consisting of the export cell or the import cells) that the ratio of value added exports (imports) to gross exports (imports) equals one. The reason for this result is that in this framework all goods are produced by primary factors capturing all value added. On the other hand, one should note that exports do not only contain value added of the domestic economy and, analogously, imports do not only contain value added from the bilateral trading partner.

2.3. Value added content of trade by factor

Instead of doing the analysis with the vector of value added coefficients \mathbf{v} we can now exploit the fact that value added is a composite of income of various primary factors. Thus given data at hand one might split up each element of the value added coefficients vector into subcomponents like labor and capital, i.e. $v_i^r = \sum_f v_{i,f}^r$ where f denotes the factors considered. The data at hand which are described below in more detail allows us to distinguish first between labor and capital income. The former can be further split into three categories by educational attainment levels according to the ISCED classification. This allows us to differentiate the value added content of trade into factor content (in value terms). These individual factors sum nicely up to the aggregate as described above. Importantly, this allows us to consider in which factors a country is running a trade deficit or surplus. For instance, a country which is running a trade deficit can nonetheless be a net exporter of a particular factor such as high-educated labor.

Summarizing, this approach of measuring value added and the factor content of trade is consistent with measures of net trade in gross terms, incorporates other measures as suggested in the recent literature and allows for a decomposition of value added trade along various dimensions which we document in subsequent sections.

2.4. Relation to vertical specialization measures

This approach can also be interpreted as a generalization of the widely used vertical specialization measures as proposed in Hummels et al. (2001). The more sophisticated measure proposed in this paper is given by $VS1 = \sum_{p,p \neq r} \mathbf{A}^{pr} (\mathbf{I} - \mathbf{A}^{rr})^{-1} \mathbf{x}^{r*}$ which is the sum of the direct import coefficients matrix \mathbf{A}^{pr} times the domestic Leontief inverse over partner countries referred to as the 'foreign import content of exports'. The availability of a full world input-output matrix however allows us to take the intra-regional linkages into account appropriately. As a special case, consider the coefficients matrix for three countries as above to be of the form

$$\mathbf{A} = \begin{pmatrix} a^{11} & 0 & 0 \\ a^{21} & a^{22} & 0 \\ 0 & a^{23} & a^{33} \end{pmatrix}$$

i.e. country 1 does not bilaterally import intermediates from country 3. The measure of vertical specialization for country 1, i.e. the foreign content of exports, would be $VS1^1 = a^{21}(1 - a^{11})^{-1}x^{1*}$. The Leontief inverse of the above coefficients matrix would however be triangular

$$\mathbf{L} = \begin{pmatrix} l^{11} & 0 & 0 \\ l^{21} & l^{22} & 0 \\ l^{31} & l^{23} & l^{33} \end{pmatrix}$$

and the corresponding measure of the foreign content of exports is

$$VS2^1 = \sum_p l^{p1} x^{1*}$$

thus taking into account indirect imports from country 3 (via imports of intermediates of country 2). More generally, one therefore has to multiply the Leontief inverse with the trade vector as specified above to arrive at a matrix of gross output requirements for exports.

$$\mathbf{VS2}^1 = \begin{pmatrix} l^{11} & l^{12} & l^{13} \\ l^{21} & l^{22} & l^{23} \\ l^{31} & l^{32} & l^{33} \end{pmatrix} \begin{pmatrix} x^{1*} & 0 & 0 \\ 0 & -x^{21} & 0 \\ 0 & 0 & -x^{31} \end{pmatrix} = \begin{pmatrix} l^{11}x^{1*} & -l^{12}x^{21} & -l^{13}x^{31} \\ l^{21}x^{1*} & -l^{22}x^{21} & -l^{23}x^{31} \\ l^{31}x^{1*} & -l^{32}x^{21} & -l^{33}x^{31} \end{pmatrix}$$

The elements in the second and third row of the first column would be the measure of vertical specialization denoted as $VS2$ above. Hummels et al. (2001) suggest to express that in terms of gross exports; alternatively one might express that in terms of gross output used (foreign and domestically) to produce country 1's exports, i.e. the sum of the first column. The measure presented here on vertical specialization also include imports allowing for a similar decomposition as in equation (1) in terms of gross output. Similarly to above, one might use only final goods exports instead of total exports (as also used in Hummels et al. (2001) to avoid double-counting.

2.5. Splitting up into sectors

Finally, we generalize the measure to consider several inter-linked sectors of the economies. For example, this might be used to pin down the role of services in manufacturing exports. Rewriting the trade matrix in value added terms above with two sectors (subscripts indicate sectors) would result in

$$\mathbf{T}_V^1 = \begin{pmatrix} v_1^1 l_{11}^{11} x_1^{1*} & v_1^1 l_{12}^{11} x_2^{1*} & v_1^1 l_{11}^{12} x_1^{2*} & v_1^1 l_{12}^{12} x_2^{2*} & v_1^1 l_{11}^{13} x_1^{3*} & v_1^1 l_{12}^{13} x_2^{3*} \\ v_2^1 l_{21}^{11} x_1^{1*} & v_2^1 l_{22}^{11} x_2^{1*} & v_2^1 l_{21}^{12} x_1^{2*} & v_2^1 l_{22}^{12} x_2^{2*} & v_2^1 l_{21}^{13} x_1^{3*} & v_2^1 l_{22}^{13} x_2^{3*} \\ v_3^1 l_{31}^{11} x_1^{1*} & v_3^1 l_{32}^{11} x_2^{1*} & v_3^1 l_{31}^{12} x_1^{2*} & v_3^1 l_{32}^{12} x_2^{2*} & v_3^1 l_{31}^{13} x_1^{3*} & v_3^1 l_{32}^{13} x_2^{3*} \\ v_1^2 l_{11}^{21} x_1^{1*} & v_1^2 l_{12}^{21} x_2^{1*} & v_1^2 l_{11}^{22} x_1^{2*} & v_1^2 l_{12}^{22} x_2^{2*} & v_1^2 l_{11}^{23} x_1^{3*} & v_1^2 l_{12}^{23} x_2^{3*} \\ v_2^2 l_{21}^{21} x_1^{1*} & v_2^2 l_{22}^{21} x_2^{1*} & v_2^2 l_{21}^{22} x_1^{2*} & v_2^2 l_{22}^{22} x_2^{2*} & v_2^2 l_{21}^{23} x_1^{3*} & v_2^2 l_{22}^{23} x_2^{3*} \\ v_3^2 l_{31}^{21} x_1^{1*} & v_3^2 l_{32}^{21} x_2^{1*} & v_3^2 l_{31}^{22} x_1^{2*} & v_3^2 l_{32}^{22} x_2^{2*} & v_3^2 l_{31}^{23} x_1^{3*} & v_3^2 l_{32}^{23} x_2^{3*} \\ v_1^3 l_{11}^{31} x_1^{1*} & v_1^3 l_{12}^{31} x_2^{1*} & v_1^3 l_{11}^{32} x_1^{2*} & v_1^3 l_{12}^{32} x_2^{2*} & v_1^3 l_{11}^{33} x_1^{3*} & v_1^3 l_{12}^{33} x_2^{3*} \\ v_2^3 l_{21}^{31} x_1^{1*} & v_2^3 l_{22}^{31} x_2^{1*} & v_2^3 l_{21}^{32} x_1^{2*} & v_2^3 l_{22}^{32} x_2^{2*} & v_2^3 l_{21}^{33} x_1^{3*} & v_2^3 l_{22}^{33} x_2^{3*} \end{pmatrix}$$

The first column would indicate the value of country 1 exports in sector 1 (e.g. manufacturing) and the second column the value of country 1 exports in sector 2 (e.g. services). Considering one column would further allow for a more detailed decomposition of a sectors value of exports. For example, sector 1 exports could be split into the value which is added in domestic manufacturing, $v_1^1 l_{11}^1 x_1^{1*}$, and the value added in domestic services, $v_2^1 l_{21}^1 x_1^{1*}$, and similarly for foreign value added (by summing up over partner countries by industry). Similar interpretations would hold for the other sectors and imports, respectively. Below we show results considering the role of value added created in service industries in a country's exports and trade in general.

3. Value added and factor content of trade since 1995 and during the crisis

In this section we present selected results on the patterns of value added by applying equation (2.1). For this we proceed in a series of steps: First, we present the magnitudes of gross and value added exports and imports and the corresponding net figures for the 41 countries including the rest of the world. We then split up trade in value added to its foreign and domestic contents. Finally, trade in value added is then differentiated by factors. We report results of the analysis for years 1995, 2000 and 2005 and over the crisis period 2008-2009.

3.1. Data

The analysis requires data on output and the use of intermediates and production factors by industry. In this section we provide information on a recently constructed database, the World Input-Output Database (WIOD), that is used to study the value added and factor content of trade.⁶ This is derived from national supply and use or input-output tables which are combined with detailed trade data resulting in a World Input-Output Table (WIOT). At the industry level the data are combined with further information obtained from Socio-Economic Accounts data (SEAs). The WIOTs are therefore a combination of national input-output tables in which the use of products is broken down according to their country of origin, national supply and use tables and detailed trade data. The information is collected on an annual basis from 1995 to 2009 for 59 products and 35 industries. The industry classification follows the ISIC Revision 3 classification for Non-EU countries compatible to NACE Revision 1.1 which is used for EU countries. The data cover 40 countries which account for about 85 percent of world GDP.⁷ The variables from the SEAs include gross output and value added, final demand expenditures, as well as employment by educational attainment, and capital compensation. The remainder of this section provides a more detailed overview of the construction of the SEAs and the WIOTs. A detailed documentation is provided in Timmer et al. (2012).

3.2. Patterns of the value added content of trade

Table 1 provides an overview of countries exports and imports as well as the net trade positions ranked by net trade in 2007, i.e. before the crisis started. The most important surplus countries have been China, German and Japan and the countries with strong deficits are Spain and the USA (together with the rest of the world). Generally, these net trade positions have been maintained over time with the surplus countries tending to have larger surpluses and deficit countries larger deficits (with the extreme cases of China and the US). A few countries managed to turn their deficits into a surplus like Brazil or the Czech Republic

⁶The construction of the database was made in an ongoing project, the World Input-Output Database project; see www.wiod.org.

⁷These countries are the EU-27 plus Turkey, Canada, USA and Mexico, Japan, Korea, Taiwan, Australia, Brazil, Russia, India, Indonesia and China.

whereas other countries slipped into a deficit like the United Kingdom. Comparing 2007 to 2009 these global imbalances are diminished in most cases, the notable exception is China showing an even larger trade surplus in 2009.

As discussed in detail above, a country's exports contain not only domestic value added but also foreign value added as do imports. These shares can be disentangled using the approach outlined above. Table 2 provides these shares according to our decomposition into the five components with respect to the domestic and foreign value added content of trade. Countries are ranked according to the foreign value added content of exports in 2007. There is a wide range of these shares from more than 60% in the case of Netherlands to levels of 12.2% in the US, 11.3% in Brazil and 7% in Russia. Generally, as expected larger countries tend to have lower shares.

As countries become more and more integrated in international production processes one would expect that the share of the foreign value added content of exports would be rising over time. In fact, this share was rising for almost all countries (with the exception of the UK and Canada) as reported in the first three columns of Table 2, albeit with the magnitudes and changes being rather different. Particularly strong increases can also be seen in some of the Eastern European countries emphasizing their increasingly important role in the European production networks together with Turkey. Relatively small changes are however found for the NAFTA countries: The share for the US rose from 9 to 12 percent, for Mexico from 28 to 31 percent, and for Canada it was even slightly decreasing. The reason for this might be that the integration process started earlier as the NAFTA agreement was signed in 1992. China's share increased from 10 percent to 25 percent whereas India which started with 10 percent in 1995 reached 22 percent. Thus, with respect to exports these results confirm existing literature indicating an increasing internationalization of production as well as the fact that smaller countries tend to have larger shares and the rapid integration of Eastern European countries.

Turning to the import side, the shares of re-imports are fairly small with a mixed tendency over time. Some significant magnitudes can be found for Germany and the US and maybe Japan. Analogously to exports, we would also expect that the share of foreign imports of value added would rise as the imports from other countries increasingly embody value added from third countries. Again this is what is actually found (see three last columns in Table 2). It is interesting to note that the shares are much more similar across countries pointing towards the fact that the factor content from the bilateral relations are more important.⁸

Table 2 further reports the ongoing changes over the crisis period, 2007-2009. The most striking fact is that the foreign value added content of exports was decreasing in most cases - with a few exceptions - over this period, thus pointing towards a disintegration of production effect. This is also supported when looking at the foreign multilateral value added content of imports which again tends to be smaller in 2009 as compared to 2007 in all cases.

3.3. Value added content of trade by factor

Value added is composed of capital and labor income as outlined above. The WIOD data allow distinguishing between the capital and labor content of trade flows in value terms, the latter being later divided by educational categories. From a theoretical perspective the HOV result suggests that countries being abundant in labor (capital) would be net exporters of labor (capital) services at least in productivity adjusted

⁸Splitting up into final goods and intermediates it turns out that the shares by use category are not too different for the individual countries though there are some notable exceptions. Particularly, the shares of the foreign multilateral value added content of imports tends to be lower for the more advanced countries. The reason for this is that these countries' shares in the bilateral content of value added imports of intermediates are high because of imports of raw materials (also from the rest of the world). Importantly however, in most cases these shares are increasing over time for both final and intermediates goods trade which implies that the production of intermediates goods trade has also become more integrated over time. Results are available upon request.

Table 1 Trade in goods and services and trade in value added, in bn US-\$

Reporter	(Value added) Exports				(Value added) Imports				Net trade			
	1995	2000	2007	2009	1995	2000	2007	2009	1995	2000	2007	2009
China	165.1	274.2	1305.6	1896.7	137.0	225.5	933.2	1370.3	28.1	48.7	372.4	526.4
Germany	541.8	571.0	1392.7	1164.3	477.2	517.5	1098.2	935.9	64.6	53.5	294.6	228.5
Japan	480.5	507.9	760.4	627.3	350.2	381.2	619.0	550.9	130.2	126.7	141.4	76.3
Russia	79.4	94.6	308.6	272.0	61.8	47.8	227.1	203.0	17.6	46.8	81.4	69.0
Netherlands	203.2	198.3	400.6	397.7	175.2	174.9	339.1	341.2	28.0	23.4	61.5	56.5
Canada	201.3	303.0	457.1	361.3	178.9	255.8	415.8	366.0	22.3	47.2	41.3	-4.7
Taiwan	120.7	163.7	263.3	216.9	112.3	150.6	228.4	180.6	8.4	13.0	34.8	36.4
Sweden	88.8	102.0	208.8	167.6	71.8	84.8	174.3	142.5	17.0	17.3	34.5	25.1
South Korea	137.2	182.5	402.4	375.4	137.1	169.0	374.6	340.8	0.1	13.6	27.8	34.6
Ireland	46.0	83.6	189.3	185.4	36.2	69.5	164.0	148.7	9.8	14.1	25.3	36.6
Indonesia	53.4	64.3	123.9	133.3	50.9	45.7	99.3	108.0	2.5	18.6	24.6	25.3
Belgium	164.3	148.6	295.4	265.5	146.8	138.5	274.1	247.4	17.5	10.0	21.2	18.1
Austria	66.2	73.3	179.7	156.4	71.3	71.3	162.5	143.1	-5.0	2.0	17.2	13.2
Brazil	50.1	57.4	162.3	158.7	61.4	68.6	147.3	160.8	-11.3	-11.3	15.0	-2.1
Luxembourg	18.4	24.6	75.0	75.0	14.9	21.5	61.5	60.6	3.5	3.0	13.5	14.4
Finland	43.1	47.1	100.3	79.8	33.5	36.6	87.1	74.9	9.6	10.5	13.2	4.9
Denmark	58.6	62.6	133.9	121.3	50.8	53.1	127.4	110.1	7.8	9.5	6.6	11.2
Czech Republic	23.6	31.0	121.9	110.8	26.0	33.2	115.4	102.4	-2.4	-2.2	6.5	8.4
Slovak Republic	9.5	12.4	55.1	51.2	9.4	12.8	55.5	51.3	0.1	-0.4	-0.4	-0.1
Malta	2.0	2.6	4.9	4.6	2.9	3.3	5.8	5.2	-0.9	-0.7	-0.9	-0.6
Slovenia	8.4	9.0	26.7	22.8	9.2	9.9	28.2	23.1	-0.8	-0.9	-1.5	-0.3
Hungary	14.9	27.2	93.2	79.1	17.4	31.4	94.9	76.8	-2.5	-4.2	-1.7	2.3
Estonia	2.0	3.6	10.7	9.2	2.4	3.9	12.6	8.2	-0.4	-0.3	-1.9	1.0
Lithuania	2.6	4.2	16.1	16.7	3.3	5.0	20.7	17.1	-0.7	-0.9	-4.5	-0.4
Cyprus	1.9	2.1	4.5	4.5	3.7	4.0	9.0	8.1	-1.8	-1.9	-4.6	-3.6
Mexico	77.0	162.1	262.4	208.1	70.0	168.0	267.1	212.1	7.0	-5.9	-4.7	-3.9
Latvia	1.8	2.8	9.3	9.0	1.9	3.2	14.3	9.3	-0.1	-0.3	-5.0	-0.3
Bulgaria	5.3	5.9	21.5	19.8	5.2	6.2	28.6	23.2	0.1	-0.3	-7.1	-3.4
Poland	29.4	43.0	158.8	152.1	26.4	51.8	167.4	147.6	3.0	-8.7	-8.6	4.5
Australia	69.8	85.5	186.9	194.0	68.2	80.8	196.0	185.3	1.5	4.7	-9.1	8.7
Italy	246.3	251.9	530.6	433.6	217.1	251.0	544.5	447.0	29.2	1.0	-13.8	-13.4
Romania	8.7	10.8	45.5	43.8	10.4	12.8	66.7	52.4	-1.7	-1.9	-21.2	-8.6
Portugal	25.3	26.7	59.3	51.4	34.2	40.5	81.2	72.0	-9.0	-13.8	-21.9	-20.6
United Kingdom	284.6	354.6	660.9	542.6	272.4	352.7	687.4	545.8	12.2	1.9	-26.5	-3.2
India	39.3	62.7	226.8	195.2	42.3	65.1	260.0	243.9	-3.1	-2.4	-33.2	-48.8
France	312.9	321.4	581.3	516.1	286.7	310.9	619.9	555.8	26.2	10.5	-38.5	-39.7
Greece	9.1	16.8	47.5	43.7	25.9	38.3	92.9	84.1	-16.8	-21.5	-45.4	-40.4
Turkey	26.5	39.0	108.7	106.9	34.6	55.9	155.6	129.5	-8.1	-16.8	-46.9	-22.6
Spain	102.8	130.5	307.3	274.7	118.3	165.6	426.4	328.2	-15.5	-35.1	-119.1	-53.6
Rest of World	698.5	1067.6	2646.2	2239.6	1018.9	1124.7	2904.5	2909.4	-320.4	-57.1	-258.3	-669.8
United States	755.9	968.5	1508.3	1426.2	801.8	1257.6	2066.2	1687.5	-45.9	-289.1	-557.9	-261.3

Source: WIOD database; author's calculations

Table 2 Decomposition of total value added trade 1995-2005, (in %)

Reporter	Foreign VA content of exports					Re-Imports of VA					Foreign multilateral VA content of imports				
	1995	2000	2005	2007	2009	1995	2000	2005	2007	2009	1995	2000	2005	2007	2009
Luxembourg	45.0	58.3	59.2	61.7	61.7	0.2	0.1	0.1	0.1	0.1	19.8	17.8	16.3	16.0	14.9
Hungary	30.3	49.4	46.4	49.4	43.7	0.1	0.1	0.2	0.3	0.2	17.8	23.9	26.9	29.2	26.0
Slovak Republic	32.8	43.8	46.7	48.2	42.3	0.7	0.3	0.3	0.4	0.4	21.1	23.2	28.3	31.2	28.1
Czech Republic	31.4	39.2	44.5	47.4	41.5	0.7	0.4	0.5	0.5	0.5	19.1	24.0	26.2	29.3	26.3
Taiwan	33.5	36.6	44.7	46.9	43.6	0.3	0.6	0.7	0.7	0.6	15.2	18.7	21.5	23.1	22.1
Bulgaria	32.4	36.7	36.3	46.0	35.8	0.0	0.0	0.0	0.1	0.1	15.6	20.9	26.8	29.2	24.3
Malta	50.2	52.4	44.1	45.8	39.6	0.0	0.0	0.0	0.0	0.0	20.1	26.7	26.0	28.0	26.9
Belgium	39.1	42.4	41.3	44.1	40.6	1.2	0.9	0.8	0.8	0.8	19.4	23.0	24.9	26.3	25.0
Slovenia	34.3	37.5	40.4	42.4	36.6	0.1	0.1	0.1	0.1	0.1	21.1	26.7	29.7	32.3	28.5
Ireland	37.8	45.2	42.6	41.9	43.2	0.2	0.3	0.2	0.2	0.2	16.7	17.2	15.9	16.9	14.2
Denmark	27.1	31.2	33.6	38.2	36.9	0.4	0.6	0.8	0.9	0.6	20.9	23.2	23.8	25.4	23.6
Estonia	38.1	44.5	39.3	38.2	33.2	0.1	0.1	0.1	0.1	0.1	22.5	26.4	26.9	29.3	26.8
South Korea	24.8	31.3	34.6	37.0	39.4	0.5	0.6	0.8	0.8	0.7	13.8	15.6	18.8	20.2	18.9
Netherlands	31.8	34.8	33.9	35.6	34.9	1.2	1.0	1.2	1.2	1.3	17.7	19.5	20.3	21.9	20.0
Finland	23.7	28.3	31.2	33.9	31.7	0.5	0.4	0.4	0.4	0.3	18.8	22.0	23.9	25.3	23.2
Poland	17.9	25.6	30.4	33.7	28.5	0.2	0.3	0.5	0.5	0.5	19.2	23.8	25.4	27.6	24.9
Portugal	27.7	31.1	32.3	32.6	28.4	0.2	0.2	0.3	0.3	0.3	19.3	23.9	24.5	26.6	24.2
Austria	22.1	26.9	30.7	32.5	28.8	0.5	0.6	0.6	0.7	0.6	18.2	23.2	25.2	27.5	24.8
Sweden	26.2	30.1	30.5	32.5	31.2	0.7	0.7	0.7	0.7	0.5	20.1	22.6	24.5	26.7	24.4
Lithuania	32.8	33.3	35.4	31.6	33.4	0.0	0.1	0.1	0.2	0.2	18.9	21.8	23.9	27.8	21.6
Latvia	24.4	26.6	30.6	30.6	24.8	0.1	0.1	0.2	0.2	0.2	22.7	26.6	29.3	30.3	28.0
Spain	20.9	27.4	27.8	30.5	24.6	0.7	0.8	0.9	1.0	0.9	19.3	22.8	23.8	25.9	23.4
Turkey	11.4	18.4	26.0	29.6	25.5	0.1	0.2	0.2	0.3	0.2	19.0	23.8	25.9	27.7	25.0
Mexico	25.4	29.7	29.0	28.5	28.2	0.5	0.8	0.7	0.8	0.7	14.2	17.2	22.7	24.0	22.2
France	19.9	25.1	25.4	27.4	25.0	2.0	1.9	1.8	1.7	1.5	19.4	22.7	24.5	26.6	24.7
Greece	17.5	29.3	25.1	27.2	22.5	0.1	0.1	0.1	0.1	0.1	19.9	20.3	22.6	24.6	22.7
Romania	22.4	26.3	29.1	27.0	22.8	0.1	0.1	0.1	0.2	0.2	18.1	23.2	24.6	29.0	26.9
Germany	16.4	22.2	24.1	27.0	23.6	4.0	3.8	4.3	4.4	3.9	18.6	22.1	23.8	25.5	24.3
Cyprus	25.0	30.3	20.9	27.0	24.9	0.0	0.0	0.0	0.0	0.0	18.7	20.3	22.2	24.4	22.9
Italy	18.4	21.0	22.8	25.9	22.1	1.2	1.2	1.3	1.3	1.0	19.0	21.6	23.2	25.2	22.5
Rest of World	20.8	21.9	24.4	25.3	23.2	2.3	3.6	4.9	5.5	4.9	12.2	13.4	15.9	17.2	16.5
China	15.9	17.1	25.3	24.6	23.9	0.7	1.2	2.5	3.1	3.8	18.4	21.9	24.4	24.9	20.5
Canada	25.3	27.4	23.8	23.4	20.2	1.3	1.4	1.4	1.4	1.0	13.5	15.6	17.8	18.9	17.5
India	9.8	14.6	20.2	20.6	20.5	0.1	0.2	0.4	0.4	0.4	17.2	17.5	23.8	23.7	23.9
United Kingdom	19.1	18.7	17.5	17.9	17.1	1.8	2.3	2.0	2.0	1.7	19.5	22.7	23.1	24.5	22.3
Japan	6.8	8.7	12.3	15.8	14.4	2.5	2.6	2.4	2.1	1.8	14.7	17.5	19.8	20.2	18.8
Australia	12.1	13.3	13.3	14.9	12.1	0.3	0.4	0.6	0.6	0.7	16.5	18.7	23.1	24.5	22.9
Indonesia	13.2	16.3	17.0	14.5	11.8	0.3	0.4	0.4	0.4	0.4	16.4	18.3	21.8	23.6	22.8
United States	9.9	11.1	12.2	12.9	10.7	6.9	7.9	5.7	5.4	4.9	14.8	17.0	20.2	21.3	19.9
Brazil	7.8	11.4	11.3	11.4	9.5	0.2	0.2	0.3	0.4	0.4	16.8	19.9	21.9	24.1	22.7
Russia	7.7	10.0	7.6	7.0	6.1	0.9	1.2	1.2	1.2	1.0	19.8	21.8	23.8	26.6	23.3

Source: WIOD database; author's calculations

terms. Since we focus in this paper on factor content in value terms (rather than in physical units) this picture becomes distorted as we allow for differences in factor rewards.

Assembly production is considered a low-value added activity which however can be capital intensive (e.g. production lines) with mainly low-skilled (and low-wage) workers occupied. As returns on capital tend to be equalized across countries one thus would expect 'assembly' countries tending to have a surplus in capital (when measured in value terms). Similarly, natural resource rich countries might tend to have a larger surplus in capital. Conversely, advanced countries which export high-tech components which are skill intensive (labor) therefore tend to be net importers of capital and net exporters of labor in value terms.

Table 3 presents the results for the value added content of trade by factors in billions of US-\$ and ranked according to net trade in labor values in 2007. The countries with the largest surplus with respect to the labor content of trade (in value terms) are Germany and Japan together with a number of other advanced economies. The countries with the largest deficits are Spain, Mexico and the United States. Looking at capital flows the pattern sketched above is actually found. For example, Germany shows much lower net figures or even small deficits which is also the case for the other more advanced economies. China, on the other hand, runs a huge surplus in terms of capital which is much larger than that for labor. And with respect to the US, the deficit in capital when compared with the deficit in labor.

Table 4 presents the components of value added trade with respect to the domestic and foreign content differentiating between capital and labor (we leave out the share of re-imports as this is rather small) with countries ranked according to the foreign labor content of exports in 2007. Overall both patterns and trends are quite similar to the ones for total trade as discussed in Section 2. But there are some interesting patterns which again confirm the hypothesis above. For example, looking at China the labor share in the foreign value added content of exports is higher (31.8% in 2007) when compared to the share of capital (19.8%) with the opposite pattern found for advanced economies like the US and Germany. The corresponding number for the US is 16.8% for capital and 10.2% for labor, and 32.2% and 23.6%, respectively, for Germany. Again this points to the fact that in value terms the advanced countries tend to import capital and export labor.

Finally, we present in Table 5 the results when splitting up trade flows in labor terms into the components high-educated and medium and low educated. According to the hypothesis above we would expect that the advanced countries tend to be net exporters of skilled labor in value terms and net importers of unskilled labor as assembly is considered to be a low-skill activity whereas the production of the high-tech components tends to be skill intensive. With respect to high educated labor the pattern is mostly as expected: more advanced countries and those better endowed with skilled labor are also net exporters of it in value terms. This is the case for most of the EU-15 countries, the notable exceptions are Austria and Italy whereas other countries with deficits like Greece, Portugal and Spain are less well endowed with skilled labor. Also the US is showing a trade surplus with respect to skilled labor. The Asian countries also show surpluses with respect to skilled labor which are rising in all cases. All the others have experienced deficits with China in particular showing a rising deficit in the trade of skilled labor. Regarding medium educated employment, most of the EU-15 countries show trade surpluses as expected with the exceptions of Greece, Spain and Portugal. These surpluses are rather high and/or increasing in Austria, Germany, Netherlands, Sweden and the UK. Also the Eastern European countries show in a number of cases a surplus in this category with the exceptions of Bulgaria and Romania. Significant and rising surpluses are found in the Czech Republic, Poland and Slovenia. The US started with a surplus in this category of medium skilled workers but this switched to a deficit in 2000 which then further increased. Canada is running a surplus whereas Mexico shows a deteriorating deficit. Again the Asian countries show increasing surpluses which is however rather small in the case of Taiwan. Within the group of the remaining countries all with the

Table 3 Net trade in capital and labor (total trade), in bn US-\$

Reporter	Capital					Labor				
	1995	2000	2005	2007	2009	1995	2000	2005	2007	2009
Germany	-27.3	-36.3	2.5	42.2	-37.3	91.9	89.8	201.6	252.4	265.8
Japan	37.6	33.7	29.4	22.7	-3.1	92.7	93.0	102.9	118.7	79.5
South Korea	-12.7	-4.0	-12.6	-21.5	-15.7	12.7	17.6	41.2	49.3	50.3
Netherlands	7.1	2.1	10.9	12.8	2.3	20.9	21.2	41.9	48.6	54.2
Italy	-1.6	-12.0	-41.8	-59.5	-64.1	30.8	13.0	33.4	45.7	50.7
France	-12.3	-14.7	-51.5	-77.9	-77.4	38.5	25.2	38.9	39.4	37.7
China	26.6	47.3	163.2	333.6	491.8	1.5	1.5	7.7	38.8	34.6
Russia	12.6	23.0	47.7	43.9	39.5	5.1	23.7	37.3	37.5	29.5
Belgium	1.7	-1.0	-2.6	-5.8	-11.2	15.8	11.0	20.5	27.0	29.3
Sweden	7.0	3.9	7.1	8.2	2.0	9.9	13.4	22.1	26.4	23.1
United Kingdom	7.2	-7.4	-39.7	-45.8	-29.4	5.0	9.3	10.2	19.3	26.2
Taiwan	1.8	9.5	10.7	18.6	18.2	6.6	3.6	10.1	16.2	18.2
Brazil	-0.9	-0.8	18.7	0.3	-6.4	-10.4	-10.4	6.7	14.7	4.3
Austria	-3.5	-0.7	-0.0	2.9	-1.0	-1.5	2.7	8.1	14.2	14.3
Canada	18.3	38.2	39.2	31.8	8.8	4.0	9.0	12.7	9.4	-13.5
Denmark	2.0	3.7	3.1	-2.8	-2.6	5.8	5.8	8.3	9.4	13.8
Finland	3.1	4.7	1.1	4.5	-5.2	6.5	5.8	6.9	8.8	10.1
Czech Republic	2.2	-0.1	0.2	1.8	1.6	-4.6	-2.0	2.1	4.6	6.8
Luxembourg	2.4	2.3	4.7	9.4	8.8	1.1	0.7	2.1	4.1	5.7
Slovenia	-1.3	-0.9	-1.3	-1.9	-2.1	0.5	0.0	0.5	0.4	1.7
Hungary	-1.3	-1.8	-2.1	-1.1	2.0	-1.2	-2.4	-2.8	-0.5	0.3
Malta	-0.2	-0.1	-0.3	-0.3	-0.1	-0.7	-0.6	-0.5	-0.6	-0.5
Estonia	-0.2	-0.1	-0.3	-1.0	0.0	-0.2	-0.2	-0.6	-1.0	1.0
Indonesia	9.9	18.0	19.1	26.5	28.7	-7.5	0.6	-2.4	-1.8	-3.4
Cyprus	-0.6	-0.7	-1.5	-2.1	-1.5	-1.2	-1.2	-1.5	-2.5	-2.1
Lithuania	-0.1	-0.1	-0.2	-1.8	0.4	-0.6	-0.7	-1.8	-2.7	-0.8
Latvia	0.2	0.0	-0.4	-2.0	0.0	-0.3	-0.4	-1.5	-2.9	-0.3
Ireland	7.3	15.0	26.5	29.7	31.6	2.5	-0.9	-2.1	-4.5	5.0
Bulgaria	0.0	0.2	-1.1	-2.4	-0.7	0.1	-0.6	-2.4	-4.7	-2.7
Slovak Republic	1.6	1.3	2.5	5.2	5.2	-1.5	-1.7	-4.3	-5.6	-5.3
Australia	1.8	4.0	4.3	0.2	11.3	-0.3	0.7	-7.2	-9.3	-2.6
Portugal	-3.9	-6.8	-11.6	-12.4	-11.7	-5.1	-7.0	-8.6	-9.5	-8.9
Romania	-0.7	-0.7	-4.0	-7.6	-0.8	-0.9	-1.2	-5.8	-13.6	-7.8
Poland	3.0	-0.4	6.1	5.2	15.7	-0.0	-8.4	-6.3	-13.8	-11.2
India	0.5	-0.9	-8.6	-13.1	-21.2	-3.6	-1.6	-9.7	-20.1	-27.5
Greece	-5.6	-7.2	-8.3	-14.0	-12.6	-11.2	-14.3	-21.8	-31.4	-27.9
Turkey	3.5	-2.2	-6.8	-12.7	0.8	-11.6	-14.7	-24.0	-34.2	-23.3
Spain	-5.7	-17.1	-41.5	-63.3	-32.1	-9.8	-18.0	-40.4	-55.9	-21.5
Mexico	22.2	34.6	42.1	57.5	45.0	-15.2	-40.5	-46.5	-62.2	-48.9
United States	-64.4	-233.2	-406.7	-444.1	-273.9	18.5	-55.9	-175.7	-113.8	12.6
Rest of World	-37.2	107.9	203.9	136.0	-103.4	-283.2	-165.0	-249.2	-394.3	-566.4

Source: WIOD database; author's calculations

Table 4 Decomposition of trade in factors (total trade), in %

Reporter	Capital						Labor					
	Foreign VA content of exports			Foreign VA content of imports (multilateral)			Foreign VA content of exports			Foreign VA content of imports (multilateral)		
	1995	2007	2009	1995	2007	2009	1995	2007	2009	1995	2007	2009
Luxembourg	40.0	56.8	59.3	21.1	17.1	15.4	48.6	66.3	63.8	19.1	15.1	14.6
Slovak Republic	24.2	39.8	33.8	19.1	32.4	29.8	44.6	57.8	51.2	22.4	30.3	26.9
Ireland	31.2	34.0	35.8	17.3	18.9	15.7	43.2	50.3	50.5	16.3	15.4	13.2
Mexico	14.9	18.7	19.0	15.5	25.9	23.2	43.6	49.4	48.3	13.5	22.5	21.4
Hungary	32.9	50.3	43.0	18.5	31.1	28.7	28.8	48.7	44.3	17.4	27.8	24.2
Malta	42.1	44.0	37.9	21.8	32.2	31.8	55.7	47.2	40.7	19.2	25.0	23.7
Czech Republic	23.6	48.8	44.0	19.9	31.1	28.2	39.3	46.3	39.8	18.6	27.8	25.0
Taiwan	35.6	47.7	44.8	15.2	22.7	21.3	32.1	46.2	42.5	15.2	23.4	22.9
Bulgaria	34.6	46.2	34.9	14.6	28.8	24.8	30.7	45.7	36.8	16.3	29.5	23.9
Slovenia	51.0	48.1	46.0	22.6	36.0	32.0	28.8	38.8	32.2	20.3	29.5	26.2
Belgium	43.4	52.4	51.8	20.8	27.8	27.0	37.0	38.5	34.4	18.6	25.0	23.5
Poland	15.9	30.2	23.3	20.0	29.4	27.3	19.5	37.1	33.6	18.7	26.2	23.3
Estonia	42.3	39.8	37.3	23.7	30.7	28.3	35.9	36.9	30.8	21.8	28.2	25.7
Denmark	29.0	42.5	43.5	21.8	27.5	26.2	26.0	35.5	33.3	20.4	23.8	21.8
Turkey	7.4	26.0	21.4	19.3	27.2	24.7	18.7	34.4	31.0	18.8	28.1	25.3
Greece	15.8	22.2	19.2	21.3	26.2	24.3	18.7	33.9	26.3	19.0	23.4	21.5
Lithuania	28.8	30.6	31.6	17.7	27.8	21.8	36.9	32.6	35.0	19.8	27.8	21.5
Netherlands	34.1	40.4	41.4	18.3	22.8	20.9	30.6	32.1	30.9	17.3	21.1	19.3
Finland	25.0	36.4	41.6	19.2	26.3	24.8	23.0	32.0	26.8	18.5	24.6	22.1
China	13.0	19.8	18.8	18.9	24.1	19.6	18.6	31.8	31.5	18.0	25.5	21.2
Austria	24.0	35.2	32.9	19.9	30.0	28.2	21.1	30.7	26.6	17.3	25.7	22.6
Rest of World	16.4	20.9	19.2	12.5	17.1	15.9	25.0	30.6	27.9	11.9	17.2	16.9
Latvia	19.5	31.1	25.1	23.4	32.0	29.5	29.5	30.3	24.6	22.3	29.1	27.0
South Korea	33.2	46.6	49.3	13.6	19.1	17.4	20.6	29.8	31.9	14.0	21.4	20.5
Sweden	25.6	36.6	37.1	21.2	28.4	26.5	26.6	29.7	27.9	19.5	25.4	22.9
Portugal	29.7	37.9	35.2	20.1	28.4	26.5	26.6	29.3	24.9	18.8	25.2	22.6
Romania	23.5	26.0	20.3	18.0	30.7	29.1	21.6	27.9	25.0	18.1	27.6	25.4
Spain	20.9	34.7	27.9	20.0	27.2	24.4	20.8	27.5	22.3	18.9	24.9	22.6
Cyprus	24.1	30.0	26.3	18.8	26.3	25.4	25.7	25.0	24.0	18.6	22.9	21.3
Canada	22.2	23.0	19.7	14.6	20.2	18.2	27.6	23.8	20.6	12.9	17.7	16.9
Germany	22.2	32.2	32.7	19.4	26.6	25.9	14.0	23.6	19.3	18.2	24.6	23.0
France	24.6	36.5	35.0	20.3	28.2	27.0	17.8	22.6	20.6	18.8	25.3	23.1
Italy	21.5	34.4	32.8	19.5	25.6	22.8	16.9	21.1	17.3	18.7	24.8	22.2
India	9.1	20.2	19.9	15.9	21.6	21.5	10.5	21.0	21.1	18.2	26.0	26.4
Indonesia	9.9	12.6	9.8	16.9	21.6	20.8	17.5	17.7	15.2	16.0	25.7	24.9
United Kingdom	19.0	21.2	20.1	20.1	25.9	23.6	19.1	15.8	15.3	19.1	23.5	21.4
Australia	12.1	15.5	12.1	15.7	23.7	21.7	12.0	14.3	12.1	17.1	25.1	24.0
Japan	7.6	18.7	17.2	13.8	18.5	16.8	6.4	13.3	12.0	15.4	22.0	21.1
United States	11.9	16.8	13.8	14.1	20.6	18.8	8.8	10.2	8.6	15.3	22.1	21.1
Brazil	6.9	13.1	10.5	15.9	22.7	21.6	8.7	10.0	8.6	17.5	25.4	23.8
Russia	7.0	6.8	5.7	19.1	27.6	24.0	8.3	7.1	6.4	20.2	25.8	22.8

Source: WIOD database, Version November 2011; author's calculations

Table 5 Net trade in labor by educational categories, in bn US-\$

Reporter	High educated				Medium educated				Low educated			
	1995	2000	2007	2009	1995	2000	2007	2009	1995	2000	2007	2009
China	-14.9	-24.6	-74.2	-122.2	-9.1	-4.1	-14.5	-22.4	25.5	30.2	127.5	179.3
Italy	-11.2	-12.2	-29.5	-22.3	-3.2	-2.0	26.2	27.0	45.2	27.2	49.1	46.0
Rest of World	-108.7	-107.9	-218.7	-298.5	-168.2	-97.5	-205.0	-243.2	-7.3	39.6	28.2	-25.6
Taiwan	0.4	-0.6	5.0	8.0	-6.9	-8.2	-2.9	0.8	13.2	12.4	14.1	9.3
Netherlands	-12.6	4.7	22.3	25.9	43.2	8.1	13.4	13.3	-9.7	8.6	12.9	15.1
Brazil	-2.6	-3.6	3.2	-1.6	-9.5	-8.7	0.2	-2.0	1.7	2.0	11.3	7.9
Australia	-3.2	-3.2	-9.5	-8.8	-4.1	-4.0	-10.1	-5.2	7.1	7.9	10.4	11.4
Indonesia	-4.8	-3.3	-4.9	-6.3	-8.2	-4.0	-7.0	-7.5	5.5	8.0	10.2	10.4
Spain	-0.1	-2.3	-8.0	2.7	-18.6	-22.8	-52.8	-33.1	8.9	7.1	5.0	9.0
Sweden	-3.0	4.2	6.3	6.5	10.1	6.7	15.5	12.9	2.9	2.5	4.6	3.7
Belgium	11.8	8.7	21.4	21.0	-3.5	-2.8	1.3	4.7	7.5	5.2	4.3	3.6
Portugal	-1.5	-3.1	-4.3	-4.5	-5.0	-5.4	-8.9	-7.9	1.4	1.6	3.7	3.5
Denmark	2.3	0.9	3.6	4.3	3.0	4.2	2.4	4.0	0.5	0.8	3.4	5.5
India	-2.3	-1.8	-3.6	-7.2	-4.2	-3.0	-19.7	-18.8	2.9	3.3	3.3	-1.4
Turkey	-3.9	-6.2	-12.5	-9.3	-8.3	-10.4	-23.5	-17.9	0.6	1.9	1.8	3.9
Finland	2.6	3.2	7.4	8.4	1.1	0.7	0.4	1.2	2.7	1.9	1.0	0.5
France	19.6	21.3	46.0	48.1	10.2	0.6	-7.5	-7.8	8.7	3.4	0.9	-2.5
Luxembourg	0.1	0.2	2.1	3.6	-0.2	0.4	1.1	1.5	1.2	0.1	0.8	0.5
Malta	-0.2	-0.2	-0.1	-0.0	-0.4	-0.4	-0.6	-0.5	-0.0	0.0	0.1	0.1
Estonia	0.1	0.1	0.0	0.7	-0.1	-0.1	-0.6	0.4	-0.2	-0.2	-0.4	-0.0
Cyprus	-0.2	-0.3	-0.6	-0.6	-0.7	-0.7	-1.3	-1.1	-0.3	-0.2	-0.6	-0.5
Slovenia	-0.0	0.1	0.9	1.4	0.8	0.2	0.1	0.8	-0.4	-0.3	-0.6	-0.6
Latvia	-0.0	-0.1	-0.8	0.3	-0.1	-0.2	-1.5	-0.4	-0.1	-0.1	-0.6	-0.2
Lithuania	-0.0	0.1	-0.3	0.4	-0.3	-0.6	-1.6	-0.7	-0.2	-0.3	-0.7	-0.4
Ireland	1.1	-0.6	3.3	7.0	-0.8	-1.0	-7.0	-1.9	2.0	0.5	-1.0	-0.3
Bulgaria	-0.2	-0.1	-1.3	-0.6	-0.8	-0.3	-2.1	-1.2	1.1	-0.2	-1.3	-0.9
Austria	-5.9	-2.1	0.7	0.7	5.8	6.4	15.0	15.5	-1.4	-1.5	-1.5	-1.9
Hungary	-0.5	-0.3	2.4	2.3	-0.1	-1.1	-1.2	-0.4	-0.7	-1.0	-1.7	-1.6
Slovak Republic	-0.5	-0.6	-1.7	-1.8	-0.4	-0.6	-1.7	-1.3	-0.5	-0.6	-2.2	-2.3
Czech Republic	-1.8	-1.3	-0.2	-0.1	-0.9	0.7	7.9	9.9	-1.9	-1.5	-3.1	-2.9
United Kingdom	7.8	15.8	31.9	30.4	-19.8	-11.6	-8.6	-1.5	17.1	5.1	-3.8	-2.6
Romania	-0.7	-1.2	-4.2	-2.8	-1.9	-2.0	-5.3	-2.2	1.7	2.0	-4.2	-2.7
Greece	-2.6	-4.4	-10.3	-9.7	-6.2	-6.9	-15.5	-13.6	-2.4	-2.9	-5.6	-4.6
Poland	-1.4	-4.8	-4.3	-4.1	3.0	0.2	-2.7	-0.6	-1.6	-3.8	-6.8	-6.4
Mexico	-6.5	-19.7	-29.3	-28.4	-7.8	-18.0	-24.3	-13.9	-0.9	-2.7	-8.6	-6.6
South Korea	7.8	13.6	46.0	41.4	4.1	6.4	15.0	18.5	0.9	-2.4	-11.6	-9.6
Germany	52.2	41.8	110.8	116.1	67.8	67.4	162.2	174.9	-28.1	-19.3	-20.5	-25.2
Russia	-1.5	1.8	-1.3	-0.8	14.0	25.0	60.9	54.6	-7.5	-3.1	-22.0	-24.4
Canada	-10.5	-11.6	-14.3	-27.0	24.3	32.5	45.8	35.5	-9.7	-11.9	-22.1	-22.0
Japan	27.4	31.9	50.9	33.6	77.4	79.1	100.3	81.4	-11.8	-17.9	-32.3	-35.5
United States	68.2	67.7	69.8	193.9	24.3	-22.1	-41.9	-52.0	-73.8	-101.2	-141.4	-129.1

Source: WIOD database; author's calculations

exception of China show deficits which are increasing for Australia, India and Russia. Finally, with respect to low educated employment the evidence for the EU-15 is somewhat mixed with deficits showing up in Austria, Germany, Greece and the UK and surpluses in Belgium, Finland, France Italy, Netherlands and Spain though in most cases these are decreasing. In the case of the Eastern European countries the evidence is again rather mixed with surpluses found in Bulgaria, Romania and also Turkey which might be expected and deficits in the Czech Republic, Hungary, Poland, the Slovak Republic and Slovenia. Canada and the US show deficits which were increasing particularly for the latter. Mexico has a surplus over the whole period in this category. With respect to Asian countries all show a deficit in low educated labor in 2005. South Korea and Taiwan have switched from a surplus to a deficit over the period considered. Finally, the remaining countries all show surpluses which are increasing particularly in Brazil, China, and Russia.

3.4. *The role of services in trade*

An often debated question is on the actual extent of services exports and imports. As manufacturing exports embody also value added created in services, services exports as derived from conventional trade statistics might therefore be misleading. As shown above, this approach allows for the calculation of the actual share of value added created in services contained in a country's exports. For comparison, we first provide the share of services in total trade from conventional trade statistics in Table 6. The share of services in total exports as well imports are very different across countries from almost zero (e.g. Turkey) to shares up to more around 80% (Luxembourg). Generally, one can also see an increase in these shares over time which in some cases are stronger in the crisis period due to the slump in manufacturing trade.

Due to the inter-linkages of services and manufacturing industries also manufacturing exports contain value added created in the services sectors whereas services exports might also contain inputs and value added from manufacturing sectors. Summing the appropriate terms as indicated in the methodological section above allows for the calculation of the share of value added created in manufacturing and services which can further be distinguished between domestic and foreign contributions. This information is shown in Table 7 for total exports and in Table 8 for manufacturing exports.

The share of value added created in (domestic and foreign) services in total exports embodied in both manufacturing and services exports (i.e. the sum of the shares of domestic and foreign services in Table 7) is higher than would appear from conventional trade statistics of services exports. Even, when only considering the share of value added created in domestic services embodied in a country's exports, this is in most cases higher than one would see from conventional trade statistics. In many cases the share of value added from domestic services is even higher than the share of value added created in manufacturing. Thus, services are in general as important as foreign manufacturing value added content, in some cases even higher. Again there is a quite large variation across countries however.

When looking at manufacturing exports only (Table 8), there is however still a dominance of value added contributed by domestic manufacturing. In all cases also the foreign content from manufacturing is higher than the foreign content of services.

A similar decomposition can be undertaken for splitting imports into the foreign content, the re-imports and the foreign multilateral content again distinguishing by manufacturing and services. Results are reported in Table 9 for the foreign and the foreign multilateral imports (the remaining part of re-imports is rather small and not reported). This completes the presentations of potential applications of this approach to disentangle the role of value added and factor content of exports, imports and net trade.

Table 6 Share of services in total exports and imports, in %

Reporter	Exports					Imports				
	1995	2000	2005	2007	2009	1995	2000	2005	2007	2009
Austria	32.1	29.5	28.6	27.9	30.9	26.1	22.6	23.9	22.6	24.7
Belgium	22.5	24.8	25.8	26.5	28.8	21.0	23.4	23.2	23.5	25.1
Denmark	18.6	31.1	35.9	39.5	39.2	16.1	29.0	33.3	35.0	37.5
Finland	14.4	11.1	15.1	13.8	21.8	28.7	26.8	28.2	26.9	36.0
France	17.5	15.2	16.2	15.3	16.6	16.8	14.3	14.9	15.0	16.5
Germany	10.4	11.8	12.9	13.3	16.3	15.2	16.3	17.1	16.4	17.9
Greece	39.7	65.5	72.4	70.7	70.0	13.1	24.8	21.8	21.1	23.0
Ireland	12.6	20.9	35.7	43.8	47.1	28.1	42.9	52.7	54.1	64.6
Italy	15.4	15.5	16.8	16.1	17.4	17.1	16.9	17.8	18.2	19.6
Luxembourg	65.8	80.0	82.9	85.2	88.0	48.4	67.0	70.5	75.9	79.5
Netherlands	23.4	26.5	28.1	26.7	30.6	26.9	30.1	33.9	31.8	35.9
Portugal	20.9	23.1	25.2	27.0	28.6	18.0	14.6	15.1	16.0	18.3
Spain	14.5	18.3	20.8	21.8	23.8	13.4	15.5	16.7	17.9	21.3
Sweden	18.6	21.5	25.4	26.8	31.1	24.8	28.7	29.7	29.4	33.9
United Kingdom	19.6	26.2	36.4	40.2	47.2	15.6	18.0	25.0	25.4	31.5
Bulgaria	31.7	37.1	28.4	29.5	33.5	26.3	22.7	9.0	10.1	14.5
Cyprus	44.1	51.3	70.0	62.3	61.7	23.0	23.4	23.1	22.2	22.1
Czech Republic	29.2	21.0	15.1	13.9	18.6	22.8	18.5	15.9	14.7	20.3
Estonia	31.7	27.8	29.2	32.4	35.1	16.8	15.0	17.4	16.5	20.1
Hungary	40.1	24.5	22.9	23.5	28.7	26.2	18.1	17.6	18.8	24.4
Latvia	46.8	48.7	46.9	50.3	52.1	20.9	15.5	15.3	16.2	19.0
Lithuania	31.6	32.7	36.5	38.9	39.3	13.5	17.2	16.5	11.3	18.5
Malta	38.0	35.9	45.8	48.8	57.7	17.3	14.8	21.4	23.3	26.3
Poland	17.5	25.5	17.6	19.0	21.4	17.7	20.0	17.2	16.2	19.3
Romania	23.8	30.6	31.0	33.9	36.4	17.3	14.3	13.4	13.5	14.1
Slovak Republic	25.1	19.2	17.5	15.3	16.2	23.7	20.4	15.3	15.2	17.9
Slovenia	14.2	11.3	15.8	16.8	18.9	11.4	8.8	14.1	14.6	16.2
Turkey	0.6	1.0	1.0	1.4	1.4	7.3	4.2	6.1	7.4	6.8
Canada	13.1	13.6	14.3	14.5	17.6	16.9	14.3	16.1	16.3	19.4
United States	32.8	33.1	36.2	36.8	37.9	12.6	12.5	13.2	13.9	17.4
Mexico	21.2	19.7	16.8	15.1	14.2	6.7	4.4	4.3	4.0	5.4
Japan	17.3	19.8	20.7	21.0	14.7	15.8	14.6	12.1	13.8	10.0
South Korea	19.1	18.9	15.8	16.2	16.2	13.0	17.1	17.0	17.3	18.1
Taiwan	13.4	10.8	8.2	7.9	7.8	14.0	14.4	12.1	12.2	12.3
Australia	23.7	24.4	23.1	22.5	24.3	26.0	24.3	21.8	22.8	24.6
Brazil	15.2	14.8	12.1	12.7	14.8	18.8	19.6	21.5	19.8	20.7
China	12.5	18.8	16.5	14.3	19.8	8.7	6.8	9.2	10.4	13.8
Indonesia	15.2	8.7	10.7	10.6	11.3	19.7	24.3	21.2	21.7	18.7
India	13.9	13.7	26.9	28.6	23.9	17.4	8.1	6.8	10.2	7.1
Russia	39.8	39.7	36.9	38.3	40.6	12.6	13.7	10.8	8.4	9.8
Rest of World	15.2	13.9	15.0	16.4	16.3	32.8	41.4	40.5	39.6	37.8

Source: WIOD database; author's calculations

Table 7 Decomposition of exports, in % of total

Reporter	Domestic						Foreign					
	Manufacturing			Services			Manufacturing			Services		
	1995	2007	2009	1995	2007	2009	1995	2007	2009	1995	2007	2009
Austria	35.7	31.0	31.4	42.3	36.4	39.8	11.5	18.1	15.1	10.6	14.4	13.7
Belgium	28.0	20.6	20.7	32.8	35.2	38.7	21.4	24.3	21.5	17.7	19.8	19.1
Denmark	40.6	29.1	29.3	32.3	32.7	33.8	14.5	14.6	13.2	12.6	23.6	23.6
Finland	46.9	38.5	32.9	29.4	27.6	35.4	12.7	18.4	14.7	11.1	15.5	17.0
France	37.4	31.8	29.3	42.7	40.8	45.7	11.5	16.2	14.1	8.4	11.2	10.9
Germany	49.1	38.7	36.9	34.5	34.3	39.5	9.7	15.8	13.2	6.7	11.2	10.4
Greece	38.2	12.6	15.6	44.3	60.1	61.9	8.9	11.4	8.8	8.5	15.9	13.7
Ireland	40.0	22.1	22.4	22.3	36.1	34.4	17.6	11.4	9.5	20.1	30.5	33.7
Italy	44.5	36.4	36.5	37.1	37.7	41.4	10.7	15.3	12.7	7.7	10.6	9.4
Luxembourg	13.4	5.4	4.1	41.6	32.9	34.2	12.7	8.0	6.7	32.3	53.8	55.0
Netherlands	33.3	27.4	25.9	34.9	37.0	39.2	16.5	18.7	17.3	15.3	16.9	17.6
Portugal	36.3	29.9	30.6	36.0	37.4	41.0	15.7	19.3	15.8	12.0	13.3	12.6
Spain	44.4	32.8	32.1	34.8	36.7	43.3	12.4	18.1	14.1	8.5	12.3	10.5
Sweden	40.7	30.2	27.2	33.1	37.4	41.6	13.8	16.5	14.6	12.4	16.0	16.6
United Kingdom	44.4	30.4	26.9	36.5	51.7	56.0	11.2	10.0	8.7	7.8	7.9	8.4
Bulgaria	34.6	25.5	28.1	33.1	28.6	36.1	16.0	29.3	20.8	16.3	16.6	15.1
Cyprus	28.4	16.8	17.0	46.6	56.2	58.1	12.8	11.5	10.5	12.3	15.5	14.4
Czech Republic	33.5	28.8	29.8	35.2	23.8	28.8	17.1	28.1	23.2	14.2	19.2	18.3
Estonia	30.3	25.4	25.2	31.5	36.4	41.6	21.2	21.0	17.1	17.0	17.2	16.1
Hungary	30.4	22.9	24.5	39.3	27.7	31.7	15.2	28.1	22.8	15.1	21.3	20.9
Latvia	32.6	19.9	20.3	43.0	49.4	54.9	12.8	17.1	13.2	11.6	13.5	11.6
Lithuania	32.1	25.8	23.8	35.1	42.6	42.9	18.5	18.3	18.1	14.3	13.4	15.3
Malta	18.1	17.1	15.7	31.7	37.1	44.7	28.7	24.5	19.2	21.4	21.3	20.4
Poland	48.1	32.3	34.4	34.0	33.9	37.2	10.2	19.6	15.5	7.7	14.1	13.0
Romania	43.7	35.9	37.5	33.9	37.1	39.7	12.7	15.7	12.6	9.7	11.4	10.2
Slovak Republic	34.9	26.1	27.7	32.3	25.7	30.0	17.8	28.9	24.3	15.0	19.3	18.0
Slovenia	39.4	31.4	32.5	26.3	26.3	30.9	20.6	24.8	20.6	13.7	17.6	16.0
Turkey	65.3	45.0	45.8	23.2	25.4	28.7	7.3	19.6	16.5	4.1	10.0	9.0
Canada	43.7	43.9	45.9	31.0	32.7	33.9	15.4	14.4	12.3	9.9	9.0	7.9
United States	39.0	35.3	36.9	51.0	51.8	52.3	6.2	8.2	6.7	3.7	4.7	4.1
Mexico	41.9	44.3	43.8	32.6	27.2	28.0	15.9	18.4	18.2	9.6	10.1	10.0
Japan	54.1	44.9	47.0	39.1	39.2	38.6	4.0	10.2	9.7	2.8	5.6	4.6
South Korea	44.0	38.3	36.6	31.2	24.7	24.0	15.8	23.5	25.0	9.0	13.4	14.4
Taiwan	35.3	28.2	29.7	31.2	24.8	26.7	21.0	31.0	28.6	12.5	15.9	15.0
Australia	47.4	46.8	50.3	40.5	38.3	37.6	6.9	9.4	7.5	5.2	5.5	4.6
Brazil	55.1	50.5	52.2	37.1	38.1	38.4	4.9	7.3	5.9	2.9	4.1	3.5
China	59.7	49.6	47.1	24.4	25.8	29.0	10.2	15.9	15.0	5.6	8.7	8.9
Indonesia	62.1	68.0	70.4	24.7	17.5	17.8	7.9	9.1	7.4	5.4	5.3	4.4
India	54.2	36.2	37.5	36.0	43.2	42.0	6.0	13.7	14.0	3.8	6.9	6.4
Russia	41.9	47.5	45.1	50.4	45.6	48.8	4.7	4.3	3.6	2.9	2.7	2.5
Rest of World	53.5	54.0	56.0	25.7	20.7	20.8	10.4	11.6	10.5	10.4	13.7	12.7

Source: WIOD database; author's calculations

Table 8 Decomposition of manufacturing exports, in % of total

Reporter	Domestic						Foreign					
	Manufacturing			Services			Manufacturing			Services		
	1995	2007	2009	1995	2007	2009	1995	2007	2009	1995	2007	2009
Austria	50.9	42.1	44.2	22.3	19.2	21.0	14.9	22.5	19.3	11.9	16.1	15.4
Belgium	35.6	27.7	28.6	19.8	20.4	22.8	25.4	30.2	27.4	19.2	21.7	21.2
Denmark	49.4	46.1	46.8	24.1	21.6	23.9	16.3	17.5	15.1	10.2	14.8	14.1
Finland	53.6	43.9	40.9	21.3	19.5	23.5	13.8	20.2	17.1	11.2	16.3	18.5
France	44.6	37.1	34.7	33.3	32.6	37.4	13.1	18.1	16.0	8.9	12.1	11.9
Germany	54.3	44.3	43.7	28.2	26.3	30.1	10.5	17.5	15.0	7.0	11.9	11.2
Greece	60.9	39.5	47.9	20.3	19.7	21.0	11.7	26.6	19.6	7.1	14.2	11.4
Ireland	45.4	38.2	40.8	14.2	11.2	8.7	19.5	16.9	13.9	20.9	33.7	36.6
Italy	51.4	42.5	43.3	28.5	29.0	32.2	11.9	17.2	14.3	8.2	11.4	10.2
Luxembourg	38.6	35.4	33.2	10.8	10.9	15.5	28.7	27.1	23.5	21.9	26.7	27.8
Netherlands	42.5	36.6	36.5	22.1	22.1	22.7	19.6	23.3	22.2	15.8	18.0	18.7
Portugal	45.0	40.0	41.7	23.9	21.6	24.8	18.5	23.6	19.4	12.5	14.9	14.1
Spain	51.0	40.9	41.1	26.2	24.0	30.2	13.8	21.4	16.9	9.1	13.7	11.8
Sweden	49.0	40.1	38.3	22.9	22.3	24.8	15.8	20.5	18.9	12.4	17.2	18.1
United Kingdom	54.3	49.2	49.1	23.8	26.1	26.3	13.3	14.9	14.1	8.6	9.8	10.5
Bulgaria	46.7	34.0	39.3	16.8	13.6	19.3	18.8	34.1	24.4	17.7	18.2	17.0
Cyprus	50.2	43.2	42.7	16.4	20.8	24.5	19.6	21.8	19.4	13.8	14.2	13.4
Czech Republic	44.3	32.8	35.7	19.7	15.4	17.6	20.5	31.2	26.9	15.4	20.5	19.8
Estonia	41.9	36.5	37.5	17.8	20.8	24.8	24.2	25.6	21.3	16.1	17.1	16.4
Hungary	46.7	29.1	33.1	17.6	13.1	14.4	19.4	33.9	28.9	16.3	23.9	23.6
Latvia	57.8	38.0	40.2	14.8	21.7	25.9	16.1	24.7	19.7	11.3	15.7	14.2
Lithuania	45.0	40.8	37.6	15.7	17.8	15.9	22.4	24.6	25.8	16.8	16.8	20.6
Malta	28.3	32.3	35.6	5.7	7.9	11.2	40.2	35.4	29.5	25.7	24.4	23.7
Poland	56.2	38.6	42.2	24.4	24.5	26.4	11.2	21.9	17.5	8.1	15.0	13.9
Romania	53.9	50.8	54.7	21.2	16.1	17.5	14.2	19.6	15.8	10.7	13.4	12.0
Slovak Republic	44.5	30.4	32.6	18.1	16.3	20.3	21.2	32.4	27.5	16.2	20.9	19.6
Slovenia	45.1	37.2	39.5	17.8	16.5	20.2	22.5	27.7	23.2	14.6	18.7	17.0
Turkey	65.6	45.6	46.4	22.9	24.7	28.0	7.3	19.6	16.6	4.1	10.1	9.1
Canada	49.7	50.6	54.7	22.6	23.4	22.7	17.1	16.3	14.1	10.7	9.7	8.6
United States	56.0	53.4	57.3	30.7	29.2	27.8	8.5	11.3	9.5	4.8	6.1	5.3
Mexico	51.8	51.5	50.4	17.8	16.2	17.8	19.1	20.9	20.6	11.3	11.4	11.2
Japan	63.9	55.5	54.2	28.7	26.9	30.1	4.6	11.8	10.8	2.8	5.7	4.8
South Korea	53.2	45.0	43.0	18.9	15.5	15.1	18.2	26.3	27.8	9.7	13.2	14.2
Taiwan	39.9	30.3	31.8	23.8	21.0	23.0	23.2	32.6	30.1	13.0	16.1	15.1
Australia	60.3	58.8	64.3	26.8	25.4	23.1	7.7	10.4	8.1	5.3	5.5	4.5
Brazil	63.0	56.5	59.5	28.5	31.1	30.2	5.4	7.9	6.5	3.2	4.4	3.8
China	64.9	54.8	54.3	18.4	18.7	19.3	10.9	17.2	16.8	5.8	9.3	9.6
Indonesia	70.6	74.5	77.4	15.2	10.8	10.5	8.6	9.5	7.7	5.5	5.3	4.3
India	60.8	47.4	46.8	28.7	27.2	28.5	6.4	17.3	17.1	4.1	8.1	7.6
Russia	64.7	70.6	68.6	25.6	22.0	24.8	6.1	4.6	3.9	3.6	2.8	2.7
Rest of World	61.4	62.7	64.7	16.2	10.2	10.5	11.3	12.7	11.5	11.0	14.3	13.4

Source: WIOD database; author's calculations

Table 9 Decomposition of imports, in bn US-\$

Reporter	Foreign content						Foreign multilateral content					
	Manufacturing			Services			Manufacturing			Services		
	1995	2007	2009	1995	2007	2009	1995	2007	2009	1995	2007	2009
Austria	40.9	36.4	35.7	40.4	35.4	38.9	10.1	15.6	13.4	8.1	11.9	11.4
Belgium	41.7	37.0	36.2	37.6	35.9	38.0	10.7	14.7	13.3	8.7	11.6	11.7
Denmark	44.9	30.9	30.2	33.8	42.8	45.6	11.6	13.5	12.0	9.3	12.0	11.6
Finland	39.5	37.4	32.6	41.3	36.9	43.9	10.2	13.9	12.1	8.6	11.5	11.2
France	44.1	41.2	40.8	34.5	30.4	33.0	10.9	15.0	13.5	8.5	11.7	11.2
Germany	44.3	39.4	38.8	33.0	30.7	33.0	10.4	14.3	13.3	8.2	11.2	11.0
Greece	46.7	40.4	40.2	33.4	34.8	37.0	11.3	13.7	12.2	8.5	10.9	10.6
Ireland	39.7	23.7	20.2	43.4	59.2	65.3	9.5	9.1	7.0	7.2	7.7	7.3
Italy	44.9	41.8	42.9	34.9	31.6	33.6	10.6	13.6	11.6	8.4	11.6	10.9
Luxembourg	25.3	11.9	10.4	54.7	72.0	74.7	10.4	7.4	6.3	9.4	8.6	8.6
Netherlands	40.7	36.0	34.7	40.3	40.9	44.1	9.8	11.9	10.3	7.9	9.9	9.7
Portugal	44.6	40.8	39.1	35.9	32.4	36.4	10.9	14.9	13.0	8.4	11.7	11.2
Spain	46.8	40.8	40.5	33.2	32.3	35.2	10.9	14.4	12.4	8.4	11.5	11.0
Sweden	40.1	34.4	32.9	39.0	38.1	42.2	11.0	14.4	12.5	9.1	12.3	11.9
United Kingdom	44.9	36.7	35.0	33.9	36.7	41.0	10.8	13.5	11.8	8.6	11.0	10.5
Bulgaria	44.0	44.1	43.9	40.4	26.6	31.7	8.5	16.8	13.5	7.1	12.4	10.8
Cyprus	42.6	39.2	39.3	38.7	36.5	37.7	10.5	13.4	12.1	8.2	10.9	10.8
Czech Republic	42.1	39.0	36.8	38.1	31.2	36.4	10.7	16.9	14.5	8.4	12.4	11.8
Estonia	43.9	40.0	38.8	33.5	30.5	34.3	12.5	16.1	13.9	10.1	13.2	12.9
Hungary	41.4	37.2	34.9	40.8	33.3	38.9	9.9	16.8	14.2	7.9	12.4	11.8
Latvia	41.4	38.5	38.0	35.9	31.0	33.8	12.6	16.7	14.6	10.1	13.6	13.4
Lithuania	49.0	44.0	44.4	32.1	28.0	33.8	10.6	15.5	11.5	8.2	12.3	10.1
Malta	44.5	35.7	33.5	35.4	36.3	39.6	11.5	16.2	15.0	8.6	11.8	11.9
Poland	44.8	40.0	38.6	35.8	31.9	36.0	10.7	15.7	13.5	8.5	11.9	11.4
Romania	47.0	40.4	40.1	34.9	30.4	32.8	10.2	16.6	14.8	7.8	12.3	12.1
Slovak Republic	41.3	39.5	38.9	37.0	28.9	32.6	11.6	17.8	15.3	9.5	13.5	12.8
Slovenia	47.1	37.6	38.9	31.7	30.0	32.5	12.0	18.7	15.8	9.1	13.6	12.7
Turkey	52.4	48.5	49.4	28.4	23.6	25.3	10.8	15.4	13.6	8.2	12.3	11.4
Canada	47.7	45.0	45.1	37.5	34.8	36.3	8.1	11.3	10.1	5.5	7.6	7.4
United States	48.2	45.8	45.3	30.1	27.5	29.9	8.8	12.6	11.5	5.9	8.8	8.4
Mexico	52.0	48.0	48.8	33.2	27.2	28.3	8.7	14.7	13.5	5.6	9.3	8.8
Japan	51.0	52.2	55.5	31.8	25.6	23.9	8.2	11.2	10.4	6.5	9.0	8.4
South Korea	53.0	49.1	49.7	32.7	29.9	30.8	7.9	11.4	10.5	5.9	8.8	8.3
Taiwan	51.0	49.3	49.6	33.5	27.0	27.6	8.7	13.2	12.5	6.4	9.8	9.6
Australia	44.1	43.1	43.5	39.1	31.8	32.9	9.1	13.4	12.5	7.4	11.0	10.4
Brazil	47.3	43.5	43.0	35.7	32.0	33.9	9.3	13.2	12.3	7.5	10.9	10.4
China	51.8	46.6	47.1	29.2	25.5	28.6	10.8	14.2	11.4	7.6	10.6	9.1
Indonesia	47.0	44.5	45.6	36.3	31.5	31.2	9.3	12.2	12.3	7.1	11.3	10.5
India	49.8	52.4	54.3	32.9	23.5	21.5	9.4	12.8	13.0	7.8	10.9	10.9
Russia	48.9	46.1	48.2	30.4	26.1	27.5	11.0	15.1	12.8	8.8	11.5	10.5
Rest of World	38.9	31.1	32.8	46.6	46.3	45.9	6.6	8.3	7.7	5.5	8.9	8.8

Source: WIOD database; author's calculations

4. Conclusions

A method for measuring the value added content of trade and its subcomponents like labor and capital based on recent approaches measuring the factor content of trade accounting for traded intermediates is introduced. This approach takes account of a country being an exporter and importer of intermediates simultaneously and the fact of considerable two-way trade in intermediates. The proposed framework allow for the splitting up of the value added content of trade into various forms of the domestic and foreign content of exports and imports which also generalizes applied measures of vertical specialization in international production networks. Based on this approach we show that a country's trade balance in gross terms equals its trade balance in value added terms which links it to national accounting identities. Finally, the approach allows one to analyze in which factors - as components of value added trade - a country is a net exporter or net importer. This shifts the focus of trade in goods (maybe differentiated by industries or types of products, e.g. by technology content) to net trade in factors in value terms. Finally, this framework is applied to disentangle the role of services in total exports again differentiated by the domestic and imported content. Further research is may go beyond the descriptive analysis presented here to explain the different patterns across countries and their changes over time for which this framework of accounting for value added and factors in trade can be useful.

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Value Added and Factors in Trade: A Comprehensive Approach [☆]

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Abstract

Based on recent approaches measuring the factor content of trade when intermediates are traded this paper provides an approach to decompose the value added and factor (capital, high, medium and low educated labor) content of trade into foreign and domestic components. This adds to the literature by simultaneously considering both exports and imports allowing a focus on the patterns and changes of net trade and its components and generalizes the commonly applied vertical specialization measures based on exports only. It is further pointed out that a country's trade balance in terms of value added content equals its trade balance in gross trade. Empirically, results of the proposed decomposition based on the recently compiled World Input-Output Database (WIOD) covering 40 countries and 35 industries over the period 1995-2009 are presented. The domestic value added content of exports tends to decrease over time, increasing again in the crisis. Splitting up by production factors, emerging economies tend to export relatively more capital and import labor in value terms, with the opposite pattern found for advanced economies. Splitting up labor by educational attainment the expected pattern of the advanced countries being relatively stronger net exporters of high-educated labor as compared to low-educated labor in value terms emerges. This provides a distinct view on the structure of trade deficits and surpluses across countries based on its factor content. Finally, it is shown that the role of services is more important than would be suggested by conventional trade statistics due to the value added created in service sectors for production of manufacturing exports.

JEL: F1, F15, F19

Keywords: value added trade, trade in factors, vertical specialization, production networks, services trade

1. Introduction

The flows of value added rather than goods across countries has become an increasingly debated topic due to the rapid integration of production processes and the further inclusion of countries in this interna-

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tionalization process. Though this process has been ongoing for quite some time there have been rapid integration processes in the world economy taking place over the last decade or so. In the 1990s this was due to the creation of the North American Free Trade Agreement (NAFTA) involving the US, Canada and Mexico and the integration of formerly communist countries with Western EU countries which started after the transformational recession in these countries and led to the accession of some countries into the European Union in 2004. Further, large emerging economies such as Brazil, Russia, India and China (and Indonesia and South Africa to a lesser extent) became important players on world markets at least in particular industries. This implied an increase in overall trade flows in the world economy with increasing shares of imports and exports between these newly integrating countries and the developed world. This integration of trade flows in the world economy was further accompanied by increasing foreign direct investment activities. One particular feature of this integration process was the integration of production structures in the sense that firms offshore activities to other countries to exploit cost advantages in particular stages of production. This integration of production processes has been theoretically analyzed under different headings including 'fragmentation', 'slicing up the value chain', 'outsourcing' and 'offshoring' or the 'second unbundling' and recent contributions emphasizing 'trade in tasks'.

From an empirical point of view there is still the challenge to properly measure this ongoing integration of production processes and its consequences for trade flows. The literature ranges from particular case studies for products like the Barbie doll (Tempest, 1996), the iPod (Linden et al., 2009; Varian, 2007), computers (Kraemer and Dedrick, 2002), or the Nokia N95 (Ali-Yrkkoö, 2010) or more complex products like cars (Baldwin, 2009) or airplanes (Grossman and Rossi-Hansberg, 2008), to studies of trade patterns in particular products such as 'parts and components' and overall trade in intermediates versus trade in final goods (Miroudot et al., 2009; Stehrer et al., 2011) and a number of studies focusing on the magnitude and changes of 'vertical specialization' patterns. In the European context the changes in the international structure of production are discussed from a multi-disciplinary point of view in Faust et al. (2004). This book also provides a number of case studies at the level of industries (the automobile industry, the electronics industry, and the apparel industry). Other recent studies focus on measuring trade in value added between countries thus trying to measure how much of value added created in the production process in one country is exported thus 'netting out' the value already embodied in imported products and the extent of 'vertical specialization' or 'vertical integration' (Hummels et al., 2001; Daudin et al., 2011; Johnson and Noguera, 2012; Koopman et al., 2010), with an overview of these approaches provided by Meng and Yamano (2010).¹ Related to these are papers on the measurement of trade in value added, examples including (examples including Escaith, 2008; Maurer and Degain, 2010; Timmer et al., 2012). Further there are a number of papers with a focus on the Asian production and trade network (recent examples include Meng and Inomata, 2009; Hiratsuka and Uchida, 2010; Yamano et al., 2010; Dean et al., 2011).

In the international trade literature this issue has been addressed in a similar way though having a different focus when measuring the factor content of trade flows. The seminal contribution in this respect was that of Vanek (1968) and the so called Heckscher-Ohlin-Vanek model.² In this model the perspective switches from that on trade in goods to trade in factors of production embodied in the goods traded. Empirically, this goes back even earlier to the important contribution of Leontief (Leontief, 1953) which triggered a number of subsequent studies focusing on the 'Leontief paradox'. Only recently have there been successful attempts to solve this 'paradox' by allowing for (Hicks neutral) technology differences across countries (Trefler, 1993). One particular concern in these contributions was to properly account for trade in intermediate products, an issue which has been the focus of some recent contributions including those of

¹See also Meng et al. (2011) for a decomposition of vertical specialization measures.

²For a recent overview see (Baldwin, 2008).

Davis and Weinstein (2001), Reimer (2006), and Trefler and Zhu (2010), though this issue was considered earlier by Deardorff (1982) and Staiger (1986).

The starting point of this paper are these recent papers focusing on the factor content of trade when accounting for intermediates trade and in particular the contribution of Trefler and Zhu (2010) where a 'Vanek-consistent' measure of the factor content of trade is proposed. Based on this approach we introduce an alternative approach to decompose trade flows in value added and its components capital and labor, (differentiated by educational attainment categories) and relate these to recent approaches of measuring vertical specialization patterns (Hummels et al., 2001; Daudin et al., 2011; Johnson and Noguera, 2012; Koopman et al., 2010). Our approach can be aligned with the measures of vertical specialization proposed in these studies which will be discussed below. We add to this literature by simultaneously looking at both exports and imports of the value added content of trade. The proposed framework allows us to show that a country's value added content of net trade equals its net exports in gross trade which aligns this approach to national accounting. On top of that, data allow us to further break down the figures of value added content of trade in to the components of value added. In particular, we split value added (in value terms) into capital and labor income. Labor income can be further split into high, medium and low educated income by ISCED categories, respectively.

The paper proceeds as follows. In Section 2 we introduce our method of decomposing trade in value added. Section 3 provides a short overview of the recently compiled world input output database (WIOD) database used and presents selected results of this approach. Section 4 concludes and points towards further avenues of research.

2. Measuring value added and factors in trade

In this section we introduce our approach to decompose trade flows into its value added components. The same approach is also used to further to split up these flows into value added components. There is already a wide literature on the measurement of vertical specialization, value added chains and trade in value added (see e.g. Hummels et al., 2001; Johnson and Noguera, 2012; Daudin et al., 2011; Koopman et al., 2010; Timmer et al., 2012).

Often this literature focuses on measuring the vertical integration of production processes focusing on exports and thus leaving out the aspect that all countries are also important importers of intermediates and the existence of two-way trade in intermediates as outlined above.³ On the other hand, the literature focusing on the effects of offshoring on labor markets (employment and wages) and other variables such as productivity often focus on the import side only. In this paper we therefore aim at including both sides of trade to measure the extent of exports, imports and net trade in value added and its relative importance across countries' trading patterns. The WIOD database (see below) further allows us to follow the respective trends over time and to further decompose value added flows into its components.

Another strand of literature which is related to the issue of trade in value added and vertical specialization focuses on trade in factors and is often motivated by the Heckscher-Ohlin-Vanek theorem with the further complication when trade in intermediates has to be accounted for (see Deardorff (1982) and Staiger (1986) for early contributions and Reimer (2006) and Trefler and Zhu (2010) for more recent ones). The approach suggested here is motivated by a recent paper on trade in factors, Trefler and Zhu (2010), which focuses on the correct (or 'Vanek consistent' way) of calculating the factor content of trade with trade in intermediates. We apply a similar method of calculating the factor content with two modifications. First, we

³The literature focuses on the 'import content of exports'; using supply-driven IO models allows one to also calculate the 'export content of imports' (see for example Meng and Yamano, 2010).

apply this approach using value added shares in gross output and capital and labor income shares in gross output rather than physical input coefficients upon which most of the papers focusing on trade in factors is based. In essence, we therefore not only allow for cross-country and cross-industry differences in direct and indirect input coefficients but also for differences in factor rewards.⁴ Second, we decompose the resulting measure into several categories which are outlined below in detail. In particular, this latter aspect links this paper to other approaches of measuring vertical integration and the value added content of trade.

2.1. A comprehensive approach

The starting point for the analysis are indicators of the share of value added in gross output denoted by a vector \mathbf{v} , the Leontief inverse of the global input-output matrix, $\mathbf{L} = (\mathbf{I} - \mathbf{A})^{-1}$ with \mathbf{A} denoting the coefficients matrix, and the flows of exports and imports of goods between countries denoted by \mathbf{t} . For simplicity we first discuss our approach for the case of three countries without an industry dimension. Further, we discuss net trade in value added from the viewpoint of country 1 without any loss in generality. In this special case the vector of value added coefficients becomes $\mathbf{v}' = (v^1, v^2, v^3)$, the Leontief-inverse is of dimension 3×3 and the trade vector is written as $\mathbf{t} = (x^{1*}, -x^{21}, -x^{31})$ where $x^{1*} = \sum_{p,p \neq 1} x^{1p}$ denotes exports of country 1 to all countries and x^{r1} denotes exports of country r to 1, i.e. imports of country 1. These imports are included as negative terms which results in the value added content of net trade for country 1, i.e. $t_V = \mathbf{v}'\mathbf{L}\mathbf{t}$. For the decomposition procedure however we need the individual entries of the matrix capturing exports and imports of country 1 which is achieved by a diagonalization of the value added coefficients and trade vector which results in the following exposition:

$$\mathbf{T}_V^1 = \begin{pmatrix} v^1 & 0 & 0 \\ 0 & v^2 & 0 \\ 0 & 0 & v^3 \end{pmatrix} \begin{pmatrix} l^{11} & l^{12} & l^{13} \\ l^{21} & l^{22} & l^{23} \\ l^{31} & l^{32} & l^{33} \end{pmatrix} \begin{pmatrix} x^{1*} & 0 & 0 \\ 0 & -x^{21} & 0 \\ 0 & 0 & -x^{31} \end{pmatrix} = \begin{pmatrix} v^1 l^{11} x^{1*} & -v^1 l^{12} x^{21} & -v^1 l^{13} x^{31} \\ v^2 l^{21} x^{1*} & -v^2 l^{22} x^{21} & -v^2 l^{23} x^{31} \\ v^3 l^{31} x^{1*} & -v^3 l^{32} x^{21} & -v^3 l^{33} x^{31} \end{pmatrix}$$

The first matrix contains the value added coefficients of the three countries, the second matrix denotes the elements of the Leontief inverse from the global input-output matrix and the last matrix contains exports of country 1 and imports of country 1 from the other countries which are included as negative values. Summing up this matrix over rows and columns therefore gives a measure of net trade in value added for country 1. It is informative to discuss the entries in the matrix separately. This will also document the decomposition of value added exports and imports in its various forms.

- *Exports*: The first column in matrix \mathbf{T}_V^1 describes value added contained in the exports of country 1.
 - * *Domestic value added content of exports*: The first entry, $v^1 l^{11} x^{1*}$, denotes the direct and indirect value added content of country 1's exports to all other countries.
 - * *Foreign value added content of exports*: The production of these exports also requires inputs from other countries. For production of these inputs - used to produce exports of country 1 - value added in the other countries is created. This is captured by the remaining terms in the first column by partner country, i.e. $\sum_{p (p \neq 1)} v^p l^{p1} x^{1*}$. Note, that this is added to country 1's value added content of exports, though value added is created in the other countries.
- *Imports*: The other columns capture the value added content of country 1's imports.
 - * *Foreign value added content of bilateral imports*: The imports of country 1 from 2 embody value added from country 2. Thus the second term in the second column captures country 2's value

⁴This can later be decomposed into the effects of changes in productivity, factor rewards and trade patterns by splitting ratios over gross output into factor rewards and physical input coefficients, i.e. to disentangle quantity and factor price effects.

added embodied in country 1’s imports from country 2. Similarly, the third entry in the third column captures country 3’s value added embodied in imports from country 3. Generally, the elements of the diagonal in the import block contain the partner country’s value added content of bilateral imports, $\sum_p (p \neq 1) v^p l^{pp} x^{p1}$.

* *Re-Imports*: Imports of country 1 from 2 can also require inputs from country 1 itself. Therefore, the first element in the second column captures country 1’s value added embodied in imports from country 2; analogously for the third term in the first row. Total re-imports of value added are therefore $\sum_p (p \neq 1) v^1 l^{1p} x^{p1}$.

* *Foreign multilateral value added content of imports*: Country 1’s imports from country 2 also require inputs from other countries. Thus, for example, the entry in row three of the second column captures country 3’s value added embodied in country 1’s imports from country 2. An analogous interpretation holds for the entry in the second of the third column. Thus, the total amount of these imports is given by $\sum_{p,q (p \neq q; p,q \neq 1)} v^q l^{qp} x^{p1}$.

Analogous interpretations would also hold for countries 2 and 3 and, more generally, for N countries. To disentangle these five components of net value added trade for country 1 it is convenient to rewrite the sum of the equation in the following way:

$$t_V^1 = \underbrace{v^1 l^{11} x^{1*}}_{\text{Domestic}} + \underbrace{\sum_{p (p \neq 1)} v^p l^{p1} x^{1*}}_{\text{Foreign}} - \left(\underbrace{\sum_{p (p \neq 1)} v^p l^{pp} x^{p1}}_{\text{Bilateral}} + \underbrace{\sum_{p (p \neq 1)} v^1 l^{1p} x^{p1}}_{\text{Re-imports}} + \underbrace{\sum_{p,q (p \neq q; p,q \neq 1)} v^q l^{qp} x^{p1}}_{\text{Multilateral}} \right) \quad (1)$$

Value added content of exports Value added content of imports

There is a close relationship between this measure and other measures in vertical specialization that already exist in the literature. Koopman et al. (2010) disentangles the measures as proposed by Hummels et al. (2001), Johnson and Noguera (2012) and Daudin et al. (2011) and provides an explicit derivation of the VS1 measure as proposed by Hummels et al. (2001). Relying on these results we can interpret the five terms in the above equation accordingly: The first term is country 1’s domestic value added contained in its exports. The second is the ‘true’ VS1 measure capturing the (value added) import content of exports (see Hummels et al., 2001; Koopman et al., 2010). The third term is the bilateral value added content of country 1’s imports from the other countries. The fourth term captures the re-imported value added which is similar to the VS1*1 measure as proposed in the literature (see Daudin et al., 2011; Koopman et al., 2010). Finally, the last term is the value added content of imports through third countries which is therefore the sum of the VS1^p measures (see Hummels et al., 2001; Koopman et al., 2010, for details).

Extending the above framework to many sectors requires only some slight modifications in the dimensionality of the matrices involved. Let N denote the number of countries and G the number of industries. $\mathbf{T}_V^r = \hat{\mathbf{v}}' \mathbf{L} \hat{\mathbf{t}}^r \mathbf{v}$ is now a $NG \times 1$ matrix, the Leontief inverse \mathbf{L} is of dimension $NG \times NG$ and \mathbf{t}^r is of dimension $NG \times 1$ with sector specific information on exports to all countries and imports from individual countries. Calculations can then be performed in exactly the same way as indicated above, summing up over industries additionally.⁵ To derive country specific results one first has to add up block-wise. Thus the algebra has to be rewritten in the following way with $\mathbf{R} = \mathbf{I} \otimes \mathbf{t}$ and $\mathbf{S} = \mathbf{R}'$ denoting summation matrices where \mathbf{I} is the identity matrix of dimension $N \times N$, and \mathbf{t} denotes a vector of ones of dimension $G \times 1$ and \otimes denotes the Kronecker product. Matrix \mathbf{R} is therefore of dimension $NG \times N$. Pre- and post-multiplying the industry specific matrix \mathbf{T}_V^r which is of dimension $NG \times NG$ by \mathbf{S} and \mathbf{R} respectively, results in a matrix of dimension $N \times N$ which has the same interpretation as above (having however incorporated industry-specific interrelations).

⁵This will further allow us to provide industry or industry-group specific results.

2.2. Value added content of trade and the trade balance of gross trade

This approach allows for the consideration of the relationship between a country's trade balance in gross and in terms of value added content. Based on the framework introduced above it can easily be shown that a country's net trade in value added terms equals net trade from gross exports and imports (for a further discussion of this see Stehrer, 2012). Intuitively it is clear that total exports in the value added of a country must be imported by another country (as all exports of goods must be imported somewhere else). As trade in goods is traced back to primary factor inputs and rewards and the coefficients of direct and indirect value added creation in a closed system is equal to one the trade deficit of a country equals the deficit measured in value added. Thus, this equality is a consequence of national accounting identities in a closed system of world trade. Further, as we view trade deficits from the viewpoint of individual countries we consider exports and imports as a form of final (exogenous) demand.

From an algebraic point of view this can be shown in a straightforward manner. The vector of value added, which we will denote by \mathbf{y} , can be expressed in the following way from which value added coefficients can easily be derived. Value added is gross output minus intermediate inputs, $\mathbf{y} = \mathbf{q} - \hat{\mathbf{q}}\mathbf{A}'\boldsymbol{\iota}$. Expressed in relation to gross output this yields

$$\hat{\mathbf{q}}^{-1}\mathbf{y} = \mathbf{v} = \hat{\mathbf{q}}^{-1}\mathbf{q} - \hat{\mathbf{q}}^{-1}\hat{\mathbf{q}}\mathbf{A}'\boldsymbol{\iota} = \boldsymbol{\iota} - \mathbf{A}'\boldsymbol{\iota}$$

and therefore $\mathbf{v}' = \boldsymbol{\iota}'(\mathbf{I} - \mathbf{A})$. Inserting into our equation for measuring net value added content of trade we get

$$t_V^{\text{net}} = \mathbf{v}'(\mathbf{I} - \mathbf{A})^{-1}\mathbf{t} = \boldsymbol{\iota}'(\mathbf{I} - \mathbf{A})(\mathbf{I} - \mathbf{A})^{-1}\mathbf{t} = \boldsymbol{\iota}'\mathbf{t} = t^{\text{net}}$$

i.e. net trade in terms of value added content equals net trade in gross terms. Similarly one can show (by using trade vectors consisting of the export cell or the import cells) that the ratio of value added exports (imports) to gross exports (imports) equals one. The reason for this result is that in this framework all goods are produced by primary factors capturing all value added. On the other hand, one should note that exports do not only contain value added of the domestic economy and, analogously, imports do not only contain value added from the bilateral trading partner.

2.3. Value added content of trade by factor

Instead of doing the analysis with the vector of value added coefficients \mathbf{v} we can now exploit the fact that value added is a composite of income of various primary factors. Thus given data at hand one might split up each element of the value added coefficients vector into subcomponents like labor and capital, i.e. $v_i^r = \sum_f v_{i,f}^r$ where f denotes the factors considered. The data at hand which are described below in more detail allows us to distinguish first between labor and capital income. The former can be further split into three categories by educational attainment levels according to the ISCED classification. This allows us to differentiate the value added content of trade into factor content (in value terms). These individual factors sum nicely up to the aggregate as described above. Importantly, this allows us to consider in which factors a country is running a trade deficit or surplus. For instance, a country which is running a trade deficit can nonetheless be a net exporter of a particular factor such as high-educated labor.

Summarizing, this approach of measuring value added and the factor content of trade is consistent with measures of net trade in gross terms, incorporates other measures as suggested in the recent literature and allows for a decomposition of value added trade along various dimensions which we document in subsequent sections.

2.4. Relation to vertical specialization measures

This approach can also be interpreted as a generalization of the widely used vertical specialization measures as proposed in Hummels et al. (2001). The more sophisticated measure proposed in this paper is given by $VS1 = \sum_{p,p \neq r} \mathbf{A}^{pr} (\mathbf{I} - \mathbf{A}^{rr})^{-1} \mathbf{x}^{r*}$ which is the sum of the direct import coefficients matrix \mathbf{A}^{pr} times the domestic Leontief inverse over partner countries referred to as the 'foreign import content of exports'. The availability of a full world input-output matrix however allows us to take the intra-regional linkages into account appropriately. As a special case, consider the coefficients matrix for three countries as above to be of the form

$$\mathbf{A} = \begin{pmatrix} a^{11} & 0 & 0 \\ a^{21} & a^{22} & 0 \\ 0 & a^{23} & a^{33} \end{pmatrix}$$

i.e. country 1 does not bilaterally import intermediates from country 3. The measure of vertical specialization for country 1, i.e. the foreign content of exports, would be $VS1^1 = a^{21}(1 - a^{11})^{-1}x^{1*}$. The Leontief inverse of the above coefficients matrix would however be triangular

$$\mathbf{L} = \begin{pmatrix} l^{11} & 0 & 0 \\ l^{21} & l^{22} & 0 \\ l^{31} & l^{23} & l^{33} \end{pmatrix}$$

and the corresponding measure of the foreign content of exports is

$$VS2^1 = \sum_p l^{p1} x^{1*}$$

thus taking into account indirect imports from country 3 (via imports of intermediates of country 2). More generally, one therefore has to multiply the Leontief inverse with the trade vector as specified above to arrive at a matrix of gross output requirements for exports.

$$\mathbf{VS2}^1 = \begin{pmatrix} l^{11} & l^{12} & l^{13} \\ l^{21} & l^{22} & l^{23} \\ l^{31} & l^{32} & l^{33} \end{pmatrix} \begin{pmatrix} x^{1*} & 0 & 0 \\ 0 & -x^{21} & 0 \\ 0 & 0 & -x^{31} \end{pmatrix} = \begin{pmatrix} l^{11}x^{1*} & -l^{12}x^{21} & -l^{13}x^{31} \\ l^{21}x^{1*} & -l^{22}x^{21} & -l^{23}x^{31} \\ l^{31}x^{1*} & -l^{32}x^{21} & -l^{33}x^{31} \end{pmatrix}$$

The elements in the second and third row of the first column would be the measure of vertical specialization denoted as $VS2$ above. Hummels et al. (2001) suggest to express that in terms of gross exports; alternatively one might express that in terms of gross output used (foreign and domestically) to produce country 1's exports, i.e. the sum of the first column. The measure presented here on vertical specialization also include imports allowing for a similar decomposition as in equation (1) in terms of gross output. Similarly to above, one might use only final goods exports instead of total exports (as also used in Hummels et al. (2001) to avoid double-counting.

2.5. Splitting up into sectors

Finally, we generalize the measure to consider several inter-linked sectors of the economies. For example, this might be used to pin down the role of services in manufacturing exports. Rewriting the trade matrix in value added terms above with two sectors (subscripts indicate sectors) would result in

$$\mathbf{T}_V^1 = \begin{pmatrix} v_1^1 l_{11}^{11} x_1^{1*} & v_1^1 l_{12}^{11} x_2^{1*} & v_1^1 l_{11}^{12} x_1^{2*} & v_1^1 l_{12}^{12} x_2^{2*} & v_1^1 l_{11}^{13} x_1^{3*} & v_1^1 l_{12}^{13} x_2^{3*} \\ v_2^1 l_{21}^{11} x_1^{1*} & v_2^1 l_{22}^{11} x_2^{1*} & v_2^1 l_{21}^{12} x_1^{2*} & v_2^1 l_{22}^{12} x_2^{2*} & v_2^1 l_{21}^{13} x_1^{3*} & v_2^1 l_{22}^{13} x_2^{3*} \\ v_3^1 l_{31}^{11} x_1^{1*} & v_3^1 l_{32}^{11} x_2^{1*} & v_3^1 l_{31}^{12} x_1^{2*} & v_3^1 l_{32}^{12} x_2^{2*} & v_3^1 l_{31}^{13} x_1^{3*} & v_3^1 l_{32}^{13} x_2^{3*} \\ v_1^2 l_{11}^{21} x_1^{1*} & v_1^2 l_{12}^{21} x_2^{1*} & v_1^2 l_{11}^{22} x_1^{2*} & v_1^2 l_{12}^{22} x_2^{2*} & v_1^2 l_{11}^{23} x_1^{3*} & v_1^2 l_{12}^{23} x_2^{3*} \\ v_2^2 l_{21}^{21} x_1^{1*} & v_2^2 l_{22}^{21} x_2^{1*} & v_2^2 l_{21}^{22} x_1^{2*} & v_2^2 l_{22}^{22} x_2^{2*} & v_2^2 l_{21}^{23} x_1^{3*} & v_2^2 l_{22}^{23} x_2^{3*} \\ v_3^2 l_{31}^{21} x_1^{1*} & v_3^2 l_{32}^{21} x_2^{1*} & v_3^2 l_{31}^{22} x_1^{2*} & v_3^2 l_{32}^{22} x_2^{2*} & v_3^2 l_{31}^{23} x_1^{3*} & v_3^2 l_{32}^{23} x_2^{3*} \\ v_1^3 l_{11}^{31} x_1^{1*} & v_1^3 l_{12}^{31} x_2^{1*} & v_1^3 l_{11}^{32} x_1^{2*} & v_1^3 l_{12}^{32} x_2^{2*} & v_1^3 l_{11}^{33} x_1^{3*} & v_1^3 l_{12}^{33} x_2^{3*} \\ v_2^3 l_{21}^{31} x_1^{1*} & v_2^3 l_{22}^{31} x_2^{1*} & v_2^3 l_{21}^{32} x_1^{2*} & v_2^3 l_{22}^{32} x_2^{2*} & v_2^3 l_{21}^{33} x_1^{3*} & v_2^3 l_{22}^{33} x_2^{3*} \end{pmatrix}$$

The first column would indicate the value of country 1 exports in sector 1 (e.g. manufacturing) and the second column the value of country 1 exports in sector 2 (e.g. services). Considering one column would further allow for a more detailed decomposition of a sectors value of exports. For example, sector 1 exports could be split into the value which is added in domestic manufacturing, $v_1^1 l_{11}^1 x_1^{1*}$, and the value added in domestic services, $v_2^1 l_{21}^1 x_1^{1*}$, and similarly for foreign value added (by summing up over partner countries by industry). Similar interpretations would hold for the other sectors and imports, respectively. Below we show results considering the role of value added created in service industries in a country's exports and trade in general.

3. Value added and factor content of trade since 1995 and during the crisis

In this section we present selected results on the patterns of value added by applying equation (2.1). For this we proceed in a series of steps: First, we present the magnitudes of gross and value added exports and imports and the corresponding net figures for the 41 countries including the rest of the world. We then split up trade in value added to its foreign and domestic contents. Finally, trade in value added is then differentiated by factors. We report results of the analysis for years 1995, 2000 and 2005 and over the crisis period 2008-2009.

3.1. Data

The analysis requires data on output and the use of intermediates and production factors by industry. In this section we provide information on a recently constructed database, the World Input-Output Database (WIOD), that is used to study the value added and factor content of trade.⁶ This is derived from national supply and use or input-output tables which are combined with detailed trade data resulting in a World Input-Output Table (WIOT). At the industry level the data are combined with further information obtained from Socio-Economic Accounts data (SEAs). The WIOTs are therefore a combination of national input-output tables in which the use of products is broken down according to their country of origin, national supply and use tables and detailed trade data. The information is collected on an annual basis from 1995 to 2009 for 59 products and 35 industries. The industry classification follows the ISIC Revision 3 classification for Non-EU countries compatible to NACE Revision 1.1 which is used for EU countries. The data cover 40 countries which account for about 85 percent of world GDP.⁷ The variables from the SEAs include gross output and value added, final demand expenditures, as well as employment by educational attainment, and capital compensation. The remainder of this section provides a more detailed overview of the construction of the SEAs and the WIOTs. A detailed documentation is provided in Timmer et al. (2012).

3.2. Patterns of the value added content of trade

Table 1 provides an overview of countries exports and imports as well as the net trade positions ranked by net trade in 2007, i.e. before the crisis started. The most important surplus countries have been China, German and Japan and the countries with strong deficits are Spain and the USA (together with the rest of the world). Generally, these net trade positions have been maintained over time with the surplus countries tending to have larger surpluses and deficit countries larger deficits (with the extreme cases of China and the US). A few countries managed to turn their deficits into a surplus like Brazil or the Czech Republic

⁶The construction of the database was made in an ongoing project, the World Input-Output Database project; see www.wiod.org.

⁷These countries are the EU-27 plus Turkey, Canada, USA and Mexico, Japan, Korea, Taiwan, Australia, Brazil, Russia, India, Indonesia and China.

whereas other countries slipped into a deficit like the United Kingdom. Comparing 2007 to 2009 these global imbalances are diminished in most cases, the notable exception is China showing an even larger trade surplus in 2009.

As discussed in detail above, a country's exports contain not only domestic value added but also foreign value added as do imports. These shares can be disentangled using the approach outlined above. Table 2 provides these shares according to our decomposition into the five components with respect to the domestic and foreign value added content of trade. Countries are ranked according to the foreign value added content of exports in 2007. There is a wide range of these shares from more than 60% in the case of Netherlands to levels of 12.2% in the US, 11.3% in Brazil and 7% in Russia. Generally, as expected larger countries tend to have lower shares.

As countries become more and more integrated in international production processes one would expect that the share of the foreign value added content of exports would be rising over time. In fact, this share was rising for almost all countries (with the exception of the UK and Canada) as reported in the first three columns of Table 2, albeit with the magnitudes and changes being rather different. Particularly strong increases can also be seen in some of the Eastern European countries emphasizing their increasingly important role in the European production networks together with Turkey. Relatively small changes are however found for the NAFTA countries: The share for the US rose from 9 to 12 percent, for Mexico from 28 to 31 percent, and for Canada it was even slightly decreasing. The reason for this might be that the integration process started earlier as the NAFTA agreement was signed in 1992. China's share increased from 10 percent to 25 percent whereas India which started with 10 percent in 1995 reached 22 percent. Thus, with respect to exports these results confirm existing literature indicating an increasing internationalization of production as well as the fact that smaller countries tend to have larger shares and the rapid integration of Eastern European countries.

Turning to the import side, the shares of re-imports are fairly small with a mixed tendency over time. Some significant magnitudes can be found for Germany and the US and maybe Japan. Analogously to exports, we would also expect that the share of foreign imports of value added would rise as the imports from other countries increasingly embody value added from third countries. Again this is what is actually found (see three last columns in Table 2). It is interesting to note that the shares are much more similar across countries pointing towards the fact that the factor content from the bilateral relations are more important.⁸

Table 2 further reports the ongoing changes over the crisis period, 2007-2009. The most striking fact is that the foreign value added content of exports was decreasing in most cases - with a few exceptions - over this period, thus pointing towards a disintegration of production effect. This is also supported when looking at the foreign multilateral value added content of imports which again tends to be smaller in 2009 as compared to 2007 in all cases.

3.3. Value added content of trade by factor

Value added is composed of capital and labor income as outlined above. The WIOD data allow distinguishing between the capital and labor content of trade flows in value terms, the latter being later divided by educational categories. From a theoretical perspective the HOV result suggests that countries being abundant in labor (capital) would be net exporters of labor (capital) services at least in productivity adjusted

⁸Splitting up into final goods and intermediates it turns out that the shares by use category are not too different for the individual countries though there are some notable exceptions. Particularly, the shares of the foreign multilateral value added content of imports tends to be lower for the more advanced countries. The reason for this is that these countries' shares in the bilateral content of value added imports of intermediates are high because of imports of raw materials (also from the rest of the world). Importantly however, in most cases these shares are increasing over time for both final and intermediates goods trade which implies that the production of intermediates goods trade has also become more integrated over time. Results are available upon request.

Table 1 Trade in goods and services and trade in value added, in bn US-\$

Reporter	(Value added) Exports				(Value added) Imports				Net trade			
	1995	2000	2007	2009	1995	2000	2007	2009	1995	2000	2007	2009
China	165.1	274.2	1305.6	1896.7	137.0	225.5	933.2	1370.3	28.1	48.7	372.4	526.4
Germany	541.8	571.0	1392.7	1164.3	477.2	517.5	1098.2	935.9	64.6	53.5	294.6	228.5
Japan	480.5	507.9	760.4	627.3	350.2	381.2	619.0	550.9	130.2	126.7	141.4	76.3
Russia	79.4	94.6	308.6	272.0	61.8	47.8	227.1	203.0	17.6	46.8	81.4	69.0
Netherlands	203.2	198.3	400.6	397.7	175.2	174.9	339.1	341.2	28.0	23.4	61.5	56.5
Canada	201.3	303.0	457.1	361.3	178.9	255.8	415.8	366.0	22.3	47.2	41.3	-4.7
Taiwan	120.7	163.7	263.3	216.9	112.3	150.6	228.4	180.6	8.4	13.0	34.8	36.4
Sweden	88.8	102.0	208.8	167.6	71.8	84.8	174.3	142.5	17.0	17.3	34.5	25.1
South Korea	137.2	182.5	402.4	375.4	137.1	169.0	374.6	340.8	0.1	13.6	27.8	34.6
Ireland	46.0	83.6	189.3	185.4	36.2	69.5	164.0	148.7	9.8	14.1	25.3	36.6
Indonesia	53.4	64.3	123.9	133.3	50.9	45.7	99.3	108.0	2.5	18.6	24.6	25.3
Belgium	164.3	148.6	295.4	265.5	146.8	138.5	274.1	247.4	17.5	10.0	21.2	18.1
Austria	66.2	73.3	179.7	156.4	71.3	71.3	162.5	143.1	-5.0	2.0	17.2	13.2
Brazil	50.1	57.4	162.3	158.7	61.4	68.6	147.3	160.8	-11.3	-11.3	15.0	-2.1
Luxembourg	18.4	24.6	75.0	75.0	14.9	21.5	61.5	60.6	3.5	3.0	13.5	14.4
Finland	43.1	47.1	100.3	79.8	33.5	36.6	87.1	74.9	9.6	10.5	13.2	4.9
Denmark	58.6	62.6	133.9	121.3	50.8	53.1	127.4	110.1	7.8	9.5	6.6	11.2
Czech Republic	23.6	31.0	121.9	110.8	26.0	33.2	115.4	102.4	-2.4	-2.2	6.5	8.4
Slovak Republic	9.5	12.4	55.1	51.2	9.4	12.8	55.5	51.3	0.1	-0.4	-0.4	-0.1
Malta	2.0	2.6	4.9	4.6	2.9	3.3	5.8	5.2	-0.9	-0.7	-0.9	-0.6
Slovenia	8.4	9.0	26.7	22.8	9.2	9.9	28.2	23.1	-0.8	-0.9	-1.5	-0.3
Hungary	14.9	27.2	93.2	79.1	17.4	31.4	94.9	76.8	-2.5	-4.2	-1.7	2.3
Estonia	2.0	3.6	10.7	9.2	2.4	3.9	12.6	8.2	-0.4	-0.3	-1.9	1.0
Lithuania	2.6	4.2	16.1	16.7	3.3	5.0	20.7	17.1	-0.7	-0.9	-4.5	-0.4
Cyprus	1.9	2.1	4.5	4.5	3.7	4.0	9.0	8.1	-1.8	-1.9	-4.6	-3.6
Mexico	77.0	162.1	262.4	208.1	70.0	168.0	267.1	212.1	7.0	-5.9	-4.7	-3.9
Latvia	1.8	2.8	9.3	9.0	1.9	3.2	14.3	9.3	-0.1	-0.3	-5.0	-0.3
Bulgaria	5.3	5.9	21.5	19.8	5.2	6.2	28.6	23.2	0.1	-0.3	-7.1	-3.4
Poland	29.4	43.0	158.8	152.1	26.4	51.8	167.4	147.6	3.0	-8.7	-8.6	4.5
Australia	69.8	85.5	186.9	194.0	68.2	80.8	196.0	185.3	1.5	4.7	-9.1	8.7
Italy	246.3	251.9	530.6	433.6	217.1	251.0	544.5	447.0	29.2	1.0	-13.8	-13.4
Romania	8.7	10.8	45.5	43.8	10.4	12.8	66.7	52.4	-1.7	-1.9	-21.2	-8.6
Portugal	25.3	26.7	59.3	51.4	34.2	40.5	81.2	72.0	-9.0	-13.8	-21.9	-20.6
United Kingdom	284.6	354.6	660.9	542.6	272.4	352.7	687.4	545.8	12.2	1.9	-26.5	-3.2
India	39.3	62.7	226.8	195.2	42.3	65.1	260.0	243.9	-3.1	-2.4	-33.2	-48.8
France	312.9	321.4	581.3	516.1	286.7	310.9	619.9	555.8	26.2	10.5	-38.5	-39.7
Greece	9.1	16.8	47.5	43.7	25.9	38.3	92.9	84.1	-16.8	-21.5	-45.4	-40.4
Turkey	26.5	39.0	108.7	106.9	34.6	55.9	155.6	129.5	-8.1	-16.8	-46.9	-22.6
Spain	102.8	130.5	307.3	274.7	118.3	165.6	426.4	328.2	-15.5	-35.1	-119.1	-53.6
Rest of World	698.5	1067.6	2646.2	2239.6	1018.9	1124.7	2904.5	2909.4	-320.4	-57.1	-258.3	-669.8
United States	755.9	968.5	1508.3	1426.2	801.8	1257.6	2066.2	1687.5	-45.9	-289.1	-557.9	-261.3

Source: WIOD database; author's calculations

Table 2 Decomposition of total value added trade 1995-2005, (in %)

Reporter	Foreign VA content of exports					Re-Imports of VA					Foreign multilateral VA content of imports				
	1995	2000	2005	2007	2009	1995	2000	2005	2007	2009	1995	2000	2005	2007	2009
Luxembourg	45.0	58.3	59.2	61.7	61.7	0.2	0.1	0.1	0.1	0.1	19.8	17.8	16.3	16.0	14.9
Hungary	30.3	49.4	46.4	49.4	43.7	0.1	0.1	0.2	0.3	0.2	17.8	23.9	26.9	29.2	26.0
Slovak Republic	32.8	43.8	46.7	48.2	42.3	0.7	0.3	0.3	0.4	0.4	21.1	23.2	28.3	31.2	28.1
Czech Republic	31.4	39.2	44.5	47.4	41.5	0.7	0.4	0.5	0.5	0.5	19.1	24.0	26.2	29.3	26.3
Taiwan	33.5	36.6	44.7	46.9	43.6	0.3	0.6	0.7	0.7	0.6	15.2	18.7	21.5	23.1	22.1
Bulgaria	32.4	36.7	36.3	46.0	35.8	0.0	0.0	0.0	0.1	0.1	15.6	20.9	26.8	29.2	24.3
Malta	50.2	52.4	44.1	45.8	39.6	0.0	0.0	0.0	0.0	0.0	20.1	26.7	26.0	28.0	26.9
Belgium	39.1	42.4	41.3	44.1	40.6	1.2	0.9	0.8	0.8	0.8	19.4	23.0	24.9	26.3	25.0
Slovenia	34.3	37.5	40.4	42.4	36.6	0.1	0.1	0.1	0.1	0.1	21.1	26.7	29.7	32.3	28.5
Ireland	37.8	45.2	42.6	41.9	43.2	0.2	0.3	0.2	0.2	0.2	16.7	17.2	15.9	16.9	14.2
Denmark	27.1	31.2	33.6	38.2	36.9	0.4	0.6	0.8	0.9	0.6	20.9	23.2	23.8	25.4	23.6
Estonia	38.1	44.5	39.3	38.2	33.2	0.1	0.1	0.1	0.1	0.1	22.5	26.4	26.9	29.3	26.8
South Korea	24.8	31.3	34.6	37.0	39.4	0.5	0.6	0.8	0.8	0.7	13.8	15.6	18.8	20.2	18.9
Netherlands	31.8	34.8	33.9	35.6	34.9	1.2	1.0	1.2	1.2	1.3	17.7	19.5	20.3	21.9	20.0
Finland	23.7	28.3	31.2	33.9	31.7	0.5	0.4	0.4	0.4	0.3	18.8	22.0	23.9	25.3	23.2
Poland	17.9	25.6	30.4	33.7	28.5	0.2	0.3	0.5	0.5	0.5	19.2	23.8	25.4	27.6	24.9
Portugal	27.7	31.1	32.3	32.6	28.4	0.2	0.2	0.3	0.3	0.3	19.3	23.9	24.5	26.6	24.2
Austria	22.1	26.9	30.7	32.5	28.8	0.5	0.6	0.6	0.7	0.6	18.2	23.2	25.2	27.5	24.8
Sweden	26.2	30.1	30.5	32.5	31.2	0.7	0.7	0.7	0.7	0.5	20.1	22.6	24.5	26.7	24.4
Lithuania	32.8	33.3	35.4	31.6	33.4	0.0	0.1	0.1	0.2	0.2	18.9	21.8	23.9	27.8	21.6
Latvia	24.4	26.6	30.6	30.6	24.8	0.1	0.1	0.2	0.2	0.2	22.7	26.6	29.3	30.3	28.0
Spain	20.9	27.4	27.8	30.5	24.6	0.7	0.8	0.9	1.0	0.9	19.3	22.8	23.8	25.9	23.4
Turkey	11.4	18.4	26.0	29.6	25.5	0.1	0.2	0.2	0.3	0.2	19.0	23.8	25.9	27.7	25.0
Mexico	25.4	29.7	29.0	28.5	28.2	0.5	0.8	0.7	0.8	0.7	14.2	17.2	22.7	24.0	22.2
France	19.9	25.1	25.4	27.4	25.0	2.0	1.9	1.8	1.7	1.5	19.4	22.7	24.5	26.6	24.7
Greece	17.5	29.3	25.1	27.2	22.5	0.1	0.1	0.1	0.1	0.1	19.9	20.3	22.6	24.6	22.7
Romania	22.4	26.3	29.1	27.0	22.8	0.1	0.1	0.1	0.2	0.2	18.1	23.2	24.6	29.0	26.9
Germany	16.4	22.2	24.1	27.0	23.6	4.0	3.8	4.3	4.4	3.9	18.6	22.1	23.8	25.5	24.3
Cyprus	25.0	30.3	20.9	27.0	24.9	0.0	0.0	0.0	0.0	0.0	18.7	20.3	22.2	24.4	22.9
Italy	18.4	21.0	22.8	25.9	22.1	1.2	1.2	1.3	1.3	1.0	19.0	21.6	23.2	25.2	22.5
Rest of World	20.8	21.9	24.4	25.3	23.2	2.3	3.6	4.9	5.5	4.9	12.2	13.4	15.9	17.2	16.5
China	15.9	17.1	25.3	24.6	23.9	0.7	1.2	2.5	3.1	3.8	18.4	21.9	24.4	24.9	20.5
Canada	25.3	27.4	23.8	23.4	20.2	1.3	1.4	1.4	1.4	1.0	13.5	15.6	17.8	18.9	17.5
India	9.8	14.6	20.2	20.6	20.5	0.1	0.2	0.4	0.4	0.4	17.2	17.5	23.8	23.7	23.9
United Kingdom	19.1	18.7	17.5	17.9	17.1	1.8	2.3	2.0	2.0	1.7	19.5	22.7	23.1	24.5	22.3
Japan	6.8	8.7	12.3	15.8	14.4	2.5	2.6	2.4	2.1	1.8	14.7	17.5	19.8	20.2	18.8
Australia	12.1	13.3	13.3	14.9	12.1	0.3	0.4	0.6	0.6	0.7	16.5	18.7	23.1	24.5	22.9
Indonesia	13.2	16.3	17.0	14.5	11.8	0.3	0.4	0.4	0.4	0.4	16.4	18.3	21.8	23.6	22.8
United States	9.9	11.1	12.2	12.9	10.7	6.9	7.9	5.7	5.4	4.9	14.8	17.0	20.2	21.3	19.9
Brazil	7.8	11.4	11.3	11.4	9.5	0.2	0.2	0.3	0.4	0.4	16.8	19.9	21.9	24.1	22.7
Russia	7.7	10.0	7.6	7.0	6.1	0.9	1.2	1.2	1.2	1.0	19.8	21.8	23.8	26.6	23.3

Source: WIOD database; author's calculations

terms. Since we focus in this paper on factor content in value terms (rather than in physical units) this picture becomes distorted as we allow for differences in factor rewards.

Assembly production is considered a low-value added activity which however can be capital intensive (e.g. production lines) with mainly low-skilled (and low-wage) workers occupied. As returns on capital tend to be equalized across countries one thus would expect 'assembly' countries tending to have a surplus in capital (when measured in value terms). Similarly, natural resource rich countries might tend to have a larger surplus in capital. Conversely, advanced countries which export high-tech components which are skill intensive (labor) therefore tend to be net importers of capital and net exporters of labor in value terms.

Table 3 presents the results for the value added content of trade by factors in billions of US-\$ and ranked according to net trade in labor values in 2007. The countries with the largest surplus with respect to the labor content of trade (in value terms) are Germany and Japan together with a number of other advanced economies. The countries with the largest deficits are Spain, Mexico and the United States. Looking at capital flows the pattern sketched above is actually found. For example, Germany shows much lower net figures or even small deficits which is also the case for the other more advanced economies. China, on the other hand, runs a huge surplus in terms of capital which is much larger than that for labor. And with respect to the US, the deficit in capital when compared with the deficit in labor.

Table 4 presents the components of value added trade with respect to the domestic and foreign content differentiating between capital and labor (we leave out the share of re-imports as this is rather small) with countries ranked according to the foreign labor content of exports in 2007. Overall both patterns and trends are quite similar to the ones for total trade as discussed in Section 2. But there are some interesting patterns which again confirm the hypothesis above. For example, looking at China the labor share in the foreign value added content of exports is higher (31.8% in 2007) when compared to the share of capital (19.8%) with the opposite pattern found for advanced economies like the US and Germany. The corresponding number for the US is 16.8% for capital and 10.2% for labor, and 32.2% and 23.6%, respectively, for Germany. Again this points to the fact that in value terms the advanced countries tend to import capital and export labor.

Finally, we present in Table 5 the results when splitting up trade flows in labor terms into the components high-educated and medium and low educated. According to the hypothesis above we would expect that the advanced countries tend to be net exporters of skilled labor in value terms and net importers of unskilled labor as assembly is considered to be a low-skill activity whereas the production of the high-tech components tends to be skill intensive. With respect to high educated labor the pattern is mostly as expected: more advanced countries and those better endowed with skilled labor are also net exporters of it in value terms. This is the case for most of the EU-15 countries, the notable exceptions are Austria and Italy whereas other countries with deficits like Greece, Portugal and Spain are less well endowed with skilled labor. Also the US is showing a trade surplus with respect to skilled labor. The Asian countries also show surpluses with respect to skilled labor which are rising in all cases. All the others have experienced deficits with China in particular showing a rising deficit in the trade of skilled labor. Regarding medium educated employment, most of the EU-15 countries show trade surpluses as expected with the exceptions of Greece, Spain and Portugal. These surpluses are rather high and/or increasing in Austria, Germany, Netherlands, Sweden and the UK. Also the Eastern European countries show in a number of cases a surplus in this category with the exceptions of Bulgaria and Romania. Significant and rising surpluses are found in the Czech Republic, Poland and Slovenia. The US started with a surplus in this category of medium skilled workers but this switched to a deficit in 2000 which then further increased. Canada is running a surplus whereas Mexico shows a deteriorating deficit. Again the Asian countries show increasing surpluses which is however rather small in the case of Taiwan. Within the group of the remaining countries all with the

Table 3 Net trade in capital and labor (total trade), in bn US-\$

Reporter	Capital					Labor				
	1995	2000	2005	2007	2009	1995	2000	2005	2007	2009
Germany	-27.3	-36.3	2.5	42.2	-37.3	91.9	89.8	201.6	252.4	265.8
Japan	37.6	33.7	29.4	22.7	-3.1	92.7	93.0	102.9	118.7	79.5
South Korea	-12.7	-4.0	-12.6	-21.5	-15.7	12.7	17.6	41.2	49.3	50.3
Netherlands	7.1	2.1	10.9	12.8	2.3	20.9	21.2	41.9	48.6	54.2
Italy	-1.6	-12.0	-41.8	-59.5	-64.1	30.8	13.0	33.4	45.7	50.7
France	-12.3	-14.7	-51.5	-77.9	-77.4	38.5	25.2	38.9	39.4	37.7
China	26.6	47.3	163.2	333.6	491.8	1.5	1.5	7.7	38.8	34.6
Russia	12.6	23.0	47.7	43.9	39.5	5.1	23.7	37.3	37.5	29.5
Belgium	1.7	-1.0	-2.6	-5.8	-11.2	15.8	11.0	20.5	27.0	29.3
Sweden	7.0	3.9	7.1	8.2	2.0	9.9	13.4	22.1	26.4	23.1
United Kingdom	7.2	-7.4	-39.7	-45.8	-29.4	5.0	9.3	10.2	19.3	26.2
Taiwan	1.8	9.5	10.7	18.6	18.2	6.6	3.6	10.1	16.2	18.2
Brazil	-0.9	-0.8	18.7	0.3	-6.4	-10.4	-10.4	6.7	14.7	4.3
Austria	-3.5	-0.7	-0.0	2.9	-1.0	-1.5	2.7	8.1	14.2	14.3
Canada	18.3	38.2	39.2	31.8	8.8	4.0	9.0	12.7	9.4	-13.5
Denmark	2.0	3.7	3.1	-2.8	-2.6	5.8	5.8	8.3	9.4	13.8
Finland	3.1	4.7	1.1	4.5	-5.2	6.5	5.8	6.9	8.8	10.1
Czech Republic	2.2	-0.1	0.2	1.8	1.6	-4.6	-2.0	2.1	4.6	6.8
Luxembourg	2.4	2.3	4.7	9.4	8.8	1.1	0.7	2.1	4.1	5.7
Slovenia	-1.3	-0.9	-1.3	-1.9	-2.1	0.5	0.0	0.5	0.4	1.7
Hungary	-1.3	-1.8	-2.1	-1.1	2.0	-1.2	-2.4	-2.8	-0.5	0.3
Malta	-0.2	-0.1	-0.3	-0.3	-0.1	-0.7	-0.6	-0.5	-0.6	-0.5
Estonia	-0.2	-0.1	-0.3	-1.0	0.0	-0.2	-0.2	-0.6	-1.0	1.0
Indonesia	9.9	18.0	19.1	26.5	28.7	-7.5	0.6	-2.4	-1.8	-3.4
Cyprus	-0.6	-0.7	-1.5	-2.1	-1.5	-1.2	-1.2	-1.5	-2.5	-2.1
Lithuania	-0.1	-0.1	-0.2	-1.8	0.4	-0.6	-0.7	-1.8	-2.7	-0.8
Latvia	0.2	0.0	-0.4	-2.0	0.0	-0.3	-0.4	-1.5	-2.9	-0.3
Ireland	7.3	15.0	26.5	29.7	31.6	2.5	-0.9	-2.1	-4.5	5.0
Bulgaria	0.0	0.2	-1.1	-2.4	-0.7	0.1	-0.6	-2.4	-4.7	-2.7
Slovak Republic	1.6	1.3	2.5	5.2	5.2	-1.5	-1.7	-4.3	-5.6	-5.3
Australia	1.8	4.0	4.3	0.2	11.3	-0.3	0.7	-7.2	-9.3	-2.6
Portugal	-3.9	-6.8	-11.6	-12.4	-11.7	-5.1	-7.0	-8.6	-9.5	-8.9
Romania	-0.7	-0.7	-4.0	-7.6	-0.8	-0.9	-1.2	-5.8	-13.6	-7.8
Poland	3.0	-0.4	6.1	5.2	15.7	-0.0	-8.4	-6.3	-13.8	-11.2
India	0.5	-0.9	-8.6	-13.1	-21.2	-3.6	-1.6	-9.7	-20.1	-27.5
Greece	-5.6	-7.2	-8.3	-14.0	-12.6	-11.2	-14.3	-21.8	-31.4	-27.9
Turkey	3.5	-2.2	-6.8	-12.7	0.8	-11.6	-14.7	-24.0	-34.2	-23.3
Spain	-5.7	-17.1	-41.5	-63.3	-32.1	-9.8	-18.0	-40.4	-55.9	-21.5
Mexico	22.2	34.6	42.1	57.5	45.0	-15.2	-40.5	-46.5	-62.2	-48.9
United States	-64.4	-233.2	-406.7	-444.1	-273.9	18.5	-55.9	-175.7	-113.8	12.6
Rest of World	-37.2	107.9	203.9	136.0	-103.4	-283.2	-165.0	-249.2	-394.3	-566.4

Source: WIOD database; author's calculations

Table 4 Decomposition of trade in factors (total trade), in %

Reporter	Capital						Labor					
	Foreign VA content of exports			Foreign VA content of imports (multilateral)			Foreign VA content of exports			Foreign VA content of imports (multilateral)		
	1995	2007	2009	1995	2007	2009	1995	2007	2009	1995	2007	2009
Luxembourg	40.0	56.8	59.3	21.1	17.1	15.4	48.6	66.3	63.8	19.1	15.1	14.6
Slovak Republic	24.2	39.8	33.8	19.1	32.4	29.8	44.6	57.8	51.2	22.4	30.3	26.9
Ireland	31.2	34.0	35.8	17.3	18.9	15.7	43.2	50.3	50.5	16.3	15.4	13.2
Mexico	14.9	18.7	19.0	15.5	25.9	23.2	43.6	49.4	48.3	13.5	22.5	21.4
Hungary	32.9	50.3	43.0	18.5	31.1	28.7	28.8	48.7	44.3	17.4	27.8	24.2
Malta	42.1	44.0	37.9	21.8	32.2	31.8	55.7	47.2	40.7	19.2	25.0	23.7
Czech Republic	23.6	48.8	44.0	19.9	31.1	28.2	39.3	46.3	39.8	18.6	27.8	25.0
Taiwan	35.6	47.7	44.8	15.2	22.7	21.3	32.1	46.2	42.5	15.2	23.4	22.9
Bulgaria	34.6	46.2	34.9	14.6	28.8	24.8	30.7	45.7	36.8	16.3	29.5	23.9
Slovenia	51.0	48.1	46.0	22.6	36.0	32.0	28.8	38.8	32.2	20.3	29.5	26.2
Belgium	43.4	52.4	51.8	20.8	27.8	27.0	37.0	38.5	34.4	18.6	25.0	23.5
Poland	15.9	30.2	23.3	20.0	29.4	27.3	19.5	37.1	33.6	18.7	26.2	23.3
Estonia	42.3	39.8	37.3	23.7	30.7	28.3	35.9	36.9	30.8	21.8	28.2	25.7
Denmark	29.0	42.5	43.5	21.8	27.5	26.2	26.0	35.5	33.3	20.4	23.8	21.8
Turkey	7.4	26.0	21.4	19.3	27.2	24.7	18.7	34.4	31.0	18.8	28.1	25.3
Greece	15.8	22.2	19.2	21.3	26.2	24.3	18.7	33.9	26.3	19.0	23.4	21.5
Lithuania	28.8	30.6	31.6	17.7	27.8	21.8	36.9	32.6	35.0	19.8	27.8	21.5
Netherlands	34.1	40.4	41.4	18.3	22.8	20.9	30.6	32.1	30.9	17.3	21.1	19.3
Finland	25.0	36.4	41.6	19.2	26.3	24.8	23.0	32.0	26.8	18.5	24.6	22.1
China	13.0	19.8	18.8	18.9	24.1	19.6	18.6	31.8	31.5	18.0	25.5	21.2
Austria	24.0	35.2	32.9	19.9	30.0	28.2	21.1	30.7	26.6	17.3	25.7	22.6
Rest of World	16.4	20.9	19.2	12.5	17.1	15.9	25.0	30.6	27.9	11.9	17.2	16.9
Latvia	19.5	31.1	25.1	23.4	32.0	29.5	29.5	30.3	24.6	22.3	29.1	27.0
South Korea	33.2	46.6	49.3	13.6	19.1	17.4	20.6	29.8	31.9	14.0	21.4	20.5
Sweden	25.6	36.6	37.1	21.2	28.4	26.5	26.6	29.7	27.9	19.5	25.4	22.9
Portugal	29.7	37.9	35.2	20.1	28.4	26.5	26.6	29.3	24.9	18.8	25.2	22.6
Romania	23.5	26.0	20.3	18.0	30.7	29.1	21.6	27.9	25.0	18.1	27.6	25.4
Spain	20.9	34.7	27.9	20.0	27.2	24.4	20.8	27.5	22.3	18.9	24.9	22.6
Cyprus	24.1	30.0	26.3	18.8	26.3	25.4	25.7	25.0	24.0	18.6	22.9	21.3
Canada	22.2	23.0	19.7	14.6	20.2	18.2	27.6	23.8	20.6	12.9	17.7	16.9
Germany	22.2	32.2	32.7	19.4	26.6	25.9	14.0	23.6	19.3	18.2	24.6	23.0
France	24.6	36.5	35.0	20.3	28.2	27.0	17.8	22.6	20.6	18.8	25.3	23.1
Italy	21.5	34.4	32.8	19.5	25.6	22.8	16.9	21.1	17.3	18.7	24.8	22.2
India	9.1	20.2	19.9	15.9	21.6	21.5	10.5	21.0	21.1	18.2	26.0	26.4
Indonesia	9.9	12.6	9.8	16.9	21.6	20.8	17.5	17.7	15.2	16.0	25.7	24.9
United Kingdom	19.0	21.2	20.1	20.1	25.9	23.6	19.1	15.8	15.3	19.1	23.5	21.4
Australia	12.1	15.5	12.1	15.7	23.7	21.7	12.0	14.3	12.1	17.1	25.1	24.0
Japan	7.6	18.7	17.2	13.8	18.5	16.8	6.4	13.3	12.0	15.4	22.0	21.1
United States	11.9	16.8	13.8	14.1	20.6	18.8	8.8	10.2	8.6	15.3	22.1	21.1
Brazil	6.9	13.1	10.5	15.9	22.7	21.6	8.7	10.0	8.6	17.5	25.4	23.8
Russia	7.0	6.8	5.7	19.1	27.6	24.0	8.3	7.1	6.4	20.2	25.8	22.8

Source: WIOD database, Version November 2011; author's calculations

Table 5 Net trade in labor by educational categories, in bn US-\$

Reporter	High educated				Medium educated				Low educated			
	1995	2000	2007	2009	1995	2000	2007	2009	1995	2000	2007	2009
China	-14.9	-24.6	-74.2	-122.2	-9.1	-4.1	-14.5	-22.4	25.5	30.2	127.5	179.3
Italy	-11.2	-12.2	-29.5	-22.3	-3.2	-2.0	26.2	27.0	45.2	27.2	49.1	46.0
Rest of World	-108.7	-107.9	-218.7	-298.5	-168.2	-97.5	-205.0	-243.2	-7.3	39.6	28.2	-25.6
Taiwan	0.4	-0.6	5.0	8.0	-6.9	-8.2	-2.9	0.8	13.2	12.4	14.1	9.3
Netherlands	-12.6	4.7	22.3	25.9	43.2	8.1	13.4	13.3	-9.7	8.6	12.9	15.1
Brazil	-2.6	-3.6	3.2	-1.6	-9.5	-8.7	0.2	-2.0	1.7	2.0	11.3	7.9
Australia	-3.2	-3.2	-9.5	-8.8	-4.1	-4.0	-10.1	-5.2	7.1	7.9	10.4	11.4
Indonesia	-4.8	-3.3	-4.9	-6.3	-8.2	-4.0	-7.0	-7.5	5.5	8.0	10.2	10.4
Spain	-0.1	-2.3	-8.0	2.7	-18.6	-22.8	-52.8	-33.1	8.9	7.1	5.0	9.0
Sweden	-3.0	4.2	6.3	6.5	10.1	6.7	15.5	12.9	2.9	2.5	4.6	3.7
Belgium	11.8	8.7	21.4	21.0	-3.5	-2.8	1.3	4.7	7.5	5.2	4.3	3.6
Portugal	-1.5	-3.1	-4.3	-4.5	-5.0	-5.4	-8.9	-7.9	1.4	1.6	3.7	3.5
Denmark	2.3	0.9	3.6	4.3	3.0	4.2	2.4	4.0	0.5	0.8	3.4	5.5
India	-2.3	-1.8	-3.6	-7.2	-4.2	-3.0	-19.7	-18.8	2.9	3.3	3.3	-1.4
Turkey	-3.9	-6.2	-12.5	-9.3	-8.3	-10.4	-23.5	-17.9	0.6	1.9	1.8	3.9
Finland	2.6	3.2	7.4	8.4	1.1	0.7	0.4	1.2	2.7	1.9	1.0	0.5
France	19.6	21.3	46.0	48.1	10.2	0.6	-7.5	-7.8	8.7	3.4	0.9	-2.5
Luxembourg	0.1	0.2	2.1	3.6	-0.2	0.4	1.1	1.5	1.2	0.1	0.8	0.5
Malta	-0.2	-0.2	-0.1	-0.0	-0.4	-0.4	-0.6	-0.5	-0.0	0.0	0.1	0.1
Estonia	0.1	0.1	0.0	0.7	-0.1	-0.1	-0.6	0.4	-0.2	-0.2	-0.4	-0.0
Cyprus	-0.2	-0.3	-0.6	-0.6	-0.7	-0.7	-1.3	-1.1	-0.3	-0.2	-0.6	-0.5
Slovenia	-0.0	0.1	0.9	1.4	0.8	0.2	0.1	0.8	-0.4	-0.3	-0.6	-0.6
Latvia	-0.0	-0.1	-0.8	0.3	-0.1	-0.2	-1.5	-0.4	-0.1	-0.1	-0.6	-0.2
Lithuania	-0.0	0.1	-0.3	0.4	-0.3	-0.6	-1.6	-0.7	-0.2	-0.3	-0.7	-0.4
Ireland	1.1	-0.6	3.3	7.0	-0.8	-1.0	-7.0	-1.9	2.0	0.5	-1.0	-0.3
Bulgaria	-0.2	-0.1	-1.3	-0.6	-0.8	-0.3	-2.1	-1.2	1.1	-0.2	-1.3	-0.9
Austria	-5.9	-2.1	0.7	0.7	5.8	6.4	15.0	15.5	-1.4	-1.5	-1.5	-1.9
Hungary	-0.5	-0.3	2.4	2.3	-0.1	-1.1	-1.2	-0.4	-0.7	-1.0	-1.7	-1.6
Slovak Republic	-0.5	-0.6	-1.7	-1.8	-0.4	-0.6	-1.7	-1.3	-0.5	-0.6	-2.2	-2.3
Czech Republic	-1.8	-1.3	-0.2	-0.1	-0.9	0.7	7.9	9.9	-1.9	-1.5	-3.1	-2.9
United Kingdom	7.8	15.8	31.9	30.4	-19.8	-11.6	-8.6	-1.5	17.1	5.1	-3.8	-2.6
Romania	-0.7	-1.2	-4.2	-2.8	-1.9	-2.0	-5.3	-2.2	1.7	2.0	-4.2	-2.7
Greece	-2.6	-4.4	-10.3	-9.7	-6.2	-6.9	-15.5	-13.6	-2.4	-2.9	-5.6	-4.6
Poland	-1.4	-4.8	-4.3	-4.1	3.0	0.2	-2.7	-0.6	-1.6	-3.8	-6.8	-6.4
Mexico	-6.5	-19.7	-29.3	-28.4	-7.8	-18.0	-24.3	-13.9	-0.9	-2.7	-8.6	-6.6
South Korea	7.8	13.6	46.0	41.4	4.1	6.4	15.0	18.5	0.9	-2.4	-11.6	-9.6
Germany	52.2	41.8	110.8	116.1	67.8	67.4	162.2	174.9	-28.1	-19.3	-20.5	-25.2
Russia	-1.5	1.8	-1.3	-0.8	14.0	25.0	60.9	54.6	-7.5	-3.1	-22.0	-24.4
Canada	-10.5	-11.6	-14.3	-27.0	24.3	32.5	45.8	35.5	-9.7	-11.9	-22.1	-22.0
Japan	27.4	31.9	50.9	33.6	77.4	79.1	100.3	81.4	-11.8	-17.9	-32.3	-35.5
United States	68.2	67.7	69.8	193.9	24.3	-22.1	-41.9	-52.0	-73.8	-101.2	-141.4	-129.1

Source: WIOD database; author's calculations

exception of China show deficits which are increasing for Australia, India and Russia. Finally, with respect to low educated employment the evidence for the EU-15 is somewhat mixed with deficits showing up in Austria, Germany, Greece and the UK and surpluses in Belgium, Finland, France Italy, Netherlands and Spain though in most cases these are decreasing. In the case of the Eastern European countries the evidence is again rather mixed with surpluses found in Bulgaria, Romania and also Turkey which might be expected and deficits in the Czech Republic, Hungary, Poland, the Slovak Republic and Slovenia. Canada and the US show deficits which were increasing particularly for the latter. Mexico has a surplus over the whole period in this category. With respect to Asian countries all show a deficit in low educated labor in 2005. South Korea and Taiwan have switched from a surplus to a deficit over the period considered. Finally, the remaining countries all show surpluses which are increasing particularly in Brazil, China, and Russia.

3.4. *The role of services in trade*

An often debated question is on the actual extent of services exports and imports. As manufacturing exports embody also value added created in services, services exports as derived from conventional trade statistics might therefore be misleading. As shown above, this approach allows for the calculation of the actual share of value added created in services contained in a country's exports. For comparison, we first provide the share of services in total trade from conventional trade statistics in Table 6. The share of services in total exports as well imports are very different across countries from almost zero (e.g. Turkey) to shares up to more around 80% (Luxembourg). Generally, one can also see an increase in these shares over time which in some cases are stronger in the crisis period due to the slump in manufacturing trade.

Due to the inter-linkages of services and manufacturing industries also manufacturing exports contain value added created in the services sectors whereas services exports might also contain inputs and value added from manufacturing sectors. Summing the appropriate terms as indicated in the methodological section above allows for the calculation of the share of value added created in manufacturing and services which can further be distinguished between domestic and foreign contributions. This information is shown in Table 7 for total exports and in Table 8 for manufacturing exports.

The share of value added created in (domestic and foreign) services in total exports embodied in both manufacturing and services exports (i.e. the sum of the shares of domestic and foreign services in Table 7) is higher than would appear from conventional trade statistics of services exports. Even, when only considering the share of value added created in domestic services embodied in a country's exports, this is in most cases higher than one would see from conventional trade statistics. In many cases the share of value added from domestic services is even higher than the share of value added created in manufacturing. Thus, services are in general as important as foreign manufacturing value added content, in some cases even higher. Again there is a quite large variation across countries however.

When looking at manufacturing exports only (Table 8), there is however still a dominance of value added contributed by domestic manufacturing. In all cases also the foreign content from manufacturing is higher than the foreign content of services.

A similar decomposition can be undertaken for splitting imports into the foreign content, the re-imports and the foreign multilateral content again distinguishing by manufacturing and services. Results are reported in Table 9 for the foreign and the foreign multilateral imports (the remaining part of re-imports is rather small and not reported). This completes the presentations of potential applications of this approach to disentangle the role of value added and factor content of exports, imports and net trade.

Table 6 Share of services in total exports and imports, in %

Reporter	Exports					Imports				
	1995	2000	2005	2007	2009	1995	2000	2005	2007	2009
Austria	32.1	29.5	28.6	27.9	30.9	26.1	22.6	23.9	22.6	24.7
Belgium	22.5	24.8	25.8	26.5	28.8	21.0	23.4	23.2	23.5	25.1
Denmark	18.6	31.1	35.9	39.5	39.2	16.1	29.0	33.3	35.0	37.5
Finland	14.4	11.1	15.1	13.8	21.8	28.7	26.8	28.2	26.9	36.0
France	17.5	15.2	16.2	15.3	16.6	16.8	14.3	14.9	15.0	16.5
Germany	10.4	11.8	12.9	13.3	16.3	15.2	16.3	17.1	16.4	17.9
Greece	39.7	65.5	72.4	70.7	70.0	13.1	24.8	21.8	21.1	23.0
Ireland	12.6	20.9	35.7	43.8	47.1	28.1	42.9	52.7	54.1	64.6
Italy	15.4	15.5	16.8	16.1	17.4	17.1	16.9	17.8	18.2	19.6
Luxembourg	65.8	80.0	82.9	85.2	88.0	48.4	67.0	70.5	75.9	79.5
Netherlands	23.4	26.5	28.1	26.7	30.6	26.9	30.1	33.9	31.8	35.9
Portugal	20.9	23.1	25.2	27.0	28.6	18.0	14.6	15.1	16.0	18.3
Spain	14.5	18.3	20.8	21.8	23.8	13.4	15.5	16.7	17.9	21.3
Sweden	18.6	21.5	25.4	26.8	31.1	24.8	28.7	29.7	29.4	33.9
United Kingdom	19.6	26.2	36.4	40.2	47.2	15.6	18.0	25.0	25.4	31.5
Bulgaria	31.7	37.1	28.4	29.5	33.5	26.3	22.7	9.0	10.1	14.5
Cyprus	44.1	51.3	70.0	62.3	61.7	23.0	23.4	23.1	22.2	22.1
Czech Republic	29.2	21.0	15.1	13.9	18.6	22.8	18.5	15.9	14.7	20.3
Estonia	31.7	27.8	29.2	32.4	35.1	16.8	15.0	17.4	16.5	20.1
Hungary	40.1	24.5	22.9	23.5	28.7	26.2	18.1	17.6	18.8	24.4
Latvia	46.8	48.7	46.9	50.3	52.1	20.9	15.5	15.3	16.2	19.0
Lithuania	31.6	32.7	36.5	38.9	39.3	13.5	17.2	16.5	11.3	18.5
Malta	38.0	35.9	45.8	48.8	57.7	17.3	14.8	21.4	23.3	26.3
Poland	17.5	25.5	17.6	19.0	21.4	17.7	20.0	17.2	16.2	19.3
Romania	23.8	30.6	31.0	33.9	36.4	17.3	14.3	13.4	13.5	14.1
Slovak Republic	25.1	19.2	17.5	15.3	16.2	23.7	20.4	15.3	15.2	17.9
Slovenia	14.2	11.3	15.8	16.8	18.9	11.4	8.8	14.1	14.6	16.2
Turkey	0.6	1.0	1.0	1.4	1.4	7.3	4.2	6.1	7.4	6.8
Canada	13.1	13.6	14.3	14.5	17.6	16.9	14.3	16.1	16.3	19.4
United States	32.8	33.1	36.2	36.8	37.9	12.6	12.5	13.2	13.9	17.4
Mexico	21.2	19.7	16.8	15.1	14.2	6.7	4.4	4.3	4.0	5.4
Japan	17.3	19.8	20.7	21.0	14.7	15.8	14.6	12.1	13.8	10.0
South Korea	19.1	18.9	15.8	16.2	16.2	13.0	17.1	17.0	17.3	18.1
Taiwan	13.4	10.8	8.2	7.9	7.8	14.0	14.4	12.1	12.2	12.3
Australia	23.7	24.4	23.1	22.5	24.3	26.0	24.3	21.8	22.8	24.6
Brazil	15.2	14.8	12.1	12.7	14.8	18.8	19.6	21.5	19.8	20.7
China	12.5	18.8	16.5	14.3	19.8	8.7	6.8	9.2	10.4	13.8
Indonesia	15.2	8.7	10.7	10.6	11.3	19.7	24.3	21.2	21.7	18.7
India	13.9	13.7	26.9	28.6	23.9	17.4	8.1	6.8	10.2	7.1
Russia	39.8	39.7	36.9	38.3	40.6	12.6	13.7	10.8	8.4	9.8
Rest of World	15.2	13.9	15.0	16.4	16.3	32.8	41.4	40.5	39.6	37.8

Source: WIOD database; author's calculations

Table 7 Decomposition of exports, in % of total

Reporter	Domestic						Foreign					
	Manufacturing			Services			Manufacturing			Services		
	1995	2007	2009	1995	2007	2009	1995	2007	2009	1995	2007	2009
Austria	35.7	31.0	31.4	42.3	36.4	39.8	11.5	18.1	15.1	10.6	14.4	13.7
Belgium	28.0	20.6	20.7	32.8	35.2	38.7	21.4	24.3	21.5	17.7	19.8	19.1
Denmark	40.6	29.1	29.3	32.3	32.7	33.8	14.5	14.6	13.2	12.6	23.6	23.6
Finland	46.9	38.5	32.9	29.4	27.6	35.4	12.7	18.4	14.7	11.1	15.5	17.0
France	37.4	31.8	29.3	42.7	40.8	45.7	11.5	16.2	14.1	8.4	11.2	10.9
Germany	49.1	38.7	36.9	34.5	34.3	39.5	9.7	15.8	13.2	6.7	11.2	10.4
Greece	38.2	12.6	15.6	44.3	60.1	61.9	8.9	11.4	8.8	8.5	15.9	13.7
Ireland	40.0	22.1	22.4	22.3	36.1	34.4	17.6	11.4	9.5	20.1	30.5	33.7
Italy	44.5	36.4	36.5	37.1	37.7	41.4	10.7	15.3	12.7	7.7	10.6	9.4
Luxembourg	13.4	5.4	4.1	41.6	32.9	34.2	12.7	8.0	6.7	32.3	53.8	55.0
Netherlands	33.3	27.4	25.9	34.9	37.0	39.2	16.5	18.7	17.3	15.3	16.9	17.6
Portugal	36.3	29.9	30.6	36.0	37.4	41.0	15.7	19.3	15.8	12.0	13.3	12.6
Spain	44.4	32.8	32.1	34.8	36.7	43.3	12.4	18.1	14.1	8.5	12.3	10.5
Sweden	40.7	30.2	27.2	33.1	37.4	41.6	13.8	16.5	14.6	12.4	16.0	16.6
United Kingdom	44.4	30.4	26.9	36.5	51.7	56.0	11.2	10.0	8.7	7.8	7.9	8.4
Bulgaria	34.6	25.5	28.1	33.1	28.6	36.1	16.0	29.3	20.8	16.3	16.6	15.1
Cyprus	28.4	16.8	17.0	46.6	56.2	58.1	12.8	11.5	10.5	12.3	15.5	14.4
Czech Republic	33.5	28.8	29.8	35.2	23.8	28.8	17.1	28.1	23.2	14.2	19.2	18.3
Estonia	30.3	25.4	25.2	31.5	36.4	41.6	21.2	21.0	17.1	17.0	17.2	16.1
Hungary	30.4	22.9	24.5	39.3	27.7	31.7	15.2	28.1	22.8	15.1	21.3	20.9
Latvia	32.6	19.9	20.3	43.0	49.4	54.9	12.8	17.1	13.2	11.6	13.5	11.6
Lithuania	32.1	25.8	23.8	35.1	42.6	42.9	18.5	18.3	18.1	14.3	13.4	15.3
Malta	18.1	17.1	15.7	31.7	37.1	44.7	28.7	24.5	19.2	21.4	21.3	20.4
Poland	48.1	32.3	34.4	34.0	33.9	37.2	10.2	19.6	15.5	7.7	14.1	13.0
Romania	43.7	35.9	37.5	33.9	37.1	39.7	12.7	15.7	12.6	9.7	11.4	10.2
Slovak Republic	34.9	26.1	27.7	32.3	25.7	30.0	17.8	28.9	24.3	15.0	19.3	18.0
Slovenia	39.4	31.4	32.5	26.3	26.3	30.9	20.6	24.8	20.6	13.7	17.6	16.0
Turkey	65.3	45.0	45.8	23.2	25.4	28.7	7.3	19.6	16.5	4.1	10.0	9.0
Canada	43.7	43.9	45.9	31.0	32.7	33.9	15.4	14.4	12.3	9.9	9.0	7.9
United States	39.0	35.3	36.9	51.0	51.8	52.3	6.2	8.2	6.7	3.7	4.7	4.1
Mexico	41.9	44.3	43.8	32.6	27.2	28.0	15.9	18.4	18.2	9.6	10.1	10.0
Japan	54.1	44.9	47.0	39.1	39.2	38.6	4.0	10.2	9.7	2.8	5.6	4.6
South Korea	44.0	38.3	36.6	31.2	24.7	24.0	15.8	23.5	25.0	9.0	13.4	14.4
Taiwan	35.3	28.2	29.7	31.2	24.8	26.7	21.0	31.0	28.6	12.5	15.9	15.0
Australia	47.4	46.8	50.3	40.5	38.3	37.6	6.9	9.4	7.5	5.2	5.5	4.6
Brazil	55.1	50.5	52.2	37.1	38.1	38.4	4.9	7.3	5.9	2.9	4.1	3.5
China	59.7	49.6	47.1	24.4	25.8	29.0	10.2	15.9	15.0	5.6	8.7	8.9
Indonesia	62.1	68.0	70.4	24.7	17.5	17.8	7.9	9.1	7.4	5.4	5.3	4.4
India	54.2	36.2	37.5	36.0	43.2	42.0	6.0	13.7	14.0	3.8	6.9	6.4
Russia	41.9	47.5	45.1	50.4	45.6	48.8	4.7	4.3	3.6	2.9	2.7	2.5
Rest of World	53.5	54.0	56.0	25.7	20.7	20.8	10.4	11.6	10.5	10.4	13.7	12.7

Source: WIOD database; author's calculations

Table 8 Decomposition of manufacturing exports, in % of total

Reporter	Domestic						Foreign					
	Manufacturing			Services			Manufacturing			Services		
	1995	2007	2009	1995	2007	2009	1995	2007	2009	1995	2007	2009
Austria	50.9	42.1	44.2	22.3	19.2	21.0	14.9	22.5	19.3	11.9	16.1	15.4
Belgium	35.6	27.7	28.6	19.8	20.4	22.8	25.4	30.2	27.4	19.2	21.7	21.2
Denmark	49.4	46.1	46.8	24.1	21.6	23.9	16.3	17.5	15.1	10.2	14.8	14.1
Finland	53.6	43.9	40.9	21.3	19.5	23.5	13.8	20.2	17.1	11.2	16.3	18.5
France	44.6	37.1	34.7	33.3	32.6	37.4	13.1	18.1	16.0	8.9	12.1	11.9
Germany	54.3	44.3	43.7	28.2	26.3	30.1	10.5	17.5	15.0	7.0	11.9	11.2
Greece	60.9	39.5	47.9	20.3	19.7	21.0	11.7	26.6	19.6	7.1	14.2	11.4
Ireland	45.4	38.2	40.8	14.2	11.2	8.7	19.5	16.9	13.9	20.9	33.7	36.6
Italy	51.4	42.5	43.3	28.5	29.0	32.2	11.9	17.2	14.3	8.2	11.4	10.2
Luxembourg	38.6	35.4	33.2	10.8	10.9	15.5	28.7	27.1	23.5	21.9	26.7	27.8
Netherlands	42.5	36.6	36.5	22.1	22.1	22.7	19.6	23.3	22.2	15.8	18.0	18.7
Portugal	45.0	40.0	41.7	23.9	21.6	24.8	18.5	23.6	19.4	12.5	14.9	14.1
Spain	51.0	40.9	41.1	26.2	24.0	30.2	13.8	21.4	16.9	9.1	13.7	11.8
Sweden	49.0	40.1	38.3	22.9	22.3	24.8	15.8	20.5	18.9	12.4	17.2	18.1
United Kingdom	54.3	49.2	49.1	23.8	26.1	26.3	13.3	14.9	14.1	8.6	9.8	10.5
Bulgaria	46.7	34.0	39.3	16.8	13.6	19.3	18.8	34.1	24.4	17.7	18.2	17.0
Cyprus	50.2	43.2	42.7	16.4	20.8	24.5	19.6	21.8	19.4	13.8	14.2	13.4
Czech Republic	44.3	32.8	35.7	19.7	15.4	17.6	20.5	31.2	26.9	15.4	20.5	19.8
Estonia	41.9	36.5	37.5	17.8	20.8	24.8	24.2	25.6	21.3	16.1	17.1	16.4
Hungary	46.7	29.1	33.1	17.6	13.1	14.4	19.4	33.9	28.9	16.3	23.9	23.6
Latvia	57.8	38.0	40.2	14.8	21.7	25.9	16.1	24.7	19.7	11.3	15.7	14.2
Lithuania	45.0	40.8	37.6	15.7	17.8	15.9	22.4	24.6	25.8	16.8	16.8	20.6
Malta	28.3	32.3	35.6	5.7	7.9	11.2	40.2	35.4	29.5	25.7	24.4	23.7
Poland	56.2	38.6	42.2	24.4	24.5	26.4	11.2	21.9	17.5	8.1	15.0	13.9
Romania	53.9	50.8	54.7	21.2	16.1	17.5	14.2	19.6	15.8	10.7	13.4	12.0
Slovak Republic	44.5	30.4	32.6	18.1	16.3	20.3	21.2	32.4	27.5	16.2	20.9	19.6
Slovenia	45.1	37.2	39.5	17.8	16.5	20.2	22.5	27.7	23.2	14.6	18.7	17.0
Turkey	65.6	45.6	46.4	22.9	24.7	28.0	7.3	19.6	16.6	4.1	10.1	9.1
Canada	49.7	50.6	54.7	22.6	23.4	22.7	17.1	16.3	14.1	10.7	9.7	8.6
United States	56.0	53.4	57.3	30.7	29.2	27.8	8.5	11.3	9.5	4.8	6.1	5.3
Mexico	51.8	51.5	50.4	17.8	16.2	17.8	19.1	20.9	20.6	11.3	11.4	11.2
Japan	63.9	55.5	54.2	28.7	26.9	30.1	4.6	11.8	10.8	2.8	5.7	4.8
South Korea	53.2	45.0	43.0	18.9	15.5	15.1	18.2	26.3	27.8	9.7	13.2	14.2
Taiwan	39.9	30.3	31.8	23.8	21.0	23.0	23.2	32.6	30.1	13.0	16.1	15.1
Australia	60.3	58.8	64.3	26.8	25.4	23.1	7.7	10.4	8.1	5.3	5.5	4.5
Brazil	63.0	56.5	59.5	28.5	31.1	30.2	5.4	7.9	6.5	3.2	4.4	3.8
China	64.9	54.8	54.3	18.4	18.7	19.3	10.9	17.2	16.8	5.8	9.3	9.6
Indonesia	70.6	74.5	77.4	15.2	10.8	10.5	8.6	9.5	7.7	5.5	5.3	4.3
India	60.8	47.4	46.8	28.7	27.2	28.5	6.4	17.3	17.1	4.1	8.1	7.6
Russia	64.7	70.6	68.6	25.6	22.0	24.8	6.1	4.6	3.9	3.6	2.8	2.7
Rest of World	61.4	62.7	64.7	16.2	10.2	10.5	11.3	12.7	11.5	11.0	14.3	13.4

Source: WIOD database; author's calculations

Table 9 Decomposition of imports, in bn US-\$

Reporter	Foreign content						Foreign multilateral content					
	Manufacturing			Services			Manufacturing			Services		
	1995	2007	2009	1995	2007	2009	1995	2007	2009	1995	2007	2009
Austria	40.9	36.4	35.7	40.4	35.4	38.9	10.1	15.6	13.4	8.1	11.9	11.4
Belgium	41.7	37.0	36.2	37.6	35.9	38.0	10.7	14.7	13.3	8.7	11.6	11.7
Denmark	44.9	30.9	30.2	33.8	42.8	45.6	11.6	13.5	12.0	9.3	12.0	11.6
Finland	39.5	37.4	32.6	41.3	36.9	43.9	10.2	13.9	12.1	8.6	11.5	11.2
France	44.1	41.2	40.8	34.5	30.4	33.0	10.9	15.0	13.5	8.5	11.7	11.2
Germany	44.3	39.4	38.8	33.0	30.7	33.0	10.4	14.3	13.3	8.2	11.2	11.0
Greece	46.7	40.4	40.2	33.4	34.8	37.0	11.3	13.7	12.2	8.5	10.9	10.6
Ireland	39.7	23.7	20.2	43.4	59.2	65.3	9.5	9.1	7.0	7.2	7.7	7.3
Italy	44.9	41.8	42.9	34.9	31.6	33.6	10.6	13.6	11.6	8.4	11.6	10.9
Luxembourg	25.3	11.9	10.4	54.7	72.0	74.7	10.4	7.4	6.3	9.4	8.6	8.6
Netherlands	40.7	36.0	34.7	40.3	40.9	44.1	9.8	11.9	10.3	7.9	9.9	9.7
Portugal	44.6	40.8	39.1	35.9	32.4	36.4	10.9	14.9	13.0	8.4	11.7	11.2
Spain	46.8	40.8	40.5	33.2	32.3	35.2	10.9	14.4	12.4	8.4	11.5	11.0
Sweden	40.1	34.4	32.9	39.0	38.1	42.2	11.0	14.4	12.5	9.1	12.3	11.9
United Kingdom	44.9	36.7	35.0	33.9	36.7	41.0	10.8	13.5	11.8	8.6	11.0	10.5
Bulgaria	44.0	44.1	43.9	40.4	26.6	31.7	8.5	16.8	13.5	7.1	12.4	10.8
Cyprus	42.6	39.2	39.3	38.7	36.5	37.7	10.5	13.4	12.1	8.2	10.9	10.8
Czech Republic	42.1	39.0	36.8	38.1	31.2	36.4	10.7	16.9	14.5	8.4	12.4	11.8
Estonia	43.9	40.0	38.8	33.5	30.5	34.3	12.5	16.1	13.9	10.1	13.2	12.9
Hungary	41.4	37.2	34.9	40.8	33.3	38.9	9.9	16.8	14.2	7.9	12.4	11.8
Latvia	41.4	38.5	38.0	35.9	31.0	33.8	12.6	16.7	14.6	10.1	13.6	13.4
Lithuania	49.0	44.0	44.4	32.1	28.0	33.8	10.6	15.5	11.5	8.2	12.3	10.1
Malta	44.5	35.7	33.5	35.4	36.3	39.6	11.5	16.2	15.0	8.6	11.8	11.9
Poland	44.8	40.0	38.6	35.8	31.9	36.0	10.7	15.7	13.5	8.5	11.9	11.4
Romania	47.0	40.4	40.1	34.9	30.4	32.8	10.2	16.6	14.8	7.8	12.3	12.1
Slovak Republic	41.3	39.5	38.9	37.0	28.9	32.6	11.6	17.8	15.3	9.5	13.5	12.8
Slovenia	47.1	37.6	38.9	31.7	30.0	32.5	12.0	18.7	15.8	9.1	13.6	12.7
Turkey	52.4	48.5	49.4	28.4	23.6	25.3	10.8	15.4	13.6	8.2	12.3	11.4
Canada	47.7	45.0	45.1	37.5	34.8	36.3	8.1	11.3	10.1	5.5	7.6	7.4
United States	48.2	45.8	45.3	30.1	27.5	29.9	8.8	12.6	11.5	5.9	8.8	8.4
Mexico	52.0	48.0	48.8	33.2	27.2	28.3	8.7	14.7	13.5	5.6	9.3	8.8
Japan	51.0	52.2	55.5	31.8	25.6	23.9	8.2	11.2	10.4	6.5	9.0	8.4
South Korea	53.0	49.1	49.7	32.7	29.9	30.8	7.9	11.4	10.5	5.9	8.8	8.3
Taiwan	51.0	49.3	49.6	33.5	27.0	27.6	8.7	13.2	12.5	6.4	9.8	9.6
Australia	44.1	43.1	43.5	39.1	31.8	32.9	9.1	13.4	12.5	7.4	11.0	10.4
Brazil	47.3	43.5	43.0	35.7	32.0	33.9	9.3	13.2	12.3	7.5	10.9	10.4
China	51.8	46.6	47.1	29.2	25.5	28.6	10.8	14.2	11.4	7.6	10.6	9.1
Indonesia	47.0	44.5	45.6	36.3	31.5	31.2	9.3	12.2	12.3	7.1	11.3	10.5
India	49.8	52.4	54.3	32.9	23.5	21.5	9.4	12.8	13.0	7.8	10.9	10.9
Russia	48.9	46.1	48.2	30.4	26.1	27.5	11.0	15.1	12.8	8.8	11.5	10.5
Rest of World	38.9	31.1	32.8	46.6	46.3	45.9	6.6	8.3	7.7	5.5	8.9	8.8

Source: WIOD database; author's calculations

4. Conclusions

A method for measuring the value added content of trade and its subcomponents like labor and capital based on recent approaches measuring the factor content of trade accounting for traded intermediates is introduced. This approach takes account of a country being an exporter and importer of intermediates simultaneously and the fact of considerable two-way trade in intermediates. The proposed framework allow for the splitting up of the value added content of trade into various forms of the domestic and foreign content of exports and imports which also generalizes applied measures of vertical specialization in international production networks. Based on this approach we show that a country's trade balance in gross terms equals its trade balance in value added terms which links it to national accounting identities. Finally, the approach allows one to analyze in which factors - as components of value added trade - a country is a net exporter or net importer. This shifts the focus of trade in goods (maybe differentiated by industries or types of products, e.g. by technology content) to net trade in factors in value terms. Finally, this framework is applied to disentangle the role of services in total exports again differentiated by the domestic and imported content. Further research is may go beyond the descriptive analysis presented here to explain the different patterns across countries and their changes over time for which this framework of accounting for value added and factors in trade can be useful.

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