GLOBAL VALUE CHAIN INDICATORS: APPLICATION TO THE ITALIAN SECTORS

1. Introduction

In the search for profitability, firms have adopted increasingly global strategies to reduce costs and strengthen their technological capability. Low production costs (i.e. labor costs, raw materials, economies of scale, etc.) are attained by exploiting the advantages of location offered by different countries on the basis of a breakdown of the production process. The internationalization of production means that the various elements that enter the process of production may come from many countries resulting in the emergence of global chains. Final products, and increasingly also intermediates, are offshored and relocated along these global value chains. The consequence is not only that final goods but also intermediate goods (primary goods, parts and components, and semi-finished goods) are traded internationally and, in recent years, this is also the case for services. As pointed out by Campa and Goldberg (1997), such traditional indicators as export share or import penetration only partially capture the growing internationalization of the production process, hence the need to find a new generation of indicators.

Input-output tables may offer much finer details in describing current globalisation since they offer information on the use of goods as an input into another sector's production or as final demand of each sector's output. By using I-O tables traditional indicators such as export share, import penetration can be computed as well as indicators of offshoring (Feenstra and Hanson, 1999), vertical specialisation (Hummel *et al*., 2001) and embodied imports (Wixted *et al*., 2006). Notwithstanding their limitations, I-O data are the most readily available source of information into the increasingly global linkages between countries[1].

[1] At the end of 2004 OECD Council decided to promote a project to look at global value chains and one of the main areas of this work is the use of input-output tables to better measure global value chains (OECD, 2008).

Using I-O tables and several indicators, this paper offers a broad picture of international fragmentation of production of Italian firms. The objective is to determine the sectors in which the fragmentation is most prevalent and the key characteristics. The paper is divided into two main parts. The first presents a survey of the global value chain indicators that can be constructed using input-output tables (Section 2). This is followed by a short review of how these have been used in the economic literature, especially with reference to the Italian economy (Section 3). The second describes the data (Section 4) and supplies empirical evidence on the international integration regarding imports of intermediate inputs in individual manufacturing industries in Italy (Section 5). Section 6 concludes.

2. Indicators on global linkages at the sector level: a review

This survey focuses on indicators of global linkages at the sector level obtained from input-output (I-O) tables[2]. The use of data on outward processing trade (OPT)[3] to measure the extent of international fragmentation of production (Baldone *et al*., 2002; Helg e Tajoli, 2005) and the analysis based on trade in the intermediate goods (Yeats, 1998)[4] are not considered in this review.

Input-Output tables describe the relationships between producers and consumers within an economy. The intermediate goods matrix provides data on the interactions between domestic suppliers and users of domestically produced raw materials, industrial components and services[5]. This information is complemented with the imported intermediate products matrix to cover all intermediate inputs. Domestic and imported intermediate tables are both square matrices of

[2] A discussion of the measurement issues associated with globalisation is found in De Backer and Yamano (2008).

[3] The OPT considers just one special case of transactions for processing purposes with the advantage of capturing a precise organizational choice of the firms, but unfortunately not all international fragmentation decisions give rise to processing trade flows that are officially recorded.

[4] Yeats (1998), using the SITC Revision 2 classification, identified the product groups composed solely of components and parts of the machinery and transport equipment sector (SITC 7). Outside this sector, however, the SITC classification fails to differentiate sufficiently between assembled goods and components.

[5] See Wixted *et al*. (2006) for a general overview of OECD Input-Output tables.

an equal number of supplying and user industries. A section of input-output table accounts for the supplies of goods that are not consumed by domestic industries, including, therefore, final consumption, gross fixed capital formation and exports. Thus, the I-O tables constitute a rich source of information on the interdependence between industries and institutional sectors. Since I-O analysis distinguishes between intermediate purchases from domestic suppliers and imported intermediate purchases, it allows the implementation of the indicators described in this section. A key advantage of using I-O tables is that it avoids the arbitrariness of classification schemes that divide goods into 'intermediate' and other categories. Input-output tables do not have this problem, because they classify the use as an input into another sector's production or as final demand of each sector's output. Other advantages are that the data are available for disaggregated sectors and allow analysis of how sector i differs from sector j on both domestic and imported inputs and final demand. One criticism of I-O tables, however, is that they are invariably out-of-date. OECD I-O tables, for example, are updated every five years. Nevertheless, as Wixted *et al*. (2006) noted, input-output analyses have shown that input structures remain relatively stable for some years, so that periodic updates can provide a reliable picture of structural changes in production, consumption and trade.

Traditional indicators to measure the international orientation and dependency of countries are import penetration (*IP*) and export share (*ES*):

$$IP_i = \frac{M_i}{X_i} \tag{1}$$

$$ES_i = \frac{E_i}{Y_i} \tag{2}$$

where M_i and E_i are total imports and exports of sector i, respectively, while X_i and Y_i are total demand and total supply of sector i. While the first one measures the extent that total demand for goods and services in a country is served by imports, the second shows the percentage of the total production of goods and services that is exported.

The simpler indicators using the matrix of imports are the share of imports for final domestic consumption, M_i^C, as a percentage of final demand, D_i^C, (*IFC*), given by:

$$IFC_i = \frac{M_i^C}{D_i^C} \tag{3}$$

and, specifically as regards intermediate inputs, the ratio of imported to domestic sourcing of inputs (IIR), given by:

$$IIR_j = \frac{\sum_i x_{ij}^m}{\sum_i x_{ij}^d} \tag{4}$$

$i = 1.....n$ supplying industries

$j = 1.....n$ user industries

where x_{ij}^d and x_{ij}^m are the domestic and imported transactions of intermediates from sector i to sector j, respectively. The two indicators quantify the contribution of foreign production to final and intermediate demand, respectively.

One widely used measure in empirical work is the 'outsourcing' indicator suggested by Feenstra and Hanson (1996, 1999), calculated as the share of imported intermediate inputs in the total purchase of non-energy materials of individual industries. Feenstra and Hanson refer to this as an 'outsourcing' indicator. However, outsourcing refers to the purchase of intermediate goods and services from outside specialist providers at arms-length be it nationally or internationally[6], while offshoring is generally defined as company purchases of intermediate goods and services from foreign providers at arms-length, or the transfer of particular tasks within the firm to a foreign location, i.e. to foreign affiliates (OECD, 2008). The cross-border aspect is the distinguishing feature in defining offshoring, i.e. whether goods and services are sourced within the domestic economy or abroad – not whether they are sourced from within the same firm or from external suppliers. Following the OECD definition, this paper considers Feenstra and Hanson's measures as offshoring indicators.

Moreover, in their original work Feenstra and Hanson used data on material purchases from the Census of Manufactures in combination with total import penetration ratios calculated from the trade data[7]. Feenstra and Hanson's offshoring measure can be calculated directly from the input-output tables, by using the import intermediate inputs matrix, as in Hijzen *et al*. (2005), Bracci (2006)

[6] Bhagwati *et al*. (2004) use a tighter definition of outsourcing considering only offshore trade in arm's length services.

[7] The census data show the value of intermediate inputs that each four-digit manufacturing industry purchases from every other four-digit manufacturing industry. Feenstra and Hanson (1996, 1999) estimate the imported intermediate inputs for a given industry as the value of input purchases from each supplier industry times the ratio of imports to total consumption in the supplier industry, summed over all supplier industries.

and Daveri and Jona-Lasinio (2008). This direct measure has the advantage that outsourcing is no longer driven by increased import penetration of all goods.

The offshoring indicator (OFS) is defined as:

$$OFS_j = \frac{\sum_i x_{ij}^m}{\left(\sum_i x_{ij}^d + \sum_i x_{ij}^m\right)} \tag{5}$$

where x_{ij}^d and x_{ij}^m are the domestic and imported transactions of intermediates from sector i, excluding the energy sectors (mining and quarrying[8], electricity and gas) to sector j, respectively.

Feenstra and Hanson have also proposed a narrower measure for offshoring, an intra-industry intermediate trade measure, by restricting attention only to those inputs that are purchased from the same industry as that in which the good is produced, that is:

$$OFS_j^N = \frac{x_{jj}^m}{\left(\sum_i x_{ij}^d + \sum_i x_{ij}^m\right)} \tag{6}$$

where x_{jj}^m is the import of intermediate input of industry j by industry j and the denominator is the total purchases of intermediate inputs by industry j.

Another measure is the differential offshoring or inter-industry intermediate trade of each industry, given by the intermediate imports from all industries, except those from the same industry, and it is the difference between the broad and the narrow indicators:

$$OFS_j^D = \frac{\sum_i x_{ij}^m}{\left(\sum_i x_{ij}^d + \sum_i x_{ij}^m\right)} \qquad \text{for} \quad i \neq j \tag{7}$$

However, there seem to be two main drawbacks to using input-output tables to analyse foreign outsourcing. First, when focusing on trade in intermediates one necessarily ignores the possibility of offshoring of the final production stage such as assembly. Second, the data do not capture foreign outsourcing when products are not re-imported, but exported to third markets (Hijzen *et al*., 2005).

[8] Energy and non-energy mining and quarrying have been excluded since this distinction was not available for 1985.

Moreover a (large) part of the intermediates locally produced by suppliers incorporate foreign raw materials, intermediaries such as parts and components, and semi-finished products produced abroad. In order to calculate the total import content, for example, of a nationally produced car, one has to consider the direct imports bought and used directly by the car makers, but also the indirect imports, i.e. the imports bought and used by domestic suppliers of these car makers. These total direct and indirect imports are known as 'embodied imports' (*EI*) and are calculated as:

$$EI = A_m * (I - A_d)^{-1} * Y \tag{8}$$

Where A_m and A_d are the input-output coefficients for imported and domestic transactions, respectively, and Y represents an *nx1* vector of outputs. Element a_{ij}^m of A_m denotes the imported inputs from sector i used to produce one unit of sector j's output. Element a_{ij}^d of A_d is calculated as the ratio of industry usage of inputs relative to total output. $(I - A_d)^{-1}$ is Leontief inverse matrix and describes how many units of one good and service have to be produced at any stage of the value added chain in order to produce one unit of the final demand for goods and services. The Leontief matrix can be used to estimate the impacts on all industries resulting from a given increase in demand for goods and services from one particular industry.

Hummels *et al*. (1998, 2001) have, instead, considered a subset of intermediate imports, those used to produce goods that are exported, by introducing the term 'vertical specialisation'. As a result of global value chains and the corresponding geographical fragmentation of activities, countries become vertically specialised within the production process for some goods or services as companies tend to concentrate different production stages for a single good in each country. The vertical specialisation measure tries to reflect the process by which different countries become part of a single production chain, linking the imported inputs required by one country with its exports. The direct and indirect foreign content of countries' exports (*VS*) is calculated as:

$$VS = A_m * (I - A_d)^{-1} * E \tag{9}$$

where A_m and A_d, as in (8), contain the input-output coefficient for imported and domestic transactions, respectively. In Hummels *et al*. (2001) E represents an *nx1* vector of exports. In the formula (9), instead, as suggested by Cadarso *et al*. (2007a)[9], E is the diagonalised

[9] Cadarso *et al*. (2007a) introduced the diagonalised vector of exports

vector of exports. In this fashion, two types of information can be obtained from the *VS* matrix. First, the sum of the elements contained in the columns of the *VS* matrix identifies the amount of the intermediate imports of all sectors that are directly and indirectly required to obtain the export of a sector (VS by sector). A vertical specialisation share of 29% for the manufacturing sector means that 29% of the manufacturing exports are directly and indirectly based on intermediates that have been imported. Second, the sum of the elements contained in the rows quantifies the total content of intermediate imports of a particular industry for all a country's exports (VS by inputs).

To calculate only the value of imported inputs used directly in production of exported goods VS_d, the formula is:

$$VS_d = A_m * E \tag{10}$$

One attractive feature of I-O tables is that they allow the calculation of the value of imported inputs used indirectly in the production of an exported good. However, it should be noted that if there is a positive or negative correlation between the two components of the VS, exports and the imported inputs/gross output ratio, within a sector, a computation that involves I-O sector-level data will be biased downward or upward, respectively; so the VS measure must be handled carefully (Hummel *et al.,* 2001). Moreover, the calculation of the import content of exports or output using I-O information makes a number of implicit assumptions[10]. First, the input-output coefficients of A_d and A_m matrix are treated as fixed and, thus, not responsive to price changes. Second, the same input-output requirements apply for the goods and services that are exported and those destined for final demand. Calculations are also based on the assumption that 100% of imports originate from foreign sources, which is not necessarily the case and may thus be a source of inaccuracy. Finally, the calculation assumes that the passing of a product back and forth among sectors occurs instantaneously or, at least, rapidly enough for the process to be completed within the time span measured in the input-output tables, typically a year.

---

instead of the simple vector of exports in the calculation of the vertical specialisation to study the VS both by industry and product.

[10] See US National Research Council of the National Academy of Science (2006) for an extensive discussion of the assumptions and limitations of measuring import content with I-O tables.

3. The global value chain indicators in practice

Several works have used offshoring indicators to study the effect of the international fragmentation of production on employment and employment composition. The literature analysing the impact of outsourcing on the labour market largely stems from the papers by Feenstra and Hanson (1996, 1999), that focused on sector wage inequality by skills in U.S.A. They found that in the period 1979-1990 outsourcing contributed substantially to the improvement of high skilled workers wages compared to those of the unskilled; however, the results are non-significant for the period 1972-1979.

Following Feenstra and Hanson, a few papers examine the impact of fragmentation on labor markets in various European countries: Hijzen *et al*. (2005)[11] for UK, Egger and Egger (2005) for Austria[12], Cadarso *et al*. (2006)[13] for Spain.

For Italy, Falzoni and Tajoli (2009) study the effect of international fragmentation of production on employment and employment composition while Broccolini *et al*. (2007) evaluate the effect on wage inequality between blue and white collar workers. Falzoni and Tajoli (2009)[14] do not find that offshoring has any significant impact on the general level of employment in the different industries for the period 1992-2003 and conclude that offshoring in Italy is driven only to a limited extent by the search for low-cost labor. Broccolini *et al*. (2007) have used offshoring indicators to evaluate the relative effects of offshoring of materials and services and of ICT capital on wage inequality in the Italian manufacturing industry during the

[11] Hijzen *et al*. (2005) use, as offshoring indicator, the ratio of imported intermediate in a given industry from the same industry to the value added of the industry.

[12] Egger and Egger (2005) have also considered the effect of inter-sector spillovers in the relationship between outsourcing and labour demand showing, in a geographical framework, that inter-sector relationships notably affect the effect of outsourcing on labour, so that models ignoring the spillover effect underestimate the role of outsourcing. In another paper, Egger and Egger (2003) study the relationship between market concentration and the outsourcing intensity measured as the share of intermediate imports in gross production.

[13] Cadarso *et al*. (2006) are interested in outsourcing to particular countries, especially Turkey, and groups of countries and use a similar methodology to Egger and Egger (2003, 2005).

[14] Offshoring indicators are calculated employing ISTAT use and supply input-output tables.

period 1985-1999[15]. Their results confirm that material and service outsourcing widen the skilled/unskilled wage gap both in traditional and innovative industries, while the role of technological change is less pronounced and limited to innovative sectors.

Even if the main focus of the studies that use offshoring measures is on labour market issues, a number of papers also investigate the impact of foreign outsourcing on productivity (see Olsen, 2006, for a survey). In the case of Italy, the relation between offshoring of intermediates and services and productivity growth in Italian manufacturing industries has been studied by Lo Turco (2007) who considered a period when the extent of offshoring was very limited (the period 1985 to 1997) and by Daveri and Jona-Lasinio (2008) for the period 1995-2003[16]. Their estimates indicate that not all types of offshoring correlate significantly with productivity growth: the offshoring of materials is positively related to productivity growth, while this is less so for the offshoring of services. For Italy, Bracci (2006) calculates broad, narrow and difference offshoring indicators[17] showing that offshoring increased between 1995 and 2003, particularly in the clothing industry (16.4%)

In their original work, Hummels *et al*. (1998) estimate VS for ten OECD and four emerging market countries. They found that VS increased by almost 30% between 1970 and 1990 and accounted for more than 30% of export growth at the beginning of the 1990s. Since then several papers have computed the import content of exports for different countries: United States (Yi, 2003; Chen *et al*., 2005), Spain (Cadarso *et al*., 2007b), several UE countries (Cadarso *et al*. 2007a; Breda *et al*., 2008), France and Japan (De Simone, 2004) and Italy (Breda *et al*., 2007).

In general, all of them found that vertical specialisation increased over the years reflecting not only an increase in terms of integration, but also and especially in terms of the importance of international fragmentation of production.

---

[15] Broccolini *et al*. (2007) use Italian input-output tables elaborated by Giorgio Rampa.

[16] Lo Turco uses deflated Italian input-output tables elaborated by Giorgio Rampa, while Daveri and Jona-Lasinio employ ISTAT use and supply input-output tables.

[17] Bracci (2006) has calculated the offshoring indicators with Istat use and supply input-output tables excluding services but including mineral energy. However, for the narrow offshoring indicator the denominator of expression (7) is the intermediate inputs from the same industry instead of total intermediate inputs.

Bergoeing *et al*. (2004) suggest that vertical specialisation can explain why, even if over the past 30 years almost all developed countries have experienced increases in manufacturing exports as a share of GDP, these countries have also experienced a decline in manufacturing value-added as a share of GDP. One possible explanation, indeed, is that the official data on merchandise record trade flows twice. To assess the quantitative importance of double-counting in the manufacturing data, Chen *et al*. (2005) calculate the amount of vertically specialized manufacturing exports for the U.S. in 2000 and subtract this amount from U.S. total manufactured exports. If double-counting is eliminated from the data, the increase in manufacturing exports is only one-third as large (in percentage of GDP) as claimed in the official data.

De Simone (2004), on the other hand, uses the VS indicator to test a general equilibrium model of trade and fragmentation that allows the author to capture the effects of vertical specialisation on the export performances of different countries in individual sectors. The model is used to explain the differences in French and Japanese exports of manufactured goods (relative to US) toward other OECD countries over the period 1980-1994. In particular, the model highlights the propensity of France to specialize vertically in order to fill possible gaps in terms of innovation and total factor productivity (TFP), while the negative impact of fragmentation on exports shows a Japanese reluctance to use imported intermediates in the production of the exported goods.

For nine EU countries[18], Cadarso *et al*. (2007a) show that VS in the EU increased widely (excluding Ireland) between 1995 and 2000 and that the leading sectors, albeit with differences between countries, are high and medium-high tech and services sectors.

For Italy, Breda *et al*. (2007)[19] evidence a growing propensity to use imported goods and services to produce exports throughout manufacturing branches between 1995 and 2000. The VS for low-tech sectors, such as leather goods, textile products and clothing, was equal and lower than the average, respectively; nevertheless, the leather products recorded the highest increase (4.5 percentage points) in the period under examination.

[18] Countries are: Austria, Belgium, Denmark, Finland, Germany, Holland, Ireland, Italy and Sweden. Data source are Eurostat Input-Output tables.

[19] Breda *et al*. (2007) use ISTAT Input-Output tables.

4. Data

The present study uses harmonised input-output tables estimated by the OECD. The OECD Input-Output Database[20] shows transactions in industry-by-industry[21] symmetric tables[22] at basic prices. The input-output tables consists of matrices of inter-industrial transaction flows of goods and services (domestically produced and imported) in current prices, for eighteen OECD countries[23] and two non-member OECD countries (Brazil and China)[24]. The data are not deflated primarily due to the lack of price deflators at industry level for imported inputs.

The tables are based on ISIC Revision 3 industrial classifications. The market services aggregate wholesale and retail trade (items 50-52 of ISIC rev3 classification), hotels and restaurants (item 55), transport (60-63), communication, finance and insurance (64-67), real estate and business services (70-74).

For more a detailed insight into the phenomenon of production fragmentation in the Italian economy, individual industries have been grouped in *high and medium-high technology industries* and *medium-low and low technology industries*. High and medium-high technology

---

[20] The development of the OECD Input-Output tables started over a decade ago and the database has been used in several works. Two major applications within the OECD concerned the analysis of the diffusion of embodied technology and the measurement of carbon dioxide emissions embodied in the international trade of goods. The latest update has been largely motivated by the recent OECD project on global value chains (Pilat, 2006).

[21] Input-output tables can be produced by illustrating flows between the sales and purchases of industry outputs or by illustrating the sales and purchases of product outputs. The OECD Input-Output database is based on the former, reflecting in part the collection mechanisms for many other data sources such as research and development data, employment statistics, pollution data, energy consumption, which are in the main collected by establishments, and so industry. More information on this aspect and on the OECD I-O tables in general is available in Yamano and Ahmad (2006).

[22] Several studies employ the use matrices of input-output tables (commodity by sector), instead of the symmetrical matrix. The main difference with respect to the symmetrical matrix is that in the latter secondary production for each sector is relocated in its corresponding 'pure industry'.

[23] Australia, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Japan, Korea, Netherlands, Norway, Poland, Spain, United Kingdom and United States.

[24] The list of countries refers to 2006 edition.

sectors include refined petroleum products, chemical, machinery, office and computing machinery, electrical machinery, radio and communication equipment, medical and precision instruments, vehicles and non motor vehicles (24 and from 29 to 35 ISIC rev3), while low-technology sectors take in food related sectors, textiles and related industries, wood products, paper and publishing, non-metallic mineral products, iron and non ferrous metals, fabricated metal products, furniture and various other industries (from 15 to 23, 25 to 28 and 36 to 37 ISIC rev3).

Moreover, the distinction between sectors with a deficit and surplus of trade balance is assessed through their contribution to the manufacturing trade balance. This is given by:

$$CT_i = (E_i - M_i) - (E - M)\frac{(E_i + M_i)}{(E + M)} \tag{11}$$

If there were no comparative advantage or disadvantage for any industry *i*, a country's total trade balance (surplus or deficit) should be distributed across industries according to their share in total trade. A positive value for an industry indicates a structural surplus and a negative one a structural deficit.

On the basis of OECD I-O tables for the years 1985, 1995, 2000, the different indices mentioned in Section 2 are calculated for individual Italian manufacturing industries. The results are reported in the next section.

5. The global value chains in Italian manufacturing industries

As a result of the growing linkages between countries a decreasing share of production is created purely within national boundaries. As for the OECD area (OECD 2008), a decline in the 'production depth' (value added over production) and a growing importance of imported intermediates can also be observed in Italy. Between 1985 and 2000 all sectors show a decline in the 'production depth' (except chemicals) and an increase in the role of imports both to satisfy final demand (with the exception of paper, rubber and plastics products and other manufacturing) and to provide intermediate inputs (except for radio and communication equipment, food and other manufacturing). The decline of production depth and the increase in the ratio of imported to domestic sourcing of inputs was more pronounced in the high and medium-high technology sectors (Table 1). As regards the two sub-periods, the decline of production depth is more pronounced between

TABLE 1 - *General Indicators*

	Production Depth			Import Penetration			Share of Import for Final Domestic Consumption			Ratio of Imported to Domestic Sourcing of Inputs		
	1985	1995	2000	1985	1995	2000	1985	1995	2000	1985	1995	2000
Low and medium-low technology												
Food products, beverages and tobacco	26.1	22.6	24.1	14.2	16.1	16.7	10.6	13.3	14.2	26.7	26.7	26.5
Textiles, textile products, leather and footwear	37.6	30.9	30.3	9.3	12.5	16.1	4.1	8.7	11.5	24.9	24.8	38.3
Wood and products of wood and cork	38.0	35.0	33.6	6.7	15.8	16.1	1.1	4.8	4.7	14.0	21.6	22.2
Pulp, paper products, printing and publishing	37.4	31.3	31.1	10.7	15.0	15.2	4.5	4.1	4.3	14.8	23.9	24.5
Rubber & plastics products	35.9	30.9	30.5	11.7	13.2	16.0	9.0	7.0	7.2	14.9	19.2	26.5
Other non-metallic mineral products	37.0	36.0	36.1	5.2	7.2	7.0	3.7	4.1	4.2	6.0	9.5	8.9
Iron, steel & non-ferrous metals	19.9	22.4	18.4	25.2	32.5	37.0	0.4	0.0	0.0	42.7	63.0	81.3
Fabricated metal products, except machinery	41.8	36.3	35.7	4.3	5.1	6.3	2.8	3.2	3.9	5.5	6.2	8.1
Manufacturing nec (including Furniture)	31.6	29.7	28.2	17.6	8.2	10.9	16.2	6.1	9.2	44.9	21.1	26.7
High and medium-high technology												
Coke, refined petroleum products and nuclear fuel	36.5	24.6	7.3	14.8	17.7	16.0	11.1	13.0	11.8	20.9	25.6	22.8
Chemicals including pharmaceuticals	27.7	28.5	28.5	23.1	31.6	35.3	3.7	7.3	9.2	50.7	77.6	104.4
Machinery & equipment, nec	37.1	30.3	29.9	13.7	16.4	19.5	7.7	10.0	11.6	50.1	61.6	99.7
Office, accounting & computing machinery	34.6	20.1	17.2	44.1	57.8	69.8	37.0	53.5	66.5	286.2	565.4	694.8
Electrical machinery & apparatus, nec	36.5	32.1	32.0	4.1	19.6	23.3	3.8	11.8	13.0	4.7	33.6	46.1
Radio, television & communication equipment	41.9	34.4	30.6	40.3	33.0	37.5	24.2	18.1	24.8	348.7	124.9	170.1
Medical, precision & optical instruments	47.4	41.3	42.6	29.5	35.9	41.8	26.8	27.0	30.9	60.0	169.2	370.5
Motor vehicles, trailers & semi-trailers	35.7	22.5	19.1	28.9	35.5	40.7	28.9	38.6	41.7	41.0	32.8	56.4
Non motor vehicle transport equipment	48.7	29.1	41.0	20.2	21.9	35.6	15.0	13.0	18.4	43.0	57.5	279.2
Total Manufacturing	34.2	28.0	28.4	15.8	19.6	23.0	10.3	13.4	16.3	27.8	33.0	44.8

Source: Author's calculations from OECD Input-Output tables.

1985 and 1995, while the ratio of imported to domestic sourcing of inputs shows a high percentage change for the majority of sectors in both sub-periods.

As shown in Table 2, the majority of industries present a decline in production share relative to total gross output, apart from six sectors. Two are from low and medium-low technology industries

TABLE 2 - *Production Share and Trade Indicators*

	Production Share			Export Share			Contribution to Trade Balance (1)		
	1985	1995	2000	1985	1995	2000	1985	1995	2000
Low and medium-low technology									
Food products, beverages and tobacco	5.8	4.64	3.95	6.7	11.1	13.3	-3.9	-2.6	-1.5
Textiles, textile products, leather and footwear	6.0	5.05	4.35	29.1	36.4	40.4	6.2	4.6	3.9
Wood and products of wood and cork	1.9	0.81	0.81	13.0	7.7	8.3	0.6	-0.6	-0.5
Pulp, paper products, printing and publishing	1.9	2.20	2.01	8.6	11.5	12.8	-0.5	-1.0	-0.6
Rubber & plastics products	1.3	1.46	1.30	19.6	27.7	31.6	0.4	0.7	0.6
Other non-metallic mineral products	1.9	1.73	1.76	16.8	23.4	21.8	1.2	1.1	1.1
Iron, steel & non-ferrous metals	2.6	2.27	1.73	18.0	23.3	26.8	-2.9	-3.6	-2.9
Fabricated metal products, except machinery	2.9	2.93	2.76	15.2	15.8	16.3	1.7	1.3	1.1
Manufacturing nec (including Furniture)	0.6	1.72	1.67	44.3	41.2	45.2	0.7	2.5	2.4
High and medium-high technology									
Coke, refined petroleum products and nuclear fuel	3.4	1.11	1.42	11.7	7.4	11.6	-1.5	-1.0	-0.6
Chemicals including pharmaceuticals	4.0	3.01	2.79	18.6	27.9	37.4	-3.4	-3.9	-2.8
Machinery & equipment, nec	3.3	3.96	3.88	42.6	56.0	58.2	4.8	6.1	5.6
Office, accounting & computing machinery	0.4	0.25	0.18	61.1	101.0	84.1	-0.6	-0.7	-1.4
Electrical machinery & apparatus, nec	1.6	1.25	1.13	12.9	28.8	34.3	0.7	0.0	0.1
Radio, television & communication equipment	0.9	0.92	1.06	47.7	28.9	34.4	-1.4	-1.3	-1.5
Medical, precision & optical instruments	0.4	0.51	0.50	27.1	42.5	50.3	-0.4	-0.6	-0.6
Motor vehicles, trailers & semi-trailers	1.8	1.71	1.87	28.2	51.6	47.8	-1.8	-1.1	-2.3
Non motor vehicle transport equipment	0.7	0.69	0.68	34.5	37.1	60.2	0.3	0.1	0.0
Total Manufacturing	41.4	36.2	33.8	20.7	29.1	32.5	-	-	-

Source: Author's calculations from OECD Input-Output tables.
(1) As % of total manufacturing trade.

(paper and other manufacturing) and four from high and medium-high technology industries (machinery and equipment, radio and communication equipment, medical and precision instruments and motor vehicles), all belonging to the machinery sector. On the contrary, the export share relative to gross output increased between 1985 and 2000 in the majority of sectors, except for wood, petroleum products and radio and communication equipment. Both phenomena are more marked between 1985 and 1995. In the group of low and medium-low technology industries, contribution to trade is positive but declining for textiles, metal products, other non metallic products, while in other manufacturing sector there was a sizeable increase between 1985 and 1995. The sector that contributed most to trade balance was a high technology industry, machinery and equipment.

The growing shares of imports as a percentage of output, final consumption and intermediate consumption provide evidence of the degree of the Italian economy's integration in the global supply chain. In particular, the growing ratio of imported to domestic input demonstrates the importance of intermediate inputs in Italian foreign trade signalling the increasing importance of international outsourcing. Offshoring indicators confirm the trend of international outsourcing in the Italian manufacturing sector (Figure 1 and Table 3). Broad offshoring increased from 21.8% in 1985 to 22.7% in 1995 and 25% in 2000 in manufacturing industry. Between 1985 and 2000, the growth

FIGURE 1 - *Broad Offshoring Indicator*

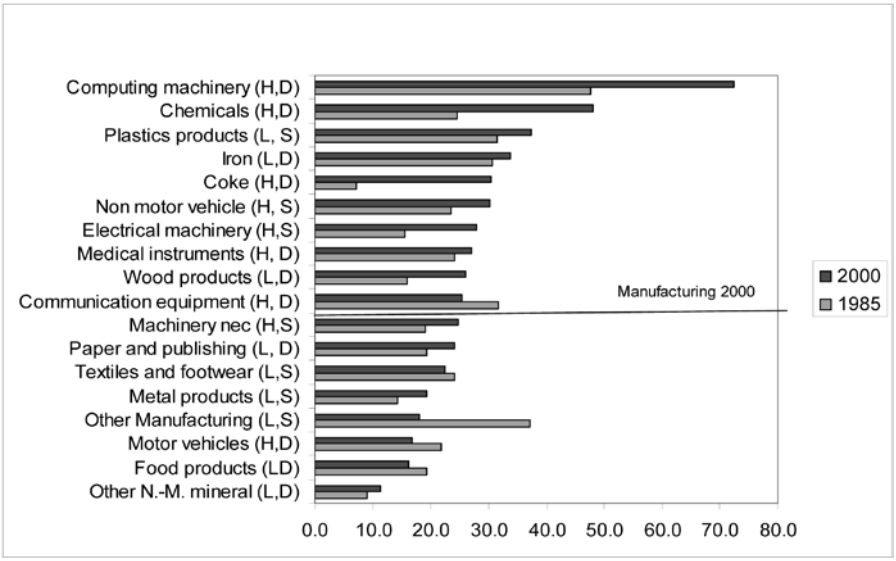


TABLE 3 - *Offshoring Indicators*

	Broad Indicator						Narrow Indicator		
	Materials			Market Services					
	1985	1995	2000	1985	1995	2000	1985	1995	2000
Low and medium-low technology									
Food products, beverages and tobacco	18.5	14.1	14.5	0.9	1.3	1.7	5.6	6.3	6.7
Textiles, textile products, leather and footwear	21.7	17.8	20.5	2.5	1.6	2.0	11.6	11.2	13.4
Wood and products of wood and cork	14.8	24.8	24.4	1.1	1.6	1.6	10.0	21.3	21.4
Pulp, paper, paper products, printing and publishing	17.9	21.2	21.8	1.4	1.8	2.3	15.0	18.0	18.3
Rubber & plastics products	30.1	30.8	36.0	1.4	1.1	1.3	6.0	4.3	5.5
Other non-metallic mineral products	7.0	7.7	8.2	1.9	2.9	3.1	2.7	2.9	2.9
Iron, steel & non-ferrous metals	23.8	26.7	32.0	6.8	1.4	1.7	22.6	24.4	28.7
Fabricated metal products, except machinery	10.7	16.6	17.3	3.6	1.9	2.1	1.0	1.2	1.6
Manufacturing nec (including Furniture)	34.7	16.5	16.2	2.4	1.8	1.9	0.7	2.0	1.7
High and medium-high technology									
Coke, refined petroleum products and nuclear fuel	5.0	39.8	29.6	2.2	0.9	0.8	0.0	32.2	25.3
Chemicals excluding pharmaceuticals	22.9	41.0	45.8	1.7	1.9	2.2	20.0	35.6	39.4
Machinery & equipment, nec	15.5	20.0	23.1	3.7	1.6	1.7	10.2	8.3	10.7
Office, accounting & computing machinery	46.6	61.0	71.2	1.0	1.0	1.4	34.4	28.4	39.8
Electrical machinery & apparatus, nec	12.3	21.1	25.7	3.2	1.9	2.2	2.0	11.6	15.0
Radio, television & communication equipment	28.9	24.4	23.5	2.8	2.1	1.9	25.8	20.2	19.4
Medical, precision & optical instruments	18.8	20.1	24.2	5.3	2.4	2.8	4.9	12.8	16.7
Motor vehicles, trailers & semi-trailers	17.3	14.4	15.9	4.6	1.0	1.0	8.3	5.5	6.6
Non motor vehicle transport equipment	19.5	20.6	28.5	3.9	1.3	1.7	9.5	10.8	16.0
Total Manufacturing	19.2	21.1	23.1	2.6	1.6	1.9	16.5	19.7	21.9

Source: Author's calculations from OECD Input-Output tables.

of narrow offshoring was more pronounced with an increase of 33% compared to 14.7% for the broad indicator. As regards the measure of broad offshoring, the three most important offshoring industries are office and computing machinery (72.5% in 2000), chemicals (48%) and plastics (37%).

As Figure 1 shows industries with an offshoring measure higher than the manufacturing value are either high and medium-high

technology sectors or scale intensive industries (plastic products and iron, steel and non-ferrous metals). The ranking does not change much if the material offshoring measure is considered, while with the narrow indicator only four industries (office and computing machinery, chemicals, iron and non ferrous metals products and petroleum products) show a value higher than that of the manufacturing sector.

In Italy, as in most countries, the offshoring indicator is higher in the group of higher technology industries than in the group of lower technology industries, which tends to reflect the greater complexity of technology intensive goods as they typically require a broad range of inputs (De Backer and Yamano, 2008). Products characterising the Italian pattern of specialisation such as textiles, clothing and footwear, other manufacturing products and machinery and equipment are less affected by the offshoring phenomenon. These results are consistent with the evidence provided by Falzoni and Tajoli (2009) that in Italy international fragmentation of production seems to be found mostly in high-tech and/or scale intensive industries rather than traditional labor intensive production, typical of the Italian pattern of specialisation such as textiles and clothing, and footwear.

The importance of international offshoring of market services for the manufacturing sector is far less than for material offshoring both in terms of value than growth. Services offshoring is 1.9% of total intermediate consumption in 2000, with an increase of 15% from 1995 but a decrease of 29% with reference to the 1985 value (Table 3). The acquisition of services from abroad is particularly important for other non-metallic mineral products and medical and precision instruments.

Table 4 reports VS and EI measures by inputs, that is the total content of intermediate imports of a particular industry for all exports of a country (VS by inputs) or for total output (EI by inputs). Table 4 shows that VS as a share of total exports has grown by 9% while EI as a share of total output decreased by 1% between 1985 and 2000 considering all inputs. Focusing only on manufacturing intermediate inputs both VS and EI share increases by 35% and 16%, respectively.

The imported inputs that are most required in the production of export goods are products with a high technological content (chemicals and pharmaceuticals, radio and communication equipment), with a clear intermediate nature (iron and steel) and inputs related to the productive specialisation of Italy (textile products, leather and footwear and machinery and equipment). Among these products, chemicals and iron are the two from which intermediate imports

TABLE 4 - *Vertical Specialisation and Embodied Imports by Inputs*

	VS *(as share of total export)*			EI *(as share of total output)*		
	1985	1995	2000	1985	1995	2000
Agriculture, hunting, forestry and fishing	1.09	0.69	0.58	1.14	0.61	0.47
Mining and quarrying	5.42	1.42	2.58	4.85	1.58	2.82
Low and medium-low technology	*6.72*	*8.66*	*8.43*	*4.27*	*5.16*	*4.75*
Food products, beverages and tobacco	0.72	0.53	0.48	0.74	0.64	0.55
Textiles, textile products, leather and footwear	1.56	1.51	1.54	0.62	0.58	0.55
Wood and products of wood and cork	0.23	0.43	0.45	0.21	0.31	0.30
Pulp, paper, paper products, printing and publishing	0.38	0.81	0.76	0.45	0.76	0.70
Rubber & plastics products	0.37	0.49	0.56	0.22	0.33	0.36
Other non-metallic mineral products	0.12	0.22	0.21	0.14	0.19	0.18
Iron, steel & non-ferrous metals	3.03	4.04	3.74	1.71	2.06	1.80
Fabricated metal products, except machinery	0.25	0.47	0.54	0.15	0.20	0.22
Manufacturing nec (including Furniture)	0.06	0.17	0.15	0.03	0.09	0.09
High and medium-high technology	*7.51*	*9.61*	*10.77*	*4.38*	*4.80*	*5.26*
Coke, refined petroleum products and nuclear fuel	0.86	0.38	0.46	0.83	0.37	0.41
Chemicals excluding pharmaceuticals	3.29	4.11	4.39	2.17	2.41	2.35
Machinery & equipment, nec	1.09	1.65	1.98	0.40	0.59	0.69
Office, accounting & computing machinery	0.51	0.45	0.40	0.11	0.09	0.13
Electrical machinery & apparatus, nec	0.09	0.72	0.81	0.05	0.38	0.40
Radio, television & communication equipment	1.04	1.21	1.16	0.45	0.41	0.48
Medical, precision & optical instruments	0.09	0.27	0.36	0.06	0.17	0.20
Motor vehicles, trailers & semi-trailers	0.30	0.44	0.55	0.18	0.22	0.28
Non motor vehicle transport equipment	0.24	0.37	0.67	0.12	0.16	0.31
Total Manufacturing	14.23	18.27	19.20	8.65	9.96	10.01
Electricity, gas and water	0.14	0.02	0.02	0.12	0.03	0.02
Construction	0.00	0.01	0.00	0.00	0.02	0.02
Wholesale & retail trade; repairs	0.89	0.82	0.82	0.57	0.53	0.52
Hotels & restaurants	0.00	0.00	0.00	0.00	0.00	0.00
Transport	0.45	1.02	1.22	0.29	0.69	0.81
Communication	0.03	0.08	0.11	0.03	0.08	0.16
Finance & insurance	0.32	0.50	0.38	0.24	0.60	0.47
Real estate & business services	0.77	0.68	0.98	0.48	0.74	1.04
Other services	0.39	0.05	0.06	0.26	0.09	0.12
Total	23.74	23.55	25.96	16.64	14.92	16.47

Source: Author's calculations from OECD Input-Output tables.

greater than 1% are needed for the Italian production (EI). As regards services, transport and real estate and business services are the most used both in exports and in output.

Considering the VS by sector, that is the amount of the intermediate imports of all industries directly and indirectly required to obtain the export of a sector (Table 5), this amounts to 29% of manufacturing

TABLE 5 - *Vertical Specialisation by Sector (as Share of Sector Exports)*

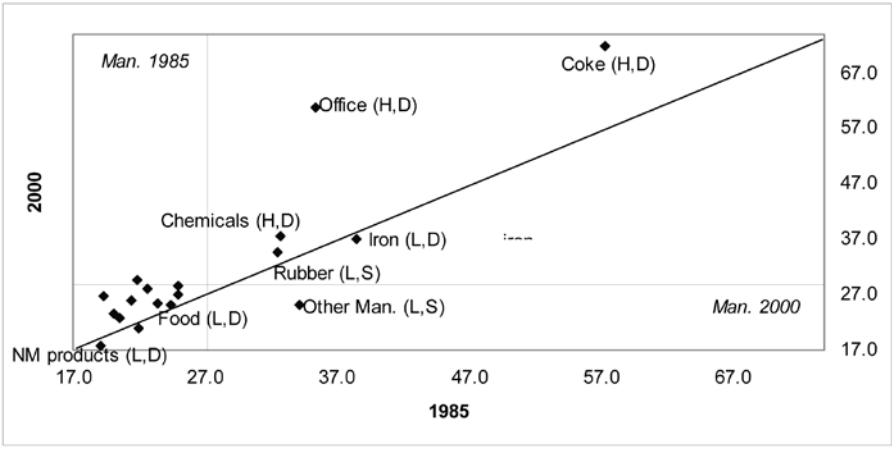
	Direct			Direct and Indirect		
	1985	1995	2000	1985	1995	2000
Low and medium-low technology	*15.1*	*13.5*	*15.0*	*25.7*	*24.1*	*26.0*
Food products, beverages and tobacco	13.4	11.6	11.9	22.1	20.6	21.0
Textiles, textile products, leather and footwear	14.6	12.6	14.6	24.5	23.2	25.2
Wood and products of wood and cork	9.6	16.3	16.3	19.5	26.1	26.8
Pulp, paper, paper products, printing and publishing	12.1	14.8	15.4	21.5	25.1	26.1
Rubber & plastics products	21.4	20.5	23.7	32.7	31.8	34.7
Other non-metallic mineral products	9.3	7.5	8.0	19.2	16.3	17.8
Iron, steel & non-ferrous metals	24.9	20.6	25.8	38.7	31.7	37.1
Fabricated metal products, except machinery	8.3	11.3	11.8	20.3	22.4	23.6
Manufacturing nec (including Furniture)	23.0	12.2	12.2	34.4	24.1	25.1
High and medium-high technology	*19.3*	*18.3*	*21.1*	*28.9*	*28.8*	*31.5*
Coke, refined petroleum products and nuclear fuel	55.9	47.5	66.7	57.7	49.2	71.9
Chemicals excluding pharmaceuticals	18.7	27.8	30.7	32.6	35.2	37.5
Machinery & equipment, nec	11.9	14.5	16.7	22.8	25.8	28.1
Office, accounting & computing machinery	30.5	48.0	57.4	35.6	54.0	60.8
Electrical machinery & apparatus, nec	9.7	15.1	18.2	21.9	26.7	29.7
Radio, television & communication equipment	18.4	16.8	16.9	25.1	25.8	27.0
Medical, precision & optical instruments	12.4	12.7	14.9	20.6	20.9	22.7
Motor vehicles, trailers & semi-trailers	14.0	11.5	13.1	25.1	25.5	28.7
Non motor vehicle transport equipment	16.7	14.8	17.0	23.5	26.3	25.5
Total Manufacturing	17.2	15.9	18.3	27.3	26.5	29.0

Source: Author's calculations from OECD Input-Output tables.

exports and shows an increase of 6% between 1985 and 2000. VS is more prominent in high and medium-high intensive technology sectors (31.5%) than low and medium-low technology industries (26%). Direct VS represents more than 60% of total manufacturing

VS, 67% for high and medium-high technology industries and 58% for medium and medium-low industries. Sectors with the highest VS shares are office and computing machinery, petroleum products and chemicals. Figure 2 indicates that office and computing machinery (the industry with the highest VS growth rate), refined petroleum products, chemicals and rubber and plastics are the sectors that show both a growth of VS between 1985 and 2000 and VS shares higher than those for manufacturing both in 1985 and 2000. All three are high and medium-high technology industries and record negative contribution to trade. Iron and non ferrous metals register VS values higher than manufacturing average in both years but with a decrease in VS between 1985 and 2000.

FIGURE 2 - *Vertical Specialisation by Sector*

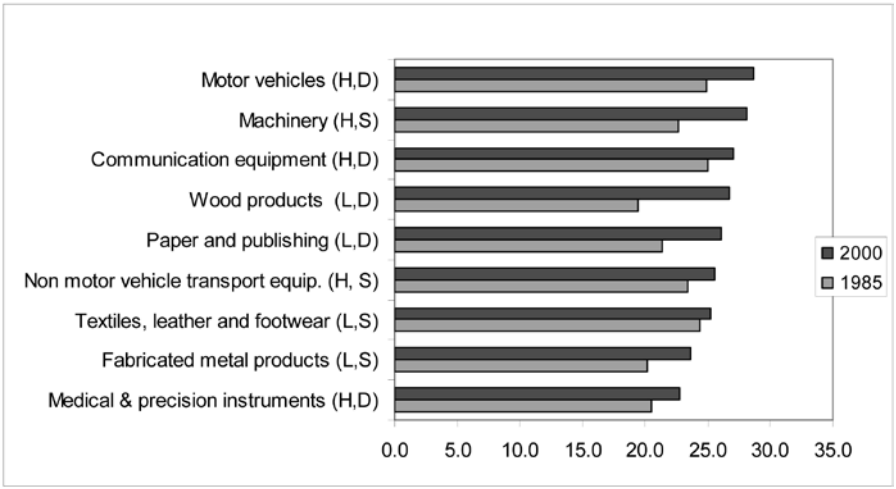


Notes: See Figure 1.
Source: Author's calculations from OECD Input-Output tables.

Figure 3 presents sectors with VS share higher in 2000 than 1985 but below the manufacturing value. Five of the nine sectors are high and medium-high technology industries and four are sectors with a trade balance surplus: machinery (23% between 1985 and 2000), metal products (16.5%), non-motor vehicle transport equipment (8.6%) and textiles products, leather and footwear (2.7%).

While vertical specialisation increased between 1995 and 2000, it declined slightly from 1985 to 1995. Between 1985 and 1995 the majority of the low and medium-low tech industries, except for wood, paper and fabricated metal products, show a decrease in VS share;

FIGURE 3 - *Sectors with VS Shares higher in 2000 than 1985 but below Manufacturing Share*



Notes: See Figure 1.
Source: Author's calculations from OECD Input-Output tables.

the list is restricted to food, textiles and various manufacturing when the material offshoring indicator is considered. The lira devaluation in 1992, probably, lessened the need for firms to use foreign cost advantages more intensively by buying inputs from the cheapest supplier or by relocating a part of their production to foreign countries. At the end of the 1990s, the adoption of the Euro and the entry into the world markets of emerging countries with low labour costs, such as China and India, made the reorganisation of production process a priority, especially in traditional sectors.

The Sperman rank correlations are used to compare the different global value chain indicators and their relationship with production depth and contribution to trade (Table 6). If the correlation statistic between the two indicators is high, the rankings of industries according to the two measures are similar. If the correlation statistic is negative, the industries with relatively high value of one indicator are more likely to have a relatively low value of the second indicator. Correlations between the different indicators on global linkages are positive and quite high. Ranking of industries in terms of production depth are negatively correlated with the ranking based on different global value chain measures. However, excluding the VS indicator,

TABLE 6 - *Sperman Rank Correlations: 2000 (18 Sectors)*

	VS by Sector	Narrow Offshoring	Broad Offshoring	Material Offshoring	Production Depth	Contribution to Trade
VS by sector	1					
Narrow Offshoring	0.6305*	1				
Broad Offshoring	0.7750*	0.7214*	1			
Material Offshoring	0.7874*	0.7276*	0.9979*	1		
Production Depth	-0.6099*	-0.3003	-0.2012	-0.2095	1	
Contribution to Trade	-0.4058*	-0.6211*	-0.3333	-0.3292	0.3975	1

Source: Author's calculations from OECD Input-Output tables.
* Significant at 10%.

correlation is low suggesting that the decreasing share of value added in production (Table 1) cannot only be explained by the rise in international outsourcing but could also be caused by firms outsourcing functions to different companies within Italy.

The Italian results are substantially in line with the evidence from other advanced economies (De Backer and Yamano, 2008; IMF, 2007). Offshoring and vertical specialisation are found to be the highest in basic industries that make heavy use of primary goods. Examples are basic metals but also chemicals, rubber and plastics and petroleum products. Another group of industries that display a rather high import content are higher technology intensive industries. Parts and components are often produced in one country before being exported for assembly. This international division of labor is found in industries such as electrical machinery, radio and communication equipment, and office, accounting and computing machinery. At the same time, low-technology sectors, such as textiles and clothing industry, are also characterised by a high degree of production fragmentation (De Backer and Yamano, 2008; Cadarso *et al*., 2007a). However, in the case of Italy, both offshoring and vertical specialisation indicators are below the manufacturing value even if the country is highly specialised (three times more than the OECD average) in the textiles, clothing and footwear industry. The VS for this sector is even below the low and medium-low tech average (Table 5). The backbone of Italy's exports, machinery and equipment, shows

TABLE 7 - *Inward and Outward Foreign Investment: 2000 (1)*

	High and Medium-high Tech	Low and Medium-low Tech
Turnover of domestic affiliates of foreign MNCs	136605	48157
Share on total Turnover	*74%*	*26%*
Inward Investment Intensity (2)	*46%*	*11%*
Turnover of foreign affiliates of domestic MNCs	49267	60263
Share on total Turnover	*45%*	*55%*
Outward Investment Intensity (2)	*17%*	*13%*

Spearman Rank Correlations (3)

	VS as a Share of Total Exports	Material Offshoring	Inward Investment Intensity	Outward Investment Intensity
VS as share of total exports	1			
Material Offshoring	0.9000	1		
Inward Investment Intensity (2)	0.5909*	0.4273	1	
Outward Investment Intensity (2)	0.04555	-0.1636	0.4818	1

Source: Author's calculations from OECD Input-Output tables and OECD (2007).
* Significant at 10%.

(1) For inward foreign investment year refers to 2001.

(2) Inward (outward) foreign direct investment intensity is measured by the share of turnover of domestic affiliate (foreign affiliates) of foreign (domestic) MNCs on Italian total production in a given industry.

(3) Correlation is calculated on 11 sectoral aggregations according to FDI data.

global value chain indicators below the manufacturing sector as a whole and the high and medium-high tech average.

Thus, production fragmentation does not appear to be related to Italian comparative advantages as the negative rank correlation between contribution to trade and the various global value chain indicators seems also to suggest (Table 6). This outcome diverges from the IMF (2007) claim that, for advanced economies, the intensity of international outsourcing is related to their comparative advantages. Some explanation can be found by looking at the characteristics

of Italian manufacturing industry. First, Italy has a comparative disadvantage in high and medium-high tech industries, so this type of intermediate good cannot be provided by the domestic industry but has to be imported as shown by the high values of the ratio of imported to domestic sourcing of inputs in these industries (Table 1). A second factor is the presence of inward foreign direct investment in medium and medium-high tech firms: turnover of domestic affiliates of foreign MNCs (multinational companies) represents 74% of foreign MNC affiliates total turnover and 46% of Italian output in this sector (Table 7). These MNCs locate only part of the production process in Italy and, therefore, need to import intermediate inputs. The positive and high correlations between VS, the material offshoring indicator and inward investment intensity seem to support this conjecture (Table 7). Finally, low correlation indicates that trade in intermediate goods is not related to outward foreign direct investment. Imports of intermediate inputs do not seem to be the result of strategies by firms to relocate a part of their production to foreign countries with comparative advantages in the production of particular products.

6. Conclusions

Various indicators have been used in this paper to analyse the international fragmentation of production in Italian manufacturing industries. The objective was to determine the sectors in which fragmentation was most prevalent and their key characteristics. The results obtained show that the degree of Italian production fragmentation is more closely linked to the characteristics of industrial sectors than to specialisation. In line with evidence from other advanced economies, as regards imports of intermediate inputs, high and medium-high industries lead the process of international integration. However, while for advanced economies this outcome is related to the comparative advantages of those countries, this is not the case for Italy. The Italian economy has not been able to foster the growth of competitive firms in high tech sectors, especially in office and computing machinery, and hence a high volume of these inputs is required. Offshoring and vertical specialisation are also found to be high in basic industries that make considerable use of primary goods and where Italy has a comparative disadvantage. Examples of this are basic metals but also chemicals, rubber and plastics, and petroleum products. The significant presence of foreign MNCs in high and medium-high tech industries can help to explain

the importance of imports of intermediate goods in these industries. In the industries where Italy has the highest comparative advantage, such as textiles, leather and footwear and machinery and equipment both offshoring and vertical specialisation indicators are below those of the manufacturing value.

For the Italian manufacturing sector offshoring of market services is far less important than offshoring of materials both in terms of value and growth.

Between 1985 and 1995 the majority of the low and medium-low tech industries show a decrease in VS share. The lira devaluation in 1992, probably, lessened the need for firms to exploit foreign cost advantages. However, regarding imports of intermediate inputs, international integration increased in Italy between 1995 and 2000. Most likely, the adoption of the Euro and the emergence of new competitors, notably China, at the end of the 1990s made the reorganisation of production a priority, especially in traditional sectors.

FERNANDA RICOTTA
Università della Calabria, Facoltà di Economia,
Dipartimento di Economia e Statistica, Cosenza, Italy

REFERENCES

Baldone S., F. Sdogati and L. Tajoli (2002), *La posizione dell'Italia nella frammentazione internazionale dei processi produttivi*, in: "L'Italia nell'economia internazionale. Rapporto ICE 2001-2002", Istituto Commercio Estero: Roma.

Bergoeing R., T.J. Kehoe, V. Strauss-Kahn and K-M. Yi (2004), "Why is Manufacturing Trade Rising Even as Manufacturing Output is Falling?", *American Economic Review*, 94(2), 134-138.

Bhagwati J., A. Panagariya and T.N. Srinivasan (2004), "The Muddles over Outsourcing", *Journal of Economic Perspectives*, 18(4), 93-114.

Bracci, L. (2006), *Una misura della localizzazione internazionale*, in: "L'Italia nell'economia Internazionale. Rapporto ICE 2005-2006", Istituto Commercio Estero: Roma.

Breda E., R. Cappariello and R. Zizza (2007), "The Measures of the External Trade Impulse to Economic Growth: How Relevant is the Internationalization of Production?", Paper presented at 16th International Conference on Input-Output Techniques, Istanbul, 2-6 July.

Breda E., R. Cappariello and R. Zizza (2008), "Vertical Specialisation in Europe: Evidence from the Import Content of Exports", Banca d'Italia, Temi di discussione No. 682.

Broccolini C., A. Lo Turco, A.F. Presbitero and S. Staffolani (2007), "International Outsourcing vs. ICT in Explaining the Wage Gap in Italian Manufacturing", Università degli studi di Ancona, Dipartimento di Economia, Quaderni di ricerca No. 299.

Cadarso, M.A., N. Gómez, L.A. López and M.A. Tobarra, (2006), "Outsourcing to CEE Countries and Spanish Industrial Employment: The Spanish-Turkey Trade Relationship in 1993-2003", Paper presented at ETSG 8th Annual Conference, Wien, 7-9 September.

Cadarso M.A., N. Gómez, L.A. López and M.A. Tobarra (2007a), "Vertical Specialisation in EU Manufacturing and Services Sectors", Paper presented at 16th International Conference on Input-Output Techniques, Istanbul, 2-6 July.

Cadarso M.A., L.A. López and M.A. Tobarra (2007b), "Especialización vertical, outsourcing e inversión directa en la industria española", *Revista de Economía Mundial,* 16, 27-55.

Campa, J. and L.S. Goldberg (1997), "The Evolving External Orientation of Manufacturing: A Profile of Four Countries", *Economic Policy Review*, 3(2), 53-81.

Chen H., M. Kondratowicz and K-M. Yi (2005), "Vertical Specialisation and Three Facts about U.S. International Trade", *North American Journal of Economics and Finance*, 16(1), 25-59.

Daveri, F. and C. Jona-Lasinio (2008), "Off-shoring and Productivity Growth in the Italian Manufacturing Industries", Luiss Lab of European Economics, Working Document No. 53.

De Backer, K. and N. Yamano (2008), *The Measurement of Globalisation Using International Input-Output Tables*, in: "Staying Competitive in the Global Economy: Moving up the Value Chain", OECD Publications: Paris.

De Simone, G. (2004), "The Effects of International Fragmentation of Production on Trade Patterns: An Empirical Assessment", Institute for Research and Business Administration Working Paper No. 17.

Egger, H. and P. Egger (2003), "On Market Concentration and International Outsourcing", *Applied Economics Quarterly*, 49(1), 49-64.

Egger, H. and P. Egger (2005), "Labour Market Effects of Outsourcing under Industrial Interdependence", *Review of Economics and Finance*, 14(3), 349-363.

Falzoni, A.M. and L. Tajoli (2009), "Offshoring and the Skill Composition of Employment in the Italian Manufacturing Industries", Paper presented at the Workshop: "Innovation, Internationalization and Global Labor Markets", Centro Studi Luca d'Agliano, Turin, 26-27 February.

Feenstra, R.C. and G.H. Hanson (1996), "Globalization, Outsourcing, and Wage Inequality", *The American Economic Review*, 86(2), 240-245.

Feenstra, R.C. and G.H. Hanson (1999), "The Impact of Outsourcing and High-technology Capital on Wages: Estimates for the United States, 1979-1990", *The Quarterly Journal of Economics*, 114(3), 907-940.

Helg, R. and L. Tajoli (2005), "Patterns of International Fragmentation of Production and the Relative Demand for Labor", *North American Journal of Economics and Finance*, 16(2), 233-254.

Hijzen, A., H. Gorg and R. Hine (2005), "International Outsourcing and the Skill Structure of Labour Demand in the United Kingdom", *Economic Journal*, 115(506), 860-878.

Hummels, D., J. Ishii and K-M. Yi (2001), "The Nature and Growth of Vertical Specialization in World Trade", *Journal of International Economics*, 54(1), 75-96.

Hummels, D., D. Rapoport and K-M. Yi (1998), "Vertical Specialization and the Changing Nature of World Trade", *Economic Policy Review*, 4(2), 79-99.

IMF (2007), World Economic Outlook – April, International Monetary Fund: Washington, D.C.

Lo Turco, A. (2007), "International Outsourcing and Productivity in Italian Manufacturing Sectors", *Rivista italiana degli economisti*, 1(4), 125-146.

OECD (2007), Measuring Globalisation. Activities of Multinationals, Vol. 1, OECD Publications: Paris.

OECD (2008), Staying Competitive in the Global Economy: Moving up the Value Chain, OECD Publications: Paris.

Olsen, K.B. (2006), "Productivity Impacts of Offshoring and Outsourcing: A Review", OECD Science, Technology and Industry Working Papers No. 1.

Pilat, D. (2006), "The Globalisation of Value Chains: Preliminary Evidence and Potential Implications for Policy", Paper presented at the OECD's Committee on Industry and Business Environment, February.

United States National Research Council (2006), Analyzing the US Content of Imports and the Foreign Content of Exports, National Academy of Sciences, <http://www.nap.edu/catalog/11612.html>.

Wixted, B., N. Yamano and C. Webb (2006), "Input-Output Analysis in an Increasingly Globalised World: Applications of OECD's Harmonised International Tables", OECD Science, Technology and Industry Working Papers No. 7.

Yamano, N. and N. Ahnad (2006), "The OECD Input-Output Database: 2006 Edition", OECD Science, Technology and Industry Working Papers No. 8.

Yeats, A. (1998), "Just how Big is Global Production Sharing", World Bank Policy Research Working Paper No. 1871.

Yi, K-M. (2003), "Can Vertical Specialisation Explain the Growth of World Trade?", *Journal of Political Economy*, 11(1), 52-102.

ABSTRACT

In this paper the extent of international fragmentation of production in Italian manufacturing industries for the years 1985, 1995 and 2000 is assessed with different indicators. The objective is to determine where fragmentation is most prevalent and to provide a description of the key characteristics of those sectors. The paper first presents a survey of global value chain indicators and how these have been used in the economic literature. The second part supplies empirical evidence on the global linkages of Italian firms. The results obtained show that the degree of fragmentation of production is more closely linked to the characteristics of industrial sectors than to specialisation. Regarding imports of intermediates, high and medium-high industries and basic industries that make considerable use of primary materials lead international integration, all sectors where Italy has a comparative disadvantage. In the industries where Italy has a comparative advantage, on the other hand, such as textiles, leather, footwear, machinery and equipment, both offshoring and vertical specialisation indicators are below the manufacturing value.

Keywords: Input-output Tables, Offshoring Indicators, Vertical Specialisation, Industry Studies

JEL Classification: D27, F15, L6

RIASSUNTO

Gli indicatori della global value chain: un'applicazione ai settori italiani

Questo lavoro analizza la frammentazione internazionale della produzione nei settori dell'industria manifatturiera italiana negli anni 1985, 1995 e 2000 attraverso l'utilizzo di diversi indicatori. L'obiettivo è di determinare in quali settori la frammentazione internazionale della produzione risulta più rilevante e le principali caratteristiche di questi settori. L'articolo in primo luogo presenta una rassegna degli indicatori della *global value chain* e di come questi sono stati utilizzati nella letteratura economica. La seconda parte offre un'analisi empirica dell'integrazione internazionale delle imprese italiane. I risultati evidenziano come il grado di frammentazione della produzione sia collegato più strettamente alle caratteristiche dei settori industriali piuttosto che alla specializzazione internazionale. I settori a media e media-alta tecnologia e i settori di base, in cui l'Italia presenta uno svantaggio comparato, sono i settori in cui l'integrazione internazionale è più spinta. Nei settori in cui l'Italia presenta un vantaggio comparato, quali il tessile-abbigliamento, il cuoio-calzature e la meccanica, sia l'indicatore di offshoring che di specializzazione verticale presentano valori al di sotto di quello del settore manifatturiero.