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Structural Transformation in Manufacturing and the Role of Business Services: Evidence from the Italian Economy

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This article investigates structural change in Italy, taking into account the evolution of manufacturing and interindustrial linkages. In particular, the analysis aims to provide new findings on the extent and principal aspects of deindustrialization. According to the «vertical» perspective, the input-output tables for a set of vertically integrated sectors have been transformed, so the number of hours worked that directly and indirectly satisfy final demand for goods can be estimated. The findings concerning the distribution of hours worked obtained by applying a subsystem approach show large differences in comparison to the sectoral approach. On average, when we adopt a subsystem approach, the share of manufacturing rises by about ten percentage points in the economy as a whole. This result clearly underestimates the ability to generate employment in manufacturing. The links between the development of business services and their role in manufacturing are also explored.

Keywords: Input-Output tables, Subsystem approach, Manufacturing, Business services
Classificazione JEL: L60; L80; O14

1. INTRODUCTION

Structural change is a key ingredient in economic development. The relationship between the structure of production and economic dynamics is one «of the main political-economic focal points in recent decades» (Maroto-Sanchèz, Cuadrado-Roura 2009; p. 256). In the theoretical debate, the prevalent neoclassical framework regards this as a minor issue. Growth rates differ among countries essentially as a result of a generalized, cross-sectional process of capital deepening in the economy. This approach asserts that growth is uniquely determined by supply and that differences in the countries' dynamics are related to the accumulation of factors of production and their distribution. Unlike these contributions, the Keynesian perspective highlights the impact of effective demand as a crucial driver of accumulation, thus it claims that the long-term growth rate is driven by demand (Dutt, 2006). Hence, both strands of research typically privilege analysis of the economy in

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the aggregate, thus neglecting sectoral-level dynamics and with a limited role played by intersectoral changes.

Growth theories with a different perspective inspired by classical economists (such as Adam Smith and David Ricardo) are called «structural», in the sense that growth is necessarily related to changes in the structure of the economy (Landesmann, Scazzieri 1996). For instance, Simon Kuznets shows that growth and structural change are deeply related. Structural change can promote economic growth if the allocation of resources is improved by reducing the gap in factor returns across different economic activities or taking advantage of economies of scale. Luigi Pasinetti emphasizes that structural change poses a continuous challenge to the stability of the economy, with increasing unemployment related to the dynamics of the production (Syrquin, 2010).

However, studies in this area show wide heterogeneity due to the complex nature of the subject. Concepts about «structure» and «structural change» are used with different meanings in economic research. Some of them have a clear meaning while others are used with a certain vagueness. The most common meaning concerns persistent long-term changes in the sectoral distribution of an economy (Syrquin, 2010). More specifically, structural change is related to the reallocation of resources from one industry to another. Empirical evidence confirms the relevance of the changing composition in economic activities; as Rodrik (2006) argues, development requires diversification more than specialization.

As economies mature, structural change is also associated with shifts away from agriculture and manufacturing and ultimately toward services. Agriculture dominates an economy during the early stages of development, but its share rapidly decreases after the initiation of industrialization, when the share of industry expands at the expense of agriculture. The evolution of interindustrial relationships mostly involves connections between services and manufacturing. The literature has at least two different ways of addressing these issues. On the one hand, regarding the rise of services, attention is paid to the trend toward the prevalence of services in the economy; on the other hand, many studies focus on the decline in manufacturing and deindustrialization. A broad debate is occurring, however, on whether the greater role of services implies an actual reduction in the leading role that manufacturing has historically played in the economy in generating welfare and supporting economic growth (Peneder, 2003; Silva, Teixeira 2008). «The reason for this is the comparatively high density of interindustrial transactions of both forward and backward linkage types formed within and around the manufacturing sector» (Park, Chan 1989; p. 199).

One way to understand of the effects of structural change on economic growth is to examine the channels through which such effects might work. The starting point is the interrelationship between the structure of production and economic dynamics. Therefore, in this connection, a selective de-

scription of the economic structure is crucial. Indeed, one of main analytical characteristics of the different theoretical approaches regards decomposing the economic system into sub-units (Landesmann, Scazzieri 1996). The main goal is to reduce the complexity of the economy but also provide a disaggregated representation of the dynamics of structural transformation.

The traditional approach to analyzing growth and structural change is based on a «horizontal» perspective of the economy. Among other things, this approach considers economic sectors as divided from one another. In other terms, the sectors are analyzed in isolation, and no interdependence is assumed. However, the evidence presented by most studies on structural change is not sufficient to provide an adequate understanding of these phenomena because they are focused on a sector-based approach. In fact, sectoral data presuppose a theoretical notion of the organization of production that is not consistent with what is said above (Montresor, Vittucci Marzetti 2011). What emerges from these approaches is that, notwithstanding the relevant results obtained, they suffer from an intrinsic difficulty in measuring the indirect effects of the reorganization of economy. In this respect, user-producer interactions are neglected, and the analysis of structural change might raise some misspecification problems. Of course, if new production patterns modify the intensity and feature of interindustrial linkages, they will generate effects on the functioning of the economy. Therefore, the structural composition and how the economy evolved over time are related to the different ways in which production is organized. Accordingly, if these changes are neglected, «analyses of value creation and structural change are running the risk of misinterpretation the contemporary growth process» (Lind, 2014; p. 13). According to the «horizontal» approach, sectors are seen as complete production systems, although, in reality, they are connected to the rest of the economy. Therefore, this approach could be influenced by changes in the way in which production processes are organized, erroneously taking them as a «sign» of structural change (Ciriaci, Palma 2016; p. 60).

The complexity of structural change can be better investigated by adopting a different analytical framework. One strand of research, known as neo-Schumpeterian or evolutionary economics, stresses the importance of vertical linkages in sustaining competitiveness. As Rosenberg (1996; p. 345) argues, «much of the impact of new technologies is realized through inter-sectoral flows», so, «sectors should instead be defined on the basis of their vertical, or inter-linked, production processes». The interindustrial linkages, thus, develop through vertical complementarities, in which intermediate inputs become increasingly important in advanced production (Castellacci, 2010; Di Cagno, Meliciani 2005; Mariotti *et al.*, 2013).

The present paper investigates the complexity of structural transformation in Italy, adopting an analytical framework that differs from the tradition-

al one. According to the «vertical» perspective, we transform the input-output (I-O) tables into a set of vertically integrated sectors, so that the number of hours worked that directly and indirectly satisfy final demand for goods and services can be estimated. With the «vertical» perspective, I-O analysis can be performed and used as an empirical approach to study this main topic. Indeed, some authors have found that organizational restructuring in several European countries has been achieved through a substantial vertical externalization (Dietrich, 1999). Manufacturing firms attempting to improve their organizational efficiency and reduce costs through the outsourcing of service activities have played a fundamental role in this shift (McCarthy, Anagnostou 2004).

Structural change in Italy has attracted a great deal of academic attention. In particular, Momigliano and Siniscalco (1982) find that intermediate demand in manufacturing is an important part of explaining the shift to services in the Italian economy in the period 1965-1975. The greater sectoral integration is related to the increasing use of the service activities' need to satisfy final demand in manufacturing. Despite the growing services sector at the time, advanced economies were still seen as manufacturing oriented, allowing continuation of a claim that the transition to services, measured by the growth of employment in that sector, did not lead to deindustrialization in Italy (Momigliano, Siniscalco 1982; Pompermaier, 2002; Sarra, 2009). In this interpretation, outsourcing is a particular kind of structural change that is merely an extension of manufacturing into nonmanufacturing sectors (Montresor, Vittucci Marzetti 2010).

Although these claims about outsourcing have become more important, empirical results to quantify these claims are far from conclusive. Rather, Montresor and Vittucci Marzetti (2011), in exploring the global dimension of the phenomenon, show evidence of deindustrialization in a virtual world composed of the sum of the I-O tables for the main member countries in the Organization for Economic Cooperation and Development (OECD). By examining the vertically integrated relationships from the early 1980s to the mid-1990s, the authors highlight that the decline in the hours worked in manufacturing is only partially offset by the increase in the services used in the production of goods. Finally, Ciriaci and Palma (2016), using OECD data for some European countries for the period 1995-2005, demonstrate the existence of a strategic relationship between knowledge-intensive business services (KIBS) and manufacturing subsystems, dominated by technologically advanced subsystems.

This paper aims to provide new empirical data on Italy using an analysis of the nature and the evolution of intersectoral relationships between manufacturing and services during the period 1995-2011. This analysis is conducted using the World Input-Output Database (WIOD). Considering the struc-

tural transformation of production in Italy, the following questions are addressed: To what extent has manufacturing become more service intensive? How are the hours worked distributed taking into account the vertical interdependencies in production?

The paper is organized as follows: section 2 describes the theoretical and methodological background of the analysis of structural dynamics; section 3 provides evidence of the evolution of manufacturing subsystems using two approaches; in section 4 the role of business services is described. A discussion of the results of our research is in section 5.

2. A VERTICAL PERSPECTIVE OF THE ECONOMY: THE THEORETICAL AND METHODOLOGICAL FRAMEWORK

Intermediate inputs and a vertical perspective of the economy comprise an interesting strand of the literature, attracting a growing number of scholars. The concept of vertically integrated sectors, identified by Pasinetti (1965, 1973), is based on the fact that final goods stem from vertically integrated production, which involves different sectors. As illustrated by Scazzieri (1990), this method provides a powerful simplifying tool, which is suitable if one wants to identify «one-way» causal linkages within the complex network of economic relationships. An analysis of transformation processes involves a breakdown of the economy into a number of distinct subsets of relationships. From the vertical perspective, the identification of the subset is useful for denoting unambiguous relationships between all production inputs required to produce final goods. The production system is, then, described using a model that implies integration between the consumption and production phases, according to a unidirectional causality between resources and final products, in which consumption is the last step of production (Schilirò, 2006).

I-O analysis has useful empirical tools for investigating different aspects of these processes. From this perspective, Pasinetti, starting with Leontief's model, developed the subsystem approach through a transformation of the I-O system into a set of vertically integrated sectors. By comparing Leontief's model with Pasinetti's structural analysis, a general system of structural economic dynamics can be obtained. Both approaches address interindustrial transactions, pointing out that the production structure is essential for understanding economic development. These models are used to reduce the degree of complexity in the economy, and, to do this, they refer to different methods of decomposition of the production structure (Schilirò, 2006). Leontief contributed to the development of an analytical framework that can configure the relationships among industries, providing an analysis that is based on «horizontally integrated industries». The starting point of his model is the

general equilibrium theory, which describes production from a circular perspective, «where commodities are produced by means of commodities and production takes place through processes of unit time duration» (Silva, Teixeira 2008; p. 283). In this way, I-O tables allow us to obtain a highly dense complex network of interrelations, which transmit the impulses of any local primary change to the farthest corners of economy (Dreyer, 1999; p. 19). Thus, when the system of general interdependence is used to describe the economy, the analysis mainly assumes a stationary equilibrium. In fact, the production structure can be decomposed into a series of homogeneous linear equations, because of the separate cost factors involved (Leontief, 1941).

In Pasinetti's approach, an important distinction is made between «industry» and «subsystem». Pasinetti's subsystem feature a generalization of the concept of subsystem elaborated by Sraffa. As Sraffa stressed (1960; p. 89): «the commodities forming the gross product can be unambiguously distinguished as those which go to replace the means of production and those which together form the net product of the system». The economy can be decomposed into as many parts as there are goods that contribute to the net product, «in such a way that each part is in a self-replacing state with a net product of one commodity only» (Harcourt, Massaro 1964; p. 717). These parts can be called «subsystems». A subsystem is an aggregation that analytically represents all the activities undertaken (directly or indirectly) to satisfy final demand for a specific good or service, given the stock of fixed capital (Di Berardino, Onesti 2017). In this manner, the analysis of structural change is based on the sequential character of productive processes, identifying a causal relationship that is different from those associated with the theory of the stationary state or of static equilibrium (Scazzieri, 1990).

The traditional analysis of sectoral interdependence is by definition a static approach, but Pasinetti offers a way of looking at the same economy from a dynamic point of view. Indeed, «the differences consist only in how economic relations are classified, but it is possible to switch from one to the other by means of linear algebraic transformations: the production coefficients of a vertically integrated sectorial model are a linear combination of the production coefficients of the corresponding input-output model» (Pomini, 2012; p. 55). In particular, Leontief's inverse matrix not only is the main building block in applied I-O research but offers common ground between the two approaches. However, from the empirical point of view, one main difference remains between the methods. As Pasinetti (1981) argues, traditional I-O analysis is based on directly distinguishable interindustrial flows, whereas, in the subsystem approach, linkages among economic activities are treated as part of an ongoing process; the relationships are completed only after the final good is realized, generating – through consumption, investments, and exports – higher aggregate demand. Hence, this empirical frame-

work emphasizes demand-driven growth, in which interindustrial relationships are identified according to the linkages between final goods and all the inputs to production. This approach indicates that each sector is considered on the basis of its contribution to the production of final goods.

Following the method illustrated by Pasinetti (1973) and later adopted by Momigliano and Siniscalco (1982), interindustrial analysis can be conducted starting with Leontief's I-O matrix. The I-O tables are reworked to define an «operator», which can decompose a vector that expresses an entity classified for a sector in a square matrix in which the same entity is remapped from the «sector» or «branch» to a «subsystem» (or «vertically integrated sector» or «block»). The subsystem is an aggregation that analytically comprises all the activities used (directly or indirectly) to satisfy final demand for a specific good or service, given the stock of fixed capital. In this way, it can identify a causal relationship that involves interindustrial linkages. The operator for the conversion from branches to subsystems is obtained as follows:

$$\Gamma = (\hat{\rho})(I - A)^{-1}\hat{\alpha} \tag{1}$$

where ρ represents the vector of labor coefficients (the ratio between hours worked and the total output of each branch i), $(I - A)^{-1}$ is the Leontief inverse, and vector α measures output at current prices of each branch i destined for final use (Di Berardino, Onesti 2017).

The Γ matrix can be examined from two different sides: (1) each row shows the number of hours worked related to branch i that is directly or indirectly used by each subsystem j; (2) each column j indicates the number of hours worked related to each branch that is directly or indirectly used by the specific subsystem j. Therefore, the integration can be seen as a process that modifies the boundaries of production and changes the sectoral contribution to the economy.

3. THE MAIN DIFFERENCES BETWEEN THE TRADITIONAL AND THE SUBSYSTEM APPROACH

In line with Tregenna (2009), deindustrialization is most commonly defined by three indicators: (1) manufacturing hours worked has a decreasing share of total hours worked; (2) the number of manufacturing hours worked declines absolutely; and (3) a manufacturing value added has a decreasing share of total value added.

The data used in this paper were obtained from the World Input-Output Database (WIOD, 2013). The WIOD is a time series of national symmetric I-O tables (industry x industry) that cover the period 1995-2011. This database is

TAB. 1. *The share of manufacturing in the economy as a whole by sector/subsystem (in percentage)*

	Hours worked		Value added	
	Sector	Subsystem	Sector	Ssubsystem
1995	22.8	32.9	24.4	32.5
2011	18.1	28.1	18.7	26.8

Source: WIOD.

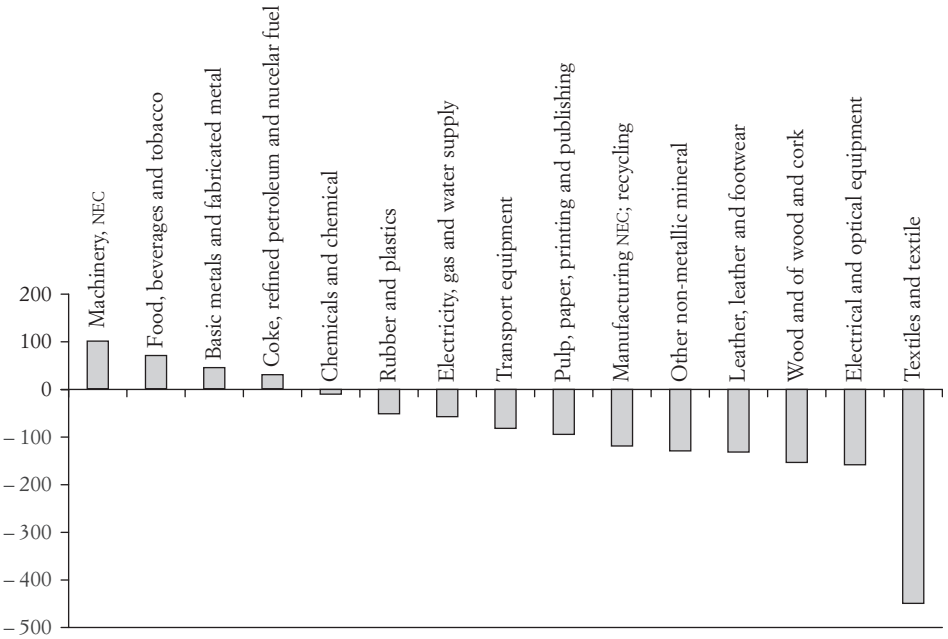
suitable for analyzing structural change in economies thanks to the specific socioeconomic accounts (SEAs) included in the database, which are entirely complementary to national I-O tables. The SEAs include information on the hours worked in each sector (through the ISIC Rev. 3 sectoral classification) and provide more precise measures of the mobility and intersectoral integration of employees.

Table 1 presents some interesting results in this respect. The share of manufacturing was lower in 2011 than in 1995. According to the sectoral approach, the share of manufacturing decreased from 22.8 per cent to 18.1 per cent in terms of the total hours worked and from 24.4 per cent to 18.7 per cent when value added is considered. The findings concerning the distribution of hours worked obtained by applying the subsystem approach show large differences in comparison to those obtained from using the sectoral approach. Indeed, the share of manufacturing in the economy rises by about eight to ten percentage points when we adopt the subsystem approach. This result shows clearly that the sectoral perspective tends to underestimate the ability to generate employment and value added in manufacturing. By contrast, by adopting a vertically integrated perspective of production, the direct effects of the higher impact of indirect investment on economy become evident, highlighting that the traditional approach does not fully reveal these effects (Ciriaci, Palma 2016; Park, Chan 1989).

However, these prevalent features are also visible in other important European economies. As shown in some cross-country studies (Di Berardino, Onesti 2017), a widespread underestimation occurs in the role of manufacturing based on the sectoral approach. This is stronger in manufacturing-oriented countries, such as France, Germany, and Italy, and it tends to increase over time. In countries with a higher level of services, however, the discrepancies are less apparent (in particular in the US and the UK), demonstrating that services tend to be more independent of other sectors in these economies.

Despite this important assessment, a trend toward deindustrialization seems to emerge. The subsystem approach can show a decrease in the share of manufacturing in terms of both hours worked and value added. Although the reduction is more pronounced relative to employment if we consider the evolution of manufacturing at constant prices, the share essentially remains the

FIG. 1. *The evolution of hours worked by sector (1995-2011)*



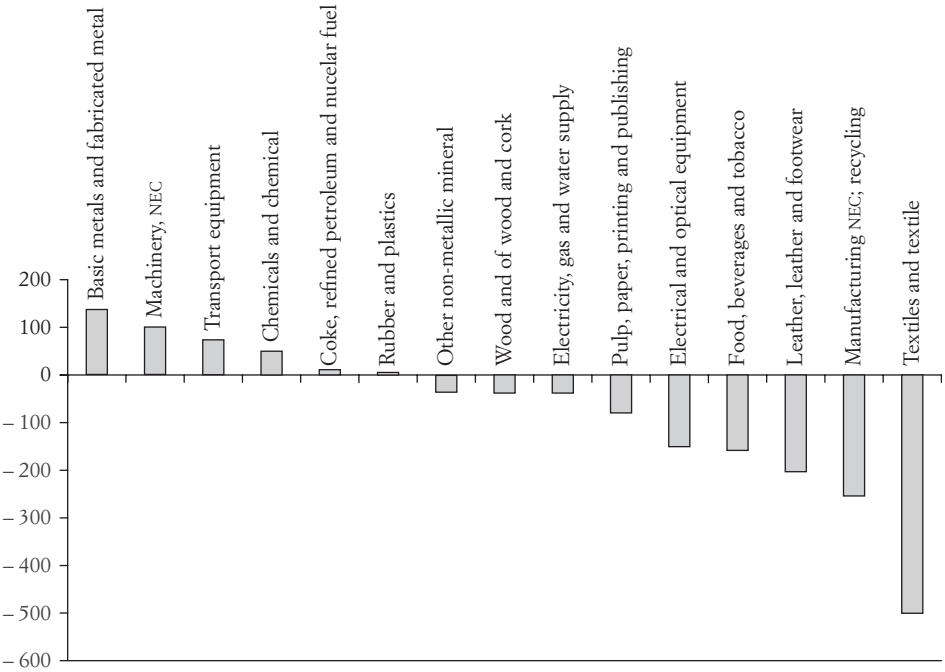
Source: WIOD.

same over the years (from 28.3 to 28.2). If we focus on the underlying structure of production, these measures confirm that deindustrialization is present only when current prices are used. As mentioned in the literature, value added trends are sensitive to relative price changes (Lapova, Szirmai 2015). Therefore, the following analysis is based on hours worked, instead of value added.

Figures 1 and 2 describe performance on a disaggregated level and show great heterogeneity by both sector and subsystem. The data confirm a strong concentration of employment in a few sectors. Conventional employment statistics thus indicate that the hours worked increase in only four sectors: *machinery, food and beverage, basic metals, and coke products.* With reference to other manufacturing branches, by contrast, the traditional and more labor-intensive sectors, such as *leather and textiles*, have a stronger fall in employment (Figure 1). The differences between subsystems are quite clear (Figure 2). As seen in the figure, hours worked in manufacturing increased in five out of 15 blocks during the period, three of which are defined in OECD classifications as medium- to high-tech subsystems [1].

[1] The empirical criterion used in OECD's classification is average R&D intensity at the sectoral level, defined as the ratio of total R&D expenditures to total turnover.

FIG. 2. *The evolution of hours worked by subsystem (1995-2011)*



Source: WIOD.

The results permit us to see that the differences between these measures are substantial and give a picture of the size of manufacturing-related changes in employment. The vertical perspective, thus, reflects the increasing complexity of the economy and reinforces the conditions in some subsystems, stressing that these subsectors use a growing amount of intermediate inputs in their production. The intensity and characteristics of this process vary among the subsystems. In particular, the *transport equipment and chemicals and chemical products* subsystems have dense intersectoral links, which confirms that the evolution of employment highly depends on outsourcing activities. In fact, the increase of 71,000 and 50,000 hours worked in two subsystems corresponds to a decline in employment by conventional measures (85,000 and 8,000 hours worked respectively). The data clearly show that, in these cases, the sectoral approach substantially underestimates because it cannot measure the indirect effects resulting from interindustrial relationships. In order to include these secondary employment effects, in the following paragraphs the linkages between manufacturing and service activities are examined.

4. THE ROLE OF BUSINESS SERVICES IN THE MANUFACTURING SUBSYSTEM

4.1. *Integration of market services*

Many studies have emphasized that the industrial sector has absorbed an increasing amount of goods and services produced by other sectors. So, industrialization generates demand for many types of services and is responsible for part of the expansion in services. Tertiary activities are imbued with knowledge and technology and strengthen intersectoral linkages, complementing rather than replacing manufacturing as a new additional engine of growth (Di Meglio *et al.*, 2015). In these cases, outsourcing seems to reflect a reclassification of economic activity, leading to a partial «statistical illusion» in deindustrialization (Tregenna, 2009).

The literature, indeed, finds the causes of employment growth in the services sector in increasing demand for these activities as intermediate inputs, mostly in manufacturing (Melikhova *et al.*, 2015). In particular, interaction between manufacturing and services has rapidly increased over the past few decades (Falk, Peng 2013; François, Woerz 2008; Pilat, Wölfl 2005). Manufacturing firms attempting to improve their organizational efficiency and to reduce costs through the outsourcing of service activities have played a fundamental role in this shift. This has led to a strengthening and increasing degree of specialization in the services sector, together with a gradual fragmentation of production chains (Lind, 2010; Wolff, 2006). Moreover, the organizational complexity of the economy in turn strengthens the need for services, both as productive inputs (Guerrieri, Meliciani 2005; Peneder *et al.*, 2003) and as ancillary elements in the supply of industrial goods (Bryson, Daniels 2010; François *et al.*, 2015).

This process is observed in a number of studies focused on intersectoral demand for services in developed countries (Kox, 2004). Many authors show that intersectoral interaction tends to be more intense between manufacturing and knowledge-intensive services (Ciriaci, Palma 2016; Lind, 2010; Wolff, 2006). Furthermore, it has been argued that many manufacturing activities are required by the services sector to improve efficiency and innovation through the optimization or the substitution of some employment functions. Studies on technological change have identified the services as the key to capture structural transformations (Ciriaci, Palma 2016; Montresor, Vittucci Marzetti 2011). As clarified, following the subsystem approach, the extent of deindustrialization is measured by the contribution of the services to the evolutionary dynamics of hours worked in manufacturing (Momigliano, Siniscalco 1982).

Table 2 describes the contribution of market services in terms of direct and indirect hours worked that are necessary to satisfy final demand in man-

TAB. 2. *The evolution of hours worked in manufacturing and market services in the manufacturing subsystem (in percentage)*

	1995 = 100	Share of manufacturing in the manufacturing subsystem		1995 = 100	Share of market services in the manufacturing subsystem	
		1995	2011		1995	2011
Food, bever. and tobacco	103	32.9	36.3	120	27.8	35.6
Textiles	66	66.4	60.6	93	25.9	33.4
Leather, leather and footwear	65	57.5	53.1	84	33.8	40.3
Wood and of wood and cork	64	75.4	66.7	102	20.4	28.6
Pulp, paper, printing, publishing	72	58.6	52.0	97	34.2	40.9
Chemicals and chemical	95	49.3	42.8	129	42.2	50.0
Rubber and plastics	91	58.8	52.1	125	34.3	41.7
Oher non-metal. mineral	62	63.9	55.6	89	29.6	37.3
Basic metals, fabricated metal	116	65.9	59.9	154	29.3	35.5
Machinery	96	63.7	57.8	126	31.4	37.8
Electrical and optical equipm.	74	63.2	56.6	102	31.7	38.8
Transport equip.	90	60.5	51.5	134	34.5	43.7
Other manufac. recycling	68	68.5	61.0	98	27.1	34.7
LMT	76	52.7	48.9	103	28.3	35.6
MHT	92	61.4	54.5	127	33.3	40.6

Source: WIOD. LMT = Low tech and Lom-medium tech; MHT = Medium-High tech and High-tech.

ufacturing. The results are quite interesting. The share of services was about 40 per cent on average, with an increase of more than six percentage points over the years. By comparing the results obtained, some significant differences emerge, in particular, for the more technologically advanced subsystems. These aggregates have recorded a share of services almost six percentage points higher than for the low- and medium-low-tech ones. The key position of market services in this process is particularly visible in *the chemicals and chemical products and transport equipment* subsystems, whose contribution to satisfying final demand in manufacturing is as much as 50 per cent and exceeds 40 per cent of total hours worked.

As noted, the subsystem approach gives a clear picture of the actual extent and intensity of deindustrialization. Table 2 presents some interesting results in this respect. The vertical view of manufacturing shows a strong decline in the number of hours worked in manufacturing, above all in labor-intensive subsystems, such as *textiles, leather, wood, and other nonmetal mineral products*, where the reduction was about 30 per cent. Hence, industrial restructuring has been particularly strengthened in the low- and medium-low-tech subsystems. However, the transformation of the production structure has led to an underestimation in the medium-high and high-tech manufacturing capacity to generate employment. The analysis, indeed, confirms that investment in indirect manufacturing, which helps to fuel the linkages within

the production system as a whole, have a greater effect than investment in direct manufacturing. In this context, the trend toward an increase in the supply of services by industrial firms is the hallmark of evolution in the Italian economy. The contribution of market services tends to change with the level of technological intensity in manufacturing subsystems. The analysis demonstrates that the importance of vertical linkages is intrinsically related to the subsystem-specific nature of innovation. The share of direct and indirect uses of market services is always higher for the medium- and high-tech subsystems than for other subsystems. This framework, as already noted, is consistent with more advanced organization of the production structure, with higher levels of outsourcing and greater use of innovative activities.

4.2. *The contribution of business services*

One services branch that has been shown to be of particular interest in many developed countries is business services. These activities are commonly studied as an important driver of innovation in the economy and a potential source of comparative advantage for manufacturing (Pilat, 2007). A definition of business services, often used in literature, is presented by Kox and Rubalcaba (2007; p. 3), as follows: «Business services is a set of service activities that – through their use as intermediate inputs – affect the quality and efficiency of the production activities, by complementing or substituting the in-house service functions». Their increasing integration into production processes means that their strategic importance is considerable, above all, because they can help in improving the performance of client firms throughout the economy. At the same time, the business services sector is a diverse one and the types of services they provide support many different business processes in many types of organizations. On the one hand they can be instrumental in helping companies to lower costs by providing services more cheaply, via economies of scale and specialization; this, after all, has been the basis for much outsourcing. On the other hand, many business services are not only innovative in their own right, but can also serve as important intermediaries and nodes in innovation systems by which they facilitate the transfer of knowledge and technology to clients and support them in their own innovation functions (Baker, 2007; p. 97).

Following Park and Chan (1989), manufacturing develops a symbiotic relationship especially with business services and distributive trade. The demand for distributive services increases less proportionately with the expansion of industrial output because of the economies of scale that can be gained in using these activities. The extent of business services, instead, gradually increases with economic development. Indeed, the stages of advanced

TAB. 3. *Annual growth rate of hours worked destined for intermediate and final use (1995-2011)*

	Intermediate uses	Final uses	Shares intermediate uses in the total hours worked as of 2011
Agriculture	0.6	3.8	49.9
Manufacturing	2.4	3.9	37.1
Construction	4.1	4.1	26.1
Market Services	5.4	5.0	53.5
Business Services	6.5	6.2	79.3
Distributive trade	6.1	5.5	52.7

Source: WIOD.

industrialization involve a proliferation of sophisticated and specialized services. These services have emerged as a crucial node of knowledge creation and knowledge diffusion, promoting greater efficiency above all in manufacturing activities (Ciriaci, Palma 2016; Di Berardino *et al.*, 2018).

As previously explained, the first thing to verify to assess the real extension of the deindustrialization process is which portion of the increase in the hours worked in market services was destined to meet final demand in the economy and which portion its intermediate demand. This second portion, in fact, cannot be entirely ascribed to deindustrialization (Sarra, 2009). The result can easily be achieved by dividing the total hours worked in each branch into two parts, according to the proportion between the total values of intermediate and final use, and then summing the results obtained for all the branches.

As shown in Table 3, for Italy the total increase in hours worked to produce market services between 1995 and 2011 is almost evenly split between intermediate (5.4 per cent) and final use (5.1 per cent), although slightly more of the former. The total hours worked in 2011 are also almost evenly divided (53.5 per cent compared with 46.5 per cent). Closer examination shows, however, that such aggregate evidence averages has quite different trends. The situation in business services is quite different from that in other services. The total increase in hours worked seems to have a more uneven distribution and is much more favorable to intermediate use (79.3 per cent compared with 20.7 per cent). Manufacturing behaves in almost the opposite way. First, the gap clearly favors final use (62.9 per cent compared with 37.1 per cent); second, even the total change in hours worked to produce final goods is directed mainly to meeting final demand (3.9 per cent compared with 2.4 per cent). This picture is just as expected.

The data clearly highlight that business services have become a more important provider of intermediate inputs to the economy.

If we focus on the underlying structure of production and with respect to the integration of each services subdivision in manufacturing, a marked difference emerges between market and nonmarket services (Table 4). Whereas

TAB. 4. *The share of services in the manufacturing subsystem (in per cent)*

	Hours worked	
	1995	2011
Total services	30.8	38.3
Market services	29.0	36.2
Non-market services	1.7	2.1
Distributive trade	15.4	15.2
Business Services	6.3	12.3

Source: WIOD.

the latter is characterized by a lower level (in most cases null) of integration, market services show a high level of integration. In light of this, the activities in the so-called distributive services take on growing importance, particularly business services that include different activities in the economy (renting and other business activities). In these branches, indeed, are both sectors with higher capital intensity, such as the «renting of machinery and equipment», and sectors with higher innovation and labor intensity, such as research and development and other professional consulting.

The results of our analysis indicate that, in Italy, 12.3 per cent of the total manufacturing subsystem comes from business services. By contrast, the dependency ratio between manufacturing and distributive services remained constant, but the gap with business services became much smaller. This may reflect the rapidly growing demand for various types of specialized and sophisticated services as inputs to manufacturing output at advanced stages of production.

One way of structuring the information concerning interindustrial linkages in individual sectors is to identify key sectors – in other words, sectors with production processes that cause strong overall employment effects in the economy (Lind, 2014). As mentioned, the subsystem accounts for direct and indirect effects of all inputs and thus can identify the interconnections respectively through forward and backward linkages (Cheng, Daniels 2014; Di Berardino, Onesti 2017). To synthesize the different types of information from the I-O tables, we define an index as follows:

$$\varepsilon = \frac{\sum_{i=1}^{n} \Gamma_{row}}{\sum_{j=1}^{n} \Gamma_{column}} \tag{2}$$

where the numerator represents the amount of hours worked supplied from sectors to production, derived from the total of the row of each activity i in the Γ matrix; the denominator represents the amount of hours worked demanded by each sector with respect to other activities, derived from the total of the col-

TAB. 5. *The forward linkages and key sectors (1995-2011)*

Key sector	1995	Key sector	2011
Renting of m&eq and other business activities	3.76	Renting of m&eq and other business activities	4.43
Other non-metallic mineral	3.74	Other non-metallic mineral	3.79
Basic metals and fabricated metal	2.82	Basic metals and fabricated metal	2.29
Wood and products of wood and cork	2.59	Wood and products of wood and cork	2.10
Agriculture	2.08	Other Inland transport	1.68
Rubber and plastics	1.86	Agriculture	1.62
Post and telecommunications	1.65	Rubber and plastics	1.52
Retail trade, except of motor vehicles and motorcycles; repair of household goods	1.58	Retail trade, except of motor vehicles and motorcycles; repair of household goods	1.39
Financial intermediation	1.53	Financial intermediation	1.37

Source: WIOD.

umn of each activity *j* in the Γ matrix. In the event that $\varepsilon > 1$, the forward linkages prevail. On the contrary, if $\varepsilon < 1$, the backward linkages are stronger.

Table 5 shows the activities most characterized by intermediate trade flows. As noted, business services have greater «forward» influence because they sell many inputs to the rest of production. Indeed, the ε index is well above one. The forward linkages in the *renting and business activities* are 4.43 in 2011. This means that, that year, an increase in final demand of one hour worked on average generated expansion in total hours worked in these activities of 4.32 hours. This increase is caused by the indirect and direct effects on the intermediate goods used throughout the economy to produce one unit of final demand. Over the period, the forward linkages increased, indicating growth in the overall repercussions for production from an initial change in final demand.

The other *non-metallic mineral and basic metals and fabricated metal* show a similar value, although the coefficients of these manufacturing activities slightly decreased. The trend is quite different in the other tertiary sectors. In particular, *post and telecommunications, retail trade, and financial intermediation* developed forward linkages, but the intensity of these relationships is lower and decreasing over time. Therefore, the forward linkages are larger for business services and indicate the greater demand pressure experienced in this sector.

Below this aggregate, the next step is to measure the direction of trade flows, by distinguishing the main purchasing sectors of the economy. As shown in Table 6, most of the hours worked of business services is consumed by market services (including business services themselves). The results illustrate that manufacturing is a relatively intensive user of these activities. In fact, the manufacturing subsystem generally accounts for a third of the demand for business services, although the intensity of demand decreases over time (from 29.8 per cent to 27.2 per cent). This shows that manufacturing is an important buyer of intermedi-

TAB. 6. *The share of direct and indirect hours worked in business services to satisfy final demand in the total hours worked in business services (in per cent)*

	Hours worked	
	1995	2011
Agriculture	0.5	0.6
Manufacturing	29.8	27.2
Construction	8.3	4.1
Market services	50.7	53.4
Business Services	32.2	25.7
Distributive trade	13.7	14.1

Source: WIOD.

ate business services in production. Second, the forward linkages toward market services gradually increased, suggesting an increase in upstream and downstream linkages in the fragmentation of the provision of service activities.

In sum, there is a strong indication that production processes are becoming dependent on business services intermediate goods. Confirming the characteristics of «producer input», in accordance with the literature on producer services, these findings indicate that business services are essential inputs for most activities and a crucial factor in enhancing the integration of production. Therefore, the contribution of these services is not only taken into account on the basis of its share of total employment but is increasingly important in the dynamics of the economy as a whole. Thus, the process of transition to the services appears to be an advanced stage of economic development, which reflects progressively more intensive use of services by many activities. Finally, the effect of these structural transformations is that the Italian economy has become slightly more vertically integrated, as indicated by a denser network of interindustrial linkages. In particular, it could be argued that the forces of change are pushing for closer interaction between the two main different components of the economy, mainly between manufacturing and business services. The findings, therefore, confirm that the «horizontal» perspective, in which the role of manufacturing is examined, has become an increasingly less-credible indicator of structural change. In accordance with this traditional approach, the intensified indirect effect is excluded, and thus a «vertical» approach can more accurately estimate these interactions and the effects on the creation of value (Montresor, Vittucci Marzetti 2011).

5. CONCLUSIONS

This article investigates structural change in Italy, taking into account the evolution of manufacturing and interindustrial linkages. In particular, the analy-

sis provides new findings about the extent and the principal aspects of deindustrialization. Two major trends characterize the period 1995-2011. The first is that the share of manufacturing in the economy as a whole is decreasing. The second trend is that services, particularly business services, account for an increasing share of the economy. These structural shifts are linked in several ways.

However, the link between the reduction in employment in manufacturing and its growth in services often suggests that these sectors are perfect competitors. In reality, this relationship is much more complex. Growth in integration between manufacturing and services is one of the main characteristics of production in recent decades. In this framework, the traditional sectoral boundaries are becoming more blurred, making it more difficult to determine the real role of each industry in the economy (Pilat, Wölfl 2005). The relationship between manufacturing and services is constantly changing. The evidence presented in most studies on structural change is insufficient for an adequate understanding of these phenomena because they take a sector-based approach. In particular, these analyses do not account for the shifting boundaries between the market and in-house firms' activities (Franke, Kalmbach 2005), and they can lead to over/underestimation of the different relationships between manufacturing and services (Ciriaci, Palma 2016). What emerges from these approaches is that, notwithstanding the relevant results obtained, they suffer from an intrinsic difficulty in measuring the indirect effects of the reorganization of the economy. The traditional analysis is based on a «horizontal» perspective of production, which considers the economic sectors separate from one another.

The present paper allows investigation of the complexity of structural transformation in Italy, adopting an analytical scheme that differs from the traditional framework. According to the «vertical» perspective, the I-O tables of vertically integrated sectors have been transformed, so that the number of hours worked that directly and indirectly satisfy final demand for goods can be estimated. The findings concerning the distribution of hours worked obtained by applying the subsystem approach show large differences in comparison to the sectoral approach. On average, the share of manufacturing rises by about ten percentage points in the economy as a whole when we adopt the subsystem approach. This result clearly underestimates the ability to generate employment in manufacturing.

In particular, this analysis demonstrates that business services play a key role in many manufacturing subsystems. Many links between the development of business services and its role in economic growth have been insufficiently explored in Italy. Growth in business services is a qualitatively new stage in the structure of production. Recent literature illustrates that business services are an important innovation and driver of economic growth, especially in terms of knowledge spillovers with manufacturing (Kox, 2004; Pilat,

2007). This is also shown in econometric analyses indicating the existence of a positive relationship between the role of business services, as intermediate inputs, and improved performance in manufacturing in terms of productivity and value added (Koenen *et al.*, 2014).

The net effect of these opposing tendencies is that since the 1990s, manufacturing has gradually lost employment, but the decline was slower than depicted by the traditional sectoral approach. Therefore, the results demonstrate that the restructuring of manufacturing is strongly linked to the extent of its reliance on business services.

From a policy point of view, the findings highlight the need to take this industrial interdependence into account, especially in the choice of policies to support manufacturing or services. The contraction in manufacturing employment is also a concern for EU policy makers. Some studies question whether the EU can sustain its economy through service-led growth and whether the trend toward deindustrialization can be reversed. As a consequence of the financial crisis in 2007-2008, the debate on the role of manufacturing has become increasingly important in governments' political agenda. The main question is whether developed economies can continue to grow without a solid manufacturing base.

A few suggestions emerge from our results. A sectoral policy, for instance, must take into account the strategic importance of the organization of the economy as a whole in satisfying final demand. Indeed, as suggested by De Backer *et al.* (2015), if they wish to support manufacturing, policy makers need to take a closer look at services. The policy debate, instead, is focused on what distinguishes manufacturing from service activities, whereas it is necessary to avoid overlooking the growing similarity and interdependence between the various sectors, going beyond the traditional definitions of products and statistical classifications. A big push for manufacturing implies more service activities. To do this, it must sustain that resurgence in manufacturing through structural reform in the services (Serafica, 2016).

In this regard, this study confirms that the subsystem approach is a useful and effective tool for delineating intersectoral networks.

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