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MESSAGE FROM AN ITALIAN BOTTLENECK: INTER-INDUSTRY RELATIONSHIPS AND EFFICIENCY SPILLOVER

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Message from an Italian bottleneck: inter-industry relationships and efficiency spillover

Abstract

In 2015, Italian manufacturing grew at rates comparable to German manufacturing, while services performance was three times poorer. This paper investigates to what extent such gaps are also due to: a) differences in the structures of inter-industry relationships, b) the ability to convey the impulse coming from manufacturing, and c) the ability to transmit efficiency across the system. Our perspective is twofold. Firstly, by applying network analysis to WIOD tables, we compare Italian and German business structures and evaluate their different capacity of activation. Secondly, a firm-level estimation of technical efficiency, combined with spatial econometrics, is used to assess the role of the inter-industry relationships in activating efficiency spillovers. Our results show that in Italy relationships between manufacturing and services are less dense than in Germany, so that the capacity of stimulating business services is lower too. Moreover, we find that business services are on average more efficient than manufacturing, and the efficiency mainly flows from the supplier sector to the buyer one. In this context, a serious bottleneck emerges for the Italian economy, which weakens the capacity of business services to grow and has negative feedbacks on the efficiency of manufacturing.

Keywords: WIOD, network analysis, technical efficiency, business service, inter-industry relationships, spatial econometrics

JEL Classification: C10, D24, D57, L60, L80

1. Introduction

In 2015, after three consecutive years of recession, Italian GDP rebounded to +0.8% in volume, but the recovery was characterized by heterogeneous sectoral trends: the value added increased by 1.5% in manufacturing and only 0.5% in services (Istat, 2016). In the same period, German GDP grew by 1.7%, with more homogeneous sectoral trends: value added increased by 2% in manufacturing and 1.5% in services (Bundesramt Statistics, 2016). When comparing the Italian and German dynamics, therefore, a significant gap emerges in the performance of services, which in Germany grew at a three times higher rate.

This difference is an important aspect of the ability to generate value added and growth. Beside other well-known factors – such as the different performance of domestic and foreign demand and other GDP components – that gap involves also the structure of relationships between manufacturing and services and, therefore, the ability to transmit impulses (basically from manufacturing to the rest of the economy) and spread knowledge and efficiency across the economic system. In fact, a structure of relationships such as the Italian one, which mostly relies on trade within manufacturing rather than between manufacturing and business services, results in a lower degree of vertical integration of manufacturing itself (therefore in a lower value added for the same amount of production). This in turn limits the possibility of taking advantage of efficiency spillovers that manufacturing-services relationships may generate (also limiting the ability to generate value added given the factors endowment).

Actually, the "tertiarization" of manufacturing (the trend towards larger supply of services by industrial companies) and networking between manufacturing and services are distinctive traits of the advanced countries in recent decades. This process is also fostered by the emergence of global value-chains and the consequent increase of trade in intermediate goods and services.[1] As a result of such dynamics, the weight of services on the whole economy is now remarkable in all advanced countries (Istat, 2015b): in 2011 (latest year available for international comparisons) services accounted for almost 75% of the overall value added of the Italian economy, while manufacturing represented nearly 20% and business services (which mostly supply the manufacturing process) just 40%. In the same year, tertiary activities and business services accounted for 70 and 35% of the overall German value added, respectively.[2]

As a consequence of the tertiarization process, business services have been playing an increasing role in intermediate consumption of manufacturing firms (about 40% both in Italy and Germany in 2013). More importantly for our purpose, in both countries manufacturing firms buy services mostly in domestic markets (94% and 90% in Italy and Germany, respectively). Furthermore, the weight of business services in the cost structure of manufacturing does not appear closely related to the technological content of the latter (on average it is about 25% in all sectors). In fact, business services are important supplier of high-tech manufacturing, where the complexity of goods and production processes generates demand for services such as R&D and engineering. But there is a significant demand for business services also in low or medium-low technology manufacturing (e.g. food, beverages, textiles

[1] The so-called "trade-in-tasks" (Baldwin and Robert-Nicoud, 2010).
[2] Business services include activities such as marketing, design, cleaning, professionals, and (sometimes) network industries such as transport and logistics, communication. For a detailed description see Kox and Rubalcaba (2007).

and clothing), due to the need of effectively managing complex value-chains or defending firm's competitiveness also through efficient transportation, marketing and after-sales services. Not surprisingly, then, the capacity to activate business services has largely supported the success of the low-tech manufacturing (Ecsip Consortium, 2014).[3]

More in general, economic literature is almost unanimous in acknowledging that a better access to business services and a high efficiency of the latter are valuable drivers of competitiveness of manufacturing across EU (Ecsip Consortium, 2014). At the same time, a large amount of empirical works showed the role of well-developed business services in creating jobs in the EU (Mustilli and Pelkmans, 2012; Bogliacino *et al.*, 2013).

In the long-run, the contribution of services results in a stimulus to productivity, innovation and dissemination of knowledge across the business system. Maroto-Sanchez and Cuadrado-Roura (2009) find that there is a positive correlation between long-run growth of services (in terms of share of total employment) and aggregate productivity in 37 OECD countries over the period 1980-2005. Using input-output tables, Mas-Verdu *et al.* (2011) show that business services are crucial for the creation and dissemination of knowledge in an economic system grace to inter-industry relationships. Ciriaci *et al.* (2015) further develop this line of research using input-output tables and a vertical integration approach to measure the knowledge directly and indirectly transferred from business services to manufacturing. Finally, based on sectoral data, Evangelista *et al.* (2013) show that business services have positive effects on innovation − and via innovation also on value added growth – of manufacturing activities that buy those services.[4]

Adopting an approach and a methodology closer to ours, Foster-McGregor *et al.* (2012) use the World Input-Output Database (WIOD)[5] to assess the presence of technological spillovers between services and manufacturing. They show that services − in particular high-tech activities such as telecommunications and IT − generate considerable increases in productivity of manufacturing via the stimulus provided to the R&D of purchasing firms. However, the WIOD dataset and network analysis have not been used so frequently to analyze these issues, so far. In recent literature, they are mostly used to study the effects of global value-chains (GVC) on the performance of economic systems, especially in advanced countries. In this respect, De Backer and Miroudot (2012) develop a set of network indicators to position the countries within the GVC, by evaluating the extension of networks and the positioning of each economy in an upstream or downstream stage of international trade. Zhu et al. (2015), in turn, further deepen

[3] These dynamics are important also from a policy point of view: all measures aimed at stimulating innovation and R&D directly affect the activity of such type of business services, and indirectly stimulate the production of the manufacturing activities that mainly rely on such services for their business. On the contrary, as far as the supply of services such as security and investigation is concerned, policies meant to stimulate innovation would improve service performance but would hardly boost the productivity of industries that buy those services.

[4] The links between manufacturing and services activities have been also found based on firm-level data. For example, Kox (2004) shows that in the Netherlands the business services, while suffering from a stagnant productivity, nevertheless play a crucial role in innovation and create knowledge spillovers in other sectors. Martinez-Fernandez (2010) highlights the fundamental role of knowledge-based business services in supporting the development of Australia's mining and quarrying industries.

[5] The WIOD database provides integrated information on National Accounts tables (Supply-Use and Input-output tables) about 35 sectors in over forty countries in the world. For details, see Timmer (2012) and Timmer *et al.* (2015).

the comparison of the GVC structures of several countries calculating "indicators of similarity" between the nodes of the different networks, where nodes indicate the industries of various countries. Among the many achievements of the authors, the most relevant for our purposes is that, taking into account the direct and indirect relationships between industries, networks generated by manufacturing tend to be more similar across countries than those generated by services.

Our work builds on this. In studying the relationships between manufacturing and services in Italian business system, we adopt a multi-stage approach and use sector- and firm-level data. In a first step, we use WIOD tables and network analysis to make a comparison of Italian and German production structures. On the one hand, this allows to pinpoint the sectors that, on the basis of the intensity of inter-industry relationships, occupy the central or peripheral positions within the input-output scheme. On the other hand, it is possible to get some insights on the role of the two countries' production structures in determining their economic performance.

In a second stage, we evaluate how the structure of Italian inter-industry relationships affects efficiency spillovers across the economy. More specifically, we use firm-level efficiency indexes estimated on a new micro-database developed by Istat, along with a spatial econometric model to verify the existence of a relationship between technical efficiency and structure of inter-industry transactions. In doing so, for each manufacturing industry, we calculate two efficiency indicators: an "activated efficiency indicator", that measures the amount of efficiency directly and indirectly activated by a specific sector in the overall economic system, and an "acquired efficiency indicator", that measures the amount of efficiency which that sector acquires through the direct purchase of goods and (especially) services.

The rest of the paper is organized as follows. Section 2 uses WIOD tables to compare production structures in Italy and Germany. Section 3 presents the models defining sectors' efficiency and assessing the relationship between efficiency and inter-industry trade. Section 4 analyzes the capacity of activation of Italian manufacturing, and studies to what extent it is able to activate and acquire efficiency through transactions with business services. Section 5 concludes.

2. The role of inter-industry relationships in Italy and Germany: a comparison

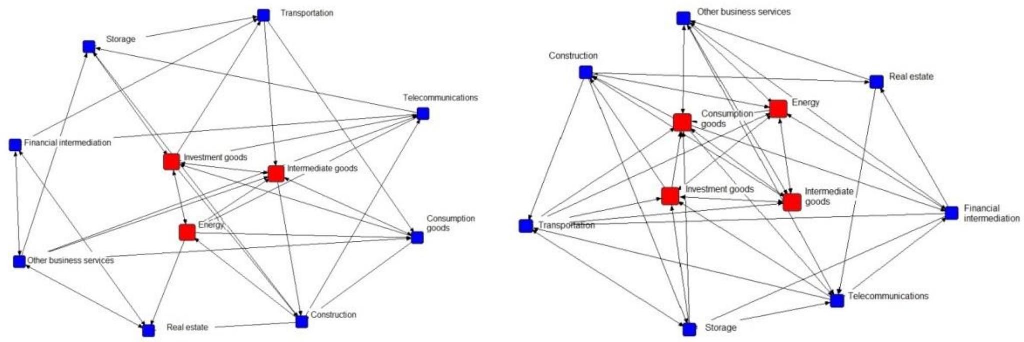
In order to make a comparison between inter-industry relationships in Italy and Germany, we use Network Analysis (NA), a methodological framework that allows to obtain a set of indicators able to identify key features of the interconnections within a network of relationships. In our case, industries are the nodes of the network resulting from input-output table values. Using NA, we can point out some structural characteristics of the two business systems in terms of inter-industry connectivity, and we can position each industry within the transaction network.

On the basis of the information included in the WIOD database,[6] input-output tables (for the domestic market) of Italy and Germany have been transformed so as to focus on relevant inter-

[6] For sake of simplicity, the NA calculations were carried out on a reduced version of the original WIOD database. In particular, manufacturing activities have been grouped into three main sectors (consumer goods, intermediate goods and investment goods), while non-business services (such as education,

industry relationships.[7] A first result is obtained by comparing the values assumed in the two countries by the "indicator of density", which represents the degree of saturation of relationships with respect to the potential relationships. In other terms, the indicator measures the extent to which the possibilities of connection are actually used within the network. For Italy this indicator is 37.3% and 42.7% for Germany. This means that Italian system activates slightly over a third of all possible connections between industries, resulting in a less "dense" system (in terms of inter-industry transactions).

In order to investigate the determinants of this difference and evaluate possible consequences, we exploit the information included in the matrix of relevant inter-industry relationships, so that, for each country, the nodes (sectors) can be classified in central and peripheral (Figure 1).[8]



A: Italy B: Germany

Figure 1: Structure of the network: central (red) and peripheral (blue) nodes.

Both in Italy and Germany, central nodes include only manufacturing industries (investment goods, intermediate goods and energy in Italy; the same, plus consumer goods, in Germany), while business services appear in peripheral nodes.

Moreover, it is possible to determine the density of each of the sub-networks (central and peripheral one), so as to measure the degree of connectivity both within and between them. We find that in Italy the relationships between central nodes of the network have a full degree of density (100%), and are denser than in Germany (where the indicator is 83.3%). In contrast, the density of relationships between center and periphery is much higher in Germany than in Italy (42.9% against 29.2% respectively), as well as the relationships within the peripheral sub-network (45.2% for Germany and 37.5% for Italy).

In other words, in Italian business system, inter-industry relationships appear to mostly rely on the trade within manufacturing. This confirms that in Italy the (direct and indirect) activation of

healthcare, social services, etc.) and trade services have been ruled out from the analysis. Finally, for business services we considered the 2-digits Nace rev. 2 level of disaggregation.

[7] By construction, input-output tables contain non-zero values in all cells. However, in order to take into account only relevant relationships, we firstly normalized the original table (both for line – i.e. output – and column – i.e. input) and then we focused the analysis only on cells with (normalized) values above the average.

[8] The nodes are classified as "central" and "peripheral" according to a clustering algorithm based on correlation. For further details see Borgatti *et al.* (2002, 2012).

services (that appear always in the sub-peripheral network) by manufacturing tends to be far weaker than in Germany.

These results, related to the general characteristics of inter-industry relationships in the two countries, have a local counterpart that can be analyzed by isolating, for each node, the sub-networks (defined *egonetwork*) that it generates through direct or mediated ties.[9] Therefore, for both Italy and Germany, it is possible to study the characteristics of all ego-networks in terms of size (number of nodes involved) and density (number of relevant relationships). Results are reported in Table 1. In this context, the sub-networks defined for German industries appear not only wider but also denser than the Italian ones. The most remarkable differences are observable in intermediate goods and especially in some important areas of business services such as transportation and other business services.

Industry	Italy		Germany	
	Number of nodes	Density of the sub-network	Number of nodes	Density of the sub-network
Consumption goods	6	0.40	9	0.43
Intermediate goods	6	0.33	6	0.47
Investment goods	7	0.40	7	0.48
Energy	6	0.37	7	0.45
Construction	7	0.36	7	0.43
Transportation	5	0.30	8	0.45
Storage	5	0.30	6	0.40
Telecommunications	6	0.33	7	0.38
Financial intermediation	4	0.33	7	0.40
Real estate	4	0.25	4	0.42
Other business services	6	0.20	6	0.37

Table 1: *Ego-network* by industry (a)
(a) The index ranges from 0 = null density to 1 = max density

German economy is thus more "connected" than the Italian one, whether we take into account the whole set of relevant relationships or we focus on the sub-networks generated by single industries. This is particularly clear in the relationship between manufacturing and business services, with the capacity of the latter to activate networks of relationships characterized by higher degrees of connection and saturation.

Considering the original matrix of inter-industry interdependencies (which includes the whole set of inter-industry trade) it is also possible to position each industry within the overall system of relationships. In particular, taking into joint consideration the inward and outward trade, a "centrality index"[10] can be defined for each industry, which measures the degree of connection that characterizes a specific industry within the transaction system (Figure 2).

[9] More in detail, ego-networks are sub-networks including a "focal node" (in our case the industry in question), the nodes to which it is directly connected (denominated "alters") and the ties (if there are any) that connect the alters.

[10] In this case, relationships are defined on the basis of the existence of an economic exchange between sectors, regardless of their relevance. The degree of centrality reported in Figure 2 is determined applying the methodology of eigenvectors, while the one reported in Table 2 is determined using the Freeman's methodology. For details on both methodologies, see Borgatti *et al.* (2002, 2012).

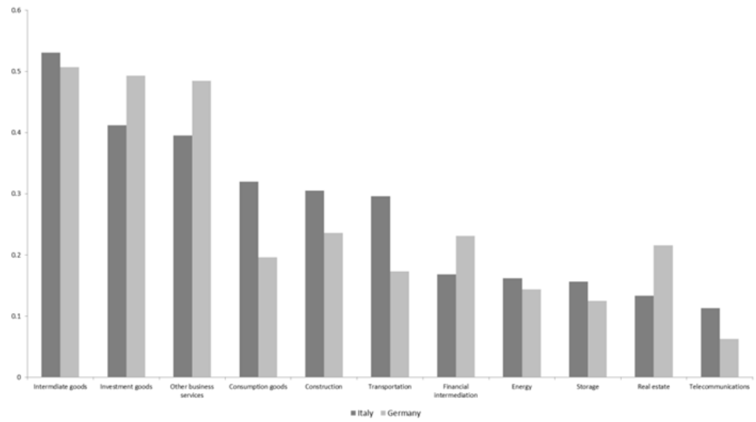


Figure 2: Centrality index (a)
(a) The index ranges from 0 = null centrality to 1 = max centrality

Firstly, this indicator confirms that for both countries, manufacturing includes the activities characterized by a higher level of connectivity. In addition, consistently with previous works on the manufacturing-services relationships (e.g. Istat, 2015a), transportation appears to have a higher degree of centrality in Italy than in Germany, while the opposite occurs in some of the most important tertiary activities, such as other business services, financial intermediation and real estate.

Finally, the overall centrality index can be split up into an “index of inward centrality” and an “index of outward centrality”, according to whether the given relationship concerns inflows (purchases) or outflows (sales) of resources from a specific industry. In this way also the activation capacity of different industries can be obtained. Results are shown in Table 2. It can be noted that, with the exception of capital goods, in both countries manufacturing has a higher degree of inward centrality (consistently with the greater ability of these industries to activate resources across the system).

Industry	Italy				Germany			
	Outward Centrality (Share on the whole outward transactions)	Inward Centrality (Share on the whole inward transactions)	Weight in terms of turn-over (Percentage)	Inward/Outward	Outward Centrality (Share on the whole outward transactions)	Inward Centrality (Share on the whole inward transactions)	Weight in terms of turn-over (Percentage)	Inward/Outward
Consumption goods	0.06	0.16	10.2	2.92	0.03	0.09	6.3	2.91
Intermediate goods	0.23	0.14	12.0	0.64	0.18	0.17	12.9	0.93
Investment goods	0.05	0.18	8.1	3.70	0.05	0.25	17.2	4.61
Energy	0.07	0.02	2.9	0.25	0.05	0.03	2.7	0.63
Construction	0.05	0.13	6.2	2.71	0.04	0.11	4.9	2.45
Transportation	0.11	0.09	4.3	0.87	0.06	0.08	2.8	1.18
Storage	0.05	0.06	1.9	1.05	0.07	0.04	2.2	0.65
Telecommunications	0.04	0.04	1.7	0.92	0.02	0.02	1.7	1.25
Financial intermediation	0.08	0.04	4.4	0.57	0.07	0.08	5.0	1.05
Real estate	0.06	0.03	7.3	0.55	0.09	0.07	7.1	0.70
Other business services	0.20	0.10	8.4	0.50	0.31	0.05	10.1	0.17

Table 2: Degree of inward and outward centrality

Moreover, in the German case the index of inward centrality is higher. This, in the light of the increased tendency of business services to develop its centrality outward, confirms that German manufacturing has a higher capacity of activating services with respect to Italian manufacturing.

More in general, the analysis carried out so far shows that Italian business system is characterized by a dense connection structure within manufacturing industries and a dense structure of outward relationships from manufacturing to services. In fact, manufacturing and (some) business services show a network of highly connected relationships, with a very significant volume of trade (as it clearly appears by comparing the connectivity results obtained using the original input-output table and the one including only the relevant relationships). By contrast, in Germany, the structure of inter-industry relationships shows greater connectivity between manufacturing and business services (especially from the latter to the former), and relationships characterized by larger trade volumes.

3. Inter-industry relationships and technical efficiency

The low degree of interaction between manufacturing and business services represents one of the main causes of the weak expansive effects of manufacturing growth in Italy. In this section, we aim to explore whether, and possibly to what extent, the lower inter-industry connection between business services and manufacturing influences the performance of the latter in terms of productive efficiency.[11]

If the structure of inter-industry trade originated efficiency spillovers, a lower intensity of relationships would have two important consequences: firstly, it would cause a reduction in the capability of manufacturing to acquire, through inter-industry trade, the efficiency incorporated in business services; secondly, it would limit the incentive to improve the efficiency of business services and, therefore, it would reduce the capability (of manufacturing, in this case) to spread productive efficiency across the whole economic system.

The link between technical efficiency and inter-industry relationships can be assessed adopting a two-step approach, in which, firstly, the efficiency of each sector is measured and, secondly, the relationship between efficiency and inter-industry trade is estimated.

3.1 Technical efficiency of sectors

Technical efficiency represents the capability of a firm to optimally use its factors endowment in order to generate value added. In this work, efficiency is measured applying a stochastic frontier model which estimates the level of value added a firm is able to generate given its factors endowment (Aigner, Lovell and Schmidt, 1977; Meeusen and Van den Broeck, 1977).[12]

Estimates are based on the innovative database "Frame-Sbs" recently developed by Istat, which, since 2011, contains information about structural characteristics and main economic performance of the universe of 4,4 million of Italian firms.[13] In order to sterilize the analysis

[11] In this work, "efficiency", "technical efficiency" and "productive efficiency" are used as synonyms.

[12] The estimate of technical efficiency has been obtained on the basis of a standard Cobb-Douglas production function, using value added as dependent variable and the input of labour and the value of capital depreciation (as a proxy of the input of capital) as independent variables. Error decomposition has been estimated following the Battese and Coelli's model (Coelli, Rao and Battese, 1998; Kumbhakar and Lovell, 2000).

[13] For the sake of consistency between the nature of the data and the estimation model, we imposed some restriction on the dataset reducing the number of observation to 2,2 million. In particular, we took into

from technological and dimensional effects, for each firm technical efficiency is estimated based on a model defined at the level of industry and dimension.[14] Results are shown in Figure 3.

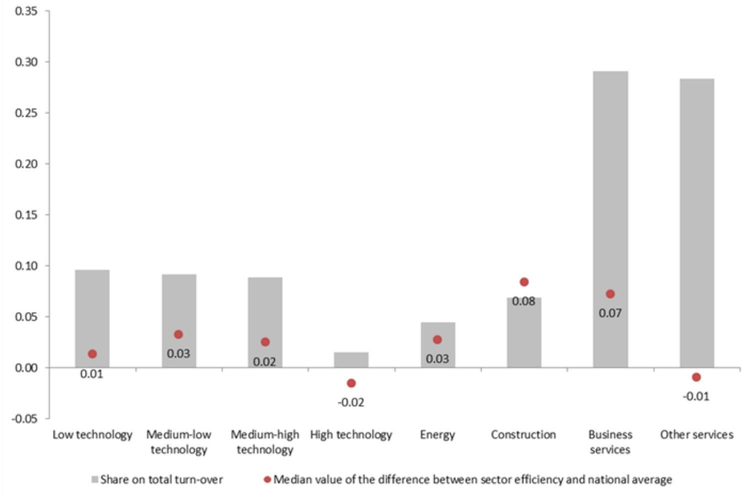


Figure 3: Efficiency indicator and weight in terms of production for each macro-sector of economic activity

The efficiency indicator is given, for each macro-sector,[15] by the median value of the distance between the individual firms' efficiency in the given domain (industry and size) and the average efficiency of the economic system as a whole. Estimates confirm that business services tend to have a higher level of efficiency with respect to manufacturing: they show a positive differential of 0.07 points with respect to national average, while manufacturing shows a lower level of efficiency, especially in high-technology (-0.02 points).

3.2 Inter-sectorial relationships and efficiency spillover

Given the efficiency gap between business services and manufacturing, relationships between these two macro-sectors – and particularly purchases of services by manufacturing – could act as a stimulus to activate efficiency across the business system and as a vehicle for manufacturing to acquire additional efficiency.

To investigate whether, and to what extent, inter-industry relationships may be interpreted as an infrastructure for efficiency transmission, we use a Spatial Auto-Regressive (SAR) model (Anselin, 1988; Cliff and Ord, 1981), having the following formulation:

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account firms having the following features: (1) turnover higher than 30.000 euros; (2) positive capital depreciation; (3) positive value added. The first condition is aimed to capture the economic relevance of the productive unit, while the others are due to the need of using logarithmic transformation of variables.

[14] We take into account 64 branch of economic activity (following the National Account classification) and four firms' size classes (1-9, 10-49, 50-249 and over 250 persons employed).

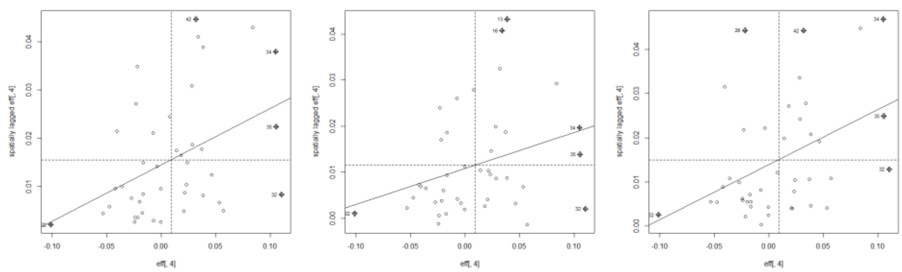
[15] Following the Eurostat-Oecd classification, manufacturing sectors are defined in terms of the technological contents of their production, obtaining four classes: "low-technology", "medium-low technology", "medium-high technology", and "high-technology" industries.

$$y = \alpha + \rho \boldsymbol{W} y + \beta x + \varepsilon$$

SAR model allows to estimate the existence and magnitude of spatial auto-correlation of a phenomenon with respect to a given structure of distances among the units on which the phenomenon is observed. In this case, for each industry, the dependent variable is represented by the efficiency indicator, while suitable transformations of input-output table are used as weighting matrices. Finally, capital and labor intensities (respectively defined as capital depreciation/value added and labour cost/value added ratios) are used as controls.

Particularly, we take into account three weighting matrices. The first represents a measure of trade intensity among industries, independently from the directionality of transactions: the magnitude of each relationship is obtained by summing up the values of (inward and outward) exchanges. The other two matrices trade intensity taking into account the directionality: for each relationship, intensity is determined based on the value of the inward/outward exchanges.

The existence of spatial auto-correlation between efficiency and the structure of distances can be preliminarily investigated by the Moran test (Figure 4).



A: Un-directional B: Inward C: Outward

Figure 4: Moran test

Results show the existence of a direct link between inter-industry relationships and efficiency (frame A), particularly in case of outward transactions (frame C), while no link is found in case of inward transactions (frame B).

Maximum likelihood estimate of SAR model (Table 3) confirms the presence of a positive (and relevant) relationship between efficiency and the structure of distances for both the un-directional (A) and outward (C) transactions: parameters indicating auto-correlation have relevant and positive values when trade intensity is taken into account from the point of view of the buyer (and not in the symmetrical case of the supplier). In all cases, the model is well specified (Wald > LR > LM) and results are not affected by heteroscedasticity.

Dependent variable	*Technical efficiency*		Dependent variable	*Technical efficiency*		Dependent variable	*Technical efficiency*	
Weighting matrix	*Un-directional exchanges*		Weighting matrix	*Outward exchanges*		Weighting matrix	*Inward exchanges*	
Estimation method	*Maximum likelihood*		Estimation method	*Maximum likelihood*		Estimation method	*Maximum likelihood*	
	Value	P-Value		Value	P-Value		Value	P-Value
Intercept	0.012	0.071	Intercept	0.017	0.017	Intercept	0.012	0.069
Rho	0.637	0.062	Rho	0.511	0.179	Rho	0.637	0.058
Capital intensity	-0.394	0.003	Capital intensity	-0.408	0.003	Capital intensity	-0.388	0.004
Labour intensity	-0.163	0.243	Labour intensity	-0.178	0.214	Labour intensity	-0.165	0.238
LR test	3.474		LR test	1.800		LR test	3.596	
LM test	0.765		LM test	0.160		LM test	1.282	
Wald test	7.106		Wald test	3.022		Wald test	6.973	
BP test	0.586		BP test	0.545		BP test	0.587	

Table 3: SAR model estimates

SAR estimate thus confirms the existence of an overall clustering effect with respect to the combination between level of efficiency and intensity of inter-industry trade. In other words, the analysis suggests that trade between manufacturing and business services can actually represent an infrastructure allowing efficiency transmission, where the spillover tends to act asymmetrically, from suppliers to buyers rather than in the opposite direction.

4. Activation and acquisition of efficiency through inter-sectorial relationships

In the introduction we pointed out that, as compared with Germany, the Italian economy suffers from a lower capability of manufacturing to generate value added and a weaker dynamics of business services. Our analyses allow us to underline that both issues can be explained, at least to some extent, by the low transactional connection between manufacturing and business services prevailing in Italy.

The weakness of inter-industry relationships has both direct and indirect consequences on the performance of an economic system. A direct implication is represented by a reduction in the activation effect of manufacturing demand on business services. The indirect implication is a reduction in efficiency transmission due to the low connection between manufacturing (as a buyer sector) and business services (as a supplier sector). In the end, this implies a lower capability to stimulate efficiency gains within the productive system and a lower acquisition of efficiency by manufacturing.

In order to deepen both direct and indirect implications, we use the Italian input-output table referred to 2013 to carry out an impact analysis of an increase in manufacturing production, measuring the impact on both the whole economic system and business services. In doing so, on one hand, we show to what extent the dynamics of manufacturing generates an activation of production and efficiency in the economic system; on the other hand, we analyze to what extent the transactions implied in the transmission of this impulse allow manufacturing to acquire efficiency from business services.

4.1 Activation of production and efficiency

Based on 2013 input-output table, a hypothetical increment by 10% of the final demand for manufacturing goods would generate a growth of the internal production equal to 3.2%. This growth would be concentrated in manufacturing (7.2%), while business services would experience a lower dynamics (1.7%). About 70% of the whole increment would be generated by the growth of low and medium-low technology manufacturing, while less than 5% would originate from the dynamics of high technology manufacturing.

By analyzing the activation of both production and efficiency coming from an increase in manufacturing production,[16] we show how the capability of manufacturing to activate efficiency is characterized by a high level of heterogeneity (Figure 5). Particularly, the highest level of efficiency is activated by medium-low technology industries. The activation of medium-high technology manufacturing does not involve industries with a degree of efficiency higher than manufacturing average. Finally, low and high technology manufacturing activate a production characterized by a lower-than-average level of efficiency.

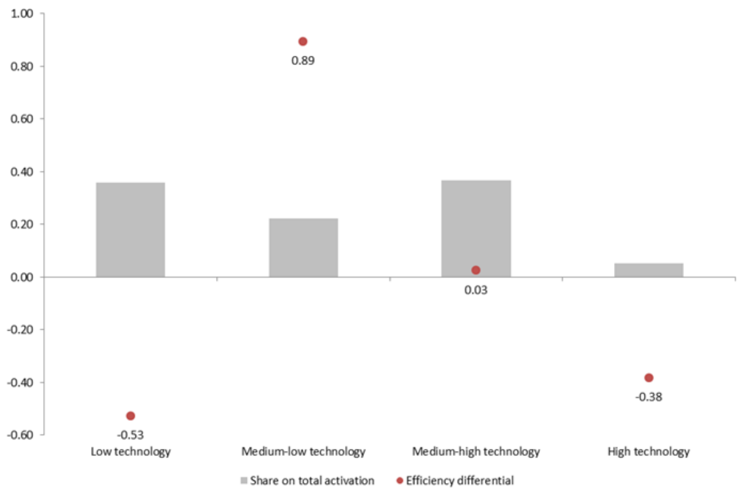


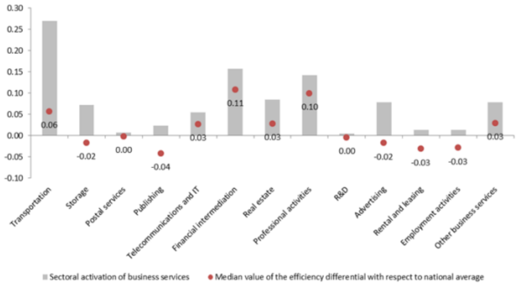
Figure 5: Share of activation and efficiency differential in activated production with respect to the general value of manufacturing for each activating macro-sector

Thus, the Italian economic system seems to be characterized by a mismatch between activation of production and activation of efficiency: sectors activating a higher amount of production tend to activate a lower level of efficiency. In this context, it is worth to stress the results of high technology manufacturing, which have a low level of activation both in production and efficiency.

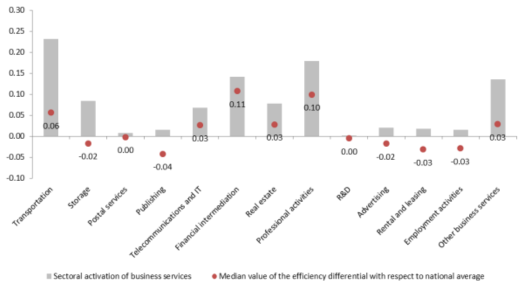
Taking into account relationships between manufacturing and business services, we find that the share of the latter on the whole activated production is 15.1%, without large differences among the activating manufacturing macro-sectors.

[16] The indicator is defined as the average of the level of efficiency by industry (64 branches of economic activity) weighted by the share of each sector on the whole production activated by manufacturing. The level of efficiency is calculated, for each sector, as the average of the efficiency of each firm, weighted by the share of turn-over on the relative sector.

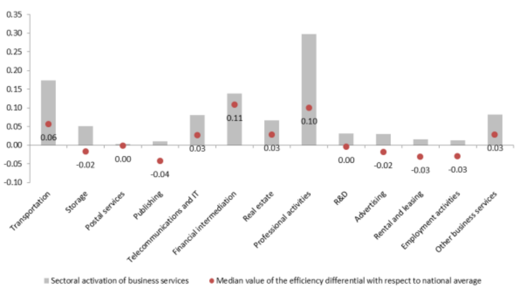
However, this evidence encompasses a somewhat heterogeneous sectoral composition, which can be understood by analyzing the level of direct activation of each activating macro-sector. Results are shown in Figure 6.



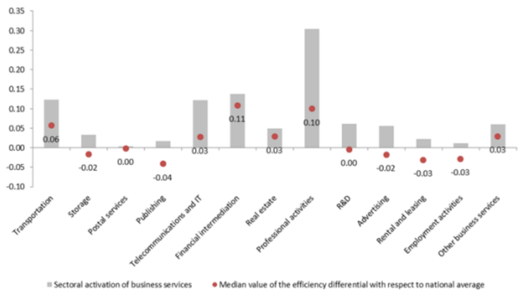
A: Low technology



B: Medium-low technology



C: Medium-high technology



D: High technology

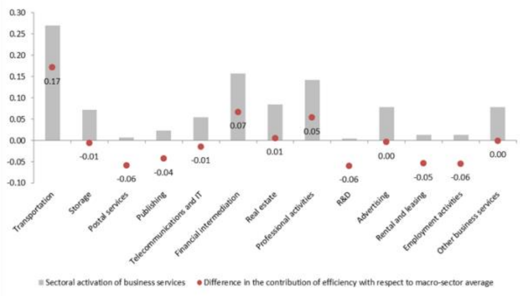
Figure 6: Sectorial share of direct activation of business services
in response to an increment by 10% of the final demand of manufacturing goods.
Median of the efficiency differential with respect to national average

Direct activation of professional activities (which have a higher level of efficiency) is mainly related to the dynamics of medium-high and high technology manufacturing, and tends to decrease as technological intensity of manufacturing production decreases. Conversely, transportation and storage, also characterized by a high level of efficiency, are mainly stimulated by low technology industries, and the activation tends to decrease as the technological intensity increases. Furthermore, high technology services, such as telecommunications and R&D, show an increasing relevance as the technological content tends to raise.

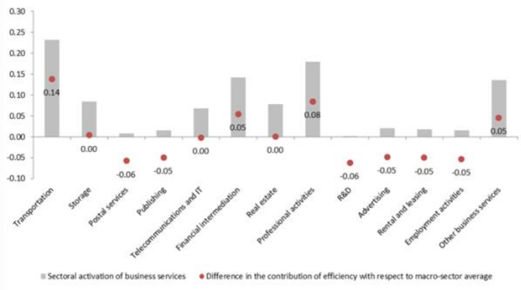
4.2 The acquisition of efficiency

The activation of production and efficiency stressed above has some relevant implications in terms of the content of efficiency that can be acquired through trade relationships. Indeed, by combining the level of efficiency of activated industries with their relevance in the cost structure of the activating sectors, we are able to define, for each manufacturing macro-sector, an “acquired efficiency indicator”, which measures the amount of efficiency obtained from trade with business services.[17]

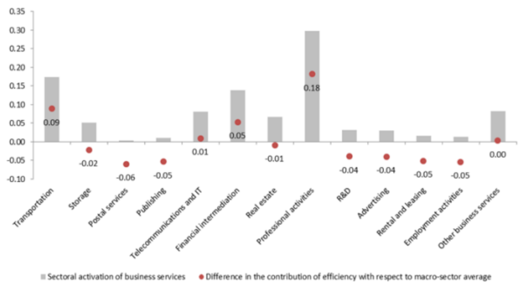
In general, the efficiency acquired through transactions tends to be negatively correlated to the technological intensity of the activating manufacturing macro-sector. Particularly, the indicator shows the lowest value for the efficiency activated by high technology industries. This aggregated result is generated by the sectoral composition of the activation for each manufacturing macro-sector (Figure 7).



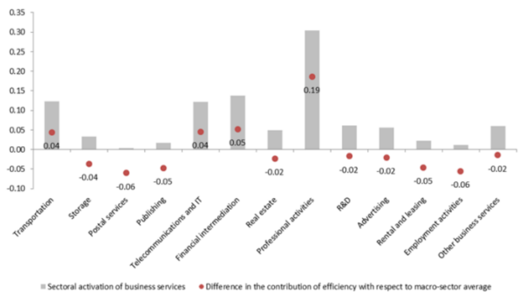
A: Low technology



B: Medium-low technology



C: Medium-high technology



D: High technology

Figure 7: Sectorial composition of the direct activation of business services
in response to an increment by 10% of the final demand of manufacturing goods.
Differential of the activated efficiency with respect to the macro-sector average

In this case, the contribution in terms of efficiency is defined based on the differential with respect to the average of the activating macro-sector. In other words, positive values indicate a higher-than-average contribution of the given industry in determining the final level of acquired efficiency, while negative values indicate a lower-than-average contribution.

[17] The “acquired efficiency indicator” is calculated according a two-step procedure: (1) the efficiency of a given sector is defined as the average of individual efficiency, weighted by the share of turn-over of each firm on the whole production of that sector; (2) the final value of the indicator is obtained as the average of the efficiency for each business service sector, weighted by the share of each sector on the whole amount of national purchase of each manufacturing macro-sector. In principle, this approach only allows us to capture the efficiency that is directly acquired by the activating sector, thus excluding the share of efficiency due to indirect activation effects. However, taking into account the main characteristics of the Italian inter-sectorial network, the direct link between manufacturing and business services accounts for virtually the whole content of efficiency transmitted through the transactions, making negligible the relevance of indirect effects.

This interpretation allows us to show that the variation in the sectoral composition with respect to technological intensity of manufacturing tends to generate a reduction in the level of acquired efficiency: the loss connected with the decreasing contribution of activities such as transportation is not offset by the efficiency generated by knowledge-intensive business services (such as telecommunication and R&D) once these increase their relevance in the structure of activating sector.

5. Conclusions

The phase of weak recovery observed in Italy in 2015 was characterized by a significant growth in manufacturing and a weak performance of (business) services. In the same period, in Germany both sectors had a good performance, and services growth was three times higher than in Italy. This paper investigates to what extent, by what mechanisms, and with what implications, such differences in the dynamics of both sectors are also due to the trade links between manufacturing and services.

In particular, we adopted a twofold perspective. Firstly, using social network analysis, we carried out a comparison between the structure of inter-industry relationships in Italy and Germany. Results show that trade between manufacturing and services in Italy is less intense than in Germany, while there is a higher incidence of transactions within manufacturing.

Such a framework of inter-industry relationships results in a lower degree of vertical integration in Italian manufacturing (and therefore in a lesser amount of value added for a given level of output) and a lower activation capacity of services by manufacturing. This, in turn, partly explains the weak growth of services in Italy.

Moreover, when combined with the higher efficiency of business services with respect to manufacturing, the low connection between manufacturing and services could end up limiting possible efficiency spillovers, thus originating negative feedbacks on the capacity of manufacturing to generate value added. In order to investigate the existence of such phenomena, a three-stage analysis has been carried out. Firstly, using a stochastic frontier model, we defined a technical efficiency indicator, which confirmed that business services have higher levels of efficiency compared to manufacturing. Secondly, using spatial econometrics and input-output tables, we verified that inter-industry trade may actually represent a vehicle of transmission for technical efficiency, and efficiency spillovers flow from suppliers to buyers. Finally, combining these latter results with our impact analysis based on the input-output tables, we measured the transmission effects of the efficiency included in inter-industry trade. In particular, using specific indicators, we were able to measure efficiency activated and acquired by manufacturing via transactional relationships.

On the one hand, it follows that manufacturing industries characterized by a higher activation capacity tend to stimulate relatively inefficient activities, thus reducing the positive effect on the production system as a whole. On the other hand, through the interactions with business services, manufacturing tends to acquire decreasing levels of efficiency as the technological content of activating industries increases.

These results confirm that in Italy the governance of production processes originates a generally unfavorable mismatch between activating and activated industries. The mismatch both tends to hamper the growth potential of business services and, as a feedback effect, to negatively influence the ability of manufacturing to efficiently generate value added.

In this context, the current governance strategy of production processes prevailing in Italy, characterized by a greater de-integration of inter-manufacturing transactions and insourcing of specific business services (or a limited use of these latter in production processes), moves exactly in the opposite direction with respect to what would be desirable for an economy like ours to thrive. With an "optimal" structure of inter-industry trade, in fact, manufacturing firms could improve their performance by integrating productive processes (insourcing manufacturing phases) and de-integrating services. Such a governance process would have a positive impact not only on manufacturing, fostering an increase in value added generation capacity (via greater integration of industrial processes and efficiency spillover), but also on the overall economic system (via the wider involvement of business services in manufacturing production processes).

Finally, our results emphasize that in the Italian business system there still persist relevant "pockets of inefficiency" in some strategic areas of business services, which adversely affect the performance of high-technology manufacturing. This could give rise to a bottleneck for the performance and development of these industries, stimulating the integration of those services in firms' production processes and, consequently, reducing even more the degree of connection between manufacturing and services.

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