COMPLEMENTARITY BETWEEN MANUFACTURING AND INTRA- AND INTER-FIRM MODERN SERVICES

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ABSTRACT

This paper discusses the current relationship between manufacturing and modern services in the process of economic development. We argue that the development of both sectors is a complementary process. The growth of modern services relies on demand generated by other sectors, in particular, high-tech industries. At the same time, a significant portion of the technological content of services is developed within manufacturing.

We introduce a new method of identifying the value added by service inputs in all sectors to calculate the effective share of modern services in the output of goods and services. This approach considers not only modern services embodied as inputs, but also modern services used for the production of these inputs. Drawing on this analysis, we seek to determine whether high-tech sectors demand more modern services than primary sectors and low-tech industries. The results for Brazil and Italy corroborate the following hypothesis: high-tech manufacturing is included among the heaviest users of modern services. Hence, there is complementarity between the growth of modern services and that of high-tech manufacturing.

Keywords: knowledge-intensive business services, manufacturing, input-output matrices, innovation, structural change.

JEL: C67, L84, L60, O14

INTRODUCTION

This paper discusses the relationship between the manufacturing and modern service sectors — also called knowledge-intensive business services (KIBS) — in the process of economic development. Many authors argue — based on Engel's Law — that higher levels of per capita income are associated with a larger share of services in GDP. Others argue that the reallocation of industrial production to Asian countries expands the share of services in GDP in other regions and that this is especially true of modern services, a sector in which the education level of workers is high. However, if we examine the data on the recent evolution of the geographical distribution of sectors and services, we observe that this change in the allocation of industrial production has been accompanied by a change in the service activities in the same regions, as these activities are intrinsically linked to manufacturing production.

In this study, we seek to reinforce the argument that the development of both sectors is complementary. KIBS are relevant as intermediate goods in the production of manufactured goods. At the same time, part of the technological content embodied in KIBS is developed in the manufacturing sector.

We adopt a new method to identify modern services and estimate their value added in all sectors in order to calculate their effective share in the final production of goods and services in the economy. The analysis considers not only modern services purchased directly from other sectors in the form of inputs to produce a specific good or service, but also modern services developed: a) to produce inputs not classified as modern services (which are used to produce that specific good or service) and, b) in the sector that produces the specific good or service itself. Additionally, we examine whether high-tech sectors require modern services

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in greater quantities than primary goods and low-tech manufactured goods sectors. This study is a relevant contribution because the theoretical discussion of this issue is broadening, and specific data that would inform this debate are lacking.

To estimate the value added of modern services in a specific sector, we assumed that total salaries paid to employees in KIBS-related occupations can be considered a substitute for expenditures on services from specialized firms. We then aggregated salaries within a given sector and the value of intermediate consumption of modern services in the production of final goods within that sector by means of an Input-Output framework, yielding the share of KIBS in the final output of each sector. We replicate this estimation for each sector.

The results reinforce the importance of manufacturing (especially high-tech manufacturing) as a driver of growth, as there is strong complementarity between the two sectors. High-tech manufacturing sectors demand more modern services, with special emphasis on technology-oriented modern services (T-KIBS).

This article is organized as follows. First, the theoretical framework of the relationship between manufacturing and modern services sectors in the economic development process and in the production processes of companies is discussed. Then, the methodology used to calculate the share of intra- and inter-firm modern services in the gross output of the various sectors is explained. Calculations based on this methodology are then performed. Finally, conclusions are drawn.

1. THEORETICAL FRAMEWORK

1.1. Relationship between manufacturing and services in the economic development process

Various arguments help explain the growth in the share of services in income that has been observed since the 1970s in several economies. The first argument is based on Engel's Law: the growth of per capita income in the early and intermediate stages of development raises the demand for manufactured goods, but as economies become richer, the share of services in the composition of demand increases proportionately more.

To this argument, Rowthorn and Ramaswamy (1999) add that productivity growth is faster in manufacturing than in services (i.e., of intersectoral productivity).[4] Such growth result from — among other factors — Verdoorn's Law, competition from producers with lower factor costs, and a decline in investment rates in richer countries, which entails both an immediate reduction in demand for manufactured goods — as capital goods are included in this category — and a reflexive reduction in the demand for other goods as a result of this initial change. The authors determined that this redirection of the production structure toward services (called "natural" deindustrialization when derived from changes in the composition of demand) occurred within the group of countries studied in their work when per capita income reached between US $8,300 and $11,000 (depending on the methodology adopted in the econometric tests) in 1996 constant dollars adjusted for purchasing power parity.

An additional factor seen to explain the reduction in the share of manufacturing and the increase in the share of services in the value added of rich countries is the displacement of production from these countries to Asian countries. There would thus be a geographical reorientation in the composition of the world production structure whereby the relative importance of services in the production structures of countries in more developed regions, such as Europe and North America, would increase. Cheaper labor, macroeconomic and industrial policies, and investment in education would have favored this movement toward Asian countries. Data computed by Marconi (2015) demonstrate that such a shift in manufacturing production occurred; however, this change was accompanied by a redirection of service activities to regions in which the share of manufacturing production rose, with the exception of Latin America, which appears

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[4] This stimulates, on the one hand, greater relative growth of employment in the services and, on the other hand, greater demand for manufactured products due to the reduction in their relative prices.

to have regressed in its production structure. Therefore, there would not necessarily be an antagonism between the evolution of the manufacturing and services sectors resulting from the replacement of one by the other; instead, the geographic shift of production to Asian countries, or a geographic shift to other countries with lower per capita income, occurred in both sectors.

The outsourcing to service providers of some activities previously performed directly by manufacturing firms also helps explain the increased share of services in the production structure (Evangelista et al., 2014; McKinsey and Company, 2012). This movement implies a transfer — to companies in the services sector — of a portion of the activities previously performed in manufacturing, generally not strategic and with lower value added. On the other hand, activities associated with and complementary to manufacturing — which add significant value to gross output — were also performed in the services sector. Examples include design, marketing, software, and logistics (Evangelista et al., 2014; McKinsey and Company, 2012; Lodefalk, 2010; Nordås and Kim, 2013). This is the so-called servitization of manufacturing, which signifies increasing value added in the manufacturing sector relative to the services sector, with manufacturing firms now buying and producing more services than in the past and selling and exporting more services (National Board of Trade, 2010). Innovations in communications and transportation have contributed to this process.

There is a clear distinction between various types of services: outsourced services are associated with reduced productivity, while those related to servitization embody greater technological content and are more sophisticated; they therefore demand more skilled labor and generate larger value added per capita. This distinction is fundamental to evaluating the impact of the change in the production structure toward services in relation to economic development.

Thus, would the modern services sector be in a position to replace manufacturing as a driver of growth? Marconi, Magacho, and Rocha (2014) show that, at least for a small sample of countries, including the so-called BRICs, these sectors do not have relevant backward linkages — only forward linkages and only in two of the countries analyzed. Thus, their production depends heavily on demand from other sectors. They are relevant as intermediate goods in the production process. Given the servitization process that various economies have undergone, it is possible that a significant share of their production depends on demand from the manufacturing sector.

Although the share of services in the production structures of many countries has increased in recent years, the above discussion points to evidence that lower growth of manufacturing production would entail a similar movement in the services sector. Additionally, a portion of the technological content embodied in the services that generate higher value added arises from the use of sophisticated machinery and equipment, which are usually developed in the manufacturing sector. Reinforcing the results found for various global regions, Marconi (2015) shows — based on data from 31 countries[5] — that the regions with the highest growth in per capita income between the 2000–2002 and 2010–2012 periods had an increasing combined share of manufacturing and modern services in value added[6]. Therefore, evaluating in detail the potential capacity of the modern service sector to leverage growth together with manufacturing is an important line of research.

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[5] The data for the services sector were sufficiently disaggregated only for these 31 countries in UNData (United Nations Database) at the time of the research.

[6] Modern and traditional services must be defined based on differentiation between their technological content, productivity, and value added. Within the national accounting framework, we can establish that modern services are those that relate to financial intermediation and insurance, information and communications, and professional, scientific, and technical activities, while traditional services are those related to commerce and maintenance, food, tourism, real estate, transport and storage, public administration, education, health, administrative support, and social and personal services. This division has generated some controversy (e.g., a part of transport services — such as air — is modern, and services associated with public administration, education, health, and social services can be grouped separately under 'public services', whose supply follows a logic distinct from that of the private sector and mixes modern and traditional activities) but is quite usual — it accords, for example, with that established by Eichengreen and Gupta (2012) and Ghani, Goswami, and Kharas (2011).

1.2. The relationship between services and manufacturing in the production processes

As defined by Arbache (2015), services are associated with manufacturing production in two ways: through their impact on production costs (i.e., in improving the production process itself through logistics, transportation, IT, and communications) and through the impact of their value added on products through differentiation and technological improvement — in this case, research and development, design, engineering and architecture, consulting, marketing, and more sophisticated IT services are important.

Guerrieri and Meliciani (2005) showed that, based on data from input-output matrices for a group of six developed countries (Denmark, the United Kingdom, Germany, France, Japan, and the United States), the share of business services in the total demand for intermediate goods grew between the mid-1970s and 1990, with the use of such services as inputs for other sectors growing steadily. The authors state that for a group of ten countries, some manufacturing sectors require more financial services, communication services, and business services (in particular, those producing office machines and computers, those with strong chemical and pharmaceutical industries, and those oriented toward the production of electronics and communication products). This finding suggests that the most technologically intensive and knowledge-intensive manufacturing sectors have a greater demand for this category of services, and countries characterized by such a production structure in manufacturing are more likely to produce and export such services.

Guerrieri and Meliciani, similarly to Triplett and Bosworth (2003), also observed that intermediate demand by the manufacturing sector and spending on information and communications technologies are two important variables defining the external competitiveness of service firms. Knowledge generated by modern services generates forward (i.e., downstream) production linkages. Services are used in manufacturing itself, and therefore, there is strong interdependence between the manufacturing and service sectors: the development of services ultimately depends on manufacturing production, and the productivity of manufacturing is also linked to services. This interdependence stimulates an improvement in services, increasing their external competitiveness. Service producers themselves also use a wide range of services, and this complementarity is very important for the development of the sector. The information and communications sector has aided the development of services by facilitating their production and use in geographically distant locations.

Ciriaci et al. (2015) studied four European countries (France, Germany, Italy, and the United Kingdom) for the 1995–2005 period, finding that R&D-intensive services acquired from KIBS made the manufacturing sectors more innovative. Vertical integration between manufacturing and services — resulting from the outsourcing strategies of industrial companies — contributes to this process.

Evangelista et al. (2014) also found that more innovative manufacturing firms require more business services. Therefore, demand for such services depends on the economy's production structure, and the development of these services also leads to increased external competitiveness — resulting in greater divergence of performance among European Union economies. The use of inputs related to information and communication technology contributes an increasing share to the export markets of both low- and high-tech industries.

A wide range of articles that have evaluated this issue, including those cited above, start by estimating the share of KIBS (defined above as modern services)[7] in intermediate inputs into manufacturing by estimating the inter-firm demand for services used in manufacturing. Arbache (2015), for example, analyzes the share of services in intermediate inputs to industry, based on the Annual Surveys of Industry of the Brazilian

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[7] KIBS designates services associated with knowledge-intensive inputs for the performance of activities and the production of goods and services in other organizations. It is possible to distinguish between P-KIBS (traditional professional services that make intensive use of new technologies, e.g., management, accounting, legal, and market research) and T-KIBS (services related to information technology and communications and that develop specialized technical knowledge, such as engineering and research and development). Companies that supply KIBS tend to spend more on innovation than other service providers, and they are currently recognized not only as suppliers of inputs that embody sophisticated knowledge but also as co-producers of knowledge together with their customers (Muller and Doloreux, 2009).

Institute of Geography and Statistics (IBGE), by comparing the expenses associated with such services (and also those classified as traditional) and the value added and gross value generated in the manufacturing industry. The study shows that industrial production employs a wide range of services but that the largest portion of these expenditures relates to financial charges.

In this article, we propose a different methodology to estimate this relationship: we estimate the demand for intra-firm and inter-firm services by calculating the wage bill among occupations related to KIBS. Thus, we account not only for the demand for services characterized as KIBS and offered by other firms (inter-firm services) but also the services thus characterized and developed within the firms that produces inputs to other firms (intra-firm services, except from the proper services characterized as KIBS). The proposed methodology assumes that the salaries paid to individuals employed in the production of KIBS in the companies themselves are a proxy for their contribution to the value added generated by these companies. In addition to adopting a different calculation methodology, we also exclude financial expenses, as the behavior of such expenses is not necessarily related to increased integration between industry and services but to the greater weight accorded financing needs and the interest rate in the expenses of firms. In the next section, we describe this methodology in detail.

2. METHODOLOGY

To analyze the distribution of the demand for modern services in the economy, it is necessary to measure the quantity of modern services utilized in production in each sector. The methodology used in this study assumes that a sector incorporates modern services in four ways: (i) buying directly from companies that produce modern services; (ii) producing them internally with employees who perform functions linked to modern services; (iii) buying other inputs with embodied modern services (from companies that produce modern services); and (iv) purchasing other inputs manufactured by companies outside the modern services sector but whose employees perform functions linked to modern services. While (i) and (iii) are viewed as inter-firm services, as they involve the hiring of companies specialized in these services, (ii) and (iv) are seen to embody intra-firm modern services, as companies specializing in the production of other goods and services hire employees — who fulfill the functions and activities associated with the execution of these services — to work within the company.

The analysis of inter-firm modern services is well established in the literature. Various studies have analyzed — via input-output matrices — how modern services are directly or indirectly embodied in the output of different sectors (Ciriati et al., 2015).

The major problem, therefore, is to determine the embodied value of modern services incorporated into manufactured output via forms (ii) and (iv). As this article will show, the share of value added of modern services within companies is highly relevant. However, because it is not possible to decompose the gross output of a company into its main product and the various embodied modern services in the form of workers who provide these services, this share is often ignored.

To overcome this problem, we propose a method of quantifying the output of intra-firm modern services. Using data on employee occupations within a company and considering the corresponding wage bill as an estimation of the contribution of those employers to the value added, it is possible to work around this problem. Thus, once the share of salaries of employees whose occupations are related to modern services on firm's value added is calculated, it is possible to obtain a reasonable estimate of the value of modern services embodied in the value added of the companies by the intra-firm mechanism. Additionally, through the input-output method of Leontief, it is possible to estimate the value of modern services embodied by the intra-firm mechanism directly and indirectly — that is, through the purchases of inputs that embody these services. Finally, adding this to the embodied inter-firm modern services (production from the modern services sector), the value of the modern services embodied in the production and in the value added of each sector is estimated.

2.1. Estimation of the total wages paid for workers linked directly and indirectly to KIBS occupations

The first step to estimate the total wages paid to KIBS occupation is to assign which sectors do we consider as KIBS sectors. The sectors linked to the following activities were selected:[8]

1-Development of systems and other information services;

2-Legal, accounting, consulting, and corporate headquarters activities;

3-Services related to architecture, engineering, technical tests/analyses, and R&D;

4-Other professional, scientific, and technical activities.

Since the data would be associated with the input and output matrices, we selected the sectors compatible with them in each country, including some aggregation, according to the respective National Accounts classification[9].The next step is to identify the typical occupations that perform KIBS activities. The criteria adopted to choose such occupations, when they are not directly associated with a specific sector, was the larger shares of wage bill for the set of employees performing each occupation on total wage bill in each KIBS sector (each occupation is related to just one sector). The list of the occupations varies among countries, according to the corresponding Household Survey and National Accounts' classification, and it is included in Annex A. Thus, to estimate the wage bill paid to KIBS occupations, salaries were aggregated among employees who fulfilled two requirements that identified them as belonging to the so-called modern services sector: their "Occupation" (variable describing the interviewee's job function) and "Sector" (variable describing the sector in which the interviewee works).

Once these sectors and occupations were defined, the share of the wage bill in modern services within a sector i (any sector, not only KIBS sector) was calculated as follows:

$$Wkibs_i = \sum_{j=1}^{m} Wkibs_{ji} \qquad (1)$$

$$\%Wkibs_i = \frac{Wkibs_i}{W_i} \qquad (2)$$

Where $Wkibs_{ji}$ is the wage bill of employees who perform functions in occupation j linked to modern services for sector i, $Wkibs_i$ is the wage bill of all employees who perform functions in m occupations linked to modern services for sector i, W_i is the total wage bill for sector i, and $\%Wkibs_i$ is the share of salaries paid to these employees in relation to total salaries paid in sector i. This estimation is based on data from National Household Surveys and the resulting share is applied to the total wage bill for each sector available at the National Accounts.

A possible limitation of the above estimation relates to auxiliary occupations linked to the modern services sector but that do not actually involve performance of activities classified as such. Taking as an example an activity of innovation within a mineral extraction company, not only will the engineers and scientists be working in this activity, but so will the administrative assistants, the secretaries, and the people charged with managing the bureaucracy in the activity, among other functions. Despite the existence of these functions, it is difficult to sort out who would be an R&D administrative assistant or would assist in another activity of the company. To correct this problem, after obtaining the share of the wage bill in modern services within a sector, the following adjustment was made:

$$\%Wkibs\_adj_{ik} = Wkibs_i \times \frac{1}{\% Wkibs_k} \qquad (3)$$

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8 The definition of these sectors as modern services comes from the one established by the European Monitoring Center on Change (EMCC).

[9] We had to aggregate the public and private health for Brazilian data, as well as for education, and we had to join data for levels of the government in the USA. For Italian data, we considered Numerical Clerks as KIBS occupations.

$$\%Wkibs\_adj_i = \sum_{k=1}^{n} \%Wkibs\_adj_{ik} \tag{4}$$

where $\%Wkibs_k$ is the share of total wages paid to the employees performing occupations linked to modern services in the modern service sector k and $\%Wkibs\_adj_{ik}$ is a proxy for the adjusted share of wages paid to persons linked directly and indirectly to the same occupations in sector i. The inverse of $\%Wkibs_k$ is adopted as the adjustment factor for the wage bill for these occupations in any sector i. This procedure is repeated n times, for the other sets of occupations k in the sector i, and subsequently the results are added to find $\%Wkibs\_adj_i$, the adjusted share of total wages paid to the employees performing occupations linked directly and indirectly to modern services in sector i.[10]

This adjustment supposes that the relation between a set of auxiliary and directly modern services related occupations is the same in modern services sectors and others. Thus, the wage bill for the team involved in the production of modern services within a company was estimated — this included both the professionals directly involved in the production of modern services and their support team, which made the estimation compatible with the way in which the wage bill for the modern service sectors is calculated in the National Accounts.

Finally, to estimate the value added by modern services in each sector, this adjusted share is multiplied by the ratio of the wage bill to the value added obtained from the value-added table in the Input-Output Matrix.

A possible limitation in this method is that it neglects the fact that a share of the profit of companies that do not belong to the modern services sector is derived from the production of these services internally. Despite this, we have chosen not to estimate this share of the profit, assuming that the wage costs of employees linked to the modern services activities in a non-modern services sector — e.g., R&D staff in a vehicle manufacturing industry — correspond to the total value of modern services embodied in a company's value added.

2.2. Estimation of the value added of inter-firm modern services in gross output

To estimate the share of the modern services value added in gross output, the Leontief method was used. In addition to the Leontief matrix, the following vectors and matrices were constructed:

$$V_n = \begin{bmatrix} \dfrac{Value\ Added_1}{Production_1} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & \dfrac{Value\ Added_n}{Production_n} \end{bmatrix} \tag{5}$$

$$u_{nx1} = \begin{bmatrix} 0 \\ 0 \\ \vdots \\ 1 \\ 1 \\ \vdots \\ 0 \end{bmatrix} \tag{6}$$

where the rows corresponding to 1 are related to the modern services sectors and n is the total number of sectors in the economy.

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[10] When $i=k$, the resulting adjusted share is equal to 1.

Based on these matrices and vectors, the total value added of modern services embodied in production can be obtained by:

$$S_n = \hat{u}_n \times (V_n \times L_n) \tag{7}$$

where S is the matrix indicating the embodiment of inter-firm modern services in the output of each sector (columns), and L is the Leontief matrix. The stress mark ^ indicates that the vector has been transformed into a square matrix whose main diagonal consists of values of the corresponding vector, while the other values are 0. This result enables an evaluation of the direct and indirect embodiment in gross output of modern services purchased from the modern services sector.

2.3. Estimation of the value added of intra-firm modern services in gross output

To analyze the magnitude of the modern services embodied by employees of companies whose main activities are unrelated to modern services, a method similar to the inter-firm estimation was used. Using the data calculated in (4), and considering that

$$Wkibs\_adj_i = \%Wkibs\_adj_i \times W_i , \tag{8}$$

we have:

$$K_n = \begin{bmatrix} \dfrac{Wkibs\_adj_1}{Production_1} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & \dfrac{Wkibs\_adj_n}{Production_n} \end{bmatrix} \tag{9}$$

$$u^*_{nx1} = 1 - u_{nx1} = \begin{bmatrix} 1 \\ 1 \\ \vdots \\ 0 \\ 0 \\ \vdots \\ 1 \end{bmatrix} \tag{10}$$

where the rows with 0 values are related to the modern services sectors.

The u^*_{nx1} rows related to modern services are set to zero to avoid double-counting modern service wages when we sum WS with S. Given that the total value added of companies that produce modern services is already considered to be inter-firm, the salaries of employees in the modern services sector cannot be included in the intra-firm analysis. Thus, the matrix that enables an evaluation of the total value added by intra-firm modern services embodied directly and indirectly in gross output is obtained by:

$$WS_n = \hat{u}^*_n \times (K_n \times L_n) \tag{11}$$

2.4. Estimation of the total value added of modern services in gross output

The total value added by modern services that each sector inserts into its own production — in accordance with our definitions — is obtained as the sum of S_n and WS_n. In this calculation, we are considering all four ways of embodying modern services described above. The embodiment from other inputs — (iii) and (iv) — results from the multiplication of the Leontief matrix, whereby we estimate the indirect demand of the sectors.

3. RESULTS

We estimated the share of intra-firm and inter-firm modern services on gross output in all sectors for Brazil, Italy and USA, based on microdata from household surveys or Census and the input and output tables[11].Before analyzing the results, it is important to consider possible limitations arising from the databases used. First, as the study utilizes information from the 2010 databases for Brazil and USA, it is possible that the results do not correspond to current realities of these economies. As some modern services have volatile demand that is elastic with respect to GDP growth (e.g., R&D), calculations related to the embodiment of inter-firm value added (services produced by companies in the modern services sectors) may be overestimated for Brazil and underestimated for USA. On the other hand, the results for the wage bill of workers linked to modern services within companies not belonging to these sectors (intra-firm) are more stable.

The second aspect to consider is the heterogeneity of the modern services sector, mainly because it has highly specialized professionals. The proposed classification aggregates several distinct activities into the same sector. However, to distinguish demand for different types of modern services, the latter were divided into professional knowledge intensive business services (P-KIBS) and technological knowledge intensive business services (T-KIBS), in accordance with the classification proposed by Muller & Dorleaux (2009) cited above.

As T-KIBS, we considered:

1- Development of systems and other information services;
2- Services related to architecture, engineering, technical tests/analyses, and R&D;
3- Other professional, scientific, and technical activities.

As P-KIBS, we considered:

1- Legal, accounting, consulting, and corporate headquarters activities.

3.1. Wage share for workers linked directly and indirectly to KIBS occupations by sector

As the first step in our calculation is estimation of the wage bill of all individuals involved in modern services activities in each sector, it was decided to present an intermediate result, namely, the wage share of workers allocated to these functions in the total wage bill of the various disaggregated sectors. This result is unprecedented, as the usual estimates of the shares in the total wage bill in various sectors do not consider employees linked directly and indirectly to modern services, but only those directly linked.

We present in Tables 1,2 and 3 the rank of the sectors according to the wage share allocated to employees linked directly and indirectly to modern services. Data is disaggregated by T-KIBS and P-KIBS occupations, and the wage share is estimated on total wage bill and gross output. Thus, four combinations are ranked, and the list is presented according to the rank of sectors by the wage share for T-KIBS occupations on gross output.[12]

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[11] These are the countries that you've already gotten access to microdata basis. We will expand the sample as soon as we get data from other countries and we will also seize the opportunity to improve the methodology. In this version of the paper, we used data from the 2010 Brazilian Census, 2010 American Community Survey and Italian Labour Force Survey (average of all 2014 quarters). In the Brazilian case, the Census was chosen instead of the National Household Sample Survey (PNAD) for two reasons: the sample size on the Census is larger, increasing the accuracy of the data, and as 2010 is coincidentally a year in which the respective IBGE input-output matrix was disclosed, it is possible to calculate the value embodied by modern services without using estimated matrices.

[12] It was not possible to classify some occupations as T-KIBS or P-KIBS for USA and we chose to preclude this disaggregation for this country.

Analyzing the results, we can say that the link between wages for T-KIBS occupations and gross output is stronger for modern services sectors, obviously, and high-tech manufacturing. This is a relevant result of the estimation, since reinforces the hypothesis of complementarity between the production in modern services and high-tech manufacturing. The relation is not the same for P-KIBS occupations; they are much more disseminated by all kind of sectors. The results for USA does not indicate a clear relation between the wages for these occupations and the gross output in any kind of sector. Since American data is not disaggregated for T-KIBS and P-KIBS occupations, it is possible that wages for P-KIBS occupations are biasing the results, reinforcing the assumption that T-KIBS are more linked to high tech manufacturing than P-KIBS occupations.

Among industries in the lower positions in the rankings, there is much similarity between industries that purchase few T-KIBS and P-KIBS for Brazilian and Italian data. This shows that industries that require few modern services require little of both types of modern services.

It is also possible to highlight that the ranks based on the share on wage bill is different of ranks based on the share in gross output, showing that the wage share on gross output is distinct for each sector.

Table 1 – Share of wages paid for KIBS occupations on total wages and gross output by sector - Brazil

Sector	Share (%) of wages paid for KIBS occupations on total wages paid in sector i				Share (%) of wages paid for KIBS occupations on gross output in sector i			
	T-KIBS		P-KIBS		T-KIBS		P-KIBS	
	Rank	% Share	Rank	% Share	Rank	% Share	Rank	% Share
Computer programming, consultancy and related activities; Information service activities	1	93,0%	28	8,4%	1	28,8%	11	2,4%
Architectural and engineering activities; technical testing and analysis; Scientific R & D	2	91,9%	8	13,9%	2	21,9%	6	3,3%
Other professional, scientific and technical activities	3	80,0%	5	17,2%	3	9,4%	15	1,6%
Manufacture of other non-metallic mineral products	8	35,5%	34	7,8%	4	5,2%	23	1,2%
Manufacture of other transport equipment	10	35,0%	54	4,4%	5	5,0%	51	0,6%
Public administration and defence; compulsory social security	36	11,0%	3	33,5%	6	4,9%	2	15,0%
Publishing activities	18	24,1%	11	12,6%	7	4,7%	10	2,5%
Extraction of crude petroleum and natural gas; Mining support service activities	4	53,9%	12	12,6%	8	4,0%	33	0,9%
Manufacture of machinery and equipment n.e.c.	16	25,8%	42	6,5%	9	3,8%	30	1,0%
Security and investigation activities	51	6,5%	9	13,7%	10	3,5%	3	7,4%
Manufacture of electrical equipment	17	25,7%	19	10,0%	11	3,5%	19	1,4%
Manufacture of basic pharmaceutical products and pharmaceutical preparations	15	27,4%	24	9,5%	12	3,3%	26	1,1%
Manufacture of fabricated metal products, except machinery and equipment	23	19,0%	44	6,5%	13	3,3%	27	1,1%
Manufacture of parts and accessories for motor vehicles	19	21,6%	31	8,3%	14	3,2%	24	1,2%
Manufacture of computer, electronic and optical products	12	30,4%	38	7,0%	15	3,0%	40	0,7%
Water supply; sewerage, waste management and remediation activities	22	19,6%	30	8,4%	16	2,9%	25	1,2%
Manufacture of leather and related products	30	13,8%	61	3,6%	17	2,9%	36	0,8%
Motion picture, video and television programme production, sound recording and music publishing activities***	29	14,9%	39	7,0%	18	2,8%	22	1,3%
Financial and insurance activities	33	13,3%	6	16,8%	19	2,6%	7	3,3%
Telecommunications	7	40,5%	10	13,4%	20	2,6%	34	0,9%
Manufacture of basic iron and steel	9	35,5%	35	7,8%	21	2,6%	52	0,6%
Other administrative activities and complementary services	45	7,2%	7	16,6%	22	2,5%	4	5,7%
Electricity, gas, steam and air conditioning supply	6	41,4%	13	12,2%	23	2,5%	41	0,7%
Manufacture of biofuels	13	30,1%	32	8,1%	24	2,5%	42	0,7%
Human health and social work activities	55	4,9%	58	4,2%	25	2,5%	13	2,2%
Education	59	3,8%	60	4,0%	26	2,5%	8	2,6%
Construction	26	16,8%	62	3,5%	27	2,5%	56	0,5%
Manufacture of motor vehicles, trailers and semi-trailers	11	31,1%	26	9,1%	28	2,3%	43	0,7%
Manufacture of pesticides, disinfectants, paints and various chemicals	20	21,1%	14	10,8%	29	2,0%	31	1,0%
Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	25	18,8%	17	10,1%	30	2,0%	28	1,1%
Legal and accounting activities; Activities of head offices; management consultancy activities	39	8,9%	1	89,9%	31	1,9%	1	21,7%
Manufacture of rubber and plastics products	32	13,6%	21	9,8%	32	1,9%	20	1,4%

Table 1 - Cont.

Sector	Share (%) of wages paid for KIBS occupations on total wages paid in sector i				Share (%) of wages paid for KIBS occupations on gross output in sector i			
	T-KIBS		P-KIBS		T-KIBS		P-KIBS	
	Rank	% Share	Rank	% Share	Rank	% Share	Rank	% Share
Manufacture of basic precious and other non-ferrous metals; Casting of metals	21	20,1%	47	5,4%	**33**	**1,9%**	57	0,5%
Manufacture of pulp, paper and paper products	27	16,6%	20	10,0%	**34**	**1,8%**	29	1,1%
Warehousing and support activities for transportation; Postal and courier activities	46	6,9%	27	8,8%	**35**	**1,8%**	12	2,3%
Printing and reproduction of recorded media	38	9,4%	36	7,6%	**36**	**1,8%**	17	1,5%
Repair and installation of machinery and equipment	35	12,4%	49	5,0%	**37**	**1,8%**	44	0,7%
Other service activities	44	7,3%	40	6,8%	**38**	**1,7%**	16	1,6%
Manufacture of sugar	28	16,1%	43	6,5%	**39**	**1,7%**	45	0,7%
Manufacture of wearing apparel	40	8,6%	51	4,8%	**40**	**1,7%**	32	1,0%
Air transport	37	10,7%	45	6,2%	**41**	**1,6%**	35	0,9%
Rental and leasing activities	41	8,3%	4	19,5%	**42**	**1,5%**	5	3,6%
Water transport	43	7,4%	29	8,4%	**43**	**1,3%**	18	1,5%
Mining of iron ores	14	28,0%	33	8,0%	**44**	**1,3%**	61	0,4%
Manufacture of organic and inorganic chemicals, resins and elastomers	24	18,8%	16	10,1%	**45**	**1,1%**	53	0,6%
Manufacture of beverages	34	13,2%	22	9,8%	**46**	**1,0%**	46	0,7%
Wholesale and retail trade; except motor vehicles and motorcycles	56	4,4%	37	7,6%	**47**	**1,0%**	14	1,8%
Manufacture of furniture; Other manufacturing	49	6,6%	46	5,5%	**48**	**1,0%**	37	0,8%
Manufacture of textiles	50	6,5%	57	4,2%	**49**	**1,0%**	47	0,7%
Manufacture of tobacco products	31	13,8%	18	10,1%	**50**	**0,9%**	48	0,7%
Accommodation	62	3,2%	25	9,3%	**51**	**0,9%**	9	2,6%
Arts, entertainment and recreation	61	3,6%	48	5,4%	**52**	**0,9%**	21	1,4%
Animal production, hunting and related service activities	54	6,2%	55	4,4%	**53**	**0,9%**	54	0,6%
Crop and related service activities	48	6,6%	64	2,7%	**54**	**0,7%**	62	0,3%
Manufacture of coke and refined petroleum products	5	45,0%	15	10,6%	**55**	**0,6%**	64	0,1%
Processing and preserving of meat, fish, crustaceans and molluscs; Manufacture of dairy products	42	7,7%	41	6,6%	**56**	**0,6%**	58	0,5%
Mining of coal and lignite; Other mining and quarrying	57	4,3%	52	4,7%	**57**	**0,6%**	49	0,7%
Forestry and logging, Fishing and aquaculture	47	6,8%	59	4,2%	**58**	**0,6%**	63	0,3%
Land transport and transport via pipelines	60	3,8%	63	3,0%	**59**	**0,6%**	59	0,5%
Manufacture of other food products	52	6,3%	23	9,8%	**60**	**0,5%**	38	0,8%
Mining of non-ferrous metal ores	58	4,1%	50	4,9%	**61**	**0,5%**	55	0,6%
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	63	2,9%	53	4,5%	**62**	**0,5%**	39	0,8%
Food and beverage service activities	64	1,5%	56	4,4%	**63**	**0,3%**	50	0,7%
Real estate activities	53	6,3%	2	46,7%	**64**	**0,1%**	60	0,5%
Activities of households as employers of domestic personnel	65	0,0%	65	0,0%	**65**	**0,0%**	65	0,0%

* Employment activities; Travel agency, tour operator, reservation service and related activities; Services to buildings and landscape activities; Office administrative, office support and other business support activities

** Advertising and market research; Other professional, scientific and technical activities; Veterinary activities

*** Motion picture, video and television programme production, sound recording and music publishing activities; Programming and broadcasting activities

Table 2 – Share of wages paid for KIBS occupations on total wages and gross output by sector - Italy

Sector	Share (%) of wages paid for KIBS occupations on total wages paid in sector i				Share (%) of wages paid for KIBS occupations on gross output in sector i			
	T-KIBS		P-KIBS		T-KIBS		P-KIBS	
	Rank	% Share	Rank	% Share	Rank	% Share	Rank	% Share
Scientific research and development	3	100,0%	14	17,3%	1	45,9%	6	7,9%
Computer programming, consultancy, and information service activities	1	100,0%	24	13,7%	2	27,9%	13	3,8%
Manufacture of basic pharmaceutical products and pharmaceutical preparations	5	93,2%	26	13,0%	3	16,0%	23	2,2%
Architectural and engineering activities; technical testing and analysis	4	100,0%	16	16,8%	4	12,4%	25	2,1%
Other professional, scientific and technical activities; veterinary activities	2	100,0%	8	27,0%	5	12,0%	15	3,2%
Manufacture of computer, electronic and optical products	6	52,8%	20	15,3%	6	11,2%	16	3,2%
Repair and installation of machinery and equipment	10	33,5%	42	8,5%	7	8,0%	29	2,0%
Publishing activities	12	30,3%	9	26,9%	8	6,4%	8	5,7%
Manufacture of machinery and equipment n.e.c.	11	32,3%	27	12,5%	9	6,0%	22	2,3%
Manufacture of other transport equipment	9	37,9%	40	9,8%	10	5,8%	35	1,5%
Telecommunications	7	47,3%	19	15,9%	11	5,5%	34	1,8%
Public administration and defence; compulsory social security	24	10,3%	29	11,9%	12	5,4%	7	6,2%
Manufacture of electrical equipment	13	24,5%	36	10,9%	13	4,5%	30	2,0%
Water collection, treatment and supply	14	24,0%	50	4,7%	14	4,5%	48	0,9%
Manufacture of chemicals and chemical products	8	39,5%	41	9,4%	15	4,3%	46	1,0%
Manufacture of fabricated metal products, except machinery and equipment	20	15,0%	38	10,2%	16	3,1%	26	2,1%
Manufacture of motor vehicles, trailers and semi-trailers	15	20,8%	37	10,5%	17	3,0%	36	1,5%
Forestry and logging	38	5,5%	53	0,3%	18	2,8%	53	0,2%
Mining and quarrying	16	19,2%	32	11,8%	19	2,4%	37	1,5%
Construction	18	16,4%	45	6,6%	20	2,4%	47	1,0%
Manufacture of furniture; other manufacturing	21	12,8%	21	15,2%	21	2,2%	21	2,6%
Education	47	3,0%	52	1,6%	22	2,2%	40	1,2%
Wholesale trade, except of motor vehicles and motorcycles	23	11,2%	10	26,3%	23	2,0%	10	4,7%
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	22	12,2%	18	16,5%	24	2,0%	19	2,7%
Motion picture, video, television programme production; programming and broadcasting activities	25	9,9%	35	11,0%	25	1,8%	31	2,0%
Postal and courier activities	49	2,9%	15	17,3%	26	1,7%	3	10,0%
Manufacture of rubber and plastic products	27	9,7%	28	12,1%	27	1,6%	32	2,0%

Table 2 - Cont.

Sector	Share (%) of wages paid for KIBS occupations on total wages paid in sector i				Share (%) of wages paid for KIBS occupations on gross output in sector i			
	T-KIBS		P-KIBS		T-KIBS		P-KIBS	
	Rank	% Share	Rank	% Share	Rank	% Share	Rank	% Share
Human health and social work activities	43	4,2%	48	5,5%	**28**	**1,6%**	27	2,1%
Manufacture of other non-metallic mineral products	29	7,5%	34	11,1%	**29**	**1,5%**	24	2,2%
Air transport	30	7,2%	11	23,2%	**30**	**1,4%**	11	4,6%
Warehousing and support activities for transportation	31	7,2%	12	20,6%	**31**	**1,4%**	12	4,0%
Printing and reproduction of recorded media	37	5,8%	17	16,6%	**32**	**1,2%**	14	3,4%
Electricity, gas, steam and air conditioning supply	17	18,0%	13	18,8%	**33**	**1,1%**	41	1,2%
Other service activities	35	6,0%	23	14,3%	**34**	**1,1%**	20	2,7%
Advertising and market research	28	9,7%	1	100,0%	**35**	**1,0%**	4	9,8%
Financial service activities, except insurance and pension funding	45	3,6%	3	89,5%	**36**	**1,0%**	1	25,2%
Activities auxiliary to financial services and insurance activities	41	4,9%	4	50,0%	**37**	**1,0%**	5	9,8%
Insurance, reinsurance and pension funding, except compulsory social security	33	6,8%	6	38,7%	**38**	**1,0%**	9	5,5%
Sewerage, waste management, remediation activities	36	5,8%	44	6,7%	**39**	**1,0%**	42	1,2%
Manufacture of basic metals	26	9,8%	46	5,9%	**40**	**0,9%**	49	0,5%
Crop and animal production, hunting and related service activities	32	7,0%	51	3,3%	**41**	**0,9%**	51	0,4%
Administrative and support service activities	48	3,0%	39	10,2%	**42**	**0,8%**	18	2,8%
Manufacture of textiles, wearing apparel, leather and related products	42	4,7%	25	13,5%	**43**	**0,7%**	28	2,1%
Manufacture of paper and paper products	39	5,5%	31	11,9%	**44**	**0,7%**	38	1,5%
Land transport and transport via pipelines	44	3,6%	49	5,5%	**45**	**0,7%**	44	1,1%
Wholesale and retail trade and repair of motor vehicles and motorcycles	46	3,1%	22	15,1%	**46**	**0,6%**	17	3,2%
Manufacture of food products; beverages and tobacco products	34	6,1%	30	11,9%	**47**	**0,6%**	43	1,2%
Retail trade, except of motor vehicles and motorcycles	51	2,4%	43	8,2%	**48**	**0,6%**	33	2,0%
Water transport	40	4,9%	33	11,3%	**49**	**0,5%**	45	1,1%
Legal and accounting activities; activities of head offices; management consultancy activities	52	1,3%	2	100,0%	**50**	**0,2%**	2	15,5%
Manufacture of coke and refined petroleum products	19	15,5%	7	32,6%	**51**	**0,2%**	50	0,5%
Real estate activities	50	2,8%	5	42,4%	**52**	**0,0%**	52	0,4%
Accommodation and food service activities	53	0,1%	47	5,8%	**53**	**0,0%**	39	1,4%
Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	55	0,0%	54	0,2%	**54**	**0,0%**	54	0,2%
Fishing and aquaculture	54	0,0%	55	0,0%	**55**	**0,0%**	55	0,0%

Table 3 – Share of wages paid for KIBS occupations on total wages and gross output by sector - USA

Sector	Share (%) of wages paid for KIBS occupations on total wages paid in sector i		Share (%) of wages paid for KIBS occupations on gross output in sector i	
	Rank	% Share	Rank	% Share
Computer systems design and related services	1	100,0%	1	68,0%
Management of companies and enterprises	2	100,0%	2	50,0%
Miscellaneous professional, scientific, and technical services	3	100,0%	3	42,0%
Legal services	4	100,0%	4	39,0%
Computer and electronic products	5	96,0%	5	27,0%
Apparel and leather and allied products	15	52,0%	6	25,0%
Support activities for mining	16	51,0%	7	22,0%
Securities, commodity contracts, and investments	22	45,0%	8	21,0%
Government	26	38,0%	9	20,0%
Other transportation equipment	6	79,0%	10	19,0%
Publishing industries, except internet (includes software)	9	70,0%	11	18,0%
Electrical equipment, appliances, and components	10	64,0%	12	17,0%
Administrative and support services	32	32,0%	13	15,0%
Miscellaneous manufacturing	14	53,0%	14	14,0%
Federal Reserve banks, credit intermediation, and related activities	20	46,0%	15	13,0%
Machinery	13	54,0%	16	12,0%
Data processing, internet publishing, and other information services	11	60,0%	17	11,0%
Wholesale trade	30	35,0%	18	11,0%
Accommodation	41	24,0%	19	10,0%
Printing and related support activities	33	32,0%	20	10,0%
Broadcasting and telecommunications	8	71,0%	21	10,0%
Insurance carriers and related activities	24	39,0%	22	10,0%
Other services, except government	46	21,0%	23	10,0%
Warehousing and storage	47	21,0%	24	9,0%
Textile mills and textile product mills	28	36,0%	25	8,0%
Performing arts, spectator sports, museums, and related activities	38	28,0%	26	8,0%
Fabricated metal products	34	32,0%	27	8,0%
Furniture and related products	36	30,0%	28	8,0%
Utilities	18	49,0%	29	8,0%
Pipeline transportation	23	41,0%	30	8,0%
Forestry, fishing, and related activities	50	20,0%	31	8,0%
Nonmetallic mineral products	37	29,0%	32	7,0%
Other retail	48	21,0%	33	7,0%

Table 3 - Cont.

Sector	Share (%) of wages paid for KIBS occupations on total wages paid in sector i		Share (%) of wages paid for KIBS occupations on gross output in sector i	
	Rank	% Share	Rank	% Share
Plastics and rubber products	29	36,0%	34	7,0%
Social assistance	59	14,0%	35	7,0%
Waste management and remediation services	45	22,0%	36	7,0%
Educational services	60	13,0%	37	7,0%
Motion picture and sound recording industries	27	37,0%	38	7,0%
General merchandise stores	54	16,0%	39	6,0%
Amusements, gambling, and recreation industries	49	21,0%	40	6,0%
Motor vehicle and parts dealers	52	19,0%	41	6,0%
Ambulatory health care services	61	11,0%	42	6,0%
Construction	55	16,0%	43	6,0%
Food and beverage stores	58	15,0%	44	6,0%
Other transportation and support activities	56	16,0%	45	6,0%
Hospitals	62	11,0%	46	5,0%
Motor vehicles, bodies and trailers, and parts	21	46,0%	47	5,0%
Chemical products	12	58,0%	48	5,0%
Wood products	42	24,0%	49	5,0%
Paper products	31	33,0%	50	5,0%
Nursing and residential care facilities	66	8,0%	51	5,0%
Air transportation	51	20,0%	52	5,0%
Food services and drinking places	63	11,0%	53	4,0%
Rental and leasing services and lessors of intangible assets	25	39,0%	54	4,0%
Rail transportation	57	16,0%	55	4,0%
Transit and ground passenger transportation	64	11,0%	56	4,0%
Water transportation	39	28,0%	57	3,0%
Food and beverage and tobacco products	35	31,0%	58	3,0%
Primary metals	40	28,0%	59	3,0%
Oil and gas extraction	7	75,0%	60	3,0%
Other real estate	43	24,0%	61	2,0%
Truck transportation	65	9,0%	62	2,0%
Mining, except oil and gas	53	18,0%	63	2,0%
Farms	67	7,0%	64	1,0%
Petroleum and coal products	17	50,0%	65	1,0%
Funds, trusts, and other financial vehicles	19	48,0%	66	0,0%
Housing	44	23,0%	67	0,0%

3.2. Estimation of the inter-firm, intra-firm and total value added of modern services in gross output by sector

The most relevant results of our study are the estimations of the share of modern services value added on gross output that incorporate not only the inter-firm demand, but also the intra-firm demand for modern services. This is the contribution of our proposed methodology.

The next tables refer to the share of intra-firm and inter-firm value added in the gross output in each sector. Based on data for salaries paid to workers linked to modern services, it was possible to calculate the intra-firm portion of KIBS embodied in the output directly and indirectly. Adding to this the share of KIBS' value added in the output through the purchase of modern services from firms specializing in the production of these services (inter-firm), it is possible to obtain the value added of modern services in the total output of each sector.

We present in Tables 4, 5 and 6 the rank of the sectors according to that share for T-KIBS, P-KIBS and all KIBS occupations, for Brazilian and Italian data, and only for KIBS occupations for American data due to the reasons explained above. The share of inter-firm, intra-firm and total value added on gross output were estimated separately, which allows to identify the differences between intra and extra-firm demand for modern sectors, the importance of both and their correlation with sectors that did not produce modern services as the final good. Three set of data are ranked by sector, based on the modern services value added share on gross output – for T-KIBS, P-KIBS and all KIBS occupations, and the list is presented according to the rank of sectors by the value added share on gross output for the group of T-KIBS occupations.

The results are quite similar to those presented in the analysis about the wage share, since we are considering that the intra-firm modern services value added corresponds to the wage bill of the employers performing these activities, that is, we assume that the wage costs of employees linked to the modern services activities in a non-modern services sector corresponds to the total value of modern services embodied in a company's value added. The link between T-KIBS employers' contribution to the gross output is also larger for modern services sectors and high-tech manufacturing. Again, the relation is not the same for P-KIBS occupations; they are much more disseminated by all kind of sectors. The results for USA reinforces this assumption. For Brazilian and Italian data, the share of intra-firm modern services value added on gross output is larger than inter-firm, showing the relevance of modern services in intra-firm demand, which is disregarded in usual analysis of the complementarity between modern services sectors and others, with emphasis to the manufacturing case.

Among industries in the lower positions in the rankings, there is much similarity between sectors that purchase few T-KIBS and P-KIBS for Brazilian and Italian data. This shows that industries that require few modern services require little of both types of modern services. Low tech manufacturing, traditional services and primary sectors are included in this group tend to present a smaller complementarity between both T-KIBS and P-KIBS related value added and gross output. Similar results apply to the previous wage share analysis, with the exception of petroleum industries.

Table 4 - Share of inter-firm, intra-firm and total modern services value added on gross output by sector – Brazil

Sector	Share (%) of inter-firm modern services value added on gross output in sector i			Share (%) of intra-firm modern services value added on gross output in sector i			Share (%) of modern services value added on gross output in sector i					
	T-KIBS	P-KIBS	KIBS	T-KIBS	P-KIBS	KIBS	T-KIBS		P-KIBS		KIBS	
	% Share	% Share	% Share	% Share	% Share	% Share	Rank	% Share	Rank	% Share	Rank	% Share
Computer programming, consultancy and related activities; Information service activities	72,6%	1,8%	74,3%	8,6%	3,3%	12,0%	1	**81,2%**	12	5,1%	1	86,3%
Architectural and engineering activities; technical testing and analysis; Scientific R & D	68,0%	4,2%	72,2%	8,4%	4,6%	13,0%	2	**76,4%**	5	8,7%	3	85,2%
Other professional, scientific and technical activities	35,9%	1,2%	37,1%	7,3%	3,3%	10,5%	3	**43,2%**	16	4,5%	4	47,7%
Manufacture of other non-metallic mineral products	1,0%	1,5%	2,5%	10,6%	2,3%	12,9%	4	**11,6%**	23	3,8%	8	15,4%
Publishing activities	3,8%	1,6%	5,4%	7,7%	4,2%	11,9%	5	**11,5%**	9	5,8%	6	17,2%
Manufacture of other transport equipment	0,8%	0,6%	1,4%	9,5%	1,2%	10,7%	6	**10,2%**	58	1,8%	15	12,0%
Public administration and defence; compulsory social security	2,6%	0,8%	3,4%	6,8%	21,1%	27,9%	7	**9,4%**	2	22,0%	5	31,4%
Motion picture, video and television programme production, sound recording and music publishing activities***	3,8%	3,1%	6,9%	4,7%	2,2%	6,9%	8	**8,5%**	11	5,3%	12	13,8%
Manufacture of basic pharmaceutical products and pharmaceutical preparations	3,2%	4,3%	7,4%	5,3%	1,8%	7,1%	9	**8,4%**	8	6,1%	9	14,5%
Manufacture of machinery and equipment n.e.c.	1,1%	0,8%	1,9%	7,3%	1,9%	9,2%	10	**8,4%**	37	2,7%	20	11,1%
Manufacture of electrical equipment	1,0%	1,5%	2,5%	7,4%	2,8%	10,2%	11	**8,3%**	18	4,4%	13	12,7%
Extraction of crude petroleum and natural gas; Mining support service activities	1,5%	3,0%	4,5%	6,2%	1,4%	7,7%	12	**7,8%**	17	4,4%	14	12,2%
Manufacture of parts and accessories for motor vehicles	0,9%	0,9%	1,7%	6,8%	2,6%	9,4%	13	**7,6%**	28	3,5%	19	11,1%
Manufacture of fabricated metal products, except machinery and equipment	0,9%	0,9%	1,9%	6,6%	2,3%	8,8%	14	**7,5%**	31	3,2%	21	10,7%
Manufacture of leather and related products	1,4%	0,8%	2,3%	6,1%	1,6%	7,6%	15	**7,5%**	40	2,4%	23	9,9%
Financial and insurance activities	3,5%	2,4%	5,9%	3,8%	4,8%	8,6%	16	**7,3%**	6	7,2%	11	14,5%
Telecommunications	2,5%	1,3%	3,8%	4,6%	1,6%	6,2%	17	**7,1%**	34	2,9%	22	10,0%
Warehousing and support activities for transportation; Postal and courier activities	4,1%	1,5%	5,6%	2,7%	3,5%	6,2%	18	**6,8%**	14	5,0%	16	11,9%
Manufacture of biofuels	0,6%	0,7%	1,3%	5,8%	1,6%	7,4%	19	**6,4%**	43	2,3%	27	8,7%
Electricity, gas, steam and air conditioning supply	1,9%	0,7%	2,6%	4,5%	1,3%	5,8%	20	**6,4%**	53	2,0%	35	8,4%
Manufacture of motor vehicles, trailers and semi-trailers	1,4%	0,8%	2,2%	4,9%	1,4%	6,3%	21	**6,3%**	46	2,2%	31	8,5%
Water supply; sewerage, waste management and remediation activities	1,5%	1,6%	3,1%	4,7%	2,0%	6,7%	22	**6,2%**	27	3,6%	24	9,8%

Table 4 - Cont.

Sector	Share (%) of inter-firm modern services value added on gross output in sector i			Share (%) of intra-firm modern services value added on gross output in sector i			Share (%) of modern services value added on gross output in sector i					
	T-KIBS	P-KIBS	KIBS	T-KIBS	P-KIBS	KIBS	T-KIBS		P-KIBS		KIBS	
	% Share	% Share	% Share	% Share	% Share	% Share	Rank	% Share	Rank	% Share	Rank	% Share
Education	2,5%	1,2%	3,8%	3,6%	3,8%	7,4%	**23**	**6,1%**	13	5,1%	18	11,2%
Manufacture of basic iron and steel	0,5%	0,6%	1,1%	5,6%	1,2%	6,8%	**24**	**6,1%**	57	1,8%	39	7,9%
Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	1,6%	1,6%	3,2%	4,1%	2,2%	6,4%	**25**	**5,8%**	24	3,8%	26	9,6%
Manufacture of computer, electronic and optical products	0,9%	0,9%	1,8%	4,9%	1,1%	6,0%	**26**	**5,7%**	49	2,1%	40	7,8%
Construction	1,1%	1,0%	2,2%	4,5%	0,9%	5,4%	**27**	**5,6%**	54	2,0%	41	7,6%
Legal and accounting activities; Activities of head offices; management consultancy activities	2,9%	73,9%	76,8%	2,6%	6,6%	9,2%	**28**	**5,6%**	1	80,5%	2	86,0%
Security and investigation activities	1,1%	2,7%	3,7%	4,3%	9,0%	13,3%	**29**	**5,4%**	3	11,6%	7	17,0%
Human health and social work activities	1,5%	1,0%	2,5%	3,8%	3,3%	7,1%	**30**	**5,3%**	19	4,3%	25	9,6%
Manufacture of beverages	3,0%	1,3%	4,3%	2,1%	1,6%	3,7%	**31**	**5,0%**	35	2,9%	38	7,9%
Other administrative activities and complementary services	1,4%	1,7%	3,1%	3,5%	7,9%	11,4%	**32**	**4,9%**	4	9,6%	10	14,5%
Manufacture of rubber and plastics products	0,9%	1,1%	2,0%	3,9%	2,8%	6,7%	**33**	**4,8%**	22	3,9%	28	8,7%
Manufacture of pesticides, disinfectants, paints and various chemicals	0,8%	1,7%	2,5%	4,0%	2,0%	6,0%	**34**	**4,8%**	26	3,7%	30	8,5%
Rental and leasing activities	2,6%	1,8%	4,4%	2,2%	5,2%	7,3%	**35**	**4,8%**	7	6,9%	17	11,7%
Manufacture of pulp, paper and paper products	0,9%	1,1%	2,1%	3,8%	2,3%	6,0%	**36**	**4,7%**	30	3,4%	36	8,1%
Manufacture of basic precious and other non-ferrous metals; Casting of metals	0,5%	0,7%	1,1%	4,1%	1,1%	5,2%	**37**	**4,6%**	60	1,8%	45	6,4%
Manufacture of sugar	0,5%	0,7%	1,2%	3,9%	1,6%	5,5%	**38**	**4,5%**	44	2,3%	42	6,8%
Arts, entertainment and recreation	3,0%	2,0%	4,9%	1,4%	2,1%	3,6%	**39**	**4,4%**	21	4,1%	32	8,5%
Other service activities	1,5%	1,6%	3,1%	2,8%	2,6%	5,5%	**40**	**4,4%**	20	4,2%	29	8,6%
Printing and reproduction of recorded media	0,9%	1,0%	1,9%	3,4%	2,7%	6,1%	**41**	**4,3%**	25	3,8%	37	8,1%
Manufacture of wearing apparel	0,9%	0,7%	1,7%	3,1%	1,8%	4,9%	**42**	**4,1%**	38	2,5%	43	6,6%
Repair and installation of machinery and equipment	0,7%	0,8%	1,5%	3,1%	1,3%	4,4%	**43**	**3,9%**	50	2,0%	48	5,9%
Air transport	1,1%	0,7%	1,8%	2,7%	1,6%	4,3%	**44**	**3,8%**	45	2,2%	47	6,1%

Table 4- Cont.

Sector	Share (%) of inter-firm modern services value added on gross output in sector i			Share (%) of intra-firm modern services value added on gross output in sector i			Share (%) of modern services value added on gross output in sector i					
	T-KIBS	P-KIBS	KIBS	T-KIBS	P-KIBS	KIBS	T-KIBS		P-KIBS		KIBS	
	% Share	% Share	% Share	% Share	% Share	% Share	Rank	% Share	Rank	% Share	Rank	% Share
Wholesale and retail trade; except motor vehicles and motorcycles	2,2%	2,1%	4,3%	1,5%	2,6%	4,2%	**45**	**3,7%**	15	4,7%	34	8,4%
Manufacture of tobacco products	1,4%	1,8%	3,1%	1,9%	1,4%	3,3%	**46**	**3,3%**	32	3,2%	44	6,5%
Mining of iron ores	1,1%	1,4%	2,5%	2,0%	0,6%	2,5%	**47**	**3,0%**	55	2,0%	51	5,0%
Accommodation	1,6%	1,1%	2,6%	1,5%	4,4%	5,8%	**48**	**3,0%**	10	5,4%	33	8,5%
Water transport	0,7%	0,6%	1,3%	2,3%	2,6%	4,8%	**49**	**3,0%**	33	3,1%	46	6,1%
Manufacture of furniture; Other manufacturing	1,0%	1,0%	2,0%	1,8%	1,5%	3,3%	**50**	**2,8%**	39	2,5%	50	5,3%
Manufacture of textiles	0,6%	0,7%	1,3%	2,1%	1,4%	3,5%	**51**	**2,7%**	48	2,1%	52	4,8%
Manufacture of organic and inorganic chemicals, resins and elastomers	0,4%	0,8%	1,3%	2,2%	1,2%	3,4%	**52**	**2,6%**	51	2,0%	54	4,6%
Animal production, hunting and related service activities	0,9%	0,8%	1,7%	1,6%	1,1%	2,7%	**53**	**2,4%**	56	1,9%	55	4,4%
Land transport and transport via pipelines	0,9%	1,0%	1,9%	1,2%	1,0%	2,2%	**54**	**2,1%**	52	2,0%	57	4,1%
Mining of coal and lignite; Other mining and quarrying	0,9%	2,1%	3,0%	1,2%	1,3%	2,4%	**55**	**2,1%**	29	3,4%	49	5,4%
Crop and related service activities	0,8%	0,9%	1,7%	1,2%	0,5%	1,7%	**56**	**1,9%**	61	1,4%	61	3,3%
Processing and preserving of meat, fish, crustaceans and molluscs; Manufacture of dairy products	0,5%	0,6%	1,1%	1,4%	1,2%	2,6%	**57**	**1,9%**	59	1,8%	60	3,7%
Manufacture of other food products	0,7%	0,9%	1,6%	1,2%	1,9%	3,1%	**58**	**1,9%**	36	2,8%	53	4,7%
Mining of non-ferrous metal ores	0,9%	1,2%	2,1%	1,0%	1,1%	2,1%	**59**	**1,9%**	42	2,3%	56	4,2%
Food and beverage service activities	1,1%	0,8%	2,0%	0,5%	1,3%	1,8%	**60**	**1,6%**	47	2,2%	59	3,8%
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	0,6%	0,8%	1,4%	1,0%	1,5%	2,5%	**61**	**1,6%**	41	2,3%	58	3,9%
Manufacture of coke and refined petroleum products	0,1%	0,3%	0,5%	1,3%	0,3%	1,6%	**62**	**1,5%**	64	0,6%	63	2,1%
Forestry and logging, Fishing and aquaculture	0,5%	0,5%	1,1%	0,8%	0,5%	1,2%	**63**	**1,3%**	63	1,0%	62	2,3%
Real estate activities	0,4%	0,5%	1,0%	0,1%	0,5%	0,6%	**64**	**0,5%**	62	1,0%	64	1,6%
Activities of households as employers of domestic personnel	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	**65**	**0,0%**	65	0,0%	65	0,0%

* Employment activities; Travel agency, tour operator, reservation service and related activities; Services to buildings and landscape activities;
  Office administrative, office support and other business support activities

** Advertising and market research; Other professional, scientific and technical activities; Veterinary activities

*** Motion picture, video and television programme production, sound recording and music publishing activities;
  Programming and broadcasting activities

Table 5 - Share of inter-firm, intra-firm and total modern services value added on gross output by sector – Italy

Sector	Share (%) of inter-firm modern services value added on gross output in sector i			Share (%) of intra-firm modern services value added on gross output in sector i			Share (%) of modern services value added on gross output in sector i					
	T-KIBS	P-KIBS	KIBS	T-KIBS	P-KIBS	KIBS	T-KIBS		P-KIBS		KIBS	
	% Share	% Share	% Share	% Share	% Share	% Share	Rank	% Share	Rank	% Share	Rank	% Share
Scientific research and development	70,4%	3,7%	74,1%	0,7%	9,4%	10,1%	1	71,1%	8	13,1%	1	84,2%
Architectural and engineering activities; technical testing and analysis	69,9%	5,7%	75,6%	0,7%	3,7%	4,4%	2	70,6%	19	9,4%	2	80,0%
Other professional, scientific and technical activities; veterinary activities	65,8%	4,8%	70,5%	0,8%	5,1%	5,9%	3	66,6%	15	9,9%	4	76,4%
Computer programming, consultancy, and information service activities	63,3%	4,4%	67,7%	0,9%	6,4%	7,3%	4	64,2%	12	10,8%	5	75,0%
Manufacture of basic pharmaceutical products and pharmaceutical preparations	4,3%	2,4%	6,8%	17,4%	4,5%	21,9%	5	21,7%	40	6,9%	9	28,7%
Manufacture of computer, electronic and optical products	3,3%	2,3%	5,6%	13,0%	5,6%	18,5%	6	16,2%	28	7,9%	10	24,1%
Publishing activities	6,5%	4,8%	11,3%	8,0%	9,4%	17,4%	7	14,5%	6	14,2%	8	28,7%
Manufacture of other transport equipment	5,4%	4,4%	9,8%	7,8%	4,6%	12,4%	8	13,2%	23	9,0%	11	22,2%
Repair and installation of machinery and equipment	2,4%	2,6%	5,0%	9,4%	4,5%	13,9%	9	11,8%	38	7,1%	17	18,8%
Manufacture of motor vehicles, trailers and semi-trailers	6,3%	4,5%	10,7%	5,1%	4,7%	9,8%	10	11,4%	22	9,1%	13	20,5%
Manufacture of machinery and equipment n.e.c.	2,9%	2,6%	5,5%	8,3%	5,4%	13,7%	11	11,2%	27	8,0%	16	19,2%
Telecommunications	3,9%	2,8%	6,7%	7,2%	4,7%	11,8%	12	11,0%	31	7,5%	18	18,5%
Advertising and market research	6,8%	28,1%	34,9%	2,8%	5,9%	8,7%	13	9,5%	2	34,0%	6	43,5%
Manufacture of electrical equipment	2,6%	2,5%	5,1%	6,4%	4,7%	11,0%	14	9,0%	36	7,2%	25	16,1%
Motion picture, video, television programme production; programming and broadcasting activities	5,8%	5,0%	10,8%	3,2%	5,3%	8,4%	15	8,9%	14	10,3%	15	19,2%
Construction	3,1%	3,2%	6,3%	4,5%	4,3%	8,8%	16	7,6%	30	7,6%	27	15,1%
Water collection, treatment and supply	1,8%	2,2%	4,0%	5,7%	3,3%	9,0%	17	7,5%	45	5,5%	36	13,0%
Manufacture of chemicals and chemical products	1,3%	1,2%	2,5%	6,1%	3,4%	9,5%	18	7,4%	48	4,5%	39	11,9%
Manufacture of fabricated metal products, except machinery and equipment	2,3%	2,5%	4,8%	4,9%	4,9%	9,8%	19	7,2%	32	7,4%	30	14,6%
Sewerage, waste management, remediation activities	4,4%	6,8%	11,2%	2,8%	4,5%	7,3%	20	7,2%	11	11,3%	19	18,5%
Public administration and defence; compulsory social security	1,2%	2,1%	3,3%	5,8%	7,7%	13,5%	21	7,0%	17	9,7%	24	16,8%
Administrative and support service activities	4,6%	4,6%	9,2%	2,0%	5,8%	7,7%	22	6,6%	13	10,3%	23	16,9%
Wholesale trade, except of motor vehicles and motorcycles	3,4%	3,5%	6,9%	3,1%	8,5%	11,6%	23	6,5%	9	12,0%	20	18,4%
Manufacture of furniture; other manufacturing	2,4%	2,1%	4,5%	4,0%	6,1%	10,1%	24	6,4%	26	8,2%	29	14,7%
Legal and accounting activities; activities of head offices; management consultancy activities	5,6%	71,3%	76,9%	0,8%	1,7%	2,5%	25	6,4%	1	73,0%	3	79,3%
Air transport	2,5%	2,6%	5,1%	3,4%	8,8%	12,2%	26	5,9%	10	11,4%	21	17,3%
Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	2,2%	2,1%	4,3%	3,6%	6,3%	9,9%	27	5,8%	25	8,4%	32	14,2%

Table 5 – Cont.

Sector	Share (%) of inter-firm modern services value added on gross output in sector i			Share (%) of intra-firm modern services value added on gross output in sector i			Share (%) of modern services value added on gross output in sector i					
	T-KIBS	P-KIBS	KIBS	T-KIBS	P-KIBS	KIBS	T-KIBS		P-KIBS		KIBS	
	% Share	% Share	% Share	% Share	% Share	% Share	Rank	% Share	Rank	% Share	Rank	% Share
Manufacture of rubber and plastic products	2,3%	2,3%	4,6%	3,4%	4,8%	8,2%	28	5,7%	37	7,1%	37	12,8%
Printing and reproduction of recorded media	3,1%	3,0%	6,2%	2,5%	6,4%	8,9%	29	5,6%	21	9,4%	28	15,0%
Other service activities	3,4%	4,3%	7,8%	2,2%	5,4%	7,6%	30	5,6%	16	9,8%	26	15,4%
Manufacture of other non-metallic mineral products	2,5%	2,6%	5,0%	2,9%	5,3%	8,2%	31	5,3%	29	7,9%	35	13,2%
Mining and quarrying	2,2%	1,8%	4,0%	3,1%	3,2%	6,3%	32	5,3%	46	5,0%	46	10,3%
Activities auxiliary to financial services and insurance activities	3,4%	3,5%	6,9%	1,7%	12,4%	14,1%	33	5,1%	4	15,9%	12	21,0%
Electricity, gas, steam and air conditioning supply	2,3%	2,0%	4,3%	2,7%	4,2%	6,9%	34	5,0%	42	6,2%	42	11,2%
Human health and social work activities	2,6%	2,7%	5,3%	2,4%	3,7%	6,1%	35	5,0%	41	6,4%	41	11,4%
Manufacture of textiles, wearing apparel, leather and related products	2,9%	2,8%	5,6%	2,0%	5,7%	7,7%	36	4,9%	24	8,4%	34	13,4%
Warehousing and support activities for transportation	2,3%	2,5%	4,7%	2,7%	7,2%	9,8%	37	4,9%	18	9,6%	31	14,5%
Manufacture of paper and paper products	2,4%	2,5%	5,0%	2,3%	4,9%	7,1%	38	4,7%	33	7,4%	38	12,1%
Wholesale and retail trade and repair of motor vehicles and motorcycles	2,8%	3,1%	5,9%	1,8%	6,3%	8,1%	39	4,6%	20	9,4%	33	14,0%
Manufacture of basic metals	2,0%	2,5%	4,5%	2,6%	3,5%	6,0%	40	4,6%	44	5,9%	45	10,5%
Manufacture of food products; beverages and tobacco products	2,3%	2,6%	4,9%	2,2%	4,6%	6,8%	41	4,5%	35	7,2%	40	11,7%
Financial service activities, except insurance and pension funding	2,9%	2,3%	5,2%	1,6%	29,8%	31,3%	42	4,4%	3	32,1%	7	36,5%
Insurance, reinsurance and pension funding, except compulsory social security	2,6%	1,8%	4,4%	1,8%	13,9%	15,7%	43	4,4%	5	15,7%	14	20,1%
Postal and courier activities	1,7%	1,3%	3,0%	2,5%	11,9%	14,4%	44	4,2%	7	13,2%	22	17,3%
Forestry and logging	1,0%	2,0%	3,0%	3,2%	1,3%	4,5%	45	4,1%	52	3,4%	50	7,5%
Education	1,6%	2,2%	3,8%	2,5%	1,9%	4,4%	46	4,1%	49	4,1%	48	8,2%
Water transport	2,0%	2,0%	4,0%	2,0%	5,1%	7,1%	47	4,1%	39	7,0%	43	11,1%
Retail trade, except of motor vehicles and motorcycles	2,3%	2,5%	4,9%	1,3%	4,9%	6,1%	48	3,6%	34	7,4%	44	11,0%
Accommodation and food service activities	2,3%	2,2%	4,5%	0,9%	3,9%	4,8%	49	3,2%	43	6,0%	47	9,3%
Land transport and transport via pipelines	1,4%	1,3%	2,7%	1,6%	3,5%	5,1%	50	3,0%	47	4,8%	49	7,8%
Crop and animal production, hunting and related service activities	1,0%	1,4%	2,4%	1,9%	2,2%	4,1%	51	3,0%	51	3,5%	51	6,5%
Manufacture of coke and refined petroleum products	1,4%	1,4%	2,7%	1,2%	2,4%	3,6%	52	2,6%	50	3,8%	52	6,4%
Fishing and aquaculture	1,0%	1,1%	2,1%	1,0%	2,0%	3,0%	53	2,0%	53	3,0%	53	5,1%
Real estate activities	0,8%	0,8%	1,7%	0,2%	1,7%	2,0%	54	1,1%	54	2,5%	54	3,6%
Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	0,0%	0,0%	0,0%	0,0%	0,2%	0,2%	55	0,0%	55	0,2%	55	0,2%

Table 6 - Share of inter-firm, intra-firm and total modern services value added on gross output by sector – USA

Sector	Share (%) of inter-firm modern services value added on gross output in sector i		Share (%) of intra-firm modern services value added on gross output in sector i		Share (%) of modern services on gross output in sector i	
	KIBS		KIBS		KIBS	
	Rank	% Share	Rank	% Share	Rank	% Share
Computer systems design and related services	66	2,7%	1	81,3%	1	84,0%
Legal services	65	2,9%	2	80,5%	2	83,4%
Miscellaneous professional, scientific, and technical services	63	3,5%	3	72,9%	3	76,5%
Management of companies and enterprises	62	3,8%	4	71,2%	4	75,0%
Securities, commodity contracts, and investments	3	27,6%	5	12,3%	5	39,9%
Apparel and leather and allied products	2	29,6%	20	8,2%	6	37,9%
Computer and electronic products	1	31,9%	59	4,0%	7	35,9%
Other transportation equipment	4	27,1%	30	7,6%	8	34,7%
Publishing industries, except internet (includes software)	7	22,6%	11	9,1%	9	31,7%
Government	6	23,2%	40	6,6%	10	29,7%
Electrical equipment, appliances, and components	8	22,4%	42	6,4%	11	28,9%
Miscellaneous manufacturing	9	19,4%	16	8,6%	12	28,0%
Funds, trusts, and other financial vehicles	13	17,9%	9	9,7%	13	27,6%
Support activities for mining	5	23,7%	60	3,7%	14	27,5%
Data processing, internet publishing, and other information services	17	15,3%	6	11,6%	15	26,9%
Administrative and support services	12	18,8%	27	7,7%	16	26,5%
Machinery	11	18,9%	33	7,4%	17	26,3%
Federal Reserve banks, credit intermediation, and related activities	10	19,0%	38	7,1%	18	26,1%
Textile mills and textile product mills	20	14,3%	8	10,5%	19	24,8%
Broadcasting and telecommunications	15	15,9%	25	8,0%	20	23,9%
Printing and related support activities	16	15,6%	22	8,2%	21	23,8%
Performing arts, spectator sports, museums, and related activities	23	13,4%	15	8,6%	22	22,1%

Table 6 – Cont.

Sector	Share (%) of inter-firm modern services value added on gross output in sector i		Share (%) of intra-firm modern services value added on gross output in sector i		Share (%) of modern services on gross output in sector i	
	KIBS		KIBS		KIBS	
	Rank	% Share	Rank	% Share	Rank	% Share
Wholesale trade	21	14,1%	26	7,9%	**23**	**22,0%**
Furniture and related products	18	14,6%	36	7,2%	**24**	**21,8%**
Insurance carriers and related activities	14	16,0%	46	5,7%	**25**	**21,8%**
Fabricated metal products	19	14,4%	35	7,3%	**26**	**21,7%**
Motor vehicles, bodies and trailers, and parts	26	12,8%	21	8,2%	**27**	**21,0%**
Accommodation	27	12,7%	17	8,3%	**28**	**21,0%**
Nonmetallic mineral products	28	12,6%	19	8,2%	**29**	**20,8%**
General merchandise stores	48	9,4%	7	11,1%	**30**	**20,6%**
Plastics and rubber products	25	13,0%	34	7,4%	**31**	**20,3%**
Wood products	29	12,3%	29	7,7%	**32**	**20,0%**
Paper products	31	12,0%	37	7,2%	**33**	**19,2%**
Water transportation	37	10,4%	14	8,8%	**34**	**19,2%**
Other services, except government	22	14,0%	53	5,0%	**35**	**18,9%**
Amusements, gambling, and recreation industries	42	10,0%	13	8,8%	**36**	**18,7%**
Hospitals	40	10,2%	18	8,3%	**37**	**18,5%**
Other retail	35	10,7%	31	7,6%	**38**	**18,2%**
Warehousing and storage	24	13,3%	54	4,7%	**39**	**18,1%**
Waste management and remediation services	30	12,2%	48	5,5%	**40**	**17,7%**
Rail transportation	46	9,5%	23	8,1%	**41**	**17,7%**
Chemical products	43	9,9%	28	7,7%	**42**	**17,6%**
Rental and leasing services and lessors of intangible assets	53	8,7%	12	8,8%	**43**	**17,6%**
Food services and drinking places	56	8,2%	10	9,3%	**44**	**17,5%**

Table 6 – Cont.

Sector	Share (%) of inter-firm modern services value added on gross output in sector i		Share (%) of intra-firm modern services value added on gross output in sector i		Share (%) of modern services on gross output in sector i	
	KIBS		KIBS		KIBS	
	Rank	% Share	Rank	% Share	Rank	% Share
Food and beverage and tobacco products	52	9,1%	24	8,1%	**45**	**17,2%**
Social assistance	32	11,3%	43	5,9%	**46**	**17,2%**
Motor vehicle and parts dealers	49	9,4%	32	7,5%	**47**	**16,9%**
Educational services	33	11,1%	49	5,1%	**48**	**16,2%**
Ambulatory health care services	44	9,6%	41	6,5%	**49**	**16,1%**
Primary metals	50	9,2%	39	6,6%	**50**	**15,8%**
Utilities	38	10,4%	50	5,1%	**51**	**15,4%**
Construction	39	10,2%	51	5,0%	**52**	**15,2%**
Other real estate	47	9,4%	47	5,6%	**53**	**15,1%**
Pipeline transportation	41	10,1%	55	4,7%	**54**	**14,8%**
Other transportation and support activities	34	10,9%	62	3,5%	**55**	**14,5%**
Food and beverage stores	51	9,2%	52	5,0%	**56**	**14,1%**
Nursing and residential care facilities	54	8,3%	45	5,7%	**57**	**14,0%**
Forestry, fishing, and related activities	36	10,6%	66	2,4%	**58**	**13,0%**
Motion picture and sound recording industries	45	9,6%	65	3,1%	**59**	**12,7%**
Truck transportation	58	7,8%	56	4,7%	**60**	**12,4%**
Air transportation	55	8,2%	57	4,1%	**61**	**12,3%**
Transit and ground passenger transportation	57	7,9%	61	3,7%	**62**	**11,5%**
Oil and gas extraction	61	4,7%	44	5,8%	**63**	**10,5%**
Mining, except oil and gas	60	5,3%	58	4,1%	**64**	**9,4%**
Farms	59	5,6%	63	3,4%	**65**	**8,9%**
Petroleum and coal products	64	3,3%	64	3,2%	**66**	**6,5%**
Housing	67	1,1%	67	0,5%	**67**	**1,6%**

4. FINAL REMARKS

This article has mapped and described the generation of intra- and inter-firm modern services. Its main contribution is to develop a method of comprehensively quantifying the integration of KIBS into production in each economic sector. In addition to considering modern services acquired through purchases of inputs from sectors classified as such (inter-firm), services embodied through the hiring of employees who perform so-called modern service functions in the sector itself were also considered, although this sector is not classified as a producer of modern services (intra-firm).

The first relevant result is that a significant share of the wage bill of KIBS workers is found within other sectors (not classified as KIBS). Neglecting this result makes a great difference, as otherwise the actual share of workers with these characteristics in the wage bill is underestimated.

This study also shows that there are relevant differences between types of KIBS. The various sectors have quite different demand structures with respect to T-KIBS and P-KIBS. Given our theoretical discussion, the most relevant result is that the high-tech manufacturing sectors are the heaviest users of T-KIBS. Thus, the growth of these sectors invariably leads to increased demand for T-KIBS. As for P-KIBS, the complementarity between high-tech manufacturing and modern services is not clear. A possible explanation is the need for reviewing the list of occupations classified as P-KIBS. Low tech manufacturing, traditional services and primary sectors tend to present a smaller complementarity between both T-KIBS and P-KIBS related value added and gross output.

It is necessary to enlarge the sample of countries included in this study, even to check the proposed methodology, but the initial results reinforce the argument presented in the article, namely, that there is strong complementarity between manufacturing production — especially high-tech manufacturing — and modern services, indicating important directions for the design of development strategies.

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ANNEX A

Sectors and occupations classified as T-KIBS or P-KIBS in each country

BRAZIL

	T-KIBS	T-KIBS	T-KIBS	P-KIBS
Sectors	**Development of systems and other information services**	**Architectural, engineering, testing / technical analysis and R & D services**	**Other professional, scientific and technical activities**	**Legal, accounting, consulting and corporate headquarters activities**
Occupations	Applications programmers	Research and development managers	Advertising and public relations managers	Accountants
	Computer network and systems technicians	Physical and earth science professionals	Life science professionals	Financial and investment advisers
	Computer network professionals	Meteorologists	Agricultural technicians	Financial analysts
	Computer systems analyst	Chemists	Environmental protection professionals	Management and organization analysts
	Data entry clerks	Geologists and geophysicists		Policy administration professionals
	Database and network professionals not elsewhere classified	Mathematicians, actuaries and statisticians	Veterinarians	Personnel and careers professionals
	Graphic and multimedia designers		Sales, marketing and public relations professionals	Training and staff development professionals
	Information and communications technicians	Industrial and production engineers	Technical and medical sales professionals (excluding ICT)	Lawyers
	Information and communications technology operations and user support technicians	Environmental engineers	Technical and medical sales professionals (excluding ICT)	Judges
	Software and applications developers and analysts	Mechanical engineers		Legal professionals not elsewhere classified
	Software and applications developers and analysts	Chemical engineer		Philosophers, historians and political scientists
	Software and applications developers and analysts not elsewhere classified	Mining engineers, metallurgists and related professionals		Psychologists
	Software developers	Engineering professionals not elsewhere classified		Accounting and bookkeeping clerks
	Systems administrators	Electrical engineers		Statistical, mathematical and related associate professionals
	Web and multimedia developers	Electronics engineers		Valuers and loss assessors
	Web technicians	Telecommunications engineers		Legal secretaries
		Building architects		Accounting associate professionals
		Landscape architects		Statistical, mathematical and related associate professionals
		Product and garment designers		Payroll clerks
		Town and traffic planners		
		Cartographers and surveyors		
		Chemical and physical science technicians		
		Civil engineering technicians		
		Electrical engineering technicians		
		Chemical engineering technicians		
		Mining and metallurgical engineering technicians		
		Draughtspersons		
		Physical and engineering science technicians not elsewhere classified		

ITALY

Sectors	T-KIBS	T-KIBS	T-KIBS	T-KIBS	T-KIBS	P-KIBS
	Computer programming, consultancy and related activities; information service activities	**Architectural and engineering activities; technical testing and analysis**	**Scientific research and development**	**Advertising and market research**	**Other professional, scientific and technical activities; veterinary activities**	**Legal and accounting activities; activities of head offices; management consultancy activities**
Occupations	Information and communications technology operations and user support technicians	Engineering professionals (excluding electrotechnology)	Physical and earth science professionals	Architects, planners, surveyors and designers	Life science technicians and related associate professionals	Legal, social and religious associate professionals
	Software and applications developers and analysts	Electrotechnology engineers	Life science professionals	Sales, marketing and public relations professionals	Veterinarians	Financial and mathematical associate professionals
	Database and network professionals	Physical and engineering science technicians		Business services agents		Numerical clerks
						Finance professionals

USA

Sectors	KIBS	KIBS	KIBS	KIBS
	Legal services	**Computer systems design and related services**	**Miscellaneous professional, scientific, technical services and management of companies and enterprises**	**Miscellaneous professional, scientific, technical services and management of companies and enterprises (CONT.)**
Occupations	Lawyers, and judges, magistrates, and other judicial workers	Computer and information systems managers	Advertising and promotions managers	Chemists and materials scientists
	Paralegals and legal assistants	Computer and information research scientists	Marketing and sales managers	Environmental scientists and geoscientists
	Miscellaneous legal support workers	Computer systems analysts	Architectural and engineering managers	Physical scientists, all other
		Computer programmers	Natural science managers	Economists
		Software developers, applications and systems software	Management analysts	Miscellaneous social scientists, including survey researchers and sociologists
		Web developers	Market research analysts and marketing specialists	Miscellaneous life, physical, and social science technicians, including social science research asistants
		Computer support specialists	Operations research analysts	Designers
		Database administrators	Miscellaneous mathematical science occupations, including mathematicians and statisticians	Public relations specialists
		Network and computer systems administrators	Architects, except naval	Photographers
		Computer network architects	Aerospace engineers	Veterinarians
		Computer occupations, all other	Civil engineers	Veterinary assistants and laboratory animal caretakers
		Computer, automated teller, and office machine repairers	Computer hardware engineers	Advertising sales agents
			Electrical and electronics engineers	Chief executives and legislators
			Environmental engineers	General and operations managers
			Industrial engineers, including health and safety	Public relations and fundraising managers
			Mechanical engineers	Human resources managers
			Petroleum, mining and geological engineers, including mining safety engineers	Training and development managers
			Miscellaneous engineeers including nuclear engineers	Human resource workers
			Engineering technicians, except drafters	Accountants and auditors
			Biological scientists	Bookkeeping, accounting, and auditing clerks
			Medical scientists, and life scientsits, all other	Production, planning, and expediting clerks