How Can Services Improve Productivity? The Case of Brazil

Jorge Arbache
University of Brasilia

Rafael Moreira
SEBRAE

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Summary

In this paper, we examine the effects of the growing use of services as inputs of other sectors. Using Brazilian data, we find evidence that service inputs are productivity enhancing. However, we also find evidence that value services – those that add value to production – as opposed to cost services, are the ones that impact productivity. These findings imply that whether services are to contribute to development that will happen by turning value services more efficient and competitive.

Keywords: service sector, service input, manufacturing, extractive, productivity
JEL Codes: O14, N56, J24.

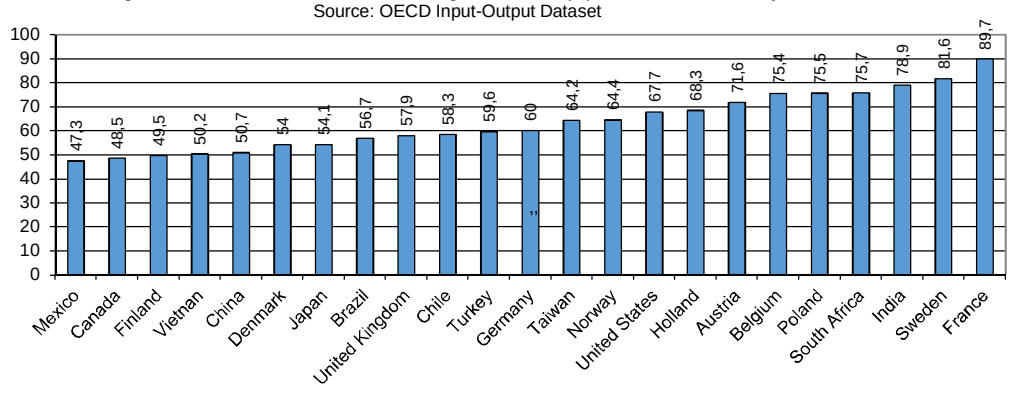
Correspondent author: Jorge Arbache, Department of Economics, University of Brasilia, Brasilia, DF, Brazil. jarbache@gmail.com.

1. Introduction

Services are becoming increasingly relevant in economic policy agendas due to their growing importance in explaining the performance of enterprises, the type and form of participation of countries in global value chains, prospects for sustained growth and growth differences across countries (Rodrik 2015, Dadush 2015, OECD 2014, Arbache 2014).

New production technologies and production organization, as well as changes in consumption patterns and in the nature of manufactured goods are bringing industry and services closer together. In fact, empirical evidence suggests that goods and services are merging together through an increasingly synergetic and symbiotic relationship to give rise to a third kind of product that is neither a traditional industrial good nor a conventional service (Arbache 2014). This complementariness between industry and services requires both activities to be competitive for them to benefit from each other. To the extent that services inputs already comprise the bulk of value added in manufacturing, as suggested by Figure 1, having a competitive service sector seems to be a critical factor for economies to grow more and more sustainably.

Figure 1: Share of services in manufacturing value added (%) - 2005 or most recent year
Source: OECD Input-Output Dataset



An important component of the rise of services as inputs to other sectors can be explained by the increasing importance of decentralization of production and outsourcing (Berlingieri 2013). But modern production technologies, market consolidation at the global level, ICT improvement and cheaper transportation

costs have also contributed to explain the rise of services as inputs to other sectors (Arbache 2014, Groot 2001).

Although a large service sector was always seen as a trait of developed economies, empirical evidence suggests that services are also becoming increasingly predominant in countries at low levels of development, i.e., a phenomenon of premature servicification of developing economies seems to be in course (Eichengreen and Gupta 2009, Rodrik 2015).

However, empirical evidence also suggests that service segments matter for the course of economic development. Accordingly, while the emergence of basic services segments such as transport and retail are associated with low levels of income, sophisticated segments, such as professional and business services, emerge at high levels of income (Eichengreen and Gupta 2009).

Perhaps even more noteworthy, data also suggest the prevalence of a close relationship between the share of professional and business services on GDP and manufacturing density, as measured by manufacturing value added per capita (Arbache 2012).

From the developing countries' perspective, one issue associated with premature servicification is whether and how it contributes to structural transformation. For that to happen, productivity growth in services should be higher than that of other sectors, which is the direct impact, or service inputs should be productivity enhancing and therefore be a driver of competitiveness of other sectors. This is the indirect impact.

In this paper, we analyze the potential impacts of services to development from the perspective of their indirect impacts. We test this empirical issue for the case of Brazil, an emerging economy where the service sector is by and far the largest economic activity, already comprising about 70% of GDP. Besides being the largest sector, services are already critical inputs to other sectors. Comparable data to that of Figure 1 show that the services share to value added in

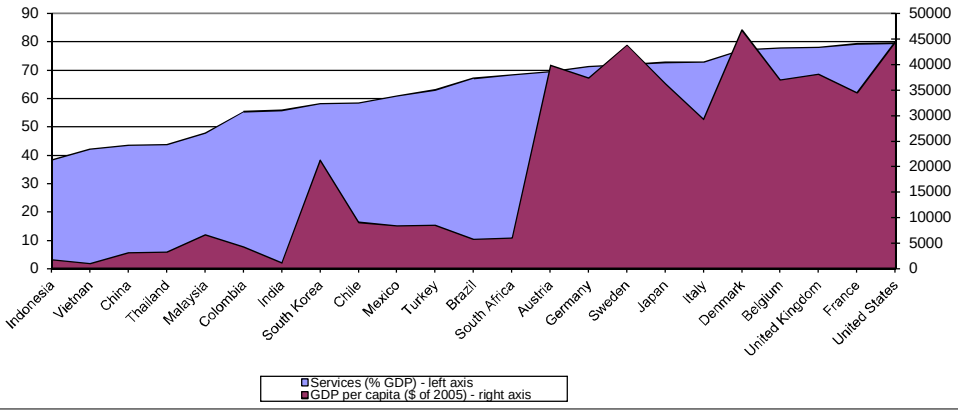
manufacturing is about 57%, a figure comparable to that of developed economies. Thus, having a competitive service sector would be critical for Brazil and perhaps to other emerging economies that are experiencing premature servicification.

This paper is organized as follow. The next session presents some basic facts of the service sector in Brazil. Section 3 presents the database and methods. Section 4 presents the results. Section 5 concludes.

2. The service sector in Brazil

The share of the service sector in GDP is disproportionately high in Brazil, having reached levels seen in advanced economies (Figure 2). The share of services is high not only in GDP, but also in employment – 73% of the workforce is engaged in services and 82 in 100 new formal jobs are in the service sector. In other words, Brazil can already be characterized as a service economy, and anything that happens in this sector will affect the economy as a whole and, in particular, the sectors most dependent on services.

Figure 2: Income per capita and services share on GDP (%) - 2011
Source: Arbache (2014)



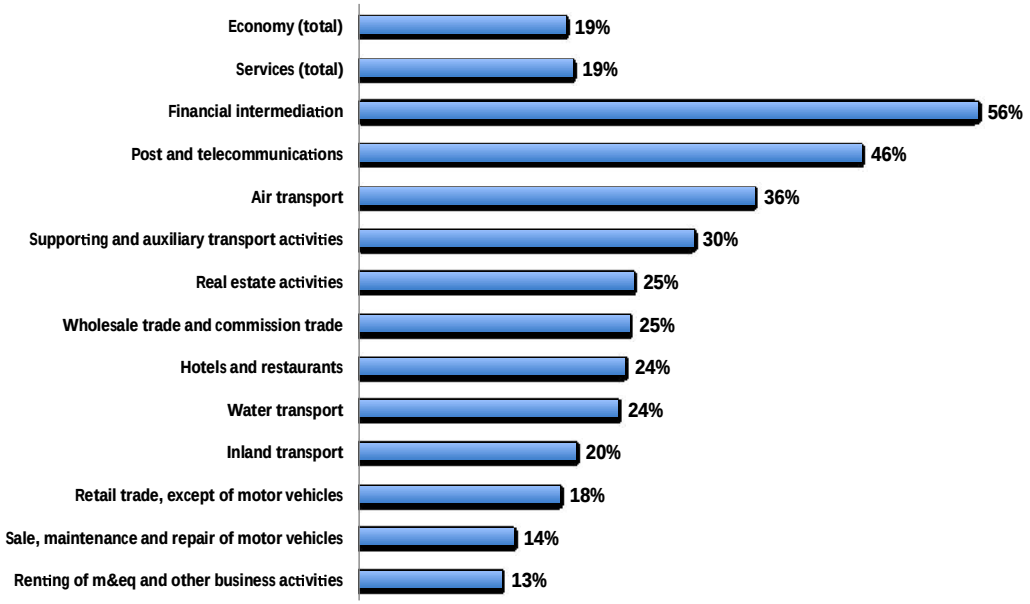
Arbache (2015a) argues that at least part of this anomaly can be explained by the impact of the economic crises of the 1980s and 1990s on manufacturing and the loss of competitiveness of this sector once the economy opened up in the early 1990s. That loss was, at least in part, a consequence of several years of import substitution industrialization strategy in which manufacturing was highly

protected from competition and perhaps excessively focused on the internal market.

While the manufacturing sector shrank rapidly therein, the service sector expanded and replaced it in terms of GDP and job opportunities. However, that replacement was not neutral as the segments of services that expanded the most were those of final consumption, usually characterized by low productivity levels (Arbache 2015b).

Indeed, the labor productivity in the services sector in Brazil is only about 19% that of United States' (Timmer 2012) (Figure 3). As one could expect, business services, such as financial intermediation and telecom, have a relatively low productivity gap, while the final consumption services gap is high.

Figure 3: Labor productivity in Brazil in selected sectors relative to the United States', 2011 in US dollars.



Source: World Input-Output Database (Timmer 2012)

3. Data and methods

To investigate whether and how the service sector is contributing to enhance productivity in Brazil, we use data of the Annual Industrial Survey (PIA)

published by Brazil's statistical institution, IBGE (2014). The dataset covers 29 extractive and manufacturing industries for the period of 1996 to 2012[1].

PIA provides details on sectoral intermediate consumption (IC), revenues and number of workers, which allow us to examine the effect of services inputs on labor productivity. More specifically, intermediate consumption is composed by:

i. raw and auxiliary materials and components purchases;
ii. parts, accessories and small tools consumption;
iii. electricity purchase;
iv. fuel consumption;
v. industrial services provided by third parties;
vi. maintenance and repair of machinery and equipment related to production and provided by third parties;
vii. rents and leases;
viii. machinery, equipment and vehicle leasing costs;
ix. advertising expenses;
x. freights and reels;
xi. insurance premium;
xii. non-industrial services provided by third parties (lawyers, cleaning, security, etc.);
xiii. royalties and technical assistance;
xiv. sales expenses;
xv. water and sewage costs;
xvi. travel and representation expenses; and
xvii. other operating costs and expenses.

IBGE started to present intermediate consumption as a variable in 2007. For that reason, IC was constructed using the disaggregated variables described above. We define "intermediate consumption of services" (ICS) as the expenses described on items (v) through (xiii), plus financial expenses, which do not originally compose intermediate consumption, but are an important service component in the cost structure of manufacturing.

[1] For the list of the 29 sectors covered, see the Annex.

Sales, water and sewage, and travel and representation expenses are also included as part of ICS; however, up until 2006, IBGE included them in the aggregate variable "other operating costs and expenses". Since it is not possible to separate them out for the period of 1996 to 2006, these expenses are not included in our analysis.[2]

As the effect of the rise of services as inputs on the performance of industries depends on many factors, different industries might see different results depending on their characteristics and the type of services they consume. To better understand this phenomenon, it might come in hand to categorize services in smaller, more homogeneous groups.

Arbache (2014) proposes a division of services in two groups based on their role as inputs. For this purpose, the author classified services into two different yet complementary families. The first family, named cost services, refers to functions that affect production costs, including logistics and transportation, general infrastructure services, storage, repair and maintenance services, production outsourcing services in general, IT in general, credit and financial services, travel, accommodation, food products, distribution, among others.

The second family, named value services, refers to functions that contribute to adding value, differentiating and customizing products and, therefore, raising their market price and increasing labor productivity and return on capital. The group is usually composed of services that require relatively high levels of human capital and other capabilities. It includes R&D, design, engineering and architecture projects, consulting services, software, specialized technical services, high-end IT services, branding, marketing, trading, among others.

Certainly, better and/or cheaper cost services might help one to achieve greater production efficiency, but they do not usually contribute to product

[2] From 2007 to 2012, period for which we have data available for these items, they represented around 4% of the total IC and 14% of the total ICS.

customization or value creation in competitive markets. In principle, the longer the supply chain of a product, the greater the importance of cost services for its competitiveness. Cost services are also relevant for commoditized goods such as corn and soybeans crops, iron ore, oil, economy cars, clothes, and textiles. On the other hand, the more sophisticated and differentiated a product is, the greater the importance of value services.

In order to isolate the effect of different kinds of services on production, the ICS was split in value and cost services. Following Arbache (2014), we classified as value services items that we believe can contribute the most to product differentiation and value creation, i.e., royalties and technical assistance and advertising expenses.

The group of cost services are composed of activities that usually contribute to cost reduction, which include industrial services, maintenance and repair, rents and leases, leasing costs, freights and reels, insurance premium, and non-industrial services and financial expenses.

Value added (VA), which is used to calculate labor productivity, is obtained by subtracting intermediate consumption from gross output. As it happens with IC, gross output is only presented as an aggregate variable from 2007 onwards. For that reason, for the whole period covered (1996-2012), gross output was constructed as the sum of net sales, rent and lease revenues, other operating revenues, and change in inventory of finished and unfinished products; minus the cost of goods purchased for resale. All monetary values were converted to 2012 Brazilian Reais using Fundação Getúlio Vargas' (FGV) wholesale price index for industrial products, IPA-OG.

One may expect that the more homogenous a product is, the more important cost cuts will be for competitiveness. The other way round also seems reasonable, i.e., competitiveness of more sophisticated products is expected to rely more on value services.

To control for sectoral characteristics that might affect productivity, we employ data of years of schooling, tenure on the job, and share of small businesses, all taken from Brazil's Ministry of Labor and Employment annual administrative record RAIS (Annual Social Information Report). We also use innovation data taken from IBGE's Innovation Survey, PINTEC (IBGE 2013), and export data made available by the Brazilian National Confederation of Industry (CNI 2015). All variables used in the analysis are described in Table 1.

Table 1 – Description of variables

Variable	*Representation*	*Description*	*Availability*	*Source*
Labor productivity	prod	$\frac{VA_{it}}{L_{it}}$ VA is the value added by the sector, and L its number of workers.	1996-2012	PIA-IBGE (2014)
Years of schooling	schooling	Average years of schooling of workers in a given sector.	1996-2012	RAIS (MTE 2015)
Tenure on the job	tenure	Workers' average tenure on the job, in months in a given sector.	1996-2012 (except for one sector for the period of 1996 to 2005)[3]	RAIS (MTE 2015)
Presence of small businesses	SME	Dummy variable. SME=1 if more than 75% of enterprises in the sector are small businesses and SME=0 if not. We use Brazil's Small Business Agency (Sebrae 2013) definition of manufacturing microenterprise, which is a business with up to 19 workers.	1996-2012	RAIS (MTE 2015)
Average number of patents granted to firms in the sector.	patent	Since there is only data for one year (2008), we use this number to all years as a proxy of how innovative the sector is	2008. Data on patents for extractive industries are all aggregated in one sector, so we use the same value for CNAEs from 05 to 09.[4]	PINTEC (IBGE 2013)

[3] The sector "support activities for mining" only presents consistent values for the variable in question from 2006 to 2012.

[4] *Classificação Nacional de Atividades Econômicas* (National Classification of Economic Activities).

Export coefficient	export	Share of sectoral total production exported.	1996-2012, except for CNAEs 09 and 33.	CNI (2015)
Service consumption as a share of total intermediate consumption	serv	$\frac{ICS_{it}}{IC_{it}}$	1996-2012	PIA (IBGE 2014)
Value service consumption as a share of total intermediate consumption	value_serv	$\frac{ICVS_{it}}{IC_{it}}$ $ICVS_{it}$ is the total intermediate consumption of value services of sector *i* on year *t*	1996-2012	PIA (IBGE 2014)
Cost service consumption as a share of total intermediate consumption	cost_serv	$\frac{ICCS_{it}}{IC_{it}}$ $ICCS_{it}$ is the total intermediate consumption of cost services of sector *i* on year *t*	1996-2012	PIA (IBGE 2014)

Source: authors' elaboration

If we find that the serv coefficient is statistically significant, then we will conclude that services can indeed contribute to structural transformation and competitiveness. On the service segments, if we find that the use of value and cost services as inputs have different coefficients, then we will conclude that they influence development differently and, therefore, there is room for policy from both the supply and demand sides. Based on our analyses, we should expect the value services coefficient to be larger than the cost services'.

To test those hypotheses, we use the following general models:

$$\ln prod_{it} = \alpha + \beta_1 X_{it} + \beta_2 serv_{it} + \varepsilon_{it} \quad (1)$$

$$\ln prod_{it} = \alpha + \beta_1 X_{it} + \beta_2 cost\_serv_{it} + \beta_3 value\_serv_{it} + \varepsilon_{it} \quad (2)$$

In this model, each industry is represented by the subscript *i* and years are represented by t. X_{it} represents a vector of specific characteristics that might affect labor productivity. This involves schooling and tenure on the job, the share of small businesses, the average number of patents granted and the export coefficient.[5] The variable $serv_{it}$ refers to the amount of services, in general, consumed as inputs as a proportion of total intermediate consumption in the sector studied. Variables $cost\_serv_{it}$ and $value\_serv_{it}$ refer to the consumption of cost and value services, respectively, as a proportion of total intermediate consumption in the sector of interest.

We apply these models to a panel of 29 manufacturing sectors in 17 years, with a total of 493 observations. We only have data for "oil and natural gas extraction" starting in 2005. Moreover, because of its nature and the price hikes of oil over the 2000s, this sector presents extreme variability in its level of labor productivity, which is considerably greater in magnitude than the other sectors'.[6] For that reason, we decided to drop the sector from our analysis.

The sector "maintenance, repair and installation of machinery and equipment" presents negative value added in 2002, so we decided to drop this observation. Finally, we do not have reliable data for tenure on the job for the "support activities for mining" for the period of 1996 to 2005.

For those reasons, we end up with a panel of 465 observations – 26 sectors covered for 17 years, 1 for 16 years, and another one for 7 years.

4. Results

Initially, we tested pooled ordinary least squares (OLS) models with control variables. Results are reported in Table 2. In the two models that the services variable was tested, service input presented a significant and positive coefficient. These results suggest that service input and therefore production

[5] There is a vast literature on how these variables might affect productivity (Lucas 1988; Gonzaga 1998; Arbache 2005, inter alia).

[6] The coefficient of variation (CV) of the natural log of labor productivity of the sector during the eight years for which we have data on it is of 1.26, whereas other sectors present a CV of 0.2.

decentralization are not neutral on productivity. In fact, they suggest that sectors that consume services the most are supposed to have high levels of productivity. The coefficients of value services inputs are substantially larger than that of cost services, thus suggesting that they are indeed a critical determinant of productivity.

These findings corroborate the idea that services and industries are highly interconnected and interdependent, and that the former might affect the performance of the latter. By interdependent, we mean that turning services more competitive and adequate for clients' needs will probably have an impact on clients' performance.

Table 2 – Pooled OLS results

	(1)	*(2)*	*(3)*	*(4)*	*(5)*
Variables	*OLS1*	*OLS2*	*OLS3*	*OLS4*	*OLS5*
serv	2.066***		2.541***		
	(0.638)		(0.517)		
cost_serv		1.421		1.657***	1.617**
		(0.880)		(0.581)	(0.597)
value_serv		6.080***		6.552***	6.696***
		(1.403)		(1.338)	(1.411)
schooling	0.026	0.033	-0.005	0.004	0.010
	(0.062)	(0.048)	(0.065)	(0.052)	(0.088)
time	0.025***	0.027***	0.027***	0.028***	0.029***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
SME	-0.475**	-0.315**	-0.274*	-0.170	-0.146
	(0.182)	(0.117)	(0.142)	(0.102)	(0.099)
export			0.742*	0.923**	0.990**
			(0.420)	(0.405)	(0.414)
patent			4.989**	3.580**	3.608*
			(2.004)	(1.676)	(1.985)
Constant	9.513***	9.298***	9.064***	8.976***	8.984***
	(0.706)	(0.580)	(0.572)	(0.519)	(0.604)
Year dummies	No	No	No	No	Yes
Observations	465	465	442	442	442
R^2	0.646	0.684	0.739	0.773	0.787

Cluster-robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Source: authors' elaboration.

It is noteworthy that the services input coefficient always appears with a positive sign, even though their performance is generally distant from that of developed

countries as discussed above. This is probably explained by the fact that, in a globalized economy, production technology is mostly given. Roughly speaking, there are certain ways of producing things and deviating from them might not be feasible. Even if depending on inefficient services is costly, one might still be better off using them than verticalizing production. Besides having to deal with increasing coordination costs (Coase 1937), firms will probably not have the knowhow required to produce everything internally if the usual production technology involves outsourcing. In other words, firms might not have the option to not decentralize production.

Since our data is in panel format, we might have problems of serial correlation and heteroscedasticity. For that reason, feasible generalized least squares (FGLS) and fixed effects (FE) models might be more appropriate for our analysis. To control for those potential problems and test for the robustness of our findings, we report the results to FGLS and FE models in Table 3. For both kinds of models, we assume that errors are autoregressive in one period. For the FGLS models, we also assume intra-panel correlation of errors.

Once again, we find that greater consumption of services in general and value services in particular are productivity enhancing. The consumption of cost services, however, presents a positive and significant coefficient in the FGLS models, but not for the FE, which show an insignificant coefficient. This result might show that sectors that consume more cost services are, in general, more productive, but those that increased their consumption of these activities have not had their productivity affected.

Table 3: Results for the FGLS and FE models

Variables	*(1) FGLS1*	*(2) FGLS2*	*(3) FGLS3*	*(4) FE1*	*(5) FE2*
serv	1.658***			0.492***	
	(0.074)			(0.188)	
cost_serv		0.604***	0.492***		-0.027
		(0.128)	(0.119)		(0.194)
value_serv		5.923***	6.556***		5.668***
		(0.356)	(0.417)		(0.820)
schooling	0.028**	0.004	0.057**	0.022	0.032
	(0.011)	(0.017)	(0.024)	(0.020)	(0.020)
tenure	0.012***	0.012***	0.011***	0.003	0.002
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)
SME	-0.225***	-0.192***	-0.140***	-0.016	-0.004
	(0.018)	(0.020)	(0.011)	(0.051)	(0.048)
export	1.142***	0.815***	0.812***	-0.187	-0.147
	(0.092)	(0.106)	(0.125)	(0.243)	(0.236)
patent	4.940***	-0.360	0.573		
	(0.413)	(0.584)	(0.557)		
Constant	9.764***	10.453***	10.127***	10.947***	10.853***
	(0.118)	(0.178)	(0.160)	(0.122)	(0.110)
Year dummies	No	No	Yes	No	No
Number of sectors	26	26	26	26	26
Observations	442	442	442	416	416

Standard errors corrected for AR(1) errors in parentheses. For the FGLS models, standard errors are also corrected for intra panel correlation.

*** p<0.01, ** p<0.05, * p<0.1

Source: authors' elaboration

Table 4 presents the results for data in first difference.[7] We find some evidence that value services increase as a share of total intermediate consumption is associated with an increase in productivity. This result, together with the fixed effects', corroborates the idea that not only the level of value service consumption, but also the growth of it, is productivity-enhancing to extractive and manufacturing sectors.

[7] Patent was dropped because there is only one observation in time.

Table 4: Results for first-difference models

Variables	*(1)* *FD1*	*(2)* *FD2*	*(3)* *FD3*
D.schooling	0.077***	0.085***	0.085
	(0.024)	(0.026)	(0.058)
D.tenure	0.003	0.000	0.002
	(0.004)	(0.002)	(0.003)
D.SME	-0.080	-0.069	-0.071**
	(0.049)	(0.048)	(0.032)
D.export	-0.104	-0.087	0.348
	(0.436)	(0.461)	(0.337)
D.cost_serv		-0.249	-0.013
		(0.292)	(0.234)
D.value_serv		7.307*	6.632*
		(4.034)	(3.811)
D.serv	0.394		
	(0.239)		
Constant	-0.018**	-0.021**	0.035
	(0.007)	(0.008)	(0.036)
Observations	416	416	416
R^2	0.037	0.191	0.381
Year dummies	No	No	Yes

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: authors' elaboration

5. Concluding remarks

If services are indeed relevant for the competitiveness of other sectors in Brazil, then improving services' performance will be critical for structural transformation and growth prospects. This finding seems to be especially critical for Brazil, a country where servicification is already acute and where productivity in general is low.

As we identified that value services are especially important for productivity enhancement, then improving value services competitiveness will contribute a great deal for the economy's competitiveness. As we also found that cost services have a minor if any impact on productivity, policies that encourage investment in value service intensive sectors will probably have a larger impact on growth prospects. Therefore, the composition of an economy from the service input perspective is a good indicator of its growth potential.

This is still a work in progress. The next step will be to explore sectoral impacts of service inputs. In particular, we aim at comparing extractive and manufacturing sectors, and sectors according with their technological intensity.

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Annex

Table 5– Sectors covered by the Annual Industrial Survey (PIA-IBGE)

CNAE	Description
05	Coal mining
06	Oil and natural gas extraction
07	Mining of metal ores
08	Mining of non-metallic mineral ores
09	Support activities for mining
10	Manufacture of food products
11	Manufacture of beverages
12	Manufacture of tobacco products
13	Manufacture of textiles
14	Manufacture of wearing apparel
15	Preparation of leather and manufacture of leather artifacts, travel items and footwear
16	Manufacture of wood products
17	Manufacture of pulp, paper and paper products
18	Printing and reproduction of recorded media
19	Manufacture of coke, petroleum derived products and biofuels
20	Manufacture of chemical products
21	Manufacture of medicinal chemicals and pharmaceuticals
22	Manufacture of rubber products and plastic material
23	Manufacture of non-metallic mineral products
24	Metallurgy
25	Manufacture of metal products, except machinery and equipment
26	Manufacture of computing equipment, and electronic and optical products
27	Manufacture of machinery, and electrical material and apparatus
28	Manufacture of machinery and equipments
29	Manufacture of motor vehicles, trailers and truck bodies
30	Manufacture of other transport equipment, except motor vehicles
31	Manufacture of furniture
32	All other miscellaneous manufacturing
33	Maintenance, repair and installation of machinery and equipment

Source: IBGE 2014.