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Article

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Multiple trends of tertiarization: A comparative input–output analysis of the service sector expansion between Brazil and United States

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Abstract

The service sector expansion has shown to be a multiple trend process, producing distinct sectorial compositions. The present paper aims to make a comparison between two large economies in different stages of development with an extensive service sector (Brazil and United States), by focusing on final and intermediary demand changes and sectorial productivity as well. Input–output matrices for Brazil and United States were used and two applications were carried out: structural decomposition analysis and total factor productivity. Main results are as follows. Firstly, the growth in services was fostered by several factors, among which household consumption assumes an important role for both countries. Second, inter-industrial linkages play a major role only for United States. Thirdly, there is now evidence of cost disease for Brazil. Finally, productivity is lower in Brazil, nonetheless labor productivity increased above the average in some service sectors.
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Keywords: Tertiarization; Input–output; Development

Resumo

A expansão do setor de serviços tem se mostrado um processo de múltiplas tendências, produzindo composições setoriais distintas. O presente artigo tem por objetivo fazer uma comparação entre duas grandes econômicas em diferentes estágios de desenvolvimento e com um extensivo setor de serviços (Brasil e Estados Unidos), focando em mudanças na demanda intermediária, final e também

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na produtividade setorial. Matrizes insumo-produto do Brasil e Estados Unidos foram utilizadas e duas aplicações foram realizadas: análise de decomposição estrutural e produtividade total dos fatores. Os principais resultados são os seguintes. Primeiramente, o crescimento do setor de serviços foi fomentado por diversos fatores, entre os quais o consumo das famílias assume papel importante para ambos os países. Em segundo lugar, as ligações inter-setoriais exercem um papel de destaque apenas para os Estados Unidos. Terceiro, não existe evidência da doença dos custos para o caso do Brasil. Finalmente, a produtividade é mais baixa no Brasil, embora a produtividade dos serviços tenha crescido acima da média para alguns setores de serviços.
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Palavras-chave: Terciarização; Insumo-Produto; Desenvolvimento

1. Introduction

The understanding of the tertiarization process involves understanding the tertiary activities composition, and its heterogeneity. Those variances manifest themselves in multiple ways related to different levels of economic development. In general, the maturity degree of each economy has effect on its productive structure, and consequently it produces effects on the composition and dynamism of the tertiary sector. Although the tertiary sector has constituted a world phenomenon whose economic determinants have been present in several countries, the features composing it – productivity, level of labor skill, growth level of value added and value of gross output – are different in developed and developing countries. Such characteristics reflect a set of historical and socioeconomic factors underlying the expansion of this sector, which have variously combined the effects of variations in final and intermediary demands, as well as differences in productivity between sectors.

For developed countries, the tertiary expansion is described by Bell (1976) from the emergence of the post-industrial society that has been characterized by income growth and, as a result, by an increased consumption of services, such as healthcare, leisure, education and cultural activities. In a society such as this, the proportion of manual and unskilled labor is reduced and the majority of population is dedicated to produce intangibles.

On the other hand, developing countries have experienced population growth and migration of rural areas to urban areas since the 1950s (Paiva, 1986). According to Pandit and Casetti (1989), these changes have given room to an increased labor supply that could not be absorbed by manufacturing in these countries. As a result, the service sector has swollen with low-productivity labor in traditional activities and even in informal activities. This process was named by Weller (2004) as a spurious growth in services sector associated with low-quality labor.

However, as Weller (2004) highlights, it is not correct to assume that all developing countries experience only spurious services sector's growth, and equally, it is not correct to assert that tertiarization carried out in industrialized economies is purely genuine or solely represented by high-skilled labor, able to produce high aggregate value. Each country and each tendency may be analyzed distinctly. There are several trends related to the tertiarization process, and all economies have spurious and genuine processes of varied proportions simultaneously, according to their development level (Weller, 2004).

In this regard, not only the total share of services in total economic activity or employment is important, but also what is inside the tertiary matters for sustainable economic growth. This perspective is in line with another broad area of the literature, analyzing the relationship between structural change, productivity and economic growth.[3] In this view, despite well-documented patterns of structural change for developed countries (for instance, Jorgenson and Timmer, 2011), with evidence of some services contributing positively for economic growth, similar statements cannot be extended to the developing world.

In this sense, the rising services participation in developing countries suggests signals of a premature process of deindustrialization, as pointed out by Rodrik (2015), combined with the rise of spurious services. Brazil is one of those countries, which occupies the seventh position in the global GDP (2.35 trillion dollars at 2014 prices), and reached 70% of value added in services in 2013. According to Squeff and Negri (2014), there is some consensus that deindustrialization process began in the 80s, nonetheless its consequences for the economy are still an open question. In this context, the present work aims to understand the driving forces of the services sector growth in Brazil, and

[3] For a literature review, see Krüger (2008) and Herrendorf et al. (2014).

how it can be different from a develop country. In view of such circumstances, we make a comparison between two economies: Brazil and United States, the latter chosen as the reference economy.[4] Focusing on potential causes to services sector growth, the assessment of the productive structures in these two countries will be carried out by the input–output matrices for 2000 and 2005,[5] which were made available by the Organization for Economic Cooperation and Development (OECD, 2010a).

The proposed methodology includes two traditional input–output methods: structural and total factor productivity decompositions. Compared to previous literature analyzing structural change toward services and productivity,[6] this paper advances in two ways: first, by taking into account simultaneously supply, demand and intraindustrial effects; and second, by comparing two countries in different stages of development and different levels of inter-sectorial integration.[7]

In addition to the introduction, this paper is organized as follows: (i) Section 2 presents a review of the literature on the economic causes of tertiarization; (ii) Section 3 describes the methodology used here, as well as data of the empirical analysis; (iii) Section 4 analyses results obtained and; (iv) Section 5 reveals major conclusions.

2. Tertiarization: economic determinants

The residual concept of the service sector refers back to the classification of economic sectors. Fisher (1933) broke the economy into: (i) the primary sector, encompassing agriculture and livestock farming; (ii) the secondary sector, manufacturing and; (iii) the tertiary sector, which includes all remaining activities not classified in those two previous sectors. Later on, Clark (1940) started using the term "services" to encompass all activities included within the tertiary sector, and treated this sector as a complement of the others. According to Kon (2004), this latter definition has led to a distinct range of activities to be classified in the same category, which ranged from commerce and domestic services to health, education, as well as research and development activities.

This heterogeneous set of activities included in the tertiary sector does not exhibit clearly shaped features. For this reason, the debate on the economic role of services has not yet been appropriately integrated into the realm of economic theory. Nevertheless, the term tertiary is still in use to designate all activities other than those within agricultural, livestock raising and manufacturing (Delgado, 2005). Therefore, the expanding tertiary sector has become recognized as tertiarization and was initially associated with a widened final demand for services, due to increased income and improvement in the living standards of populations. Such a situation would be a result of the high-income elasticity of demand as proposed by Fisher (1933) and Clark (1940).

Although the increased demand for final services could have explained the expanding service sector, the consequences of this sectorial employment composition was not clear enough, which led Baumol (1967) to question one of the most intriguing aspects of this sector – its low productivity. For this author, the stagnant productivity of tertiary activities would account for the expanding employment in this sector, which needed more workers as compared to the other sectors in each period of their increasing productivity.

As pointed out by Sánchez (2010), productivity differences between sectors and the effect of increased income were able to explain the growth of service sector until the 1980s, mainly in the developed economies. However, since then, requirements of a flexible production system have introduced new service demands. In this context, using services as production inputs for it and for the other two sectors, intermediary demand has increased. Consequently, the interaction and synergy between the secondary and tertiary sectors has been considered as a source of dynamism for modern economies (Illeris and Philippe, 1993; Greenhalgh and Gregory, 2001; Braibant, 2002; Siddiqui and Saleem, 2010).

Although each of these explanations have evolved in a specific socioeconomic context aiming at understanding different moments of services expansion, it is possible to state that tertiarization is influenced by multiple trends acting

[4] United States is the world's largest economy with a GDP of 17.42 trillion dollars in 2014, and reached 78% of valued added in services in 2013. Those are the latest data available according to World Bank (2015).

[5] The limitation of period of analysis is due to the existence of consistent data that allow the comparison of input-output matrices at different time points.

[6] Previous studies includes Timmer and de Vries (2009), Mcmillan and Rodrik (2011), Bosworth and Collins (2008) and de Vries et al. (2012).

[7] Using the methodology of the field of influence, Souza et al. (2012) show that in the case of Brazil, the service sector is still poorly integrated with the rest of the economy, unlike what happens to the United States where the most important links production chain spread over all sectors.

simultaneously for their expansion (Weller, 2004). Summarizing the set of factors described, the three major economic dimensions related to the growth of services are defined as follows: (i) changes in final demand; (ii) productivity differences between sectors and; (iii) changes in intermediary demand (Schettkat and Yocarini, 2003; Wölfl, 2005; Sánchez, 2010). Further down, each of these dimensions is detailed.

2.1. Final demand

In his reflections on the British economy, Marshall (1890) has anticipated the tertiarization movement. According to him, services of all kinds have appeared in England after 1851, such as medical, musical, theater and transport services, for which technological advancements did not bring productivity gains. Therefore, Marshall (1890, p. 325) predicts that: "*if the necessities that they* (the mentioned activities) *provide increase proportionately to general wealth, they are expected to absorb an increasing proportion of the industrial population*".

The increasing demand for services resulting from income growth was perceived by Fisher (1933) and Clark (1940) as a consequence of economic development. For these authors, development involves progression through three stages: from farming to manufacturing activities, and from the latter to the service economy. The latter stage would occur as a result of high income elasticity of services, i.e., an increasing income level would lead to an expanding demand for services, which, in turn, would expand the tertiary sector, to the extent that consumer preferences, priorities and price variations occur (Daniels, 1993).

Such effect would be an adaptation of Engel's Law, which states that the higher the income, the smaller the proportion spent with food (Sánchez, 2010). According to Fuchs (1968), an increased final demand involves a relation between expenditure patterns and levels of income. This is because as income increases, the demand for products tends to increase more slowly than that for services, which amplifies the relevance of services in the economy. In this case, the demand for leisure, health, education, transport services, among others, increases (Wölfl, 2005).

In addition, to increased income, other factors contribute to changing the final demand for services. Such as: (i) the demographic transition of society, which alters the demand structure of services – such as that of education and health – with lower birth rates and population aging; (ii) an increasing provision of public services of all kinds and; (iii) changes in international trade services that become striking with the growing use of information and communications technologies (Wölfl, 2005).

2.2. Labor productivity

The productivity analysis of the service sector brings a relevant question, known as the "*service paradox*", i.e., how activities with low productivity can improve their participation in the economy in terms of both employment and income?

Baumol (1967) was the first author to formulate a theory, attempting to explain productivity differentials among sectors and their impacts on the economy. In his theory, Baumol introduces a two-sector economy as an example: a sector with increasing labor productivity, and a sector with constant productivity. While the first sector – progressive and related to manufacturing – improves its productivity and is able to save capital and labor, the second sector – stagnant and related to service production – remains with the same proportion of capital and labor. Then, in course of time, the progressive sector participation is reduced in terms of employment in detriment of the increased participation of stagnant activities. In this way, the expansion of the service sector would lead to a decline in the economy productivity as a whole, with reduced social welfare due to a change from dynamic activities into stagnant ones.

However, this process could not sustain itself for a long period, as the service sector would be prone to the named "cost disease". This means that increasing productivity in the manufacturing sector as opposed to low productivity in services would lead to successive wage improvements, which even in the absence of productivity gains would result in labor claims for wage increases. Therefore, service production costs would rise inducing higher service prices and lower service demand. In an extreme, the service sector would be extinct. Gershuny (1978) finishes his analysis by stating that a structural change would occur in the service sector that could convert it into a *self-service economy*. Therefore, to the extent that wages would become higher, there would be propensity to self-service by final consumers and to an increase of intermediary services incorporated into durable goods (for example, a washing machine that would save domestic service).

Later on, Baumol (2001) states that – when final demand is measured at constant prices – it is possible to conclude that tertiarization simply constitutes a price effect caused by low productivity in the service sector. This author points

out information and telecommunications as dynamic portions of the service sector, which would not undergo the so-called cost disease.

Conversely to the argument of cost disease, Triplett and Bosworth (2000), Hoekman and Matoo (2008), Sánchez and Manso (2009), and Siddiqui and Saleem (2010) assert that – when estimating the productivity effect of the service sector – the relation between this sector and the remaining sectors is not taken into account. Therefore, the influence of services on manufacturing and on productivity gains brought about by such interaction is not considered. Conversely, information and communications services must be taken into account, as they make it possible higher growth and productivity in other sectors, including manufacturing (Pilat, 2005).

Thereby, industrial productivity itself may be understood as a key factor in explaining tertiarization. According to Pereira (1989), the growth of services can be viewed as a positive and basic feature of development in central capitalist economies in the twentieth century, since the surplus generated by the increased industrial productivity starts to be used for the development of services, which in turn may induce industrial production to become more efficient or produce an improved quality of consumption (and of living) for the population (Sánchez, 2010).

Still in relation to labor productivity and in contrast to the cost disease notion, the intangible and customized character of services explains per se its low productivity, due to labor-intensive requirements (Silva et al., 2006) and difficulties in substituting labor and capital or even incorporating technological advances (Sánchez, 2010). Since such characteristics are essential for distinguishing this sector, low productivity is also a striking feature (Silva et al., 2006).

Therefore, it is not possible to increase labor productivity in the same way as for other service activities. Personal services, e.g., medical, education services, show a very low service provider/client ratio, the productivity increase of which may lead to a reduced quality of the service rendered. Other services, mainly those using Information and Communication Technologies – TIC (such as computing and marketing services), have high capacity to continuously improve their productivity[8] (Daniels, 1993).

2.3. Interfirm division of labor

As for tertiarization of activities, according to Braibant (2002) and Arriagada (2007), only a portion of the service sector improvement accounts for a real increase of total volume of services rendered or the volume of the economy output. The remaining constitutes transfers of service functions from businesses and firms mainly devoted to manufacturing that have abandoned functions now carried out by the tertiary sector.

Therefore, expansion of services is a consequence of changes in the division of labor among firms that have occurred at their specialization level (Daniels, 1993). The interaction between industry and services may be then explained by two different trends: (i) the growth of services supplementary to industrial activities and; (ii) the trend to tertiarization of activities that can be rendered at lower costs and/or better quality as compared to those internally produced (Wölfl, 2005).

However, the service sector role in the division of labor goes well beyond a mere activity transfer. For Hoekman and Matoo (2008), diversity in services conceals their main function: services are production inputs. In this way, services facilitate transactions through space (transport and telecommunications) and time (financial services), in addition to contribute to productivity of primary factors of production through knowledge generation and improvement of labor productivity with the use of education and health services.

The linkage between industry and services is taken as a positive item in tertiarization. According to Siddiqui and Saleem (2010), while it may bear high growth rates of value added in the economy as a whole, as well as high technological spillover due to being highly capital-intensive, the growth produced by industry fails to generate enough jobs and improve social indicators. On the other side, the growth led by services results in increasing employment levels and improvement of socioeconomic indicators (by means of health, education, social care, and research and development). However, wherever economic growth is led by the service sector and no competitive manufacturing can be found, the economy may come to be feeble and volatile. Therefore, competitiveness and diversification of the economy depend on the synergy effects between both factors.

It is possible to say that the inter-sectoral and intra-sectoral borderlines can hardly be defined (Bernardes et al., 2005) and distinguishing industrial activities from those of services becomes less attainable (Pilat and Wölfl, 2005; Wölfl,

[8] For a discussion about the relation between structural change and ICT-related industries, see Silva and Teixeira (2011).

2005; Arriagada, 2007; Lima and Rocha, 2009; Siddiqui and Saleem, 2010). Therefore, a convergence between these sectors emerges by which manufacturing is increasingly oriented to services and services, in turn, become gradually more industrialized (Gallouj, 2002). According to Boden and Miles (2000), *apud* Freire (2006a, p. 35), "*the economic system may be understood as an interconnected net of functions, some of which are classified as services and others as industries*".

In this context, "*interaction between services and manufacturing has become a driving force of wealth generation*" (Illeris, 1996, *apud* Kon, 2006, p. 248). Conversely, a low interaction between industry and services constitutes what is pointed out as the main cause of a distinct behavior of the tertiary sector when developed countries are compared to developing countries (Greenhalgh and Gregory, 2001; Braibant, 2002; Siddiqui and Saleem, 2010).

3. Methodology

Generally speaking, the service sector analysis is restrained by availability of data, whose aggregate level and number of observations (both in time and space) are limited. However, the input–output method is understood as an adequate analytical mode in this case, due to data availability and disaggregation; the possibility of comparison at the international level; and because it allows to make a diagnosis of the tertiary sector through its economic dimensions (changes in final demand, inter-firm division of labor and changes related to inter-sectorial productivity differentials).

Compatible data for this analysis are provided by OECD. The matrices for Brazil and United States (US) of 1995, 2000 and 2005 include 48 sectors, 18 out of which refer to services. However, as for Brazil and the US not all matrices for these sectors were available and this has required that matrices should be made compatible with 26 sectors and 10 out of which refer to services (Appendix A). OECD data were provided including currency of each country, i.e., real and dollar at current basic prices.

As for the analyses of structural decomposition and total factor productivity, using data at current prices is not recommended as estimates are carried out by means of variation rates obtained from two matrices for different periods. In order to solve this problem, prices in 2005 matrices were changed into 2000 prices by using sectoral implicit price deflators for value added. These data were made available by OECD (2010b) for US and IBGE (2010) for Brazil. These same sources were used for adjusting employment data. Finally, capital stock data for Brazil, and US were obtained from IBGE (2010); and Bureau of Economic Analysis (2011), respectively.

Based on information contained in the input–output matrices[9] for Brazil and United States, an analysis of structural decomposition and an estimate of total factor productivity were carried out. The structural decomposition analysis indicates what are the sources of variation in the product of each sector in terms of variations in intermediate consumption, stating shifts in the production structure and the level of integration of national sectors,[10] in addition to changes in final consumption, which can be decomposed changes in household consumption and government investment, changes in inventories and exports sector. Finally, the calculation of total factor productivity enables us to observe the differences in productivity between sectors and between countries.

3.1. Structural decomposition analysis

The structural decomposition analysis (SDA) allows to breakdown the value variation of gross output between input–output matrices of two distinct years (consecutive or not) as for their effects from changes in technical coefficients of production and variation in final demand patterns (Savona and Lorentz, 2006). The output variation between year t and year $t-k$ is:

[9] This paper follows the basic input-output structure described by Miller and Blair (2009) in chapters I and II.

[10] It is worth mentioning that the terminology used in input-output analysis, technological change, technical change or change production technique are terms used to describe changes in the pattern of combination between production inputs in a Leontief structure. Therefore, even if in the analyzed period (2000–2005) there have been no major changes in production technology; the structural decomposition will capture how changes in the use of production inputs affect the final demand of each sector.

$$\Delta \boldsymbol{X} = \underbrace{\left(\frac{1}{2}\right)\Delta \boldsymbol{B}(\boldsymbol{f}_{t-k} + \boldsymbol{f}_t)}_{\text{(i)}} + \left(\frac{1}{2}\right)(\boldsymbol{B}_t + \boldsymbol{B}_{t-k})(\underbrace{\Delta \boldsymbol{C}}_{\text{(ii)}} + \underbrace{\Delta \boldsymbol{I}}_{\text{(iii)}} + \underbrace{\Delta \boldsymbol{G}}_{\text{(iv)}} + \underbrace{\Delta \boldsymbol{X}}_{\text{(v)}}) \tag{1}$$

where $\boldsymbol{X}$ is the vector of gross product value; $\boldsymbol{B}$, the Leontief inverse matrix; $\boldsymbol{f}_t$, the total final demand in period t; $\boldsymbol{C}$, vector of household consumption; $\boldsymbol{I}$, vector of investments; $\boldsymbol{G}$, vector of government expenditure and; $\boldsymbol{X}$ is the vector of exports. As can be seen in Eq. (1), the variation in gross product value between year t and year $t-k$ can be divided as follows:

(i) Changes in intermediary demand or changes in Leontief production function: which represents a change in output stemming from variations in technical coefficients of production, i.e., if the gross product value is kept constant, what is the induced effect by the technical variation (change in technical coefficients of production)?
(ii) Changes in household consumption: given the technical structure of year t, the coefficient reveals those changes stemming from the variation of final consumption of households between the analyzed years.
(iii) Changes at the investment level: the coefficient captures those changes stemming from the variation in gross fixed capital formation between analyzed years with technical structure of year t kept constant.
(iv) Changes in government expenditures: with fixed intermediary consumption structure, the coefficient shows the impact of government expenditure variations on each sector.
(v) Changes in foreign demand: again, if the technical coefficient matrix of year t is kept constant, the coefficient shows which changes in total demand were determined by export variations.

3.2. Total factor productivity

Economic productivity may be defined as the level of a product an industry manufactures by input unit (Miller and Blair, 2009). Therefore, total factor productivity (TFP) or absolute productivity can be measured by means of input–output data using technical coefficient variations of sectorial capital and labor employed (Baumol and Wolff, 1984; Wolff, 1999).

For this purpose, information on the technical coefficient information on sectorial employment, e_i, and technical coefficient information on capital stock of sector i, k_i are necessary, as defined below:

$$k_i = \frac{K_i}{x_i} \tag{2}$$

where K_i is the capital stock of sector i. And total employment and total capital stock, respectively, are defined as follows:

$$E = \sum_{i=1}^{n} w_i \tag{3}$$

$$\kappa = \sum_{i=1}^{n} K_i \tag{4}$$

where w_i is employment in sector i.

The price vector of commodities is defined by the Leontief equation, as follows:

$$p_i = (\bar{s}e_i + \bar{r}k_i)(\boldsymbol{I} - \boldsymbol{A})^{-1} \tag{5}$$

where $\bar{s}$ is the annual wage (corresponding to the wage average in the economy), and $\bar{r}$ is the gross profit rate (total net operating surplus divided by capital stock), which are both considered equal for all economic sectors.

Therefore, the TFP variation rate of sector j is given by:

$$\pi_{jT} = -\frac{\left(\sum_i \bar{p}_{iT}\Delta a_{ijT} + \bar{s}_T \Delta e_{iT} + \bar{r}_T \Delta k_{iT}\right)}{p_{jt_o}} \tag{6}$$

Table 1
Structural decomposition of the annual average growth rates of GPV for the Brazil and United States between 2000 and 2005 at constant prices.

Sectors	Δ GPV annual average	Δ in technical pattern	Final demand			
			Household consumption	Government expenditure	Investment	Exports
Brazil						
Primary	0.11	−0.05	0.08	0.01	−0.01	0.08
Secondary	1.62	−0.19	0.78	0.12	0.22	0.68
Tertiary	2.12	0.10	1.13	0.59	0.10	0.20
Total	3.85	−0.14	1.98	0.73	0.32	0.96
United States						
Primary	0.04	0.00	0.03	0.00	0.00	0.00
Secondary	0.67	−0.07	0.35	0.07	0.25	0.07
Tertiary	2.14	0.05	1.37	0.43	0.17	0.12
Total	2.85	−0.02	1.75	0.51	0.42	0.19

Source: Prepared by the author based on OECD (2010a).

where Δ is the variation between t_0 and t_1, which is equal to T, and $\bar{p}_{iT}$ the average price during period T; $\bar{s}_T$ is the average wage during period T; $\bar{r}_{iT}$ is the average profit margin during period T, and p_{jt_o} is the sector j price in the initial period.

4. Results

4.1. Structural decomposition analysis

Results of structural decomposition analysis (SDA) are presented as variations in the technical pattern of production, which involve changes in supply and demand of inputs, i.e., goods and services designed for intermediary consumption, as well as changes in final demand (household consumption, government expenditure, investment and exports).

Looking at aggregated sectors (Table 1) it is possible to see the decomposition of changes in the Gross Product Value (GPV) between 2000 and 2005 for the overall economies. The average annual change in GPV for Brazil was 3.85% and 2.12% is due to the role of services activities, which corresponds to 55.06% of the total change,[11] explained by household and government expenditure. In the case of United States, the general picture is analogous, 2.85% of average annual growth in GPV, mainly explained by services and its final consumption, however the services sector accounts for 75.23% of the total growth and 63.35% are related with household and government consumption.

Therefore, despite the expansion of the services sector in Brazil during this period, its contribution to the growth in the Gross Product Value is still less important than in United States, and to explore these differences, it is possible to rummage around for the decomposition in disaggregated activities. As can be seen in Table 2, for Brazil 22.46% of the change in GPV for the tertiary sector was a consequence of "Transport services, storage and communications", followed by "Wholesale and retail trade and repairs" with 16.71%. For United States the most important activity was "Wholesale and retail trade and repairs" (18.19%) followed by "Business services" (15.87%) and "Real estate activities" (15.80%).

These variations may be decomposed by sector, as can be seem in Fig. 1, which shows changes in the gross production value (GPV), between 2000 and 2005, for Brazil at current and constant prices. As can be observed, the highest growth has occurred in "health and social work" (25)[12] sector, followed by "education" (24); for these two sectors, the expansion is an effect of privatization and public incentives, reflecting the role of social areas in the early 2000s to sustain economic dynamics.

[11] This percentage was calculated by dividing the percentage change in household and government consumption (1.13% plus 0.59%), divided by the total change (3.85%).

[12] In 2000, was approved the constitutional amendment (EC – no. 29/2000) which determined an appropriate and stable share of public revenue for health financing (Cardoso, 2010).

Table 2
Structural decomposition of the annual average growth rates of GPV for services activities in Brazil and United States between 2000 and 2005 at constant prices, in % of the total change in services.

Activity	Brazil	United States
Wholesale and retail trade and repairs	16.71	18.89
Hotels and restaurants	3.12	2.70
Transport services, storage and communications	22.46	11.56
Finance and insurance	12.02	7.87
Real estate activities	4.58	15.80
Business services	9.10	15.87
Public administration, defense and compulsory social security	6.86	11.01
Education	8.37	0.80
Health and social work	10.68	9.68
Other community, social and personal services	6.10	5.82
Total	100.00	100.00

Source: Prepared by the author based on OECD (2010a).

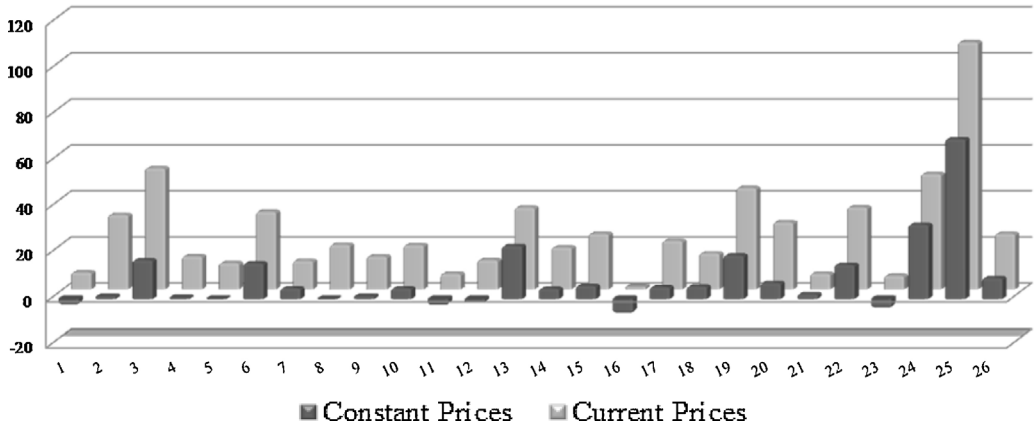

Fig. 1. Annual average variation in GPV (in %) for the Brazil between 2000 and 2005.
Source: Prepared by the author based on OECD (2010a).

In general, the difference between nominal growth (at current prices) and real growth (at constant prices) is greater for the following sectors: "agriculture, hunting, forestry and fishing" (1); "coke, refined petroleum products and nuclear fuel" (8); "other nonmetallic mineral products" (11), "basic metals and metallic products" (12)[13]; "construction" (16) and "public administration, defense and compulsory social security" (23). Such differences reinforce the relevance of constant price analysis, which lessens the price effect.

Comparing results at current and constant prices was carried out in order to verify Baumol's assertion (2001). According to this author, when final demand is measured at constant prices, it is possible to conclude that tertiarization is a price effect stemming from low productivity of services. Therefore, if Baumol's assertion is correct, the tertiary sector should increase at a higher level as compared to the rest of the economy, if changes in service production are verified at current prices; and the resulting difference should disappear at constant prices. However, this effect cannot be verified for Brazil, where there is no evidence that the growth of services, between 2000 and 2005, was a result of price pressure.

The variations of gross production value sector by sector for Brazil between 2000 and 2005 are shown in Table 3. The results confirm that the variation for most sectors (mainly for the tertiary) can be explained by the household

[13] The price effect for those sectors occurred mainly due to the increase in commodities prices, after 2002. For a discussion about the boom in commodity prices, see Helbling (2012).

Table 3
Structural decomposition of the annual average growth rates of GPV for the Brazil between 2000 and 2005 at constant prices.

Sectors	Δ GPV annual average	Δ in technical pattern	Δ in final demand			
			Household consumption	Government expenditure	Investment	Exports
1	−2.88	−2.83	−1.82	0.48	−1.22	2.52
2	1.25	−8.73	3.69	0.47	0.22	5.60
3	16.90	8.88	0.11	0.27	−0.75	8.40
4	0.71	−0.67	−0.82	0.70	−0.56	2.05
5	0.05	−2.88	2.18	0.26	−0.74	1.22
6	15.55	9.93	−0.49	0.23	−4.43	10.31
7	4.68	−4.96	5.73	0.61	−0.07	3.36
8	−0.09	−6.67	3.67	0.49	−0.09	2.52
9	1.33	−2.47	0.99	1.12	−1.02	2.71
10	4.70	−0.37	1.77	1.50	−1.02	2.83
11	−3.04	−0.53	−0.22	0.31	−4.84	2.25
12	−1.73	−6.02	0.04	0.24	0.76	3.25
13	23.09	4.59	2.27	0.08	6.22	9.92
14	4.49	−2.27	1.36	0.28	2.11	3.02
15	5.80	1.12	2.30	0.92	−0.06	1.52
16	−6.45	0.15	0.16	0.15	−7.03	0.12
17	5.20	−0.44	3.44	0.50	0.83	0.88
18	5.50	−1.42	4.65	0.10	−0.01	2.18
19	18.97	12.02	3.67	0.77	0.30	2.20
20	7.01	−3.67	9.15	0.45	−0.17	1.25
21	2.10	−0.44	1.71	0.11	0.36	0.35
22	14.93	6.23	5.44	1.36	−0.15	2.04
23	−4.20	−0.92	0.14	−3.40	−0.03	0.01
24	32.33	−0.45	−3.58	36.22	0.08	0.07
25	69.55	0.00	20.88	48.31	0.19	0.17
26	9.11	−5.99	14.53	0.13	0.01	0.42

Source: Prepared by the author based on OECD (2010a).

consumption increase when values are measured at constant prices. This effect is particularly important for "health and social work" (25); "other community social, and personal services" (26) and "finance and insurance" (20), which reflects the credit expansion, rising incomes and purchasing power of the Brazilian population targeted attention to the basic needs. As for industry, there is also a positive influence of final demand for exports. Government expenditure, in turn, is essential for GPV improvement in some service activities, particularly in "education" (24) and "health and social work" (25).

On the other hand, only sectors "transport services, storage and communications" (19) and "business services" (22) presented positive technical variation, which suggests that these activities had been more intensively used as production inputs, serving as support for expanding production in the rest of the economy. In turn, the exports effect is slightly significant for Brazil, where exportable services, in particular knowledge-intensive, are still not very competitive.

The increased intermediary demand for these service groups was induced both by activities within the service sector itself and those in the remaining sectors (Fig. 2). As can be seen, intra-sectorial relations (between services activities) are stronger than inter-sectorial relations. As a result, technical variation is influenced – both positively and negatively – by variations in intermediary demand within the sector itself. The results found for the intermediary consumption variation are distinct from those found by Flores and Santos (1995) and Rocha (1997) for the 1980s and 1990s, when there was no increase in intermediary consumption of services in Brazil, except for those related to the public sector.

Despite the short period of analysis, this result can be considered positive for the Brazilian economy, as sectors showing positive technical variation for 2000 and 2005, i.e., the pattern of specified combination of inputs; were exactly those linked to the flexible production system "transport, storage and communications" (19) and "business services" (22).

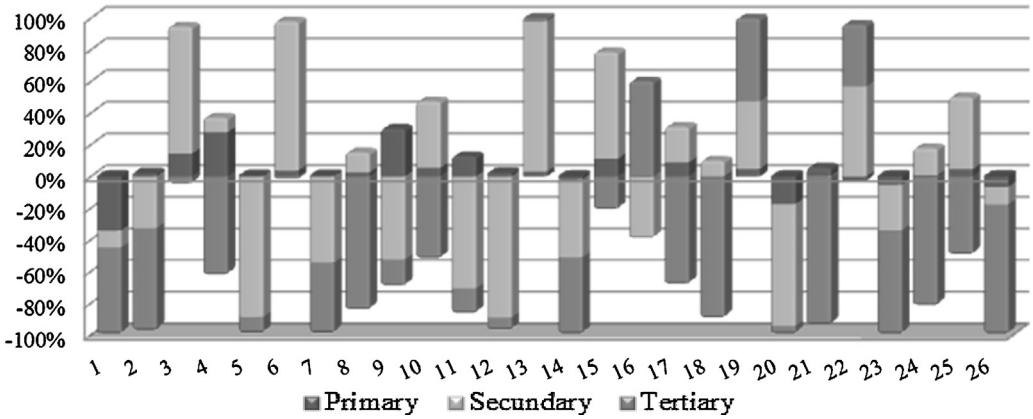

Fig. 2. Structural decomposition of technical variation by sector for Brazil between 2000 and 2005, at 2000 constant prices.
Source: Prepared by the author based on OECD (2010a).

As regard United States (Fig. 3), the sectors presenting a higher GPV growth in 2000 and 2005 were "mining and quarrying (non-energy)" (3) and "coke, refined petroleum products and nuclear fuel" (8), and then the tertiary services of "real estate activities" (21) and "transport, storage and communications" (19).

There are no indications of a crowding-out effect in the growth of the US manufacturing and services in the face of a reduced production of goods combined with increased production of services. Despite the service's growth, there are some industry sectors like "mining and quarrying (non-energy)" (3) and "coke, refined petroleum products and nuclear fuel" (8) which are increasing above average. Similarly to Brazil, household demand is the main component in the increasing tertiary production (Table 4), especially for "health and social work" (25); and "wholesale and retail trade and repairs" (17).

In spite of an increasing final demand for services, the intermediary demand was reduced for most service activities, except for "real estate activities" (21); "business services" (22); and "education" (24), the demand of which was basically induced by activities in the tertiary sector itself (Fig. 4). The greater stability of the indicators, compared to the same from Brazil, are the results of the higher level of economic maturity, which translates into greater smoothness of changes production techniques.

As for Brazil, household consumption became the key factor for explaining demand for services in 2000 and 2005. Still as for final demand and in accordance with Wölfl (2006), although it has positive effects on the demand for services, export growth is slightly significant. On the other hand, changes in intermediary demand have occurred mainly among service producers, though with slight inter-sectorial changes.

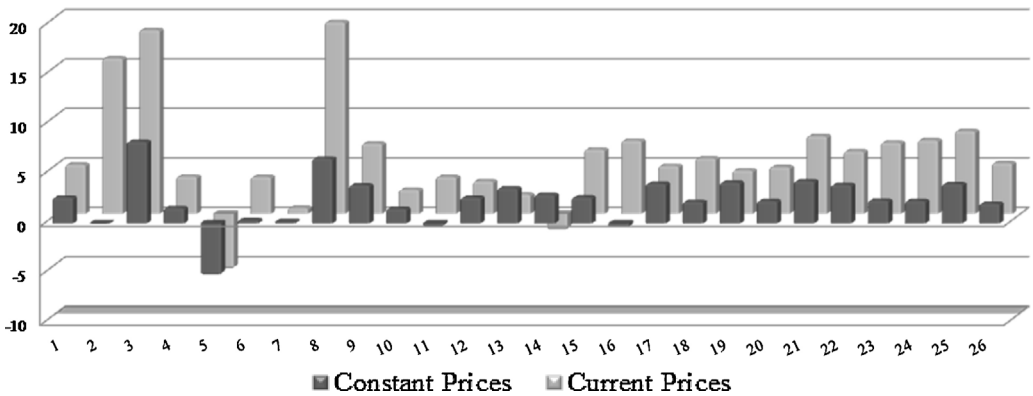

Fig. 3. Annual average variation in GPV (in %) for United States between 2000 and 2005.
Source: Prepared by the author based on OECD (2010a).

Table 4
Structural decomposition of the annual average growth rates of GPV for United States between 2000 and 2005, at 2000 constant prices.

Sectors	Δ GPV annual average	Δ in technical pattern	Δ in final demand			
			Household consumption	Government expenditure	Investment	Exports
1	2.63	0.24	1.63	0.16	0.27	0.33
2	−0.01	−1.08	0.65	0.38	−0.11	0.16
3	8.26	−0.43	0.72	0.18	7.33	0.47
4	1.56	−0.34	1.54	0.16	0.11	0.09
5	−5.27	−1.91	−3.51	0.06	0.24	−0.14
6	0.32	−0.42	1.05	0.12	−0.48	0.05
7	0.20	−2.82	1.48	0.18	0.93	0.42
8	6.56	5.85	0.08	0.40	0.06	0.17
9	3.86	0.39	2.13	0.15	0.08	1.11
10	1.50	−1.56	1.77	0.14	0.43	0.72
11	−0.33	−1.43	0.64	0.17	0.04	0.24
12	2.61	−0.32	0.96	0.14	0.84	0.99
13	3.55	−0.63	1.76	0.10	0.90	1.42
14	2.90	−1.72	1.41	0.07	1.56	1.58
15	2.63	0.63	2.31	0.25	−0.76	0.20
16	−0.49	0.14	0.19	0.09	−0.94	0.03
17	4.01	0.02	3.40	0.07	0.14	0.39
18	2.18	−0.21	2.15	0.08	0.06	0.10
19	4.14	0.35	2.55	0.20	0.26	0.78
20	2.26	−0.54	2.07	0.10	0.16	0.47
21	4.27	0.98	2.25	0.07	0.87	0.10
22	3.89	1.01	1.73	0.24	0.15	0.75
23	2.31	−0.14	0.44	1.89	0.09	0.04
24	2.27	0.36	1.67	0.16	0.02	0.07
25	3.99	−0.02	3.98	0.02	0.00	0.00
26	2.00	−0.07	1.38	0.19	0.23	0.27

Source: Prepared by the author based on OECD (2010a).

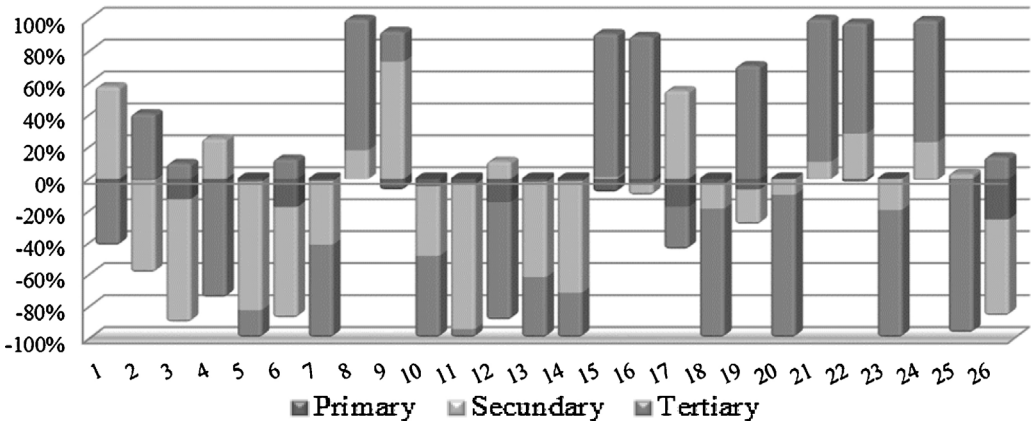

Fig. 4. Structural decomposition of technical variation by sector for United States between 2000 and 2005 at 2000 constant prices.
Source: Prepared by the author based on OECD (2010a).

4.2. Total factor productivity

Estimating total factor productivity (TFP) concludes the analysis of the three economic dimensions of tertiarization. TFP measures the productivity growth rate in the economy[14] and it may be broken down into three different effects:

[14] Eq. (6), Section 3.2.

Table 5
Total productivity of factors for Brazil and United States between 2000 and 2005 (in %).

	Sector	Brazil	United States
1	Agriculture, hunting, forestry and fishing	−6.31	12.42
2	Mining and quarrying (energy)	−10.13	7.88
3	Mining and quarrying (non-energy)	9.16	2.33
4	Food products, beverages and tobacco	−1.59	3.75
5	Textiles, textile products, leather and footwear	−7.76	10.18
6	Wood, wood products and cork	31.17	9.72
7	Pulp, paper, paper products, printing and publishing	3.39	9.70
8	Coke, refined petroleum products and nuclear fuel	5.51	−0.35
9	Chemicals	2.91	9.38
10	Rubber and plastics products	2.43	19.26
11	Other non-metallic mineral products	−8.21	14.11
12	Basic metals and metallic products	15.63	33.35
13	Transport equipments	62.82	28.99
14	Other industries	69.25	35.93
15	Electricity, gas, steam and hot water	3.62	15.29
16	Construction	72.98	68.81
17	Wholesale and retail trade and repairs	23.94	25.09
18	Hotels and restaurants	8.58	1.92
19	Transport services, storage and communications	25.53	15.68
20	Finance and insurance	2.37	3.93
21	Real estate activities	14.96	19.29
22	Business services	28.90	32.39
23	Public administration, defense and compulsory social security	−19.04	6.42
24	Education	45.31	3.21
25	Health and social work	54.83	4.09
26	Other community, social and personal services	19.50	8.55
	Average	17.30	15.44

Source: Prepared by the author based on OECD (2010a).

(i) price effect,[15] which corresponds to growth in total cost of using primary factors – capital and labor – as production inputs; (ii) effect of labor productivity itself, measured in terms of output generation capacity per unit of labor and; (iii) capital productivity effect, measured in terms of generation of output based on the amount invested in each sector.

Table 5 displays the results for TFP by sector for both countries and Fig. 5 shows the composition of total productivity factors for the two countries analyzed. As can be seen in the case of Brazilian services, the TFP variation was positive for all activities, except for "public administration, defense and compulsory social security" (23).[16] While much of Brazil's manufacturing sectors presented low or even negative growth rates, important service sectors such as "Transport services, storage and communications", "Business services"; "Education"; and "Health and social work" grew above average. This observation reinforces the heterogeneity of the tertiary activities showing branches that contributed positively to the growth of total productivity of the country during the review period. For the most part of this sector, labor accounted for most of absolute productivity growth.

On the other hand, in the case of US, the service sector showed TFP increases in 2000 and 2005 due to a rise in capital productivity. This is the case for "real estate activities" (21), "business services" (22), and "other community, social & personal services" (26). Unlike what was observed for Brazil, sectors such as "Health and social work" and "Education" do not have positive influence of labor productivity and demonstrated low growth in overall productivity.

As stated in Section 2.2, the discussion on service sector productivity refers to labor productivity. In Brazil, several goods-producing activities underwent a decline in productivity as in "agriculture, hunting, forestry and fishing" (1)

[15] Eq. (5), Section 3.2.

[16] According to Simpson (2009), the productivity in public services is complicated mainly because its output is often unpriced and some public services are consumed collectively. This particular result for Brazil was mainly driven by the increase in the hiring of public servants that was not accompanied by a proportional increase in the value added of the sector.

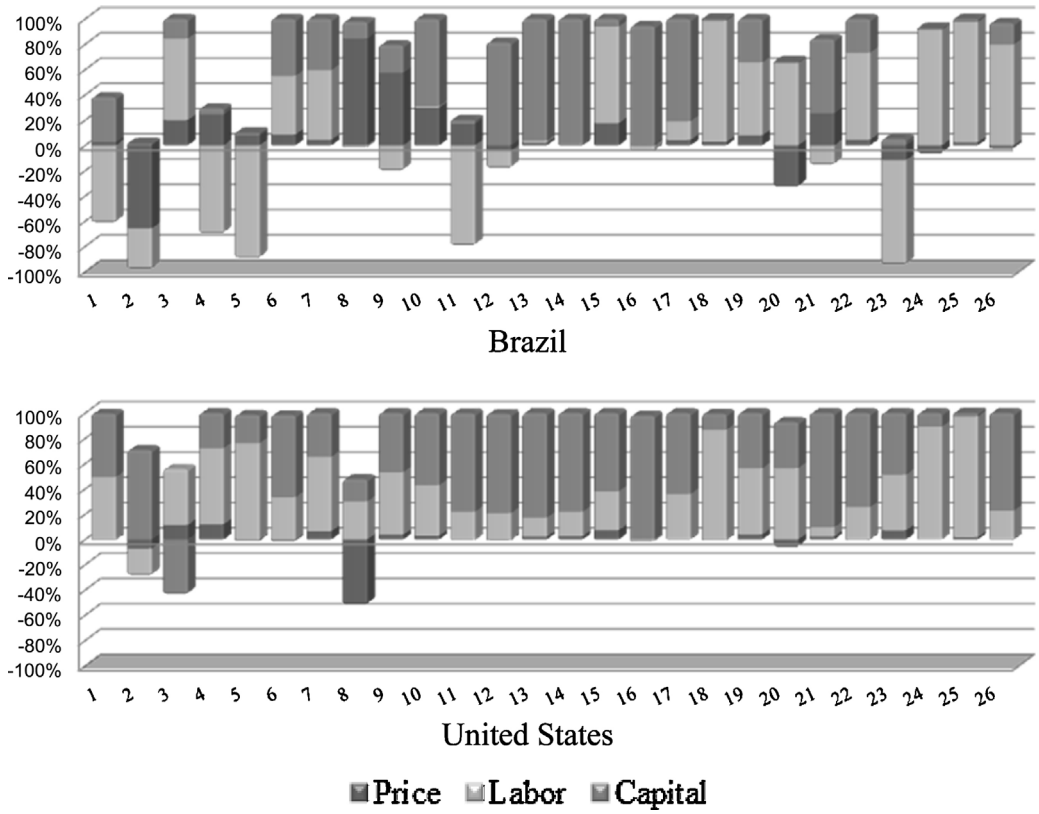

Fig. 5. Composition of total productivity of factors for Brazil and United States between 2000 and 2005.
Source: Prepared by the author based on OECD (2010a).

and "other non-metallic mineral products" (11), with losses of 16.47 and 10.93% in labor productivity, respectively for the five years period. As for service activities, "real estate activities" (21) and "public administration, defense and compulsory social security" (23) reduced their ability to generate product from labor factor – 3.53% and 17.65%, respectively.[17] According to the methodology used, such losses may be related to two factors: changes in the intensity of labor usage; or changes in sectorial wages. In the first case is "public administration, defense and compulsory social security" (23), for which the labor usage increased more than value added, causing productivity loses. On the other hand, for "agriculture, hunting, forestry and fishing" (1) and "real estate activities" (21), wage growth was above average, which may be related to the minimal wage growth in the period.[18] As for "other non-metallic mineral products" (11) combined the two factors. It is worth noting that important sectors, such as "transport, storage and communications services" (19) and "business services" (22) showed labor productivity gains in all countries, especially in Brazil with 14.76% and 19.91%, respectively.

For Brazilian services, the capital is important only for the increasing productivity in "real estate activities" (21), and for others activities the main factor is labor. Although for US, it can be said that capital is important in the productivity not just for "real estate activities" (21), as well as "other community, social & personal services" (26); "business services" (22) and "public administration, defense and compulsory social security" (23).

Differently from what Baumol (1967) predicted, for Brazil results showed that labor productivity in goods-producing activities had declined in many sectors, while some service sectors showed increased labor productivity above the rest of the economy. In US, however, variation in productivity between 2000 and 2005 was homogeneous between goods and service producers, where few industry's sectors presented loss in labor productivity.

[17] This result is given by Eq. (6).
[18] According to IPEA (2015), real minimum wage growth between 2000 and 2005 was 28.56%.

5. Conclusion

The purpose of this paper was to assess the multiple trends involved in tertiarization in countries with an intensive service sector but different development levels. The tertiary dimension and its capacity to produce jobs and income by itself justify the need to understand the service sector behavior. There is a series of factors differentiating the tertiary sector among developed and developing countries, which make it essential to understand the relation between tertiarization and economic development.

Multiple trends are known that intensify services expansion. Among the economic determinants linked to supply and demand, the following can be highlighted: increased final demand, sectorial differences in labor productivity, and interfirm division of labor. On the other side, historical differences characterize the expanse of the tertiary sector, bringing about diverse productive structures that are subject to the development level of each economy. Based on such a frame, it was worth analyzing the tertiary growth and its determinants, as well as verifying which tertiarization characteristics were specific for Brazil, and United States.

Despite the expansion of the services sector in Brazil, its contribution to the growth in the Gross Product Value is still less important than in United States, and for both the results show that household service consumption was vigorous and proved to be an essential element to explain tertiarization. These effects can be explained both by the Engel's law and changes in household preferences (Wölfl, 2005), despite it could not be tested within the methodological framework employed in this study.

The differences between current and constant prices show that, for Brazil there is no evidence of price pressures in services. It could be explained by the excess of labor surplus that reduces the "cost disease" effect, as low-productivity workers accept low wages, to the extent that these workers count on few opportunities in the labor market.

The analysis of total factors productivity indicated signs of growth for almost all sectors in the US, while it showed loss of productivity in nine out of sixteen goods-producing sectors and in two service sectors for Brazil. The techniques used do not allow access to the causes of differences in behavior of total factor productivity, which may explained, in general terms, by several factors, such as differences: in the maturity levels of the production structure; in the qualification of workforce; or the development of the financial system, which imposes constraints on capital productivity.

The comparison between countries showed that improving service performance in Brazil requires strengthening sectors, such as "business services" (22) and "transport, storage and communications services" (19), which are essential elements of specialization requirements of a flexible production. In fact, the performance of these sectors would be better off as soon as labor becomes more skilled and hence more productive.

In brief, the following results can be highlighted: (i) the growth in services was fostered by several factors, among which increased final demand – mainly that of household consumption – which was accounted for the improvement of the service sector output; and (ii) the industrial labor productivity decreased in Brazil in the period, while labor productivity increased above the average in some other service sectors.

Two issues are essential for the Brazilian economic policy targets: the small integration between goods and services (as intermediate inputs) and a decreased productivity in some activities subsectors. As Freire (2006b) states: "*it is not a case of asserting the existence of a post-industrial society, but to assume the development of a new kind of industrial society in which the tertiary and secondary sectors are even more strongly interconnected*". The mInter-American Development Bank (IDB, 2010) pointed out productivity, mainly labor productivity, as the main determinant of the low economic growth in Latin America and the Caribbean.

Therefore, two extreme cases should be treated in the service sector, namely: firstly, as for the high productivity services that are associated with the industrial sector and technological innovation (as "business services" and "communications"), strengthening their productive links with the rest of the economy is needed, as suggested by Domingues et al. (2006). It is necessary to integrate technological policies and regional development policies for specific industrial segments, i.e., for those highly technological sectors that need skilled services. This argument is reinforced by the empirical evidence showed by Silva and Teixeira (2011), how argues that ICT-related industries are strategic branches of economic activity especially for less develop countries during the catching-up process.

Secondly, low productivity affects mainly personal services and – for Brazil and other developing countries as well. For this reason, fostering growth in the service sector should not only include improving technological services linked to production of goods, but also creating job opportunities and labor qualification so as to absorb labor force and improve its productivity.

The sectorial aggregation level, unfortunately, does not allow a detailed reading of the productivity growth in services. However, the results for Brazil show signs that based on productivity, greater involvement of manufacturing related services in the economy can be a positive spin. This way the economic policy for stimulating growth of the service sector and fostering further integration with manufacturing should give special attention to the potential of services in terms of productivity.

Increased trade productivity and personal services sectors (including health and education) may be linked to the policies of the Brazilian government to encourage the credit, as well as the social income distribution programs. Given the difficulty in the continuity of these incentives, it is increasingly necessary specific policies to encourage the sectors of manufacturing and related services in order to make them a sustainable source of growth, increasing output and potential employment. Practical policies may include measures such as hand-to-work training programs; credit policies (specially destined to small businesses, that are concentrated in services), as well as supporting management methods programs.

Appendix A. Sectors

1	Agriculture, hunting, forestry and fishing
2	Mining and quarrying (energy)
3	Mining and quarrying (non-energy)
4	Food products, beverages and tobacco
5	Textiles, textile products, leather and footwear
6	Wood, wood products and cork
7	Pulp, paper, paper products, printing and publishing
8	Coke, refined petroleum products and nuclear fuel
9	Chemicals
10	Rubber and plastics products
11	Other non-metallic mineral products
12	Basic metals and metallic products
13	Transport equipments
14	Other industries
15	Electricity, gas, steam and hot water
16	Construction
17	Wholesale and retail trade and repairs
18	Hotels and restaurants
19	Transport services, storage and communications
20	Finance and insurance
21	Real estate activities
22	Business services
23	Public administration, defense and compulsory social security
24	Education
25	Health and social work
26	Other community, social and personal services

Source: Prepared by the author.

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