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TERTIARIZATION AND HUMAN CAPITAL: DO THEY MATTER FOR GROWTH? INSIGHTS FROM PORTUGAL

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Abstract

We investigate the existence of causality among sectoral productivity, services sector expansion, human capital, and aggregate productivity over the period 1970-2006 in the Portuguese economy taking into account the contribution of services sub-sectors with different potential for productivity improvements, market and non-market services. The main aim is to examine whether the increasing tertiarization of the Portuguese economy constituted an obstacle or an opportunity for its aggregate productivity performance and if the expansion of the services sector is related to human capital availability, based on the former disaggregation of the services sector. The evidence suggests bi-directional causality between sectoral and aggregate productivity, with sectoral employment shares and human capital not revealing themselves as relevant for the explanation of the other variables nor being influenced by them. Across services categories, non-market services seem to be the most influential one, making a positive and lasting contribution to aggregate productivity, while market services seem to have had no influence on aggregate productivity dynamics.

Keywords: services, human capital, growth, Portugal, VAR
JEL classification: L80, O14, O15, O52

1. INTRODUCTION

The Portuguese economy has become almost stagnant since the late 1990s and is currently undergoing a strong recession following the 2007-08 economic and financial crises. The services sector is the largest sector in Portugal, employing in 2005 a little more than 65% of the labor force and representing almost 70% of value added. It is thus important to understand if the services sector contributed to the current lack of growth situation of the Portuguese economy and whether it can help Portugal to overcome its present dismal growth prospects. The persistence of relatively low aggregate income and productivity levels and performance in Portugal might be closely linked to the strong weight of non-market services, which are usually non-tradable and have fewer opportunities for enhancing its

productivity (see e.g. Mateus (2006), Silva (2011), Ramos and Simões (2011), Silva and Teixeira (2012)). Market services, on the other hand, have registered higher labor productivity growth rates, since they are more receptive to the use of information technologies and increasingly tradable across borders. However, some of these market services sub-sectors demand higher levels of human capital and so the relatively low educational levels of the Portuguese workforce might have prevented Portugal from capitalizing on the opportunities provided by market services growth and might continue to do so in the future.

Services is currently the largest sector in many economies, accounting in OECD countries for around 70% of value added and employment (see e.g., OECD (2005); Maroto-Sánchez and Cuadrado-Roura (2009); and Jorgenson and Timmer (2011)), and according to Uppenberg and Strauss (2010), p. 8, "(…) high-growth [EU] countries have mostly expanded on account of their services sectors, not manufacturing." Portugal is no exception. For instance, Duarte and Restuccia (2007) show that between 1956 and 1995 the share of employment in the services sector increased from 33% to 65%, and Catarino and Claro (2009) argue that the services sector was the driver of Portuguese economic growth during the period 1995-2006, with an average annual growth rate of real value added higher than that of the other sectors. Silva (2011) and Silva and Teixeira (2012), on the other hand, present evidence on the difficulties faced by Portugal in promoting major changes towards high-skill and high tech-based services activities over the period 1980-2007, that were probably the cause of the aggregate productivity slowdown after 1995. The authors also argue that the slow change in structure observed in Portugal may have its roots in the still relatively low qualified Portuguese workforce since "(…) a large supply of high-skilled labour seems to be a prerequisite to promote significant structural change, by enabling the adoption and creation of technology and stimulating innovation. As a consequence, education influences structure, but the inverse relationship is plausible as well." (Silva and Teixeira (2012), p. 21). Additionally, Silva (2011), p. 20 also points out that "(…) a vicious circle between low education attainment and low-tech industry structure seems to have been in place, making it more difficult to implement the modernization of the economy and promote its adaptation to global competition."

Structural change into a services based economy seems to have the potential to sustain growth, despite the concerns of some economists. In his seminal work, Baumol (1967) suggests that, due to differences in the rate of technological progress, the three major sectors grow at different rates, which means that changes in the composition of production and employment can determine important differences in the aggregate growth rate of an economy. Since the services sector was traditionally viewed as a low productivity/stagnant sector, increased specialization towards services would lead to a growth slowdown. However, the services sector can no longer be considered a homogeneous sector composed of non-tradable services with no opportunity for scale economies and improvements in productivity. Technological change allowed the development of services that can be easily transported, face low transports costs and have a high potential to increase productivity through the incorporation of technological advances. These services, that share many characteristics with manufacturing, are mostly included in what is known as market services (see Baumol (1967) and Ghani (2010)), and are also assumed to be relatively skill intensive, so human capital and thus education play an important role in driving growth in this services sub-sector. For instance, Peneder (2007) performs a taxonomy of 49 manufacturing industries and services and presents evidence that the activities with a very high educational

intensity, and also most industries with a high or intermediate level, were the ones that registered the highest growth rates in terms of value added and employment in a sample of 24 OECD countries over the period 1992-2000.

This paper gives some clues on these issues by investigating the existence of causality among services sector productivity and expansion, aggregate productivity, and human capital over the period 1970-2006 for Portugal. The main aim is to examine whether the increasing tertiarization of the Portuguese economy constituted an obstacle or an opportunity for its aggregate performance and if the expansion of the services sector is related to human capital availability in this economy. Given the varied theoretical predictions and empirical results on the linkages between the expansion of the services sector and economic growth this seems the most suitable approach.

The paper adds to the literature by empirically investigating in a comprehensive manner the linkages between structural change towards services, human capital and productivity growth. The main concern of most studies is to test whether tertiarization leads to a lower rate of aggregate growth, as predicted by Baumol, based on the assumption that demand increases in stagnant sectors faster than in productive ones, or on the contrary to a higher rate of aggregate growth if structural change occurs towards activities with a high degree of knowledge creation and positive externalities that spill over to the rest of the economy. The contribution of services sub-sectors with different potential for productivity improvements is generally not acknowledge with most studies considering the sector as a whole. The issue of reverse causation is usually also not dealt with and the role of human capital in the process of structural change is ignored. With this work we try to fill this gap, focusing on the recent experience of a country that has gone through important transformations in the structure of production and employment but seems to be stuck in a pattern of specialisation based on low-tech and low educational intensive activities, Portugal. By focusing on the experience of a single country we also avoid data comparability issues, exploring time series data that allows to overcome some of the problems of cross section (omitted variable bias) and panel data empirical growth studies (parameter heterogeneity and endogeneity), see e.g. Durlauf *et al.* (2005), the most often applied methodologies to study these linkages in the existing literature.

The remainder of the paper is organized as follows. In section 2 we review some theoretical arguments and empirical evidence on the linkages between the expansion of services, human capital and growth. In section 3 we describe the main data for Portugal. Section 4 presents the methodology and discusses the results. Section 5 contains the main conclusions.

2. THE SERVICES SECTOR, HUMAN CAPITAL, AND GROWTH: A SELECTIVE SURVEY OF THE LITERATURE

In advanced countries, but also in many developing countries, the structure of production has changed towards an increased specialization in the services sector and away from manufacturing, traditionally viewed as the driver of technological change and thus economic growth. This dynamic structural change process has thus raised the question of whether services can be a source of sustained growth. From a theoretical point of view, earlier theories on structural change and growth predicted a negative influence of an increased specialisation in services. From a supply-side perspective, Baumol (1967) suggests that, due to differences in the rate of technological progress, the three major sectors

grow at different rates, which means that changes in the composition of production and employment can determine important differences in the aggregate growth rate of an economy. Since the services sector was traditionally viewed as a low productivity (stagnant) sector, increased specialization towards services would lead to a growth slowdown, i.e. would cause the growth rate of real income per capita to decline. Kaldor (1966) had already defended that the manufacturing sector was the engine of growth, with faster growth in the manufacturing sector leading to faster growth of overall output due to spillover effects to the other sectors of the economy. Additionally, Kaldor argues that the growth of output in manufacturing is due mainly to productivity growth that in turn is positively related with employment in the manufacturing sector.

More recent theories consider that services can also be a driver of sustained growth, as long as the change in the composition of production and employment occurs towards services sub-sectors that have benefited from technological advances and have become more productive as well as participating in global trade (see e.g. Ghani (2010)). From an endogenous growth point of view, the expansion of these services sub-sectors will have a positive growth impact if it occurs towards activities with a high degree of knowledge creation and positive externalities that spill over to the rest of the economy. For instance, some services (e.g. financial and business services) serve as intermediate inputs to manufacturing and other services activities "with great benefits for productivity and quality throughout the economy" (Pugno (2006), p. 100).

In fact, market services such as communications, banking, insurance, and business related services, can be an important driver of economic growth since these services take advantage of ICT, globalization, and scale economies and thus benefit from higher productivity growth rates (see e.g. Ghani (2010)). For instance, Desmarchelier *et al.* (2012) review the literature on the importance of knowledge intensive business services (KIBS) - such as survey, consultancy, research and engineering activities targeted at businesses - for growth due to their role as "as users, diffusers and sources of innovation" and build a theoretical model with consumers, industrial firms and KIBS activities to investigate in more detail the channels through which KIBS foster (or inhibit) economic growth. The authors conclude that "KIBS are ultimately a factor of economic growth. (...) industry still appears as a significant factor for explaining the economic growth, even if it is via the demand of industrial firms for KIBS." (Desmarchelier *et al.* (2012), p. 17). Kapur (2012) develops a model with heterogeneous services, progressive and asymptotically stagnant services, and manufacturing, where innovation drives productivity growth and delivers different endogenous stages of growth. At earlier stages, consumer demand is directed mainly towards manufacturing products and so innovation is more profitable in this sector. As income rises, demand shifts towards services, but progressive services are more productive and thus respond more to innovation so the latter should concentrate on this sector in order for the economy to maximize growth. In summary, changes in the structure of the economy towards modern/progressive services influence positively the aggregate growth rate due to differing sectoral productivity gains.

Ngai and Pissarides (2007) and Acemoglu and Guerrieri (2008), on the other hand, introduce some changes in the assumptions of Baumol's two-sector unbalanced growth model in terms of either the inputs considered or factors proportions and conclude that, even with differences in total factor productivity growth across sectors, it is possible for an economy, under certain conditions, to reach a balanced growth path in the aggregate so that structural change will have no impact on the growth rate of real income per capita.

But even the non-market services can make a positive growth contribution, according to some authors. Pugno (2006) augments Baumol's model by considering that the consumption of services (such as education, health and culture), which the author also designates as household services to contrast with business services, may contribute to human capital formation and in this way offset the negative contribution to overall growth due to its low productivity. van Zon and Muysken (2005) focus on the importance of health for economic growth arguing that it is not only an important factor in final goods production but also fundamental to knowledge accumulation and thus a driver of growth, i.e. health is a source of human capital, which in turn makes workers more productive and is also crucial for innovation and technology diffusion activities. The authors also incorporate Baumol´s concerns with the expansion of low productivity sectors by distinguishing between cure and care health activities, where the first change the health status of the population and thus might have a positive growth impact while the latter do not but compete with higher productivity sectors for scarce resources.

Reverse causation from economic growth to the expansion of services is also possible since economic growth leads to higher income per capita levels which, according to Engel's law (higher income elasticity of demand in the services sector), results in a change in the structure of demand that shifts away from manufacturing products towards services (see e.g. Echevarria (1997), Foellmi and Zweimüller (2008), Ngai and Pissarides (2007) and Bonatti and Felice (2008)). Adjustments in the structure production occur in response to demand side changes so that economic growth is causing structural change towards the services sector. Peneder (2003) also points out the possibility of higher income levels leading to more investment in R&D and education, which in turn would create incentives to higher specialisation towards services industries that make greater use of these complementary institutions.

The idea that services can no longer be viewed as an homogeneous sector characterized by low productivity/stagnant activities is well documented in a number of recent papers focusing on the OECD and advanced countries. Wölfl (2005) shows that in a sample of 30 OECD member countries analysed between 1970 and 2001, services value added share steadily increased in most countries and was between 55% and 70% in 2001. Finance, insurance and business services accounted for 20-30% of value added in the total economy, while the share of trade, restaurants and hotels, and also transport and communications services changed little. However, the shares of the different services presented considerable differences across countries. The author presents evidence that in most countries productivity growth in manufacturing was higher than in the services sector as a whole, but disaggregating this sector leads to comparable productivity growth rates across manufacturing and services sub-sectors. While social and personal services and hotels and restaurants registered weak or even negative productivity growth rates, financial intermediation, transport and storage, and post and telecommunication services registered growth rates comparable to those of some high-growth industries within manufacturing. Portugal, however, is given as an example of a country where the contribution of high-growth services industries to overall productivity growth was almost fully balanced by negative contributions of social and personal services, and of trade, hotels and restaurants. The heterogeneity of the services sector is also confirmed in the work of Jorgenson and Timmer (2011) for a sample composed of European Union countries, the U.S.A. and Japan since 1980. They find that distribution services showed rapid productivity growth, while finance and business services and personal services suffered from low productivity growth.

The authors thus conclude that "(…) our findings suggest that the treatment of the services sector as a homogeneous and stagnant sector in contrast to dynamic manufacturing is completely unwarranted." (Jorgenson and Timmer (2011), p. 26). Maroto-Sánchez and Cuadrado-Roura (2009) applying shift-share analysis to a sample of 37 countries (the EU-25 plus the U.S., Japan and others) over the period 1980-2005 had also already identified important disparities in terms of productivity levels and performance across services sub-sectors, with communications and transport in the European countries or wholesale and retail and financial services in the United States showing improvements comparable to those of manufacturing industries. Uppenberg and Strauss (2010) also show that in EU countries that registered high aggregate productivity growth rates, market services productivity was the major contributor. To maintain high productivity growth in the best services performers and increase it in the worst performers, Uppenberg and Strauss (2010) point three main areas of intervention: more tangible fixed investment, more intangible capital, and enhancing innovation. The authors also stress that "Services industries attain higher productivity by combining investment in fixed capital, new computer software and human capital so as to create new organisational structures and business models, and sometimes entirely new service products." (p. 4). As far as Portugal is concerned, Silva (2011) shows that market services have been a major contributor to aggregate labour productivity growth in Portugal but the still low weight in the Portuguese economy has prevented Portugal from capitalizing on these productivity improvements.

Early empirical analyses of the impact of services expansion or tertiarization on economic growth from the 1990s include cross-country studies like Dutt and Lee (1993) and time series studies such as Ansari (1992) that point to a negative growth impact of increased specialisation towards the services sector. Ansari (1992) investigates whether the aggregate growth slowdown in the Canadian economy from 1961-72 to 1973-88 can be attributed to the shift in resources from manufacturing to services. Based on the evidence of a positive influence of the growth rates and shares of output in the industrial and manufacturing sectors on real GDP growth the author concludes for an adverse effect of deindustrialization on growth. Dutt and Lee (1993) use data for a sample of between 57 to 98 countries to estimate growth regressions (with total real GDP growth as the dependent variable) for three sub-periods, the 1960s, the 1970s and the 1980s, and conclude that the impact of the services sector on real GDP growth depends on the period considered and the way the role of services is measured, but argue for stronger evidence in favour of a negative growth impact. However, these studies do not differentiate across services sub-sectors and do not consider more recent periods when information and communication technologies became more important for productivity growth, especially in the services sector. In fact, Dutt and Lee (1993), p. 324 suggest that "(…) aggregative cross-section exercises such as ours ignore the important structural differences between countries as well as the characteristics of different components of the services sector. Time series studies for particular countries which can take into account such structural differences are preferable to the work reported here."

More recent studies apply panel data methodologies to study the relationship between tertiarization and growth taking advantage of both the cross section and time series information of the data. Peneder (2003) estimates how the share of services affects either the level of real GDP per capita or its growth rate in a sample of 28 OECD countries over the period 1990-1998. Besides some typical control variables always present in the estimation of growth regressions, the author considers as additional variables to control for the

influence of structure on the level or growth of real GDP, the value added shares of technology driven and human capital intensive manufacturing industries, and the relative exports and imports shares of technology driven and high skill industries. The results point to a negative influence of an increasing share of services on the aggregate growth of GDP per capita, as well as on its level, and are thus consistent with Baumol's predictions. However, the impact is weak and the author stresses that it might be the case that opposite signs effects are netting out, and that in any case there might be a positive contribution from certain types of services industries that systematically achieve higher rates of productivity growth. Following up on this idea, Maroto-Sánchez and Cuadrado-Roura (2009) assess the impact of tertiarization on overall productivity growth for a sample of 37 OECD countries over the period 1980-2005. The authors estimate a panel data productivity growth regression to test how structural change or growth of services contributed to the evolution of overall productivity. The dependent variable is the labour productivity growth rate and the variables that control for the influence of structural change towards the services sector are the initial total employment share of services and its change. The main empirical finding is that the increase in the weight of services had a positive and quantitatively important effect on overall productivity growth. Additionally, the initial weight of services at the beginning of the period is also statistically significant with a positive sign. The heterogeneity of the services sector is taken into account by estimating the productivity growth regression differentiating the structural variables for market services and non-market services. The estimated coefficients are positive in both cases but the productivity growth impact of market services is quite stronger. The same conclusions apply when the regression is estimated with data for Portugal alone, although the quantitative impact is lower than in most advanced countries.

Silva and Teixeira (2011) adopt two different classifications of industries, one that takes into account the industries' skill requirements, and a classification based on technological characteristics, to assess the importance of structural change for productivity growth in a sample of 10 countries described by the authors as 'relatively less developed' in the late 1970s but that exhibited different paths of structural change from then onwards. The main idea is to test whether these differing paths in terms of promoting changes in the economic structure towards more skilled and technology-intensive activities can explain the different growth performances (in terms of value added over employment measured in hours) registered over the period 1980-2003. The evidence suggests that a change in the high-skill industries (these include services such as communications, financial intermediation, except insurance and pension funding, real estate activities, computer and related activities, research and development, legal, technical and advertising, and education) and science-based industries shares influences positively labour productivity growth. In contrast, an increase in the VAB share of supplier-dominated industries (such as hotels and restaurants) results in a decline in labour productivity growth.

Hartwig (2012) main aim is to test the more recent view that even the so-called stagnant services can make a positive growth contribution "(…) because of the human capital-accumulating nature of major 'stagnant services' like health care and education" (p.19). The data used refers to 18 OECD countries between 1970 and 2005 and the variables of interest are the growth rates of real per capita GDP and the real per capita education and health care expenditures, with the latter serving as proxies for the importance of health and education services in the economy. The results however lend at most support to Baumol's

predictions, with expenditure growth on health and education Granger-causing real per-capita GDP growth with a negative sign.

There is also considerable debate around whether the causality runs from services expansion to growth or primarily the other way around. Studies that investigate this issue explicitly include Linden and Mahmood (2007) and Dietrich (2012). The first study estimates cointegration and causality between real GDP per capita growth and sectoral shares (agriculture, industry, services) in 14 Schengen countries over the period 1970-2004. The evidence points to two-way causality between the growth rates of GDP per capita and the services sector share. Growth in the services sector share leads to slower GDP per capita growth but faster GDP per capita growth has a positive impact on services share growth. Dietrich (2012) computes structural change indexes using both employment and real value added sectoral shares and finds evidence to support bi-directional causality between these and the growth of real GDP in a sample of 7 OECD countries over the period 1960-2004. However, the results vary across countries. Aggregate economic growth causes structural change in the largest economies, Germany, Japan, the UK and the U.S., while the results for the other countries depend on the measure of structural change used, either employment or value added. In the other direction, structural change in the form of employment causes economic growth in Japan and the U.S. only with the results for all remaining countries not statistically significant. Structural change in the form of real value added causes economic growth in Japan, the U.S., Italy, Germany and the UK, but not in the remaining countries.

Using data for 28 manufacturing industries from 44 countries over the period 1980-1999, Ciccone and Papaioannou (2009) provide evidence of the importance of human capital availability for structural change. The authors find a positive and statistically significant correlation between initial schooling levels and value added and employment growth in schooling-intensive industries, stronger for more open economies. Faster educational attainment growth also seems to lead to faster shifts in production towards human capital-intensive industries. It is thus also likely that the availability of high levels of human capital, by facilitating technology adoption in education-intensive services sub-sectors, leads to faster value added and employment growth in modern progressive services. In fact, Peneder (2007) performed a taxonomy of 49 manufacturing industries and services activities according to educational intensity, ranging from very low, that include services like hotels and restaurants/catering and private households with employed persons, to very high, that include services such as computer and related activities and R&D, but also education. Wholesale trade, communications, real estate, and other services are classified in the intermediate educational intensity group, and activities such as financial intermediation and business services as a whole in the high educational intensity group. The author presents evidence that the activities with a very high educational intensity, and also most industries with a high or intermediate level, were the ones that registered the highest growth rates in terms of value added and employment in a sample of 24 OECD countries over the period 1992-2000.

3. GROWTH, HUMAN CAPITAL AND SERVICES IN THE PORTUGUESE ECONOMY

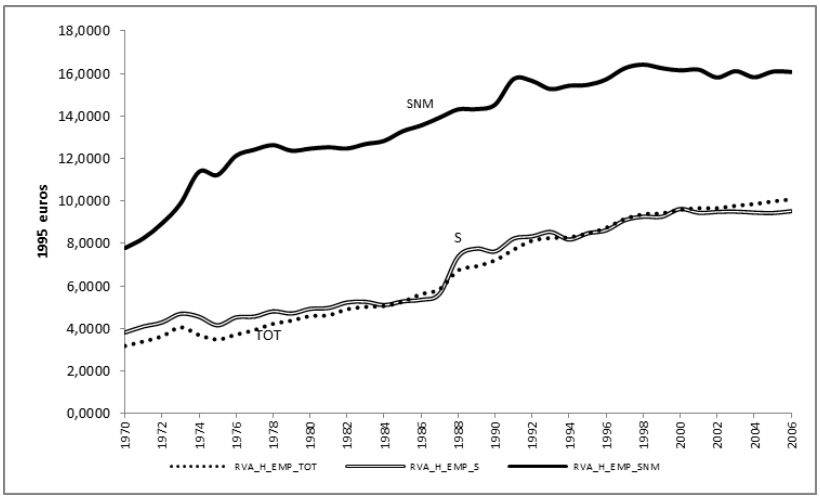
The main aim of this paper is to shed some light on causality between the services sector productivity and expansion, aggregate productivity and human capital and not to deliver a comprehensive model of output or productivity behaviour. Specifically, we focus

on the role of services sector productivity performance and expansion in aggregate productivity performance and its interactions with human capital. Our variables of interest thus refer to the four dimensions under analysis.

Annual output and employment data from 1970 to 2006 were obtained from the EU KLEMS database (see O'Mahony and Timmer (2009)), especially suited for sectoral studies. The choice of the time period was essentially dictated by data availability concerning sectoral data, with the final year of the November 2009 release of the EU KLEMS database corresponding to the year 2006. In any case, even if more recent data was available it would not be wise to include the crisis years in our analysis since we would be considering years when the evolution of output was dictated by particular events that could mask the identification of the true long-run influence of tertiarization and human capital on output. Output is measured as gross value added at 1995 prices. Employment corresponds to total hours worked by persons engaged. Labour productivity was obtained dividing gross value added by the total hours worked by persons engaged. In order to better ascertain the role of services productivity on overall productivity in the Portuguese economy we considered the separate influence of market services (S) and non-market services (SNM). According to the EU KLEMS classification, the market services category comprises the following services sub-sectors: DISTRIBUTION (Trade and Transport and storage); FINANCE AND BUSINESS, EXCEPT REAL ESTATE; and PERSONAL SERVICES (Hotels and restaurants; Other community, social and personal services; Private households with employed persons). Non-Market services include public administration, education and health and real estate activities.

The labour productivity and services total real value added and employment shares series by major services sub-sectors are depicted in Figures 1-3. Tables 1-3 detail the previous information in terms of the values of the series for some of the years under analysis and respective annual average growth rates.

Figure 1 and Table 1 trace the evolution of labour productivity in the Portuguese services sector over the period 1970-2006. Both services categories considered exhibit a positive labour productivity trend over the period under analysis, although at different paces. There was faster growth in market services over the whole period, although some volatility is present across sub-periods. Non-market services grow distinctly faster than market services during the 1970s, and the reverse happens during the 1980s and the 1990s. Over the period 2000-06, non-market services stagnate while market services show a very slight decline. Towards the end of the period under analysis both categories registered a productivity growth slowdown, especially strong in the market services, and there was also an aggregate productivity growth slowdown since the 1990s. As far as the productivity levels are concerned, non-market services present the highest level in 1970 and again in 2006. Relative to aggregate productivity, productivity in the non-market services was always higher than aggregate productivity: it was more than de double in 1970 and 1.5 times aggregate productivity in 2006. The same applies to market services, except in 2006, although the figures are in this case only slightly higher than aggregate productivity.



Notes: RVA_H_EMP corresponds to real value added by hour worked by person engaged in 1995 euros. TOT= total economy; SNM=non-market services; S=market services excluding post and telecommunications.

Source: author's computations based on data from the EU-KLEMS database

Figure no.1 Labour productivity in the services sector, Portugal 1970-2006

Table no. 1 Labour productivity (€) – total and services sub-sectors, Portugal 1970-2006

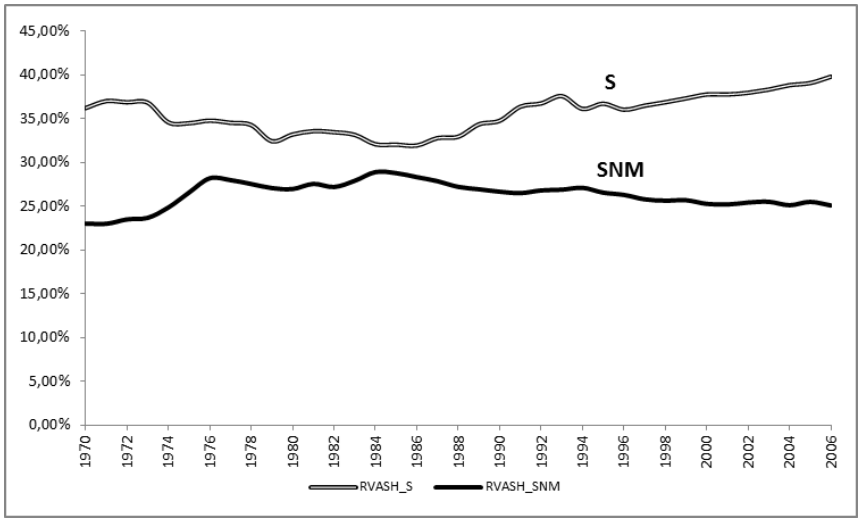
Years	TOTAL	Market Services	Non-Market Services
1970	3.181	3.815	7.788
1980	4.586	4.926	12.468
1990	7.211	7.625	14.539
2000	9.590	9.625	16.149
2006	10.079	9.524	16.077
Annual average growth rate (%)			
1970-06	3.20%	2.54%	2.01%
1970-80	3.66%	2.55%	4.71%
1980-90	4.53%	4.37%	1.54%
1990-00	2.85%	2.33%	1.05%
2000-06	0.83%	-0.18%	-0.08%

Notes: Labour productivity corresponds to real value added by hour worked by person engaged in 1995 euro.

Source: author's computations based on data from the EU-KLEMS database

The process of tertiarization of the Portuguese economy can be described by looking at the evolution of the shares of the different services sub-sectors in total real value added. Figure 2 and Table 2 contain information on the real value added shares of both services categories from 1970 until 2006. Considering the whole period, both market and non-market services increased its participation in total value added, confirming that Portugal underwent a tertiarization process over the period under analysis, but the participation of non-market services reached its peak in the 1980s and from then onwards registered a decrease. In 1970 and throughout the whole period market services contributed the most to total value added,

representing in 2006 almost 40% of the total, against 25% of non-market services share. From the 1980s onwards market services increased its total value added share, and the reverse applies to non-market services.



Notes: RVASH is the share of the corresponding services activity(ies) in total real value added. SNM=non-market services; S=market services excluding post and telecommunications.
Source: author's computations based on data from the EU-KLEMS database.

Figure no. 2 Total real value added shares of the services sector, Portugal 1970-2006

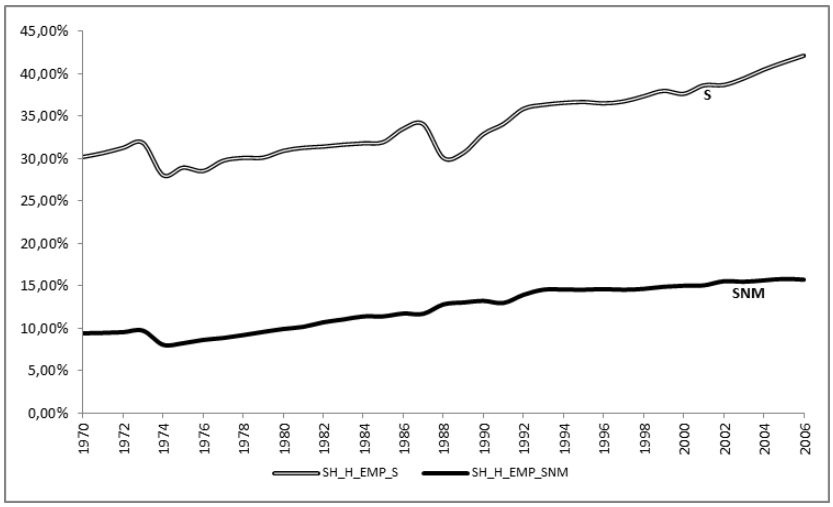
Table no. 2 Real value added shares of services sub-sectors, Portugal 1970-2006

Years	Market Services	Non-Market Services
1970	36.234%	23.036%
1980	33.215%	26.988%
1990	34.789%	26.687%
2000	37.787%	25.296%
2006	39.832%	25.105%
Annual average growth rate (%)		
1970-06	**0.26%**	**0.24%**
1970-80	-0.87%	1.58%
1980-90	0.46%	-0.11%
1990-00	0.83%	-0.54%
2000-06	0.88%	-0.13%

Source: author's computations based on data from the EU-KLEMS database, November 2009 release

Structural change towards the services sector can also be analyzed from the perspective of employment. Figure 3 and Table 3 contain information on the total employment shares of both services categories over the period 1970-2006. Employment refers to total hours worked by persons engaged. Market and non-market services increased their participation in total employment over the period under analysis, confirming the increasing importance of

the services sector in the Portuguese economy. In 1970, employment in the market services category represented a little more than 30% of total employment, and by 2006 this share increased to around 42%. The corresponding figures for non-market services are 9.41% and 15.74%, respectively. Over the whole period non-market services increased its total employment share at a faster pace than market services, although some volatility is present across sub-periods. Non-market services total employment share grew faster than market services share during the 1970s and the 1980s, and the reverse happened during the 1990s and over the sub-period 2000-06.



Notes: SH_H is the share of the corresponding services activity(ies) in total employment (total hours worked by persons engaged). SNM=non-market services; S=market services excluding post and telecommunications.

Source: author's computations based on data from the EU-KLEMS database.

Figure no. 3 Total employment shares of the services sector, Portugal 1970-2006

Table no. 3 Total employment shares of services sub-sectors, Portugal 1970-2006

Years	Market Services	Non-market Services
1970	30.21%	9.41%
1980	30.92%	9.93%
1990	32.90%	13.24%
2000	37.65%	15.02%
2006	42.15%	15.74%
Annual average growth rate (%)		
1970-06	0.93%	1.43%
1970-80	0.23%	0.54%
1980-90	0.62%	2.88%
1990-00	1.35%	1.27%
2000-06	1.88%	0.78%

Source: author's computations based on data from the EU-KLEMS database

Human capital is measured as the average number of years of education, total and by schooling level, of the working age population. Data from 1970 until 2001 was taken from Teixeira (2005) a human capital database specific for the Portuguese economy that follows the Barro and Lee methodology for the computation of average years of schooling but presents two main advantages. First, problems of poor data quality are mitigated due to stronger consistency of national data sources, and second, data frequency is annual which is convenient given the time series methodologies we apply. Data from 2002 until 2006 were computed applying the human capital annual average growth rates based on the data from Barro and Lee (2013), which has data for the years 2000, 2005 and 2010. Table 4 contains some summary information for these human capital variables. In 1970, Portugal still registered low levels of educational attainment with only an average of 3.276 of years of education per working age person. By 2006 the situation had improved considerably with 8.286 average years of total schooling. In any case, according to Barro and Lee's data, this figure is still lower than the values registered by countries at similar stages of development such as Greece or Spain that in 2005 stood at, respectively, 9.891 and 9.720, and much lower than in Germany (11.845). Growth was faster at the higher schooling levels, which is not surprising given the low initial levels, but has slowed down considerably during the last sub-period.

Table no. 4 Average years of schooling of the working age population, Portugal 1970-2006

Years	**Average years of total schooling tyr**	**Average years of primary schooling pyr**	**Average secondary of total schooling syr**	**Average years of tertiary schooling hyr**
1970	3.276	2.280	0.876	0.119
1980	4.439	2.844	1.373	0.223
1990	5.700	3.239	2.133	0.328
2000	7.770	3.531	3.580	0.659
2006	8.286	3.626	4.009	0.721
Annual average growth rate (%)				
1970-06	2.58%	1.29%	4.22%	4.99%
1970-80	3.04%	2.21%	4.49%	6.23%
1980-90	2.50%	1.30%	4.41%	3.87%
1990-00	3.10%	0.86%	5.18%	6.99%
2000-06	1.07%	0.44%	1.89%	1.48%

Source: author's computations based on data from Teixeira (2005) *and* Barro and Lee (2013)

4. EMPIRICAL MODEL AND RESULTS

We apply econometric time-series analysis techniques to examine the relationship between services sector expansion and productivity performance, human capital and aggregate productivity in Portugal. For this purpose we estimate VAR models with annual data for the period 1970–2006 and four variables: aggregate productivity, sectoral productivity, structural change, and human capital. VAR models allow us to take into account inter-dependencies and dynamic relationships between variables by explaining the

behavior of the endogenous variables by their own past values and the past values of exogenous variables.

The variables in our database are integrated of order one, *I(1)*[1]. We tried to establish cointegration relations and in this way study long-run relationships between the variables, as well as analyzing the consequences of shocks to the variables in the models estimated. However this strategy revealed itself not very helpful. In most cases the number of cointegration relationships was the maximum possible, so that we could not reject the hypothesis of joint stationary of the variables. In other situations, the short term parameter had the wrong sign that is positive for the corresponding error correction (ECM) term. The choice of the optimal lag order also lead us to reject VECM models as the basis of our econometric methodology. In fact, if we have a VAR defined in levels with *h* lags, to determine the ECM we have to impose a VAR with *h-1* lags. In our study, for most models estimated *h* was equal to 1, which would lead to a VECM with only the short term residual ECM. All these results pointed to an analysis based on the Doan-Litterman-Sims strategy that consists in estimating VAR models in levels, which we think is the most suitable strategy in this case.

Specifically, we estimate VAR models of the following general form:

$$y_t = A_1 y_{t-1} + - - - + A_p y_{t-p} + B_1 x_t + ... B_q x_{t-q} + CD_t + u_t \quad (1)$$

where $y_t = \left(y_{1t}, ..., y_{Kt}\right)$ is a vector of K observable endogenous variables; $x_t = \left(x_{1t}, ..., x_{Mt}\right)$ is a vector of M observable exogenous variables; D_t contains the constant as the deterministic variable; and u_t is a K-dimensional unobservable zero mean noise process with positive definite covariance matrix $\mathrm{E}\left(u_t u_t^{'}\right) = \sum_u$. A_i, B_j and C are parameter matrices of suitable dimension.

Our VAR models consider four variables each: aggregate labour productivity (LY), the average number of years of education, either total, secondary or tertiary, of the working age population, (LTH, LSH, and LHH, respectively)[2]; labour productivity of services sub-sector *i* (LYi); and the employment share of services sub-sector *i* (Eir), as the structural change indicator. To consider in a more detailed manner the importance of the heterogeneity of the services sector for aggregate productivity, we do not take the services sector as a whole but the two categories described in the previous section, market (S) and non-market (SNM) services.

We began by estimating VAR models considering all variables as endogenous. However, based on the results from the impulse response analysis carried out further along the paper concerning the influence of the human capital and employment share variables on the other variables of the model, which turned out not to be statistically significant in most of the models, we decided to estimate models considering those variables as exogenous[3]. We identify the first type of models with a capital A, and the second type of models with a capital B. For each type of model A we thus have K=4 and M=0, and for each type of model B we have K=2 and M=2. In the second type of models the two endogenous variables are aggregate productivity and sectoral productivity and the two exogenous variables are human capital and the sectoral employment share. In summary, we estimated four VAR models, according to the services category considered and the model type, A or B. We thus have models 1A and 2A, and models 1B and 2B.

The optimal lag order for each model was chosen using the Bayesian or Schwarz information criteria (BIC) is equal to one. For all models, the absolute value of the eigenvalues of the reverse characteristic polynomial lie inside the unit circle, which indicates model stability (see Table A.2, Appendix A). Autocorrelation of the residuals was tested using two LM type tests for autocorrelation with one lag, see Doornik (1996)). The LM test and the LMF test (which applies an F-approximation) consider as the null hypothesis the absence of autocorrelation of order one of the residuals (see Table A.3, Appendix A). Model 1B exhibits autocorrelation. This might imply that the impulse-response analysis results depend on the order of the variables in the model when the Cholesky decomposition is applied, which is the case here. However, this potential problem is mitigated because the ordering of the variables in the model obeys to theoretical criteria.

To identify the role of services categories productivity and structural change on aggregate productivity, and respective interdependencies with human capital, two types of causality were tested, Granger causality and instantaneous causality. In the former case, a variable X does not Granger-cause variables Y or Z if the respective lags do not appear in the equations for these variables. In the latter case, X does not instantaneously cause Y or Z if and only if the respective residuals are uncorrelated. The logic behind this last concept is the following: if X causes instantaneously Y or Z then knowing the value of X in the forecast period helps to improve the forecasts of Y or Z (see Lütkepohl (2004)). The Granger and instantaneous causality analysis results are summarized in Table 5 (see also Table A.4, Appendix A) that highlights only the results concerning the influence of each of the services sectors variables on the other variables considered in the specific model estimated.

Table no. 5 Summary of the Causality Analysis Results – services categories influence

	Granger Causality	**Instantaneous Causality**	**Granger Causality**	**Instantaneous Causality**
Variables	LYSNM	LYSNM	ESNMr	ESNMr
Model 1A	NO	YES	NO	YES
Model 1B	YES	YES	---	---
Variables	LYS	LYS	ESr	ESr
Model 2A	YES	YES	NO	NO
Model 2B	NO	YES	---	---

Notes: LY=logarithm of labour productivity; E_r=employment share; S=market services; SNM=non-market services

According to the results presented in Table 5, non-market, SNM, and market, S, services behave quite differently in terms of causality. The employment share of market services (ESr) never causes the other variables in the models (2A and 2B), while in the case of non-market services the respective employment share (ESNMr) instantaneously causes the other variables in models 1A and 1B. As for productivity, instantaneous causality is confirmed for both sectors but Granger causality is only confirmed for model 2A in the case of market services and for model 1B in the case of non-market services. From the inspection of Table 5 some interesting conclusions can be drawn. First, services sectors productivity variables seem to be more relevant than employment shares in causing the remaining variables, either in the Granger or the instantaneous sense. Second, in the case of services

sectors productivity, the results are mixed, depending on the notion of causality under analysis. Third, market and non-market services behave somewhat differently in terms of causality: the results in terms of instantaneous causality coincide for productivity, but differ in terms of Granger causality. As for the employment share, the results coincide in terms of Granger causality, but differ in terms of instantaneous causality.

In order to shed additional light on the relationship and forecasting ability of the variables in our model we also performed an impulse response analysis. The impulse response analysis shows how a shock to one of the endogenous variables of the model affects the contemporaneous and future values of all endogenous variables in that same model. Specifically, we considered orthogonal shocks, which allow us to take into account uncertainty in the variables' equations contrary to the more usual consideration of unit shocks. We considered confidence intervals (CIs) at the 90% level of significance, computed by bootstrapping. When interpreting the statistical significance of the different shocks we always assumed the worst, which means that we only retain point estimates within the CI when the null is outside the CI.

Figures B.1 to B.4, Appendix B, present the results from the impulse response analysis for the different types of models. Models of type A consider all variables as endogenous. We start by summarizing the results of the responses to orthogonal shocks to the human capital and employment shares variables, one at a time, in models 1A and 2A. A shock to human capital has no influence over sectoral services productivity or employment shares since the results are not statistically significant with a CI at the 90% significance level. The same result applies to the response of aggregate productivity. As for shocks to the employment share, the influence upon human capital and sectoral services productivity is also not statistically significant. However, the influence on aggregate productivity is positive in model 1A and with a long and lasting effect. Concerning the responses to sectoral services productivity shocks, only shocks to market services productivity influence aggregate productivity, with a negative sign and significant after the 3rd year.

Models of type B consider as endogenous aggregate productivity and sectoral productivity and as exogenous human capital and sectoral employment shares. Table 6 summarizes de results from the impulse-responses analysis for these models. The detailed results can be found in Figures B.1.B to B.4.B in Appendix B. In what concerns the influence of shocks to services productivity on aggregate productivity, non-market services productivity shocks are the most influential ones with a positive and lasting effect. This makes this category very interesting from the perspective of its potential positive contribution to growth. As for the influence of shocks to aggregate productivity on sectoral services categories productivity, the main results are that the shocks are positive and have a high magnitude, although the time duration exhibits a certain degree of heterogeneity.

If we analyze jointly the results for the different services categories we come to the conclusion that market services and non-market services sectors productivity shocks contribute quite differently to aggregate productivity growth. In the first case, the contribution is not significantly different from zero but in the latter case the contribution is positive.

As for the impact of a shock to aggregate productivity on sectoral productivity, the influence is positive in both market and market services.

Table no. 6 Summary of the impulse-responses results with models of type B

Models	Impulse responses variables	Time duration (years)	Maximum shock magnitude (%)
Model 1B	LYSNM --> LY	10 (+)	26 (2)
	LY--> LYSNM	10 (+)	63 (1)
Model 2B	LYS --> LY	---------	---------
	LY--> LYS	7 (+)	109 (1)

*Notes: (+), (-) denote positive and negative shocks; (...) - time duration exceeds 10 years; ( ) – the year at which the maximum magnitude of the shock occurred; * the year refers to the point estimate with statistical significance and not to the year associated with the maximum point estimate of the shock magnitude; S=market services; SNM=non-market services.*

5. CONCLUSIONS

This paper examined the linkages between the services sector productivity and expansion, aggregate productivity and human capital in the Portuguese economy over the period 1970-2006. The main aim was to examine whether the increasing tertiarization of the Portuguese economy constituted an obstacle or an opportunity for its growth performance and if the expansion of the services sector is related to human capital availability in the Portuguese economy. Since the services sector is composed of heterogeneous activities in terms of its potential for productivity improvements we distinguished between different services categories.

Given the varied theoretical predictions and empirical results on the linkages between the expansion of the services sector and economic growth the most suitable approach seemed to be testing for the existence causality among the relevant variables. In this way we can account for endogeneity and reverse causation in the relationship between aggregate productivity, sectoral productivity, services sector expansion, and human capital based on the estimation of VAR models with these four variables. We studied the dynamic relationships between variables in levels that are *I(1)* by testing for the presence of two types of causality, Granger and instantaneous, and performing an impulse response analysis. The interdependence between the variables was in this way emphasized and the transitory paths to the long run equilibrium were explicitly considered.

Our findings concerning Granger and instantaneous causality analysis indicate that the results according to the division into market and non-market services are mixed. Non-market services show instantaneous causality in both productivity and the employment share. Market services also show stronger evidence for instantaneous causality but only in terms of productivity. These findings point to non-market services as the most influential category. The impulse response analysis showed how an orthogonal shock to one of the endogenous variables of the model affected the contemporaneous and future values of all endogenous variables in that same model. In this way it was possible to shed additional light on the relationship between each variable. The findings again point to a mixed contribution of services sectors productivity to aggregate productivity. Market services and non-market services sectors productivity shocks contribute quite differently to aggregate productivity growth, not statistically different from zero in the first case, and positively in the second case.

The employment shares of the two services categories do not seem to cause the other variables in the model, namely aggregate productivity or human capital, and the impact of shocks to these sectoral variables are also not statistically significant. These results seem at

odds with Baumol´s structural burden hypothesis since non-market services are usually described as services activities where productivity gains are hard to achieve and thus would make a negative contribution to aggregate productivity. The mechanism of transmission in action could thus be that of human capital accumulation since community social and personal services include education and health activities. This result is in line with Pugno (2006) perspective of the existence of countervailing factors, such as household services (where education and health are included) to Baumol's prediction of an aggregate productivity slowdown due to the expansion of stagnant sectors, i.e. sectors with less potential for productivity improvements.

The methodology applied also did not allow us to confirm that human capital in the form of education plays a role in driving productivity growth and expansion in the different services categories, nor is it influenced by their evolution. Nevertheless, the relevant schooling levels identified as potentially relevant varied across services sub-sectors. Fruitful avenues for future research applied to the Portuguese economy thus include a more detailed analysis of human capital availability across sectors, introducing quality issues as well as other forms of human capital such as training and experience. It can also be the case that factors other than human capital availability, such as changes in international and domestic demand as suggested by Silva (2011) and Silva and Teixeira (2012), are the most relevant ones in explaining structural change towards the services sector in Portugal.

Avenues for future research include additionally a more detailed analysis of the mechanisms of transmission from some services sub-sectors productivity to aggregate productivity. For instance, financial, insurance, and business services, included in the market services category, are activities usually viewed as having a high potential for knowledge creation and that generate positive externalities that spill over to the rest of the economy. The consideration of their impact on productivity in the manufacturing sector, for example, could thus help us to improve our understanding of their role in aggregate productivity (see Pugno (2006)).

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Appendix A

Table no. A.1 - VAR Models Variables

VAR Models	Endogenous Variables				Exogenous Variables	
Model 1A	LY	LSH	LYSNM	ESNMr	---	---
Model 1B	LY	LYSNM	---	---	LSH	ESNMr
Model 2A	LY	LSH	LYS	EYSr	---	---
Model 2B	LY	LYS	---	---	LSH	EYSr

Table A.2 - Model Stability

Models type A	Eigenvalues	Models type B	Eigenvalues
Model 1A	|z| = (1.5117 1.5117 1.0348 1.1947)	Model 1B	|z| = (2.7098 1.1711)
Model 2A	|z| = (2.5342 1.05151.0515 1.1998)	Model 2B	|z| = (1.1576 1.5308)

Notes: |z| denotes the modulus of the eigenvalues of the reverse characteristic polynomial.

Table no. A.3 - Autocorrelation Results with 1Lag

Models A	LM and LMF statistics	Models B	LM and LMF tests
Model 1A	LM: 21.91 LMF: 1.26	Model 1B	LM statistic: 9.46* LMF: 2.30*
Model 2A	LM:18.33 LMF:0.95	Model 2B	LM: 4.43 LMF: 0.95

*Notes: LM type test for autocorrelation with 1 lag, Doornick (1996), LM test and LMF test (with F-approximation); H0 = no autocorrelation of order one of the residuals. *; **; *** - significance at 10%, 5% and 1% levels, respectively.*

Table A.4 - Causality Results

Variables and tests	Models		
	Model 1A		Model 1B
Causality variables	LYSNM $\not\rightarrow$ "LY,LSH, ESNMr"	ESNMr $\not\rightarrow$ "LY,LSH, LYSNM"	LYSNM $\not\rightarrow$ "LY"
Granger causality test:	1.1969	1.4184	10.0538***
Instantaneous causality test:	14.5105***	9.9634**	10.3318***
	Model 2A		Model 2B
Causality variables	LYS $\not\rightarrow$ "LY,LSH, ESr"	ESr $\not\rightarrow$ "LY,LSH, LYS"	LYS $\not\rightarrow$ "LY"
Granger causality test	5.6932***	0.8796	1.7238
Instantaneous causality test	17.3618***	6.0993	14.3311***

*Notes: Granger causality test the null hypothesis is equivalent in the case of class A models to H0= X does not Granger cause Y,Z,W; Instantaneous null hypothesis is equivalent to H0=No instantaneous causality between X and Y,Z, W. *; **; *** - significance at 10%, 5% and 1% levels, respectively.*

Appendix B

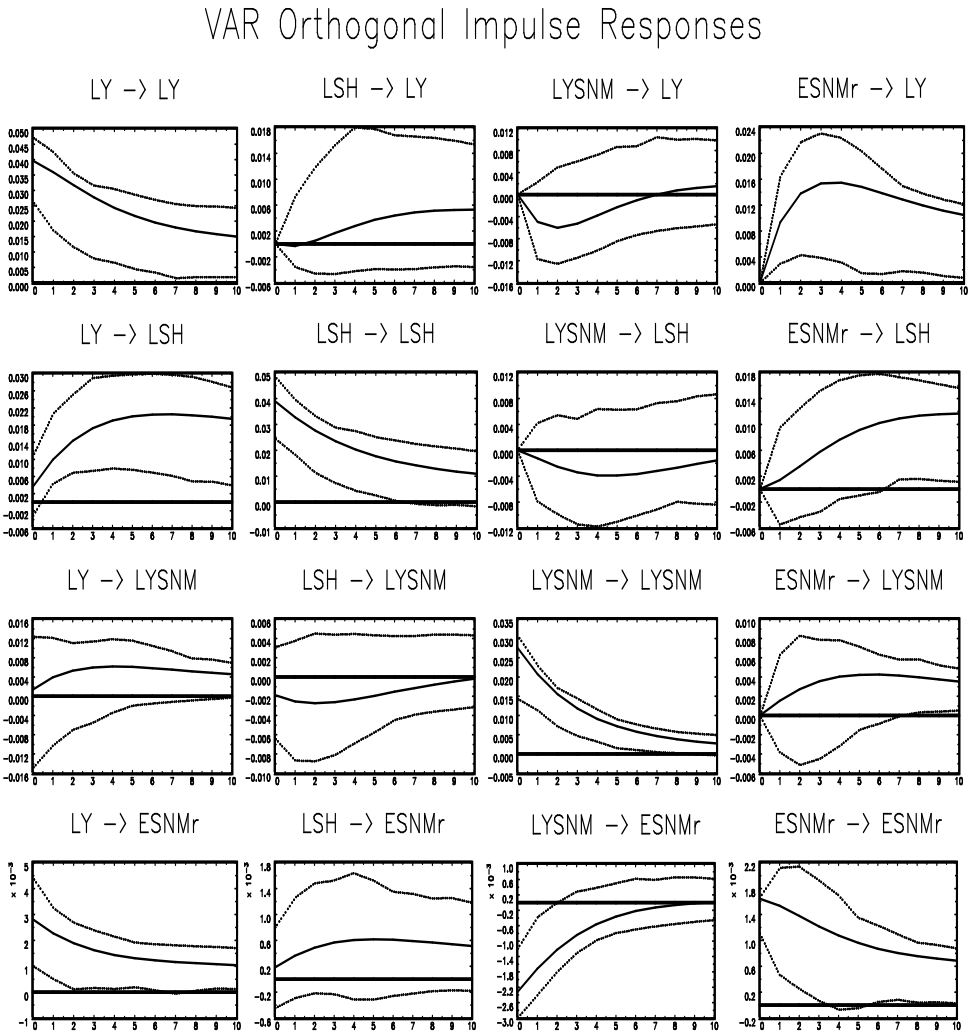

Figure no. B.1A Impulse response shocks, Model 1A

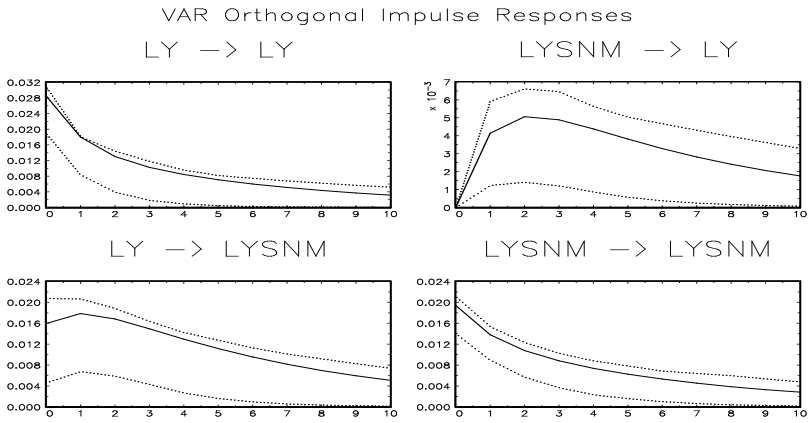

Figure no. B.1B Impulse response shocks, Model 1B

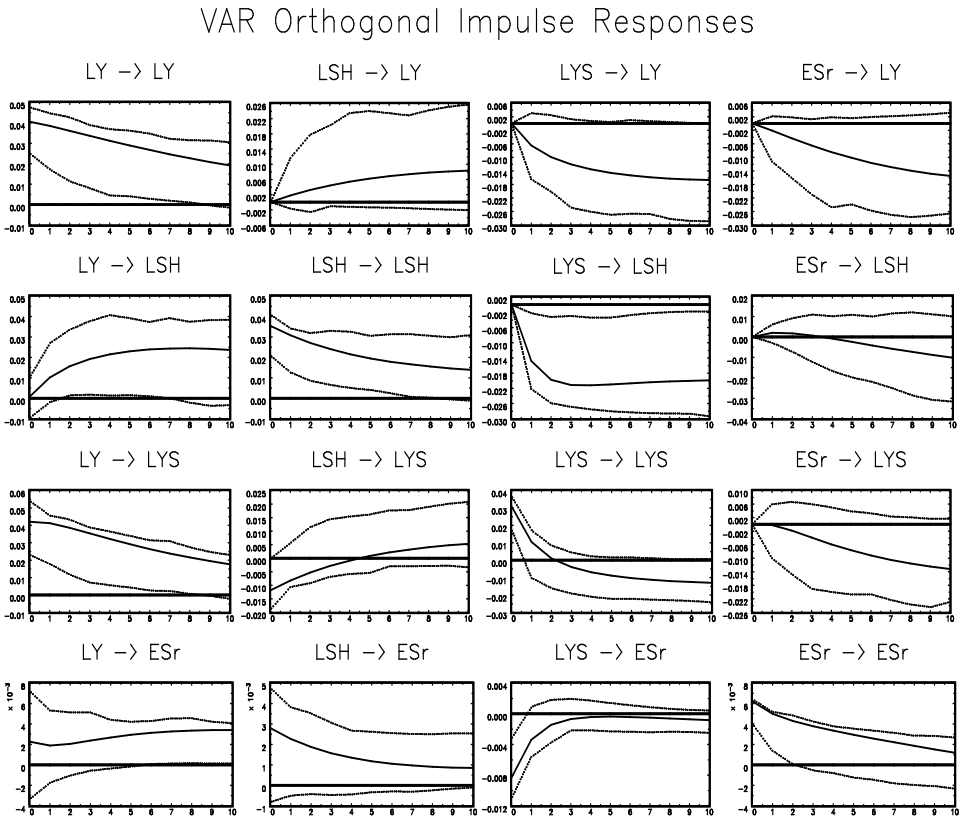

Figure no. B.2A Impulse response shocks, Model 2A

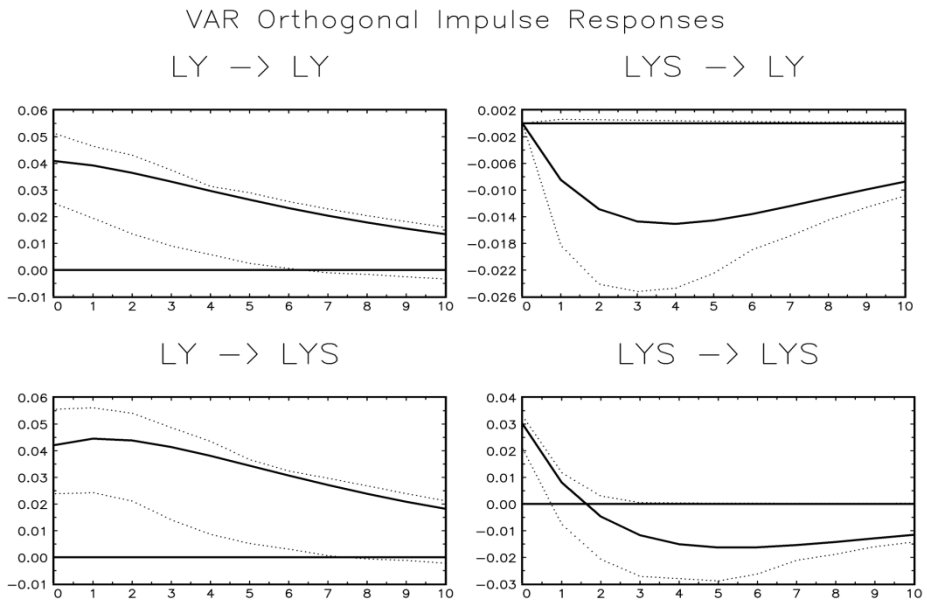

Figure no. B.2B Impulse response shocks, Model 2B

Notes

[1] Results of the stationarity tests are available from the authors upon request.

[2] For each services sector, we estimate VAR models using different schooling levels. We retained the model with the best estimate for human capital (see Table A.1 in Appendix A). The full results can be obtained from the authors upon request.

[3]Since the long run behavior of the human capital and employment share variables might not be adequately captured in our VAR models, and consequently their effects upon the remaining variables, we consider type B models where these variables are assumed exogenous.