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Structural change, labour productivity and the Kaldor-Verdoorn law: evidence from European countries

Matteo Deleidi * Walter Paternesi Meloni * Antonella Stirati *

Abstract

Mature European countries have recently experienced a slackening in output growth and stagnating labour productivity, which may result both from poor 'within sector' growth and/or 'structural change'.

In this regard, the contribution of the paper is twofold. First, we assess the weight of 'structural change' *versus* 'within sector' growth in affecting overall productivity dynamics by means of a shift-share analysis. Second, we investigate the impact of demand factors on 'within sector' productivity growth by estimating the Kaldor-Verdoorn long-run coefficients in response to the dynamics of *autonomous demand* (1980-2015).

We find that: (i) productivity growth is mainly driven by the 'within sector effect', with a relatively smaller role played by structural change; (ii) autonomous demand growth is relevant in determining productivity dynamics, especially in manufacturing.

A major policy implication is that coordinated expansionary policies would matter for productivity growth in the EU, and at the same time contribute to sustain employment.

JEL classification: E240; L160; O470.

Keywords: Structural Change; Tertiarisation; Shift-Share Analysis; Labour Productivity; Kaldor-Verdoorn Law.

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1. Introduction

In the last two decades, we have witnessed a slackening in economic growth and stagnating labour productivity in several advanced countries, and particularly in Europe – as also documented by institutional research (Estevão 2004; Denis et al. 2005). The poor performance of productivity growth has caused preoccupation, and often has been regarded as the direct cause of slow growth. This consideration is based on a theoretical approach that has a canonical representation in the neoclassical Solow's growth model, according to which GDP growth is determined by population growth and technical progress. In this paper we adopt a different theoretical framework, whereby long-term growth depends on aggregate demand, and particularly on the growth of its autonomous components.[1] Even in this perspective however productivity growth is important in affecting export growth and the propensity to import, hence demand and employment growth and trade balance sustainability (Cesaratto et al. 2003). In addition, productivity dynamics is important for the sustainability of welfare systems, including public health and pension systems, particularly in mature economies that are facing a progressive ageing of population. Understanding the causes of slow productivity growth and policy measures that might help overcoming and governing this danger it is thus of great importance.

Among other explanations, stagnating productivity has been related to 'structural change' (Fagerberg 2000; McMillan et al. 2014), namely the process whereby many industrial economies have faced radical transformations in their productive structures by shifting from the manufacturing towards the service sectors – the so-called process of 'tertiarisation'.[2] Notably, the economic literature has argued that this change in the production structure can be related to several socio-economic reasons, among which income distribution (Kuznets 1955), institutional factors (Chang 1994; Fadda 2017) and globalisation (McMillan et al. 2014). Moreover, a very important long-term

[1] See Cesaratto (2015) and Lavoie (2016) for surveys of this literature.

[2] There are several definitions of *structural change*. In this paper, we adopt a macroeconomic perspective, and with this term we mostly refer to changes in the composition of aggregate output. This feature is also apparent in Ishikawa's (1987, p. 523) definition of structural change, in which it is seen as "a change in the relative weight of significant components of the aggregative indicators of the economy, such as national product".

structural factor behind this change is the interaction among technical progress, increasing per capita income and the composition of consumption, with an increasing *weight* of services relatively to food and manufactured goods, consistently with Engel's law (Leon 1967; Pasinetti 1981; Saviotti and Pyka 2017).

The influence of structural change on productivity growth depends on the fact that aggregate labour productivity growth besides resulting from supply- or demand-side factors affecting its dynamics within each sector also depends on the shifts in GDP and employment composition from high to low and from fast- to slow-growing sectors in terms of productivity (or *vice versa*). In this respect, a re-emerging line of research based on the so-called Baumol effect (Baumol 1967) considers the shift towards the tertiary sector as one of the causes of slow productivity growth, since "a transfer of resources from manufacturing to services may provide a structural change burden if many service activities indeed have little potential for productivity increase" (Szirmai and Verspagen 2015, p. 47).[3] In particular, being the tertiary sector characterised by labour-intensive production techniques, according to this argument a shift towards services would have exacerbated the slowdown of labour productivity dynamics (see Hartwig 2011; Tridico and Pariboni 2017).

In addition to the effect of structural change, weak dynamics of aggregate labour productivity can be generally explained by within sectors supply- or demand-side factors. Though we do not deny the role of supply-side factors, (i.e., research and industrial policies) in affecting productivity, in this paper we have chosen to focus on the too often neglected demand-side and particularly on the role of the Kaldor-Verdoorn law (henceforth, KV law). In this perspective, the service sector – the share of which in terms of employment and value added dramatically increased

[3] The Baumol's law states that aggregate per capita growth will tend to slow down along with an increasing share of services in GDP. To some extent this view emerged in contrast with the *structural change bonus* argument, which was however central in the Rostow (1960) theory of growth by 'stages of development'. Various mechanisms for the linkage between industrial structure and economic growth have been identified (see Peneder et al. 2003). In particular, the 'bonus' hypothesis postulates a positive relationship between structural change and economic growth (Timmer and Szirmai 2000), based upon the assumption that during the process of development economies upgrade from industries with comparatively low to those with a higher value added per labour unit. However, in fact, both processes may be taking place at the same time: for example 'within sector' productivity growth, particularly but not exclusively in manufacturing, may be related to the upgrading of productive activities, while at the same time an increasing weight of personal services in overall production may result in the 'Baumol effect'.

during the last decades – might feature not only lower value added per labour unit, but also less scope for labour productivity increases to be achieved through economies of scale stimulated by aggregate demand growth, in contrast to what occurs in manufacturing.

Along these lines, the paper proceeds as follows. In Section 2, after documenting the process of tertiarisation, we assess the respective weight of structural change and 'within sector' productivity growth in determining aggregate labour productivity dynamics by means of a shift-share analysis conducted on major European countries. In Section 3, we first introduce and explain different theoretical approaches to labour productivity, then we focus on the Kaldor-Verdoorn law and particularly on the role of demand factors in determining labour productivity dynamics even in the long run. In Section 4, in the spirit of Millemaci and Ofria (2014) and by making use of an ARDL cointegration-based methodology, we empirically investigate the Kaldor-Verdoorn sectoral coefficients. However, an element of originality of our empirical analysis is that as our independent variable we use the growth rate of autonomous components of demand (i.e., public spending and export) as a proxy for output growth. In Section 5, we present and discuss estimations of the Kaldor-Verdoorn coefficients confirming the importance of demand-side factors in stimulating the rate of growth of labour productivity. According to the empirical evidence Section 6 draws some policy implications, and finally Section 7 concludes.

2. Structural change and labour productivity

The question of a link between productivity dynamics and output composition emerged during the last decades, when advanced economies and particularly European countries experienced slow growth, unemployment and stagnating labour productivity. As many industrial economies faced far-reaching changes in their productive structures by shifting from the manufacturing towards the services sector, a lively reappraisal of the Baumol law has been advanced (Baumol 1967). Specifically, low productivity dynamics has been related to the structural change burden stemming from the shift towards the tertiary sector (see Szirmai and Verspagen 2015; Hartwig 2011; Tridico and Pariboni 2017), being characterised by labour-intensive production techniques and slower productivity growth. Actually, the expansion of the services sector weight in total output combined with the decline of the manufacturing one is detectable in several advanced economies during the last decades. This process has been often termed 'tertiarisation', describing it as a further structural change, in the spirit of the shift from agriculture towards manufacturing experienced during the 19th and 20th century (see Peneder et al. 2003).

According to these premises, a sectoral analysis is necessary to verify to what extent the structural change towards services can explain the dynamic of aggregate labour productivity. To do so, in the following, we first propose a survey of sectoral employment shares to document the process of tertiarisation, and second we perform a shift-share analysis to assess the contribution of structural change to labour productivity growth. In our empirics we consider the primary sector, industrial sector, construction and services for nine major European countries (namely, Austria, Belgium, Finland, France, Germany, Italy, Netherlands, Spain and Sweden). Notably, the selection of countries depended on the availability of yearly sectoral series consistent with the implementation of the shift-share analysis.

2.1 Structural change and sectoral employment shares

The structural change occurred in advanced economies during the last century was dramatic, especially in terms of workers' reallocations among sectors. At the beginning of the 20th century about 47% of labour force was engaged in agriculture, 28% in manufacturing and 25% in services (see Feinstein 1999). Nevertheless, while up to the 1970s structural change was mainly driven by the growth of manufacturing at the expense of a rapid decline of the primary sector share in GDP, the subsequent developments resulted, at the end of the century, "in an employment share of the secondary sector of 28% as opposed to the 67% of the service industries".[4] Some evidence of this in

[4] According to Peneder et al. (2003), although on a smaller scale this holds for value added shares, as "in the European Union between 1970 and 1995 the output shares of the primary sector shrank from about 6 to 2% and those of the secondary sector from 44 to 31%. In the same period the share of the tertiary sector rose from one half to two thirds.

Figure 1, featuring sectoral employment shares in major European countries (expressed in hours worked to avoid potential bias caused by part-time contracts).

[Figure 1 about here]

Among the nine European countries represented in the figure, Belgium, France, Netherlands and Spain have virtually reached the 80% threshold the service sector employment share, Sweden stands at about 75% while Austria, Finland, Germany and Italy at 70%. The process of tertiarisation seems to be quite continuous overtime, even though somewhat more pronounced during the '70s and the '80s. In parallel, the share of employment in the industrial sector presents a dramatic fall for Belgium, France and Netherlands (halved between 1975 and 2015) and a large decrease for Spain (from 25% to 11%). Austria (from 27% to 16%), Italy (26% to 17%) Finland (23% to 14%), Sweden (24% to 14%) all have a downsizing of the share comprised between 11 to 9 percentage points. For what concerns Germany, we observe a reduction from 27% to 20%, despite the fact that series start in 1991. Finally, the agriculture share of employment exhibits a downward trend in the first part of the period (especially in Finland, France, Italy and Spain) and stabilisation at around 5%, after the '80s, while the share of hours worked in the construction sector is quite steady during the period in all countries. However, it is interesting to note that in all these countries the industrial share in term of value added declined less markedly than in terms of employment, and currently holds at around 20%. This of course depends on different sectoral productivity dynamics, which is why in the next section we will try to assess the connections between structural change and aggregate labour productivity growth.

Similar developments can be observed in Japan and the USA, where in 1997 the share of services amounted to 62 and 73%, respectively".

2.2 Shift-share analysis

A useful tool in accounting for the contribution of structural change to aggregate labour productivity dynamics is the so-called ‘shift-share analysis’. Essentially, it is a purely descriptive technique which decomposes the change of aggregate labour productivity growth[5] into changes within the sectoral units that make up the aggregate and changes in the structural composition of the aggregate (see Fagerberg 2000; Timmer and Szirmai 2000 among others).[6] This derives from the fact that economy-wide labour productivity growth can be achieved in two ways: on the one hand, productivity can grow within economic sectors through capital accumulation, technological change, division of labour or increased efficiency; on the other hand, productivity depends on how employment shares shift across sectors, where an increase in aggregate labour productivity growth should occur in case an economy moved (in terms of shares in total employment) from low-productivity to high-productivity sectors and from slow-growing to fast-growing sectors in terms of productivity (McMillan et al. 2014). Analytically, aggregate labour productivity growth can be decomposed as in equation (1):

$$\frac{\Delta P_t}{P_0} = \sum_{i=1}^{m} \left(\frac{P_{i,o} \cdot \Delta S_{i;t}}{P_0} + \frac{S_{i,o} \cdot \Delta P_{i,t}}{P_0} + \frac{\Delta P_{i,t} \cdot \Delta S_{i,t}}{P_0} \right) \tag{1}$$

where P_i is real value added per hour worked in the *i* sector ($P_i = \frac{Q_i}{H_i}$, being Q_i sectoral value added at constant prices and H_i the number of hours worked in each sector, with $i = 1 \dots m$), P represents the aggregate real value added per hour worked ($P = \frac{Q}{H}$), and S_i denotes the share of employment, measured in hours worked, of each sector in total employment ($S_i = \frac{H_i}{\sum_i^m H_i}$). Consistently, $\Delta P_{i,t}$ and

[5] In analysing labour productivity, we do not consider the contribution of labour to output stemming from the total factor productivity approach based on the neoclassical growth model (Solow 1957). The reason for this is that growth accounting along these lines requires the use of an aggregate production function grounded on the marginalist theory of distribution (see Felipe and McCombie 2006). Particularly, it requires that distributive shares are regarded as representative of factors’ marginal products. We prefer to refer to productivity as value added per hour worked, which can be considered a theoretically-neutral indicator of productivity, reflecting technology and output composition.

[6] This approach can be also extended at firm-level, by decomposing productivity change into inter- and intra-firm effects.

$\Delta S_{i,t}$ show the changes in sectoral labour productivity ($P_{i,t} - P_{i,0}$) and employment share ($S_{i,t} - S_{i,0}$) experienced from time 0 to time t, while ΔP_t represents the change in aggregate value added per hour worked for the same period under investigation ($P_t - P_0$).

With respect to equation (1), the first addend is the *'static' structural change effect*, namely the sum of changes in employment shares weighted by the initial relative productivity level (i.e., the ratio of sectoral productivity to aggregate productivity). The second addend is the *within sector effect*, that is the sum of sectoral productivity growth rates weighted by the initial employment shares. The third addend is the interaction term, usually defined *cross effect*, and it measures what we may call the *'dynamic' structural change effect* due to the changes in the employment shares of industries *and* their relative productivity growth. That is, it measures the contribution to overall productivity growth of employment weight moving towards or away from the fastest growing sectors in terms of productivity. It will be negative if the employment share of the fastest growing sectors in terms of productivity declines and *vice versa*. By means of this empirical exercise, we decompose the growth rate of economy-wide labour productivity into three different components, which denote the contribution to aggregate productivity growth stemming from:

1. changes in the allocation of labour among sectors; if the first term is positive, the employment share of the sectors that had a higher productivity level in the initial period increased at the expense of low productivity sectors;
2. changes in productivity within individual sectors weighted by the initial share of each sector in total employment; this term is positive in case of *tout court* productivity gains;
3. changes in sectoral productivity interacted with changes in the allocation of labour across sectors; a positive value means that fast growing sectors in terms of productivity also increase their share of total employment.

The results of the shift-share analysis, conducted on the basis of the four macroeconomic sectors listed above, are reported in Figure 2.[7]

[Figure 2 about here]

As mentioned, the object of this empirical exercise is to gauge the contribution of structural change in shaping productivity dynamics. To this respect, three major stylized facts emerge from the shift-share analysis.

First, labour productivity growth rate is lower in the last phase (1999/2015) than in the earlier period (1980/1998), and this is mainly due to a lower ‘within sector effect’. The labour productivity slowdown is verified for all European countries, and particularly for Italy (from an average yearly rate of 1.88% to 0.29%), Spain (from 1.63% to 0.67%), France (from 2.64% to 1.11%) and Austria (from 1.98% to 0.62%). Only Sweden and Netherlands present a similar pattern in the determinants of labour productivity growth when sub-periods are considered.

Second, the importance of both (generally positive) static and (generally negative) dynamic effects of structural change in affecting aggregate labour productivity growth has reduced in recent times, that is, the impacts are lower in absolute values from 1999 to 2015 than before. This may reflect a shrinking difference between industry and services in terms of productivity levels and growth rates. In turn the latter may result from a poorer performance of the industrial sector with respect to the earlier phase and/or an improved one of the service sector, where the impact of new technologies may have led to some extent to overcoming the ‘Baumol disease’ at least in some lines of production.

[7] The *within industry effect* is computed assuming that labour shares are unchanged, and it measures the impact of productivity growth within each sector on total economy productivity growth. The *structural change effect* is computed assuming that the level of labour productivity in each sector is unchanged, and it measures the impact on aggregate productivity growth resulting from the ‘movement’ of labour intra sectors. The *cross effect* indicates the change in both labour share and productivity in each sector and accounts for the impact of labour re-allocation among sectors with varying productivity dynamics.

The 'dynamic' structural change effect is *negative* in all periods and countries (with the exception of Finland where it is virtually zero in the 1980-1999 sub-period), reflecting the fact that employment shares have moved away from the fastest growing sector in terms of productivity (industry) towards the slower growing service sector. In parallel, the 'static' structural change effect is generally positive but very small, reflecting the fact that contrary to what could be expected value added per labour unit in the service sector was generally *moderately higher* than in industry both in 1970 and in 1999 (in Italy for example value added per hour worked has become higher in industry than in services only after 2005). Upon reflection this is not too surprising, as the service sector comprises very heterogeneous productive activities, some of which are characterised by a much higher proportion of qualified labour than manufacturing production (e.g., health and education). This results in higher labour compensations or by a very high value of capital per labour unit (e.g., transports, including railways infrastructures), both entailing high value added per labour unit.[8] However, overall aggregate productivity growth is driven in all countries and periods by the 'within sector effect', which is by far the dominant one in absolute size.[9]

Consistently with the evidence provided by the shift-share analysis then, stagnating productivity in the last phase cannot be *mainly* ascribed to the process of structural change towards the service sector. Although the latter has involved a negative 'dynamic' structural change effect, this effect has been lower in absolute size in the post-1999 period, while it is the 'within sector' slow-down of productivity growth that determined the much slower aggregate labour productivity dynamics in that period relatively to the earlier one in all countries. In line with this, in the following section we will deal with explanations of the slowdown of labour productivity growth which can be related to the 'within sector effect'. To do so, we will first discuss the determinants of

[8] The service sector comprises services provided by the public sector. Concerning these, value added is measured by the costs of production net of intermediate costs, hence in sectors like health and education it is essentially measured by labour costs.

[9] A similar result, despite using a different approach, has been achieved by Storm (2017) with respect to the US economy: "unlike Baumol's prediction (…), the secular stagnation of productivity growth in the U.S. after 1972 was not so much due to 'non-progressive' structural change, but to a drop in intra-industry productivity growth in (…) the 'stagnant' sector".

labour productivity growth from supply- and a demand-side perspectives, and subsequently focus on the Kaldor-Verdoorn law.

3. The labour productivity puzzle

The slowdown in labour productivity dynamics has led economists to carry out several theoretical and empirical studies to identify the long-run determinants of productivity growth rate. In this regard, and complementarily to structural change arguments, the economic literature shows two main strands of thought on this topic. The former follows the traditional neoclassical approach to the analysis of growth and considers productivity as mainly determined by supply-side factors. The latter – though admitting a role played by 'exogenous' technical progress – also considers the existence of a stable and positive effects of output dynamics on productivity growth. This second approach refers to the KV law (Verdoorn 1949, 1956; Kaldor 1957, 1966) and its recent reappraisal within a theoretical framework regarding output growth as determined by aggregate demand growth.[10]

According to the traditional neoclassical view, the rate of growth of productivity, especially in the long-run, is generally determined by exogenous supply-side factors. Even though endogenous growth models have more recently admitted for the role of learning-by-doing or other endogenous factors with regard to output growth (see Arrow 1962; Romer 1994; Barro and Sala-i-Martin 2004 among others), no role is recognised to aggregate demand trends in determining the latter. Consistently, a weak growth of productivity is usually explained by low human and social capital endowments, high labour costs caused by rigidities in the labour market, overregulation, corruption and inefficiency.[11] Furthermore, a low level of spending in private research and development

[10] It becomes worthy underline that Verdoorn (1949, 1956) did not regard the output as determined by demand as instead advocated by supporters of the Keynesian tradition.

[11] On the predominant mainstream explanations of the slow rate of UK growth during the decade 1953-1964, Kaldor (1966, p. 101) quoted: "some put the blame on the inefficiency of our business management; some on the nature of our education [...]; some on over-manning and other restrictive practices of trade unions [...]; some on the alleged national dislike for hard work; some on the insufficiency of investment".

(R&D),[12] as well as a lack in information and communication technology (ICT) investment are assumed to negatively affect labour productivity dynamics.[13] In this framework, the abovementioned supply-side features are supposed to stem the upward shift of the production function thus lowering productivity growth.[14] In turn, the low dynamics of productivity is usually considered as the main cause of slow economic growth. Often this is viewed as the result of a poor performance of labour and the labour market caused by over-regulation.[15] Therefore, all policy measures devoted to increase labour market flexibility, decrease labour costs, reduce state intervention – both in terms of regulation and spending (Parascandolo and Sgarra 2006) – and to promote competition can be considered as related to this neoclassical perspective. Specifically, such policies – which are currently pursued in the European framework (for instance, see European Commission 2016) – are supposed to increase the efficiency of firms, which would then result in a higher productivity growth rate and hence in a greater GDP growth. Often advocated policy measures aimed at improving public efforts in funding basic and applied research and in implementing industrial policies aimed at upgrading and orienting the composition of production, unlike the approaches strictly rooted in neoclassical theory, do recognise a need for public policies in certain fields where free market forces and profit seeking alone would not ensure the desired outcomes (e.g. Mazzucato 2013, 2017; Cirillo et al. 2014). They are however also mostly focused on the supply-side. Thus, they still tend to overlook the importance of aggregate demand as a stimulus for private investments and as a source of scale economies on the one hand, while on the

[12] Although the R&D has to be considered as a determinant of innovation processes and then a supply-side factor, R&D spending can also be considered as a part of aggregate demand. As stated by Cesaratto et al. (2003) and Deleidi and Mazzucato (2018), R&D is considered as expenditure of firms, different from investments, and it does not create productive capacity.

[13] For a review of the literature concerning the so-called supply-side factors, see among others Baumol (1990), Becker et al. (1990), Bentolila and Bertola (1990), North (1990), Romer (1990), Aghion et al. (2001), Barro (2001), Scarpetta et al. (2002), Acemoglu (2006), Pellegrino and Zingales (2017), De Rosa et al. (2015) and Preenen et al. (2017).

[14] For the criticism of neoclassical theory emerged with the capital controversy and concerning the notion of capital as a productive factor and the existence of a solution to neoclassical general equilibrium, see among others Sraffa (1960), Pasinetti (1969) and Garegnani (1970, 2012).

[15] With respect to the Italian economy, this aspect has been described and criticised by Deleidi and Paternesi Meloni (2014).

other they tend to neglect the negative side-effects on employment that would result from technical progress unaccompanied by increasing demand.

By contrast, a stream of literature inspired by the Keynesian principle of effective demand has extended the latter to the analysis of output growth. In particular, by focusing on the relevance of demand-side factors, it is possible to consider a causality moving from the rate of growth of output to productivity growth, that is the reverse of what is usually supposed. Indeed, according to the supporters of the demand-side perspective, a stable long-run relationship would hold from the rate of growth of output to the growth rate of productivity (Palumbo 2013). This causal link is based on the so-called Kaldor-Verdoorn law (Verdoorn 1949, 1956; Kaldor 1957, 1966) which, by making use of the insight of the Keynesian principle of effective demand (Keynes 1936) and the idea of economic growth driven by demand (Kaldor 1975),[16] provides both empirical support and theoretical explanation for labour productivity dynamics to be influenced by demand-side factors. With a focus on the manufacturing sector (Kaldor 1966), this law shows a positive long-run relationship between the rate of growth of output and the labour productivity growth rate, with the former affecting the latter.[17] Endorsing this theoretical perspective, both the labour productivity and its growth rate appear as endogenously determined by the level and the rate of growth of output, with the latter depending on aggregate demand. In particular, when the level of output and of labour productivity are considered, a 'static' version of the KV law can be verified, even though the economic literature is more focused on its 'dynamic' version, where output and labour productivity

[16] Kaldor (1975, p. 896) considers the exogenous components of demand as the main drivers of economic and then labour productivity trend growth rate. In particular, Kaldor underlines the role played by exports in determining the rate of growth of output and therefore of productivity. The same view is shared by the supporters of the supermultiplier approach. See among others Serrano (1995), Cesaratto et al. (2003), Freitas and Serrano (2015), Deleidi and Mazzucato (2018). For an empirical analysis of the role of exports and exchange rates on productivity growth in European countries see Bagnai and Mongeau Ospina (2017).

[17] Specifically, Kaldor (1966, p. 104) found "a positive correlation between the overall rate of economic growth and the *excess* of the rate of growth of manufacturing output over the rate of growth of the non-manufacturing sectors. […] Since the differences in growth rates are largely accounted for by differences in rates of growth of productivity (and not of changes in the working population), the primary explanation must lie in the technological field". In parallel, Verdoorn (1949, p. 28) found that "the average value of the elasticity of productivity with respect to output is approximately 0.45 (with extreme values of 0.41 and 0.57). This means that over the long period a change in the volume of production, say of about 10 per cent, tends to be associated with an average increase in labour productivity of 4.5 per cent. […] one could have expected a priori to find a correlation between labour productivity and output, given that the division of labour only comes about through increases in the volume of production".

growth rates are analysed instead of their levels (McCombie 1982; Ofria 2009; Castiglione 2011).[18] The simplest version of the dynamic KV law, as initially exposed by Verdoorn,[19] can be expressed as follows:

$$\dot{p} = \alpha + \eta\dot{y} \quad (2)$$

where $\dot{p}$ represents the rate of growth of labour productivity, $\dot{y}$ is the rate of growth of output and α is the rate of growth of the exogenous technical progress. Accordingly, η is the Verdoorn's coefficient showing the linear relationship between $\dot{p}$ and $\dot{y}$ or, in a Kaldorian fashion, the range and the size of dynamic returns to scale.

In his inaugural lecture at Cambridge, Kaldor (1966) showed that the estimation of the Verdoorn coefficient (η) was of about 0.5 in the manufacturing sector.[20] Furthermore, since labour productivity growth is equal to output growth less employment growth (with $\dot{p} = \dot{y} - \dot{e}$, where $\dot{e}$ is the rate of growth of employment), equation (2) can be rewritten as follows (Kaldor 1966, p. 128; Bianchi 2002):

$$\dot{e} = -\alpha + (1 - \eta)\dot{y} \quad (3).$$

Being Kaldor's estimate of η close to 0.5, one percent increase of the rate of growth of output lead to a growth in employment of about 0.5%.

The evidence of a positive coefficient was explained by emphasising the presence of static and dynamic increasing returns to scale in the manufacturing sector, which are crucial in affecting productivity especially during the phase of economic development characterised by an increasing

[18] For a discussion concerning the use of the static and the dynamic version of the KV law, see McCombie (1982) and McCombie and Roberts (2007).

[19] Contrary to Verdoorn (1949), in Kaldor (1957, 1961, 1966, 1972, 1975) the role played by effective demand in setting the output and, in turn, labour productivity becomes relevant.

[20] Such relationship was estimated for the manufacturing sector of industrialised countries in a timespan going from 1953 to 1964.

weight of the manufacturing sector.[21] In addition to this, Kaldor (1966, p. 106) affirmed that the Verdoorn law "is a dynamic rather than a static relationship – between the rates of change of productivity and of output, rather than between the level of productivity and the scale of output – primarily because technical progress enters into it, and is not just a reflection of the economies of large-scale production". The same idea is also shared by McCombie (2002, p. 97), who affirmed that "the Verdoorn law is a long-term relationship in the sense that a faster trend rate of growth of output, both through induced technical progress, and static and dynamic increasing returns to scale, leads to a higher trend rate of growth of productivity (and a faster induced rate of capital accumulation)".[22] Therefore, the KV law can be considered as a long-run relationship showing the presence of increasing returns to scale, both static and dynamic (Bianchi 2002). On the one hand, the static or 'reversible' increasing returns to scale explain the dynamics of labour productivity as a consequence of the increase in the scale of production and the decrease in costs per unit of output (Kaldor 1972; McCombie 2002). On the other hand, the dynamic increasing returns are related to learning by doing, specialisation and embodied technical progress – which, differently from the static increasing returns, are not reversible (McCombie 2002).[23]

Following the footsteps of Young (1928), Kaldor (1966, 1972) affirmed that the presence of dynamic economies of scale is caused by specialisation processes both between and within firms, positive externalities among firms and industries (especially for the manufacturing sector) and,

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[21] This can be stated since this relationship is weak and questionable when estimated for other economic sectors (e.g., agriculture or services). On this point, which is crucially related to structural change, see Bianchi (2002).

[22] Concerning the estimation problems, McCombie (2002, p. 97) affirmed that "a number of studies have used time-series data. The problem is that, over the cycle, variation occurs in the intensity of use of both labour (labour hoarding occurs during the downswing of the cycle) and the capital stock. This will lead to a positive relationship between the growth of productivity and output, but one that is due merely to these short-term cyclical factors and has nothing to do with the presence of increasing returns to scale. This short-term relationship is known as Okun's law". In other words, the Verdoorn's law explains the long-run productivity growth rate whereas the Okun's law determines the short-run productivity growth rate, influenced by cyclical factors as the flexibility of the degree of capacity utilization and the intensity of labour use (see Okun 1962). For a discussion on this parallelism see Erber (1994) and Jeon and Vernengo (2007).

[23] A similar view can be also found in Verdoorn (1956, p. 434) through the idea of internal and external economies. With the former related to specialisation processes, whereas the latter explained by the development of skilled labour force and technological discoveries.

more importantly, because of technical progress embodied in new capital goods.[24] Furthermore, the presence of dynamic increasing returns to scale is also explained by learning by doing and knowledge diffusion mechanisms (Kaldor 1961, 1966; McCombie 2002; Ofria 2009; Millemaci and Ofria 2014). **S**till inspired by Young, Kaldor affirmed that dynamic increasing returns to scale have to be considered as macroeconomic rather than micro and firm-level based phenomenon, due to the existing relationships among firms and industries (McCombie and Roberts 2007).

According to this approach, differently from the original version of the Verdoorn's law, Kaldor (1966, p. 128) included in the estimation of Verdoorn law an additional term in order to take into consideration embodied and/or induced technical progress (Kaldor 1957, 1961; Kaldor and Mirrlees 1962), that is the investment-output ratio.[25] In particular, following Kaldor (1961, 1966), technical progress and knowledge are largely embodied in new capital goods. For this reason, Kaldor estimates the Verdoorn's law as represented in equation (4):

$$\dot{p} = \alpha + \eta\dot{y} + c\frac{I}{Y} \tag{4}$$

where $\frac{I}{Y}$ is the investment ratio and c can be defined as the Kaldor's coefficient, showing the effect of technical progress on labour productivity growth. However, although in all empirical specifications $\frac{I}{Y}$ is treated as an exogenous variable as in Kaldor's original estimations (Kaldor 1966), he recognised investment – from a theoretical standpoint – as endogenously determined and

[24] The work of Young (1928) was clearly inspired by Smith (1776), according to which labour productivity is determined by the division of labour, that in turn is influenced by the size of the market. Particularly, Smith "suggested that the division of labour leads to inventions because workmen engaged in specialised routine operations come to see better ways of accomplishing the same results. The important thing, of course, is that with the division of labour a group of complex processes is transformed into a succession of simpler processes, some of which, at least, lend themselves to the use of machinery. In the use of machinery and the adoption of indirect processes there is a further division of labour, the economies of which are again limited by the extent of the market" (Young 1928, p. 530).

[25] For a review of the two versions of the Kaldorian technical progress function, see Kaldor (1957, 1961), Kaldor and Mirrlees (1962) and McCombie and Spreafico (2015).

dependent on the level of current and expected demand: in other words, induced investment would reflect the accelerator principle (Kaldor 1972).[26]

From an empirical standpoint, after the estimations of Verdoorn (1949) and Kaldor (1966), several economists have validated the KV law. In particular, the Kaldor-Verdoorn approach has been applied to study structural change patterns among twelve countries by Knell (1994), who estimated a Kaldor-Verdoorn coefficient of 0.53 with respect to the manufacturing during the '90s. Moreover, McCombie and De Ridder (1984) and McCombie (1985) verified the KV law at regional level. Bianchi (2002), Ofria (2009), Forges Davanzati et al. (2016) estimated the KV coefficient for the Italian economy between 0.5 and 0.7. McCombie and Roberts (2007) discussed and validated both a static and dynamic KV law by using cross-regional data. Castiglione (2011) estimated the KV coefficient for the manufacturing sector through a cointegration analysis applied to US data. Similarly, Millemaci and Ofria (2014) validated the long-run dynamic KV law for the manufacturing industry sector in several developed economies.[27] Magacho and McCombie (2017), by using a GMM estimator in a dynamic panel of manufacturing industries, show that a faster output growth increases the growth of labour productivity.[28]

In the following, we focus on selected European countries and we estimate the KV law by considering four different sectoral level. To the best of our knowledge, there has been very little analysis of the KV law at sectoral level (Bianchi 2002; Pieper 2003; Ofria 2009; Magacho 2016), from which quite mixed results emerge, despite a convergence on the existence of Kaldorian increasing returns to scale in the manufacturing sector. For this reason, we are going to investigate the existing relationship between the rate of growth of the economy and the sectoral labour

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[26] Kaldor (1972, p. 1250) affirmed: "producers carry their own stocks and adjust the rate of their production in response to changes in their sales (or in the state of their *order book*) and there will be *induced investment* in response to an increase in demand and the associated depletion of stocks. Such induced investment will partly take the form of circulating capital-that is to say, of an increase in the value of goods in process that is inevitably associated with the rise in production-and partly of fixed capital, in so far as the rise in current sales causes a revision of expectation of future sales".

[27] In particular, they have re-parameterised an ADL model in a ECM form in order to capture the long-run relationship between the considered variables. Notably, in this paper we adopt similar econometric techniques.

[28] For a deepened review on the empirical estimations of the KV law, please see the introduction in McCombie et al. (2002) and Castiglione (2011).

productivity growth. Differently from other empirical works in this field, the present paper will use the autonomous components of aggregate demand as a proxy for the rate of growth of output.[29] In particular, such a choice is motivated by the demand-led growth theoretical framework (Serrano 1995; Cesaratto et al. 2003; Girardi and Pariboni 2016; Serrano and Freitas 2015; Deleidi and Mazzucato 2018) and by statistical and methodological reasons connected to potential endogeneity issues.

4. Methodology and data

4.1 Methodology

To estimate the dynamic version of the KV coefficient (sectoral and economy-wide), we have to make use of a methodology which captures the long-run relationship between the rate of growth of output and rate of growth of labour productivity.[30] To do so, we estimate an autoregressive distributed lag model (ARDL) and, as suggested by Pesaran and Shin (1998), we apply a re-parameterisation of the model in order to obtain long-run coefficients. This methodology emerged in applied economics and contributed to develop a new approach to cointegration applicable irrespective of whether variables are stationary, non-stationary or cointegrated (Pesaran et al. 2001). With respect to the aim of our research, this methodology has been applied by Millemaci and Ofria (2014), who have re-parameterised an ARDL model in order to capture the long-run relationship. Formally, the simplest ARDL(1,1) can be specified as follows in equation (5):

$$y_t = \delta + \theta y_{t-1} + \varphi_0 x_t + \varphi_1 x_{t-1} + \varepsilon_t \quad (5)$$

[29] In a similar vein, Bagnai and Mongeau Ospina (2017) look at the impact of exports on productivity growth, with results that confirm the relevance of the KV law in explaining productivity dynamics.

[30] In case techniques based on first-differences were used we would not be able "to distinguish the long-term influence of the demand on the productivity growth rate from that deriving from the short-term business cycle, which instead reflects the behavior of the so-called Okun law" (Millemaci and Ofria 2014). Furthermore, alternative methodology to detect long-run relationships, as cointegration models, are not feasible in our framework (namely, the dynamic version of the KV law) due to the fact that we are dealing with stationary variables, namely the growth rates of labour productivity and demand, as well as the investment ratio.

where x_t and y_t are stationary processes.[31] We can derive the long-run relationship by rearranging equation (5) in its dynamic form, as shown in equation (6):

$$\Delta y_t = -(1-\theta)\left\{y_{t-1} - \frac{\delta}{1-\theta} - \frac{\varphi_0+\varphi_1}{1-\theta}x_{t-1}\right\} + \varphi_0 \Delta x_t + \varepsilon_t \quad (6).$$

Finally, as can be seen in equation (6), the long-run relationship between x_t and y_t can be represented as follows in equation (7):

$$y_{t-1} = \frac{\delta}{1-\theta} + \frac{\varphi_0+\varphi_1}{1-\theta}x_{t-1} \quad (7).$$

It is worth noticing that equation (6), which has been proved to stem from the dynamic version of equation (5), represents the deviation of y_{t-1} from its long-run equilibrium.[32] Accordingly, in order to detect the coefficient of the dynamic KV law, which represents a long-term relationship between labour productivity growth rate and output growth rate, we will estimate a dynamic equation where the dependent variable is the growth rate of value added per hour worked, while the main regressor is a metric of the growth rate of output.

4.2 Model specification

After having checked that our variables are I(0) by means of the Augmented Dickey-Fuller test, we select the optimal lag structure of the ARDL according to the Schwarz Bayesian information criteria. As for each sector in all countries the selected optimal lag structure of the ARDL equation is (1,1), for each country in our dataset we estimate the following dynamic equation (8):

$$\dot{p}_t = \alpha + \beta_1 \dot{y}_t + \beta_2 \dot{y}_{t-1} + \gamma \dot{p}_{t-1} + \varepsilon_t \quad (8)$$

[31] Notice that θ has to be lower than 1 in absolute value to make y_t stationary.
[32] Essentially, it is the term within curly brackets in equation (6) set at zero.

where p represents the growth rate of labour productivity at time t (where $\dot{p}$ is the ratio of value added in real terms on the number of hours worked by total engaged) in total economy and in each sector of the economy; $\dot{y}$ is the growth rate of the autonomous components of demand; α is the constant term and ε is the error term.

Furthermore, in the spirit of the empirical studies developed by Kaldor (1966), we consider also the investment-output ratio ($\frac{I}{Y}$) as a proxy for technical progress within an augmented version of the ARDL model specification, as shown in equation (9):

$$\dot{p}_t = \alpha + \beta_1 \dot{y}_t + \beta_2 \dot{y}_{t-1} + \beta_k \left(\frac{I}{Y}\right)_t + \gamma \dot{p}_{t-1} + \varepsilon_t \qquad (9).$$

As demonstrated in the methodological section (4.1), the long-run KV coefficient (η) is given by the following expression:[33]

$$\eta = \frac{\beta_1 + \beta_2}{1-\gamma} \qquad (10).$$

According to the demand-led productivity growth argument, we expect η (the KV coefficient) to be positive. Moreover, we expect a less significant impact of the investment ratio, a proxy for technological progress, which should be to some extent considered endogenous, that is dependent on the level of demand (see Millemaci and Ofria 2014; Deleidi 2017; Girardi and Pariboni 2017 among others).[34] Finally, a brief discussion will be proposed on β_1, namely the coefficient that represents the effects of demand on labour productivity in the short-run, that is the Okun coefficient.

[33] This is immediate for Equation (4), in which we do not control for additional regressors. Indeed, it applies also for Equation (5) since we treat investment ratio as exogenous, hence with do not consider $\frac{I}{Y}$ within the long-run form.

[34] Ofria (2009) stated that "the statistical insignificance of $\frac{I}{Y}$ confirms the original Kaldorian hypothesis, according to which investments should be to a great extent normally considered as endogenous within a process of demand-led growth" (our translation).

4.3 Data

In order to estimate the KV coefficient, we make use of the STAN database with respect to above-mentioned European countries from 1970 to 2015. In particular, for each country we estimate the dynamic version of the KV law with respect to total economy and to the four main sectors of the economy – namely primary sector, industrial sector, construction and services, according to the ISIC Rev. 4 classification; to which we add a specific analysis for manufacturing (see Appendices A and B).

Specifically, labour productivity growth rate ($\dot{p}$) is calculated on the basis of value added per hour worked, at sectoral level and for total economy. Moreover, we proxied the growth rate of the economy ($\dot{y}$) by means of the growth rate of the autonomous components of aggregate demand. This variable has been calculated as the sum of primary public expenditure (comprising public consumption, transfers except interest payments and capital formation) and export (Girardi et al. 2018). The use of the autonomous components of demand is an element of originality of our work and provides two main advantages, allowing us to be theoretically consistent with the Kaldorian analysis of growth,[35] and from an empirical standpoint to mitigate endogeneity issues. Finally, the investment-output ratio ($\frac{I}{Y}$) considers gross fixed capital formation and gross output, with respect to total economy and different sectors, alternatively (see Appendix A for details and data sources).

5. Empirical findings

The long-run KV coefficients, estimated for nine European countries through two different specifications allow us to support the relevant role played by autonomous components of aggregate demand in determining the dynamics of labour productivity. The results of our estimations of equations (8) and (9) are accurately reported in Table 1 and 2, respectively.

[35] As already mentioned, the role played by demand factors in enhancing labour productivity growth are clearly stated in Kaldor (1957, 1961, 1966, 1972, 1975). Especially, Kaldor underlined the role play by exogenous components of demand (Kaldor 1975).

[Table 1 and 2 about here]

For the majority of considered countries, KV coefficients (η) are positive and statistically significant in both specifications, especially when estimated for the total economy, the industrial sector and the sub-sector of manufacturing. In the latter sectors, KV coefficients assume the highest value (on average 0.5 when significant), meaning that demand stimulus generates the greatest impact on labour productivity in those sectors where increasing returns to scale are usually considered to be more pervasive. These findings are in line with the seminal works presented by Kaldor and Verdoorn and with the subsequent empirical literature.

Focusing on Italy and France, KV parameters are positive and significant on aggregate and for many other sectors, particularly industry and manufacturing (in the latter, estimated coefficients are 0.71 for Italy and 0.51 for France), but also construction and services. These estimations are almost totally confirmed when the investment-output ratio is introduced in the augmented specification, even though in this case the KV coefficient is not significant for the Italian construction sector. In both countries, the investment-output ratio does not show any effect on the productivity dynamics. Looking at Germany, the KV parameter is positive and significant for the total economy (0.51) and also for the service sector (0.67). In the second specification, the investment-output ratio has a positive effect on labour productivity (β_k is positive and statistically significant) in the estimations concerning total economy (0.37) and service sector (0.41). Concerning Austria and Sweden the KV coefficients are positive and significant for the total economy (0.24 and 0.30), for the industrial sector (0.62 and 0.74), and for the manufacturing sub-sectors in both specification. Indeed, in Austria, the introduction of the investment-output ratio makes the KV parameter significant also in the agricultural sector (0.67). In Finland, the KV coefficients is positive and significant for the total economy (0.45) and the service sector (0.35), while the introduction of the investment-output ratio makes also the industry KV parameter positive and statistically significant (0.49). On the contrary, for Belgium, Netherland and Spain the KV parameters are never statistically significant either at sectoral level or for the economy as a whole, thus indicating the absence of a relationship between the rate of growth of autonomous components of demand and labour productivity.

As shown in Table 1 and 2, significant KV coefficients are ranged from 0.2 and 0.8. Not surprisingly, from our results a positive relationship seems to emerge between the magnitude of the KV coefficient and the size of the manufacturing sector. Interestingly, the statistically non-significance of $\frac{I}{Y}$ (a variable which should capture the effect of embodied technical progress on productivity growth) may be related to the dependency of investment on the level of aggregate demand, consistently with the well-known accelerator principle.[36] In such circumstances, the effects of increasing aggregate demand on investment and consequently on productivity growth would be already captured by the coefficient on $\dot{y}$, that is the rate of growth of demand and output.

As argued, our methodology allows to distinguish the long-term influence of demand factors on productivity dynamics from the impact stemming from the short-term business cycle, which instead represents the Okun effect. In this respect, our estimates validate also this effect, since the short-term coefficient (β_1) is positive and statistically significant in both specifications for all countries (except Spain) with respect to total economy and industry (including the sub-sector of manufacturing), while results are mixed for the other sectors.

Summing up, our results allow us to conclude that a higher rate of growth of autonomous components of demand strongly stimulate labour productivity dynamics even in the long run in the industrial sector (and particularly manufacturing), especially in those countries where the weight of the industrial sector in the economy is larger. Mixed results and lower effects emerge in services and construction, confirming the view that increasing returns to scale are higher in the manufacturing than in other sectors of the economy. In this perspective, the dramatic structural

[36] The analytical premises of the 'induced' nature of investment were analysed by Garegnani (1962 [2015]). For a survey on this point, see Cesaratto (2015). Particularly, Girardi and Pariboni (2017) documented that changes in the rate of growth of autonomous demand tend to be followed by changes of the same sign in the share of business investment in GDP.

change in advanced economies towards tertiarisation would involve an overall lower responsiveness of productivity growth to aggregate demand growth and less scope for scale economies. However, given the internal diversity of the service sector, sensitivity to increasing returns and embodied technical change may differ across industries within the sector, and more disaggregated future empirical enquires may be needed.

6. Evidence-based policy implications

Slow growth of productivity in advanced economies and particularly in mature European countries has been viewed with preoccupation and various supply-side measures have been advocated to enhance productivity growth. Even though we adopt an analytical perspective according to which output growth is determined by aggregate demand and not (directly) caused by technical progress, productivity growth remains of great importance for economic and social sustainability, given its impact on external trade and per-capita income. The objective of our empirical investigation therefore has been to single out some major factors in affecting productivity dynamics. Concerning structural change intended as tertiarisation, we have found that although it had a negative 'dynamic' impact on productivity growth (the 'cross effect' shown in the shift-share analysis), such negative effect was smaller in the 1999-2015 period than it had been before, owing to a shrinking difference between productivity growth in industry and services. The major factor in slow growth has been, in the last phase, a slow 'within sector' productivity growth. Although several causes may affect productivity growth, our empirical analysis has focused on the often overlooked impact of demand factors on 'within sector' and aggregate productivity dynamics. In this respect, we have found that in five out of nine European countries autonomous demand growth has been very important in determining overall productivity growth and in six out of nine it is important for industry and manufacturing productivity growth. Service sector responsiveness to autonomous demand and output growth is also found in the three largest economies (France, Germany and Italy) and Finland. Accordingly, it can be argued that a poor dynamics of aggregate demand and its autonomous components in the Eurozone in the last phase, and particularly after the 2008 crisis (see Figure 3), have significantly contributed to productivity stagnation, especially in large economies and in those economies with a larger manufacturing sector. A major policy implication of these results is that coordinated expansionary fiscal policies aimed at achieving a higher growth rate of autonomous components of demand and hence of internal demand in the Eurozone as a whole (and individual countries exports within the area) would improve productivity growth. This would be the case even in the present context of an increased weight of the service sector, and notwithstanding the generally lower or statistically non-significant responsiveness of its productivity to demand and output growth. Actually, the increased tertiarisation imply that demand and output growth would involve some kind of balance between productivity growth in the manufacturing sector, which is most important for the sustainability of the trade balance and international competitiveness,[37] and employment growth in the service sector, which might compensate for the labour-saving improvements in manufacturing. Employment growth is the result of output growth minus productivity dynamics, where output growth depends, according to the Keynesian perspective adopted here, on aggregate demand growth. Both productivity growth and employment rates in turn affect average per-capita (per head of population) income, which is important for the sustainability of welfare systems, particularly in the face of an ageing population.

[Figure 3 about here]

On the basis of our estimates, a 1% additional growth in the autonomous components of demand would generate an additional overall increase in productivity growth of at least 0.6% in France and of at least 0.4% in Germany and Italy. Given that $\dot{e} = \dot{y} - \dot{p}$ (see Section 3), and assuming an elasticity of output to autonomous demand equal to one, employment would grow

[37] Contrary to what we suggest, restrictive policies have been recently implemented in the Eurozone to foster productivity and competitiveness. For a critical survey on these measures see Paternesi Meloni (2017).

0.4% in the former and 0.6% in the latter two countries.[38] Of course, not all types of public spending have the same impact on GDP and private investments. On analytical grounds, it can be argued that public expenditure in mission-oriented innovation policies, aimed to set a new direction for the economy and to promote technical progress, tend to have a particularly high impact on output. These policies enhance the responsiveness of private investments to GDP growth by increasing the size of the 'accelerator' (Deleidi and Mazzucato 2018).

7. Conclusions

In this article we focus on the relationship between the recent slowdown in labour productivity growth and the structural change that has taken place in output composition in advanced countries, whereby productive structures dramatically shifted from the manufacturing towards the service sectors (tertiarisation). In this regard, the aim of this research is to assess the contribution of 'structural change' to labour productivity growth and to verify to what extent demand factors can affect productivity dynamics. The results of this enquiry are important in order to address policy issues concerning how to stimulate productivity growth in order to ensure economic and social sustainability.

We carry out empirical analyses on STAN data broken down at sectoral level on nine selected European countries from 1970 to 2015. Specifically, to evaluate the 'structural change effect' we implement a shift-share analysis, while we estimate sectoral Kaldor-Verdoorn coefficients through an ARDL cointegration-based methodology in order to determine the role played by aggregate demand (and particularly its autonomous components) in shaping labour productivity growth. Concerning the results of the shift-share analysis, we conclude that the overall effect (and particularly the 'dynamic' effect) of structural change on labour productivity growth, is generally negative, but not sizeable and *lower* in the most recent phase (1999-2015) than in the

[38] Given that the average ratio of our autonomous demand variable to GDP is between 70% (Italy) and 80% (France and Germany) an elasticity of 1 implies a Keynesian multiplier greater than one. If we assume the latter to be equal to one, the impact on employment growth of a 1% increase in autonomous demand growth rate would reduce to 0.2 percentage point for France, 0.3 for Italy and 0.4 for Germany.

earlier one; while the dominant factor in affecting aggregate productivity dynamics is the 'within sector' productivity growth. Accordingly, stagnating labour productivity cannot be mainly ascribed to the process of structural change and tertiarisation, but is to a larger extent related to the 'within sector effect'.

For this reason, we investigate possible explanations of the slowdown of labour productivity growth in different sectors of the economy. In particular, we empirically test the KW law, postulating a positive long-run relationship between aggregate demand (or output) growth and productivity growth, especially in the industrial sector Our findings indicate that the KW law is validated (i.e., demand factors matter in determining the long-run labour productivity growth rate) for six out of nine considered countries and for the biggest in terms of GDP (namely Italy, France and Germany). In line with relevant empirical literature on the Kaldor-Verdoorn law, long-run KV coefficients are found higher in manufacturing and industry compared to other sectors. Results concerning Italy, Finland, France and Germany show that demand growth generates a positive influence on the labour productivity growth also within the service sector. These results may indicate that the occurred structural shift towards services may hinder aggregate labour productivity dynamics, since increasing returns to scale that can foster long-run productivity growth exist in manufacturing but only to a limited extent in the service sector.

However, concerning the puzzling phenomenon of stagnating productivity growth in the recent past, our empirical analysis indicates a moderate contribution played by structural change, while a substantial lack of aggregate demand growth appears to have been at the roots of the slowdown of labour productivity in European countries. The policy implications of our results are that the conventional wisdom in macroeconomic and industrial policies, especially in the European context, may have to be revised: since aggregate demand is found to bring about substantial effects on productivity growth, the latter should not be seen as uniquely determined by supply-side factors, and should not be pursued only by means of supply-side policies. A major policy implication of our analysis is that coordinated expansionary macroeconomic policies would contribute to enhancing productivity growth, particularly in large economies and in those with a higher weight of the manufacturing sector, thus improving external competitiveness. At the same time, such policies would have positive effects on employment growth. Both effects, on productivity and employment, would increase average per capita income thus positively contributing to the sustainability of welfare systems.

References

Acemoglu D (2006) A simple model of inefficient institutions. *The Scandinavian Journal of Economics*, *108*(4), 515-546.

Aghion P, Harris C, Howitt P, Vickers J (2001) Competition, imitation and growth with step-by-step innovation. *The Review of Economic Studies*, *68*(3), 467-492.

Arrow KJ (1962) The Economic Implications of Learning by Doing. *The Review of Economic Studies*, 29(3), 155-173.

Bagnai A, Mongeau Ospina CA (2017) Neoclassical versus Kaldorian explanations of Southern Europe's productivity slowdown. *Acta Oeconomica*, *67*(s1), 113-135.

Barro RJ (2001) Human capital and growth. *The American Economic Review*, *91*(2), 12-17.

Barro RJ, Sala-i-Martin X (2004) *Economic Growth* (2nd ed.). New York: McGraw-Hill.

Baumol WJ (1967) Macroeconomics of unbalanced growth: the anatomy of urban crisis. *The American Economic Review*, *57*(3), 415-426.

Baumol WJ (1990) Entrepreneurship: Productive, unproductive, and destructive. *Journal of Political Economy*, *98*(5, Part 1), 893-921.

Becker GS, Murphy KM, Tamura R (1990) Human capital, fertility, and economic growth. *Journal of political economy*, *98*(5, Part 2), S12-S37.

Bentolila S, Bertola G (1990) Firing costs and labour demand: how bad is eurosclerosis? *The Review of Economic Studies*, *57*(3), 381-402.

Bianchi C (2002) A reappraisal of Verdoorn's law for the Italian economy (1951–1997). In McCombie JS, Pugno M, Soro B (Eds.) (2002) *Productivity Growth and Economic Performance: Essays on Verdoorn's Law*. Palgrave Macmillan UK.

Castiglione C (2011) Verdoorn-Kaldor's Law: An empirical analysis with time series data in the United States. *Advances in Management and Applied Economics*, *1*(3), 135-151.

Cesaratto S (2015) Neo-Kaleckian and Sraffian controversies on the theory of accumulation. *Review of Political Economy*, *27*(2), 154–182.

Cesaratto S, Serrano F, Stirati A (2003) Technical change, effective demand and employment. *Review of Political Economy*, *15*(1), 33-52.

Chang HJ (1994) State, institutions and structural change. *Structural Change and Economic Dynamics*, *5*(2), 293-313.

Cirillo V, Guarascio D, Pianta M (2014) *Will Europe's industry survive the crisis? Competitiveness, employment and the need for an industrial policy*, Working Papers Series in Economics, Mathematics and Statistics, Università degli studi di Urbino Carlo Bo (No. 1408).

De Rosa D, Gooroochurn N, Görg H (2015) Corruption and productivity: Firm-level evidence. *Jahrbücher für Nationalökonomie und Statistik*, *235*(2), 115-138.

Deleidi M (2017) Post Keynesian endogenous money theory: A theoretical and empirical investigation of the credit demand schedule. *Journal of Post Keynesian Economics*, 41(2), 185-209.

Deleidi M, Mazzucato M (2018) Putting austerity to bed: Technical progress, aggregate demand and the supermultiplier, *UCL Institute for Innovation and Public Purpose, Working Paper Series* (IIPP WP 2018-01).

Deleidi M, Paternesi Meloni W (2014) Italian Economic Trends and Labor Market Reforms: A 50-Years Overview. ASTRIL working paper, 12/2014.

Denis C, Mc Morrow K, Röger W, Veugelers R. (2005) *The Lisbon Strategy and the EU's structural productivity problem* (No. 221). Directorate General Economic and Financial Affairs (DG ECFIN), European Commission.

Erber G (1994) *Technical change, economics of scale, and factor augmentation: Impacts on relative differences in productivity and price competitiveness between US and German industries* (No. 93). DIW Discussion Papers.

Estevão MM (2004) *Why is productivity growth in the euro area so sluggish?* (Vol. 4). International Monetary Fund.

European Commission (2016) *The Economic Impact of Selected Structural Reform Measures in Italy, France, Spain and Portugal*, Institutional Paper 023, April 2016.

Fadda S (2017) Structural change, employment and institutions. Paper presented at the International Conference "Reassessment and perspectives of labour policies", Roma Tre University, Department of Economics, 14/15 December 2017.

Fagerberg J (2000) Technological progress, structural change and productivity growth: a comparative study. *Structural change and economic dynamics*, *11*(4), 393-411.

Felipe J, McCombie JS (2006) The tyranny of the identity: growth accounting revisited. *International Review of Applied Economics*, *20*(3), 283-299.

Feinstein C (1999) Structural Change in the Developed Countries During the Twentieth Century, in: *Oxford Review of Economic Policy*, 15 (4).

Forges Davanzati G, Patalano R, Traficante G (2016) *The Italian economic decline in a Kaldorian theoretical perspective* (No. PKWP1606). Post Keynesian Economics Study Group (PKSG).

Freitas F, Serrano F (2015) Growth rate and level effects, the stability of the adjustment of capacity to demand and the Sraffian supermultiplier. *Review of Political Economy*, 27(3), 258–281.

Garegnani P (2015) On the Factors that Determine the Volume of Investment [English translation of chapters III & IV of Garegnani P (1962) *Il problema della domanda effettiva nello sviluppo economico italiano*. Svimez, Rome.]. *Review of Political Economy*, *27*(2), 111-133.

Garegnani P (1970) Heterogeneous capital, the production function and the theory of distribution. *The Review of Economic Studies*, *37*(3), 407-436.

Garegnani P (2012) On the present state of the capital controversy. *Cambridge Journal of Economics*, Oxford University Press, vol. 36(6), pages 1417-1432.

Girardi D, Pariboni R. (2016) Long-run Effective Demand in the US Economy: An Empirical Test of the Sraffian Supermultiplier Model. *Review of Political Economy*, *28*(4), 523-544.

Girardi D, Pariboni R (2017) Autonomous demand and the Investment Share. Paper presented at the Analytical Political Economy Workshop, May 19-20 2017, Queen Mary University.

Girardi D, Paternesi Meloni W, Stirati A (2018) Persistent Effects of Autonomous Demand Expansions, Institute for New Economic Thinking *working paper* n. 70, February 2018.

Hartwig J (2011) Testing the Baumol–Nordhaus model with EU KLEMS data. *Review of Income and Wealth*, *57*(3), 471-489.

Ishikawa S (1987) 'Structural Change' an entry of: The New Palgrave. A Dictionary of Economics, Macmillan, London, IV, 523-5.

Jeon Y, Vernengo M (2008) Puzzles, Paradoxes, and Regularities: Cyclical and Structural Productivity in the United States (1950–2005). *Review of Radical Political Economics*, *40*(3), 237-243.

Kaldor N (1957) A model of economic growth. *The Economic Journal*, *67*(268), 591-624.

Kaldor N (1961) Capital accumulation and economic growth. In *The Theory of Capital* (pp. 177-222). Palgrave Macmillan UK.

Kaldor N (1966) *Causes of the slow rate of economic growth of the United Kingdom*. Cambridge University Press. In Kaldor N (1978) *Further Essays on Economic Theory*, published by Holmes & Meier Publishers, Inc., New York.

Kaldor N (1972) The irrelevance of equilibrium economics. *The Economic Journal*, *82*(328), 1237-1255.

Kaldor N (1975) Economic Growth and the Verdoorn Law – A Comment on Mr Rowthorn's Article. *The Economic Journal*, *85*(340), 891-896.

Kaldor N, Mirrlees JA (1962) A new model of economic growth. *The Review of Economic Studies*, *29*(3), 174-192.

Keynes JM (1936) *The General Theory of Employment, Interest and Money*. London: Macmillan.

Knell M (2004) Structure change and the Kaldor-Verdoorn law in the 1990s. *Revue d'économie industrielle*, *105*(1), 71-83.

Kuznets S (1955) Economic growth and income inequality. *The American economic review*, 45(1), 1-28.

Lavoie M (2016) Convergence Towards the Normal Rate of Capacity Utilization in Neo-Kaleckian Models: The Role of Non-Capacity Creating Autonomous Expenditures, *Metroeconomica*, *67*(1), 172–201.

Leon P (1967) *Structural Change and Growth in Capitalism. Baltimore: Johns Hopkins.*

Magacho GR (2016) Estimating Kaldor-Verdoorn's law across countries in different stages of development. In *Anais do XLII Encontro Nacional de Economia [Proceedings of the 42ndd Brazilian Economics Meeting]* (No. 140). ANPEC-Associação Nacional dos Centros de Pósgraduação em Economia [Brazilian Association of Graduate Programs in Economics].

Magacho GR, McCombie JS (2017) Verdoorn's law and productivity dynamics: An empirical investigation into the demand and supply approaches. *Journal of Post Keynesian Economics*, *40*(4), 600-621.

Mazzucato M (2013) *The Entrepreneurial State: Debunking the Public Vs. Private Myth in Risk and Innovation.* London: Anthem Press.

Mazzucato M (2017) Mission-oriented Innovation Policy: Challenges and Opportunities, *UCL Institute for Innovation and Public Purpose Working Paper*, (IIPP WP 2017-1).

McCombie JS (1982) Economic growth, Kaldor's laws and the static-dynamic Verdoorn law paradox. *Applied Economics*, *14*(3), 279-294.

McCombie JS (1985) Economic growth, the Harrod foreign trade multiplier and the Hicks' Super-Multiplier. *Applied Economics*, *17*(1), 55-72.

McCombie JS (2002) Increasing returns and the Verdoorn Law from a Kaldorian perspective. In McCombie JS, Pugno M, Soro B (Eds.) (2002) *Productivity Growth and Economic Performance: Essays on Verdoorn's Law*. Palgrave Macmillan UK.

McCombie JS, De Ridder JR (1984) "The Verdoorn Law Controversy": Some New Empirical Evidence Using US State Data. *Oxford Economic Papers*, *36*(2), 268-284.

McCombie JS, Pugno M, Soro B (Eds.) (2002) *Productivity Growth and Economic Performance: Essays on Verdoorn's Law*. Springer.

McCombie JS, Roberts M (2007) Returns to scale and regional growth: the static-dynamic Verdoorn Law paradox revisited. *Journal of Regional Science*, *47*(2), 179-208.

McCombie JS, Spreafico MR (2015) Kaldor's 'technical progress function'and Verdoorn's law revisited. *Cambridge Journal of Economics*, *40*(4), 1117-1136.

McMillan M, Rodrik D, Verduzco-Gallo Í. (2014) Globalization, structural change, and productivity growth, with an update on Africa. *World Development*, *63*, 11-32.

Millemaci E, Ofria F (2014) Kaldor-Verdoorn's law and increasing returns to scale: a comparison across developed countries. *Journal of Economic Studies*, *41*(1), 140-162.

North DC (1990) *Institutions, institutional change and economic performance*. Cambridge University Press.

Ofria F (2009) L'approccio Kaldor-Verdoorn: una verifica empirica per il Centro-Nord e il Mezzogiorno d'Italia (anni 1951-2006). *Rivista di Politica Economica*, *1*, 179-207.

Okun AM (1962) Potential GNP & Its Measurement and Significance, *American Statistical Association, Proceedings of the Business and Economics Statistics Section*, 98-104.

Palumbo A (2013) La produttività è endogena? Il ruolo della domanda. *Economia & Lavoro*, *47*(3), 46-53.

Parascandolo P, Sgarra G (2006) Crescita e produttività: gli effetti economici della regolazione. Centro Studi Confindustria.

Pasinetti LL (1969) Switches of Technique and the "Rate of Return" in Capital Theory. *The Economic Journal*, *79*(315), 508-531.

Pasinetti LL (1981) *Structural Change and Economic Growth: a Theoretical essay on the dynamics of the wealth of nations. Cambridge University Press.*

Paternesi Meloni W (2017) Austerity & Competitiveness in the Eurozone: a misleading linkage (No. 0223). Department of Economics-University Roma Tre.

Pellegrino B, Zingales L. (2017) *Diagnosing the Italian disease* (No. w23964). National Bureau of Economic Research.

Peneder M, Kaniovski S, Dachs B (2003) What follows tertiarisation? Structural change and the role of knowledge-based services. *The Service Industries Journal*, 23(2), 47-66.

Pesaran MH, Shin Y (1998) An autoregressive distributed-lag modelling approach to cointegration analysis. *Econometric Society Monographs*, *31*, 371-413.

Pesaran MH, Shin Y, Smith RJ (2001) Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, *16*(3), 289-326.

Pieper U (2003) Sectoral regularities of productivity growth in developing countries—a Kaldorian interpretation. *Cambridge Journal of Economics*, *27*(6), 831-850.

Preenen PT, Vergeer R, Kraan K, Dhondt S (2017) Labour productivity and innovation performance: The importance of internal labour flexibility practices. *Economic and Industrial Democracy*, *38*(2), 271-293.

Romer PM (1990) Human capital and growth: theory and evidence. In *Carnegie-Rochester conference series on public policy* (Vol. 32, pp. 251-286). North-Holland, March.

Romer PM (1994) The origins of endogenous growth. *Journal of Economic perspectives*, *8*(1), 3-22.

Rostow WW (1960) *The process of economic growth* (No. HB199 R65 1960).

Saviotti PP, Pyka A (2017) Innovation, structural change and demand evolution: does demand saturate?. *Journal of Evolutionary Economics*, *27*(2), 337-358.

Scarpetta S, Hemmings P, Tressel T, Woo J (2002) The role of policy and institutions for productivity and firm dynamics: evidence from micro and industry data. *OECD Economics Department Working Paper No. 329.*

Serrano F (1995) Long period effective demand and the Sraffian supermultiplier. *Contributions to Political Economy*, 14(0), 67-90.

Smith A (1776) An Inquiry into the Nature and Causes of the Wealth of Nations, 2 vols. *W. Strahan and T. Cadell.*

Solow RM (1957) Technical change and the aggregate production function. *The Review of Economics and Statistics*, 39(3), 312-320.

Sraffa P (1960) *Production of Commodities: Prelude to a Critique of Economic Theory*. Cambridge University Press.

Storm S (2017) The New Normal: Demand, Secular Stagnation, and the Vanishing Middle Class. *International Journal of Political Economy*, *46*(4), 169-210.

Szirmai A, Verspagen B (2015) Manufacturing and economic growth in developing countries, 1950–2005. *Structural Change and Economic Dynamics*, *34(C)*, 46-59.

Timmer MP, Szirmai A (2000) Productivity growth in Asian manufacturing: the structural bonus hypothesis examined. *Structural change and economic dynamics*, *11*(4), 371-392.

Tridico P, Pariboni R (2017) *Structural Change, Aggregate Demand And The Decline Of Labour Productivity: A Comparative Perspective* (No. 0221). Department of Economics-University Roma Tre.

Verdoorn PJ (1949) On the Factors Determining the Growth of Labour Productivity, L'Industria. In McCombie JS, Pugno M, Soro B (Eds.) (2002) *Productivity Growth and Economic Performance: Essays on Verdoorn's Law*. Palgrave Macmillan UK.

Verdoorn PJ (1956) Complementarity and long-range projections. *Econometrica, Journal of the Econometric Society*, 24(4), 429-450.

Young AA (1928) Increasing returns and economic progress. *The Economic Journal*, *38*(152), 527-542.

APPENDIX

A. International Standard Industrial Classification of all economic activities

The sections subdivide the entire spectrum of productive activities (divisions from 01 to 99) into the following broad groupings. In our empirics we considered four sectors, consistently with the sections indicated below, namely A (primary sector), B_E (industrials sector), F (construction) and Services, whose sum equals total output according to ISIC Rev. 4.

Classification ISIC Rev. 4	*Division*	*Section*
Agriculture, forestry and fishing	D01T03	A
Mining and quarrying	D05T09	B
Manufacturing	D10T33	C
Industry including energy	D05T39	B_E
Energy supply and related	D35T39	D_E
Construction	D41T43	F
Wholesale and retail trade, repair	D45T47	G
Transportation and storage	D49T53	H
Accommodation and food service activities	D55T56	I
Information and communication	D58T63	J
Financial and insurance activities	D64T66	K
Real estate, renting and business activities	D68T82	L_N
Non-agriculture business sector excluding real estate	D05T82X	Sub1
Community, social and personal services	D84T99	O_U
Total services	D45T99	Services

B. Data and sources

B.1 – Variable descriptions

Labour productivity (by sector)	Real labour productivity has been computed, for each sector, as the ratio of VALK (value added, volumes, local currency) on HRSN (hours worked, total engaged). Since our analysis involves growth rates, to have longer series we interpolated backwards (from 1979 to 1970) labour productivity series based on hours worked with labour productivity based on number of persons engaged (EMPN) using their growth rates, after having checked that their are very closely correlated to each other. *Source*: STAN Database for Structural Analysis (ISIC Rev. 4) from OECD.Stat; https://stats.oecd.org/Index.aspx?DataSetCode=STANI4#.
Investment (by sector)	Gross fixed capital formation by sector is GFKC (volumes, local currency). *Source*: STAN Database for Structural Analysis (ISIC Rev. 4) from OECD.Stat; https://stats.oecd.org/Index.aspx?DataSetCode=STANI4#.
Output (by sector)	Production (gross output) by sector is PRDK (volumes, local currency). *Source*: STAN Database for Structural Analysis (ISIC Rev. 4) from OECD.Stat; https://stats.oecd.org/Index.aspx?DataSetCode=STANI4#.
Public primary expenditure	Current disbursements general government (YPG), value, local currency (the sum of final consumption expenditure (CGAA), social security benefits (SSPG), property income paid (YPEPG), other current outlays (YPOTG)); Government fixed capital formation (IGAA), value, local currency; Gross government interest payments (GGINTP), value, local currency. (Variables converted into volumes by applying the GDP deflator). *Source: OECD (Economic Outlook No 100 – November 2016).*
Export	Exports of goods and services, current LCU (converted into volumes by applying GDP deflator). *Source: World Bank, World Development Indicators (WDI).*

B.2 – Samples

Austria: 1976-2015. Labour productivity growth before 1995 is the growth rate of value added per person engaged, while after is the growth rate of value added per hour worked.

Belgium: 1970-2015. Labour productivity growth before 1999 is the growth rate of value added per person engaged, while after is the growth rate of value added per hour worked.

Finland: 1970-2015. Labour productivity growth before 1975 is the growth rate of value added per person engaged, while after is the growth rate of value added per hour worked.

France: 1970-2015. Labour productivity growth is the growth rate of value added per hour worked in all sample.

Germany: 1991-2015. Labour productivity growth is the growth rate of value added per hour worked in all sample.

Italy: 1970-2015. Labour productivity growth before 1980 is the growth rate of value added per person engaged, while after is the growth rate of value added per hour worked.

Netherlands: 1970-2015. Labour productivity growth is the growth rate of value added per hour worked in all sample.

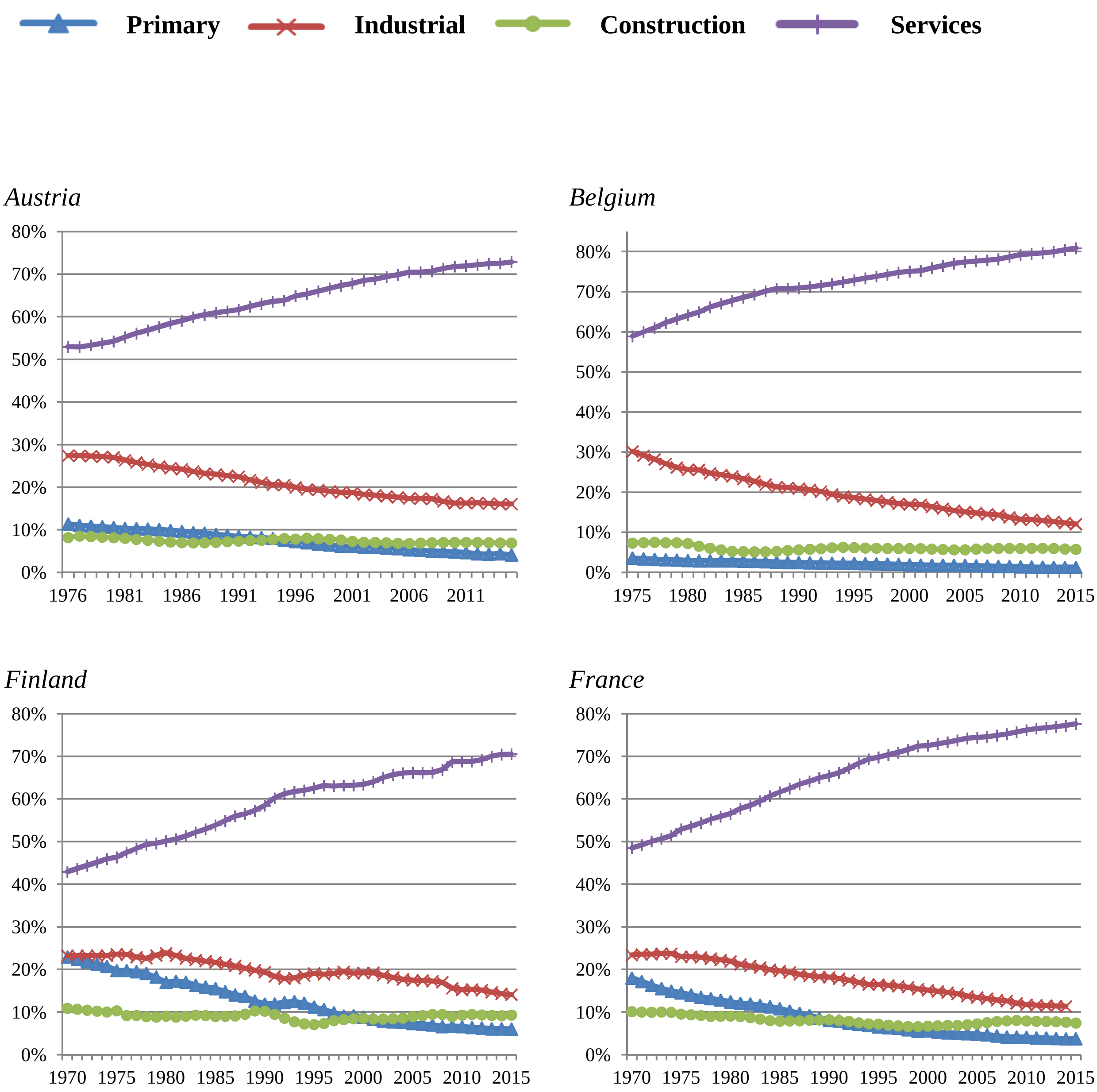
Spain: 1980-2015. Labour productivity growth is the growth rate of value added per hour worked in all sample.

Sweden: 1980-2015. Labour productivity growth is the growth rate of value added per hour worked in all sample.

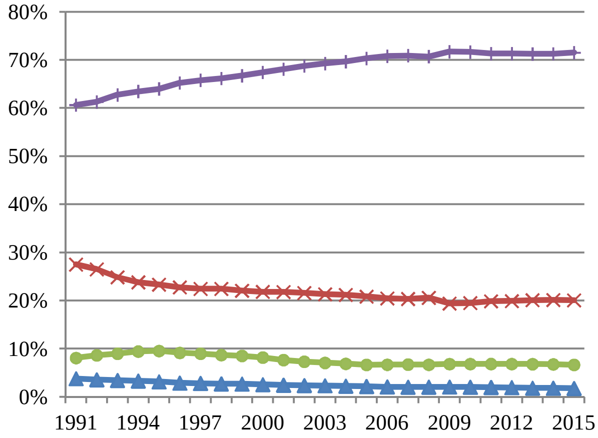
FIGURES

Figure 1. Employment shares in major European countries

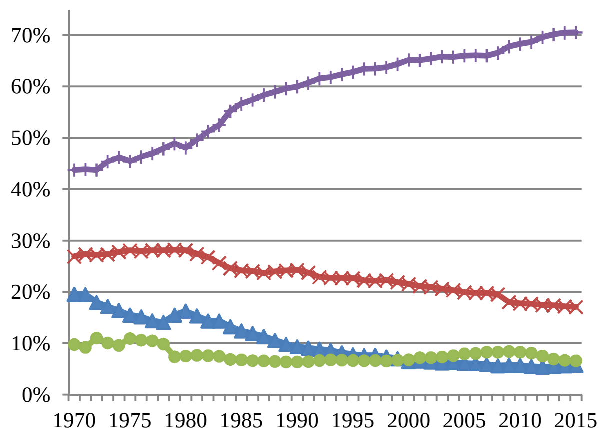
Legend:



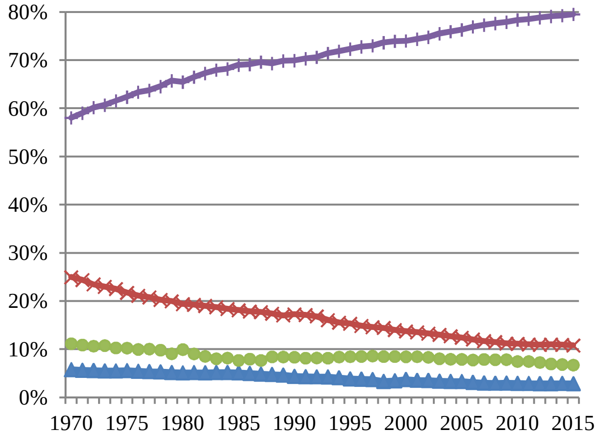
Germany



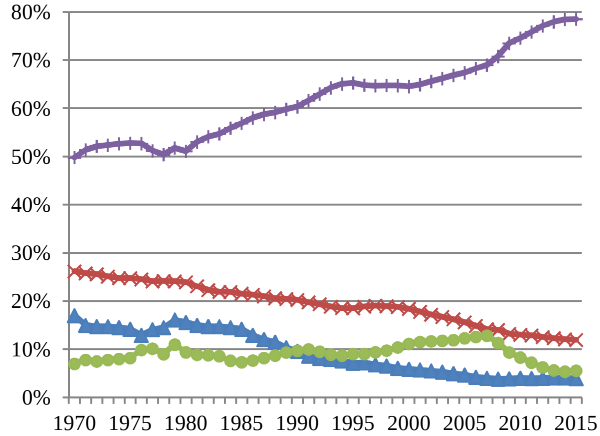
Italy



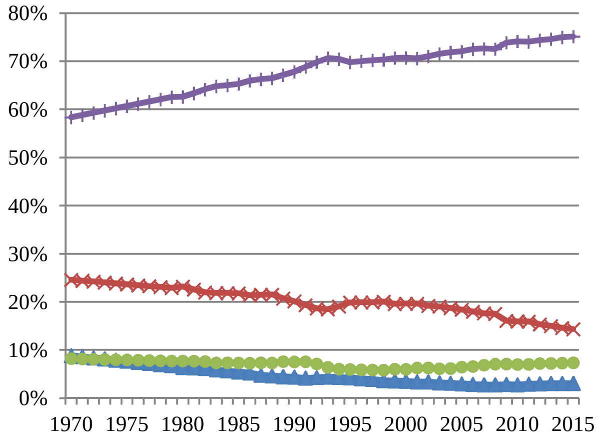
Netherlands



Spain



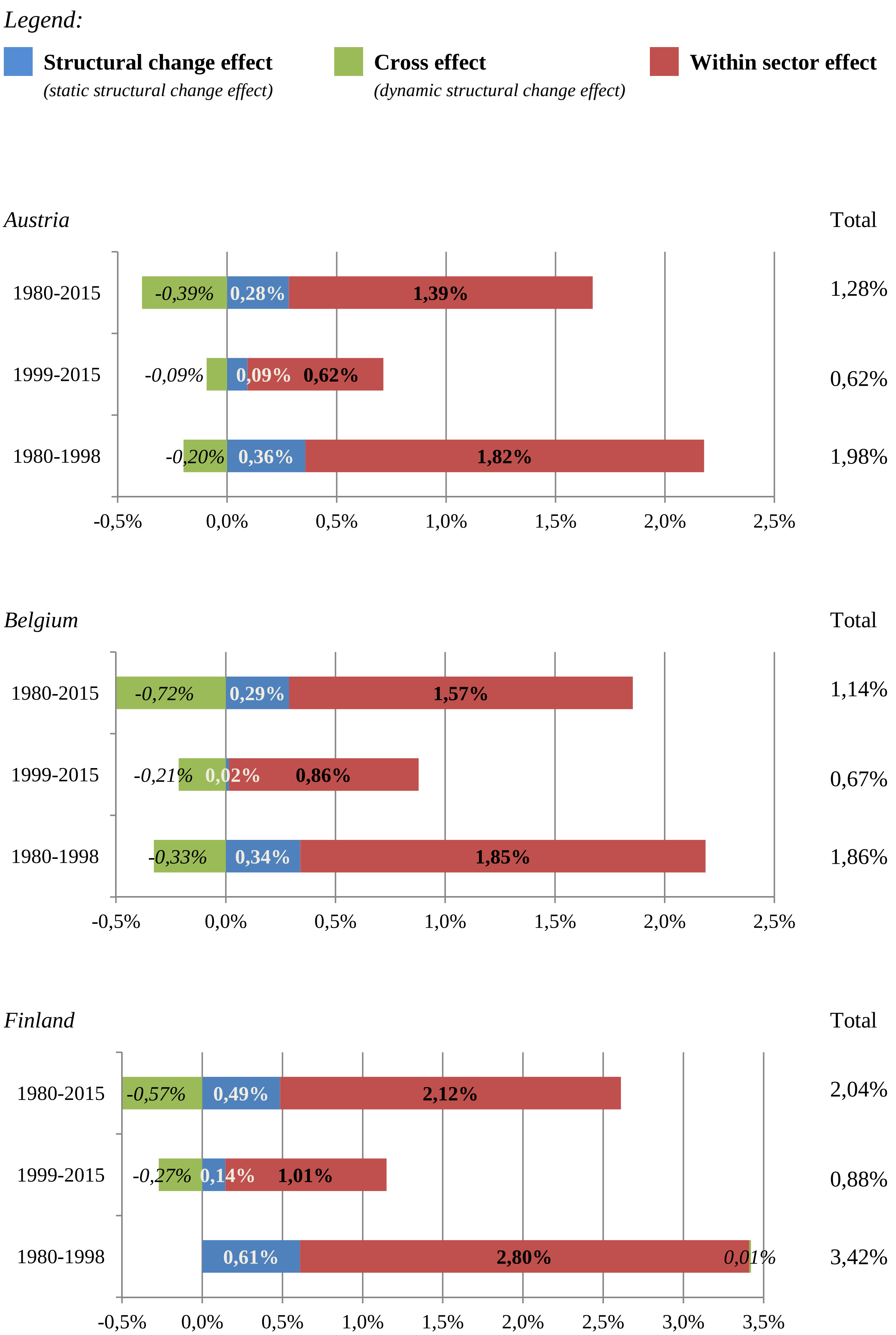
Sweden



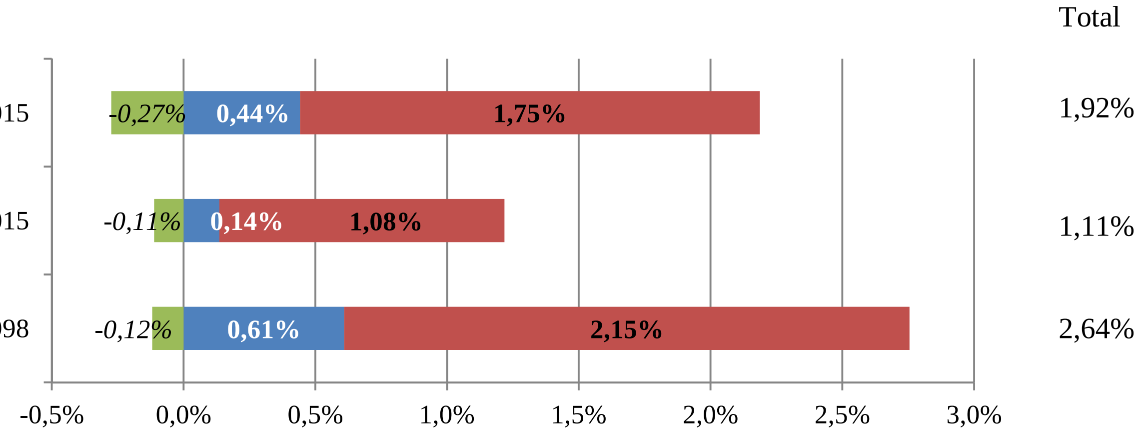
The graphs depict the dynamics of employment shares (in terms of total hours worked, and backwards interpolating the number of persons engaged before 1980) for nine European countries from 1970 to 2015, with respect to four economic branches (primary, industry, construction and services), as described in Section 2.1.

Source: our elaboration on OECD, http://stats.oecd.org (see Appendix B for details).

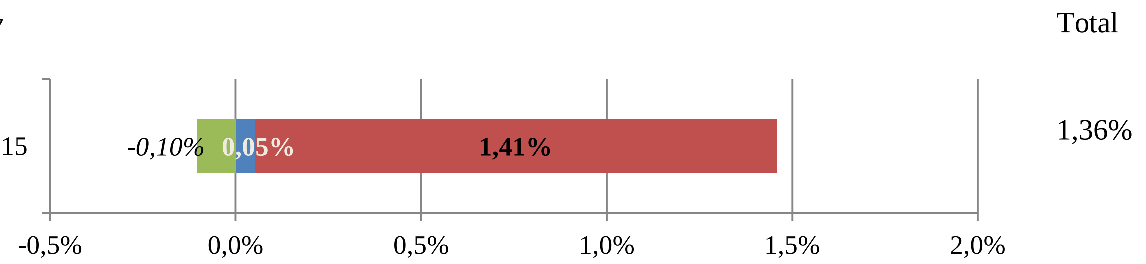
Figure 2. Shift-share analysis for labour productivity dynamics



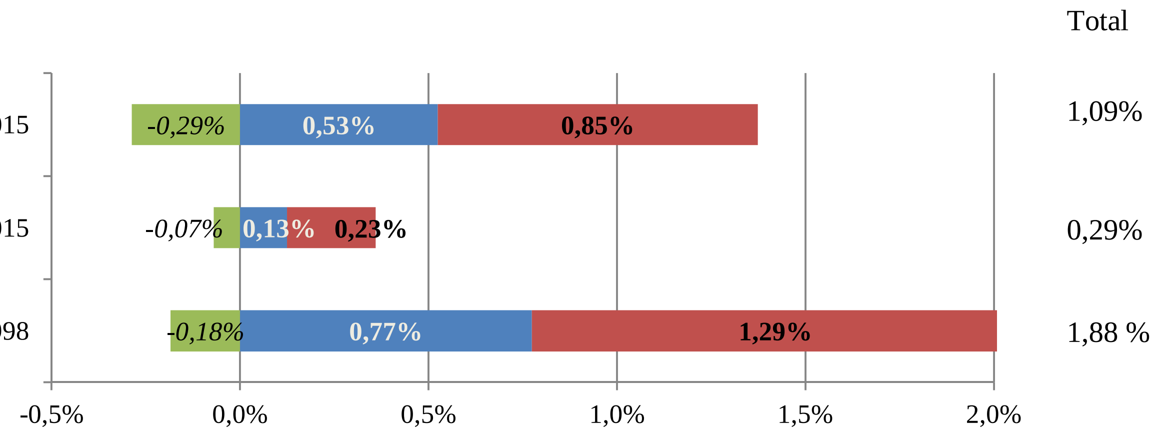
France



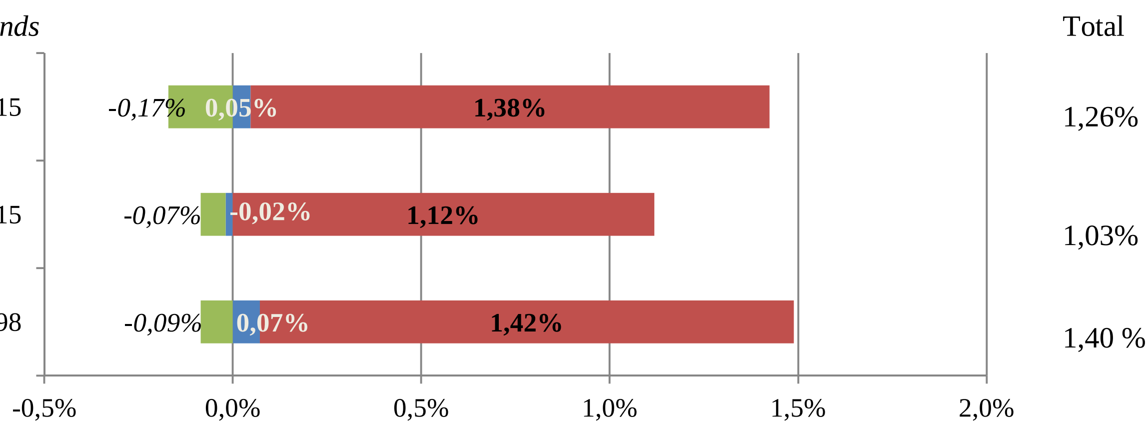
Germany

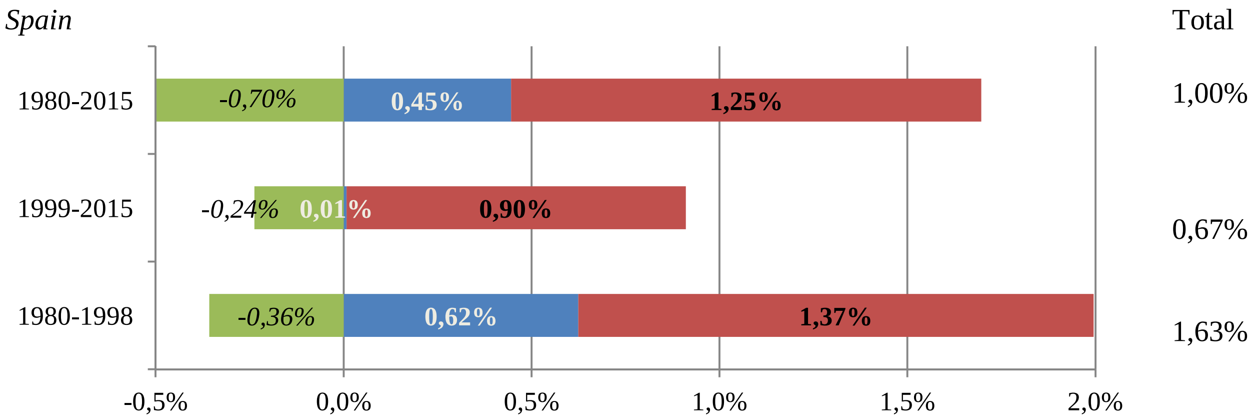


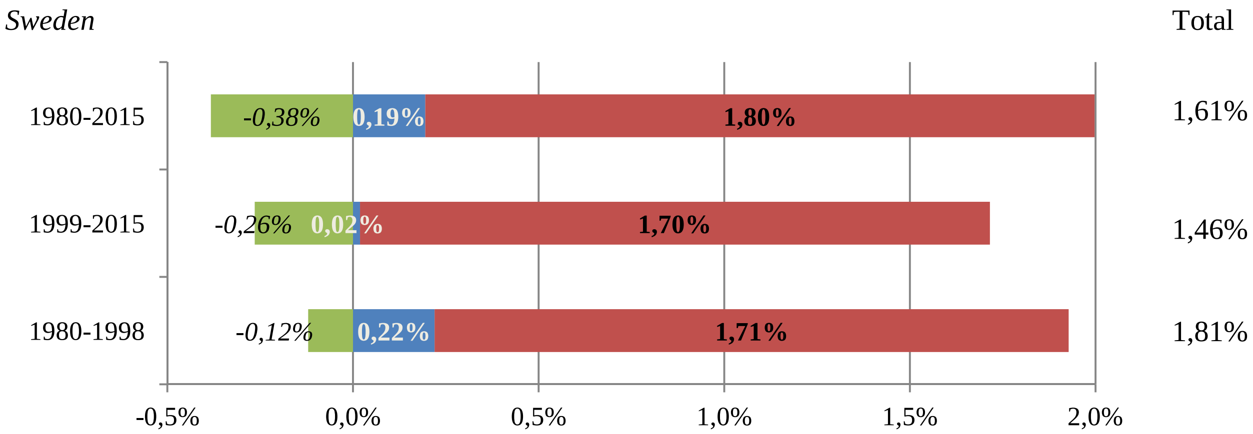
Italy



Netherlands



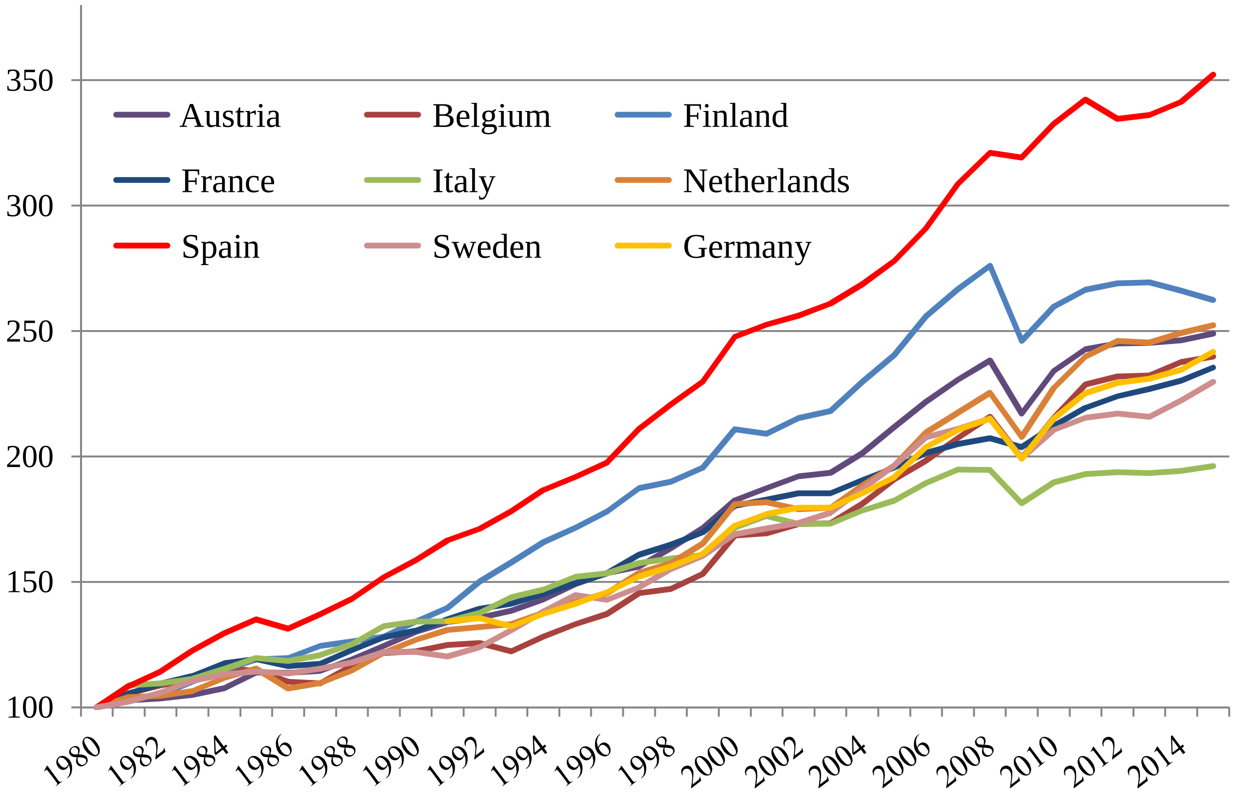




The bar charts depict the contribution of different effects (namely, structural change, within and cross) to the dynamics of aggregate labour productivity for nine European countries from 1980 to 2015 (when available) and sub-periods.
The total magnitude of the bar indicates the yearly average productivity growth rate (being productivity measured in terms of value added per hour worked). Bold labels for the 'within sector effect', white labels for the 'structural change effect', italics labels for the 'cross effect'. As described in Section 2.2, the analysis refers to four economic branches (primary, industry, construction and services).

Source: our elaboration on OECD, http://stats.oecd.org (see Appendix B for details).

Figure 3. Autonomous demand dynamics



The graph displays the dynamics of autonomous demand (calculated as the sum of primary public expenditure and export). Index: 1980=100. Germany starts at 1991 at the same level of Italy since countries show a similar level of value added for hour worked.

Source: own elaboration based on Girardi et al. (2018) (see Appendix B.1 for details).

TABLES

Table 1. Kaldor-Verdoorn sectoral coefficients, baseline model

Austria		**AGR**	**IND**	**CON**	**SER**	**TOT**	**MAN**
$\dot{p}_{-1}$		-0.095	-0.070	0.135	-0.379**	**-0.342****	0.027
	s.e.	(0.168)	(0.172)	(0.169)	(0.154)	**(0.159)**	(0.171)
$\dot{y}$		0.283	0.602***	0.263	0.067	**0.224*****	0.786***
	s.e.	(0.262)	(0.093)	(0.187)	(0.077)	**(0.064)**	(0.108)
$\dot{y}_{-1}$		0.350	0.071	0.091	0.048	**0.115**	-0.018
	s.e.	(0.263)	(0.138)	(0.193)	(0.078)	**(0.073)**	(0.172)
η		0.578	0.628***	0.409	0.083	**0.253*****	0.790***
	s.e.	(0.354)	(0.127)	(0.316)	(0.081)	**(0.069)**	(0.162)
R^2		0.085	0.550	0.081	0.160	**0.313**	0.611
Obs.		38	38	38	38	**38**	38
Belgium		**AGR**	**IND**	**CON**	**SER**	**TOT**	**MAN**
$\dot{p}_{-1}$		-0.086	0.356***	-0.199	0.125	**0.381****	0.284*
	s.e.	(0.173)	(0.126)	(0.165)	(0.157)	**(0.149)**	(0.142)
$\dot{y}$		0.422	0.203**	0.008	0.108**	**0.219*****	0.290**
	s.e.	(0.329)	(0.101)	(0.183)	(0.052)	**(0.054)**	(0.117)
$\dot{y}_{-1}$		-0.153	-0.428***	-0.029	-0.055	**-0.173****	-0.322
	s.e.	(0.324)	(0.107)	(0.178)	(0.054)	**(0.064)**	(0.127)
η		0.248	-0.348	-0.017	0.060	**0.073**	-0.044
	s.e.	(0.420)	(0.271)	(0.215)	(0.085)	**(0.137)**	(0.252)
R^2		0.069	0.408	0.042	0.147	**0.454**	0.292
Obs.		39	39	39	39	**44**	39
Finland		**AGR**	**IND**	**CON**	**SER**	**TOT**	**MAN**
$\dot{p}_{-1}$		-0.182	0.309**	0.152	0.124	**0.215**	0.272*
	s.e.	(0.156)	(0.144)	(0.164)	(0.154)	**(0.162)**	(0.146)
$\dot{y}$		0.121	0.734***	0.187	0.237***	**0.404*****	0.836***
	s.e.	(0.290)	(0.147)	(0.183)	(0.055)	**(0.072)**	(0.166)
$\dot{y}_{-1}$		0.209	-0.492**	-0.166	0.073	**-0.049**	-0.526**
	s.e.	(0.297)	(0.182)	(0.180)	(0.065)	**(0.097)**	(0.208)
η		0.280	0.350	0.025	0.354***	**0.452*****	0.427
	s.e.	(0.332)	(0.302)	(0.296)	(0.081)	**(0.119)**	(0.322)
R^2		0.047	0.452	0.075	0.421	**0.525**	0.440
Obs.		44	44	44	44	**44**	44
France		**AGR**	**IND**	**CON**	**SER**	**TOT**	**MAN**
$\dot{p}_{-1}$		-0.415***	0.209	0.284**	-0.041	**0.177**	0.141
	s.e.	(0.147)	(0.162)	(0.129)	(0.155)	**(0.147)**	(0.158)
$\dot{y}$		0.074	0.514***	0.239	0.365***	**0.402*****	0.545***
	s.e.	(0.549)	(0.113)	(0.175)	(0.089)	**(0.093)**	(0.121)
$\dot{y}_{-1}$		0.292	-0.048	0.375**	0.152	**0.124**	-0.108
	s.e.	(0.540)	(0.141)	(0.182)	(0.111)	**(0.116)**	(0.148)
η		0.259	0.589***	0.859***	0.497***	**0.640*****	0.509***
	s.e.	(0.431)	(0.161)	(0.271)	(0.097)	**(0.128)**	(0.155)
R^2		0.178	0.410	0.367	0.409	**0.451**	0.361
Obs.		44	43	44	44	**44**	44
Germany		**AGR**	**IND**	**CON**	**SER**	**TOT**	**MAN**
$\dot{p}_{-1}$		0.010	0.099	0.340*	0.449***	**0.580*****	0.188
	s.e.	(0.225)	(0.194)	(0.189)	(0.149)	**(0.175)**	(0.201)
$\dot{y}$		1.815*	0.879***	0.338	0.163**	**0.351*****	1.195***
	s.e.	(1.034)	(0.152)	(0.122)	(0.058)	**(0.047)**	(0.187)
$\dot{y}_{-1}$		-0.606	-0.618**	-0.237	0.208**	**-0.138**	-0.804
	s.e.	(1.076)	(0.238)	(0.112)	(0.052)	**(0.071)**	(0.323)

η		1.221	0.290	0.152	0.675***	**0.507****	0.481
	s.e.	(1.749)	(0.321)	(0.278)	(0.259)	**(0.192)**	(0.439)
R^2		0.169	0.776	0.422	0.607	**0.761**	0.789
Obs.		23	23	23	23	**23**	23
Italy		**AGR**	**IND**	**CON**	**SER**	**TOT**	**MAN**
$\dot{p}_{-1}$		0.109	-0.173	0.284*	0.177	**0.073**	-0.176
	s.e.	0.156	(0.150)	(0.150)	(0.153)	**(0.158)**	(0.149)
$\dot{y}$		0.108	0.736***	0.352**	0.243***	**0.404*****	0.816***
	s.e.	(0.229)	(0.179)	(0.140)	(0.067)	**(0.082)**	(0.181)
$\dot{y}_{-1}$		0.033	0.036	-0.029	-0.027	**0.043**	0.017
	s.e.	(0.222)	(0.195)	(0.146)	(0.076)	**(0.099)**	(0.200)
η		0.158	0.658***	0.452*	0.263**	**0.482*****	0.708***
	s.e.	(0.323)	(0.192)	(0.247)	(0.102)	**(0.109)**	(0.193)
R^2		0.021	0.302	0.216	0.297	**0.428**	0.342
Obs.		44	44	44	44	**44**	44
Netherlands		**AGR**	**IND**	**CON**	**SER**	**TOT**	**MAN**
$\dot{p}_{-1}$		0.294*	0.444***	0.466***	0.337**	**0.654*****	0.347**
	s.e.	(0.145)	(0.147)	(0.156)	(0.154)	**(0.121)**	(0.154)
$\dot{y}$		0.018	0.456***	0.097	0.106*	**0.162*****	0.492***
	s.e.	(0.214)	(0.121)	(0.163)	(0.058)	**(0.049)**	(0.117)
$\dot{y}_{-1}$		0.046	-0.312***	-0.185	-0.010	**-0.152**	-0.293**
	s.e.	(0.212)	(0.142)	(0.158)	(0.059)	**(0.055)**	(0.141)
η		0.091	0.259	-0.165	0.144	**0.027**	0.306
	s.e.	(0.422)	(0.322)	(0.417)	(0.119)	**(0.221)**	(0.264)
R^2		0.097	0.435	0.202	0.245	**0.574**	0.436
Obs.		44	44	44	44	**44**	44
Spain		**AGR**	**IND**	**CON**	**SER**	**TOT**	**MAN**
$\dot{p}_{-1}$		0.092	0.304*	0.305*	0.444***	**0.722*****	0.293*
	s.e.	(0.176)	(0.171)	(0.168)	(0.159)	**(0.115)**	(0.169)
$\dot{y}$		1.021**	0.124	-0.785*	0.005	**0.034**	0.091
	s.e.	(0.476)	(0.121)	(0.399)	(0.071)	**(0.060)**	(0.129)
$\dot{y}_{-1}$		-0.484	-0.064	0.786	0.106	**0.099***	-0.130
	s.e.	(0.455)	(0.117)	(0.361)	(0.066)	**(0.056)**	(0.124)
η		0.591	0.085	0.001	0.199	**0.478**	-0.056
	s.e.	(0.613)	(0.202)	(0.696)	(0.166)	**(0.329)**	(0.216)
R^2		0.154	0.111	0.289	0.264	**0.604**	0.109
Obs.		34	34	34	34	**34**	34
Sweden		**AGR**	**IND**	**CON**	**SER**	**TOT**	**MAN**
$\dot{p}_{-1}$		0.293*	-0.064	0.333	0.270	**0.292***	-0.075
	s.e.	(0.168)	(0.180)	(0.203)	(0.175)	**(0.155)**	(0.182)
$\dot{y}$		0.338	1.140***	0.520*	0.099	**0.269*****	1.411
	s.e.	(0.317)	(0.203)	(0.273)	(0.065)	**(0.068)**	(0.231)
$\dot{y}_{-1}$		0.331	-0.290	-0.229	-0.031	**-0.179****	-0.323
	s.e.	(0.324)	(0.270)	(0.279)	(0.067)	**(0.080)**	(0.323)
η		0.946	0.798***	0.436	0.094	**0.128**	1.013***
	s.e.	(0.626)	(0.268)	(0.562)	(0.122)	**(0.144)**	(0.302)
R^2		0.180	0.554	0.287	0.165	**0.413**	0.595
Obs.		33	33	33	33	**44**	33

$\dot{p}$ = growth rate of labour productivity (dependent variable)
$\dot{y}$ = growth rate of autonomous demand (short run effect)
η = KV long-run coefficient, as $(\dot{y} + \dot{y}_{-1})/(1 - \dot{p}_{-1})$
Standard error (s.e.) in parentheses; *, **, and *** denote levels 0.1, 0.05, and 0.01 of significance

AGR = primary sector; IND = industrial sector; CON = construction; SER = services;
TOT = total economy; MAN = manufacturing (sub-sector of IND)
Notice that AGR + IND + CON + SER = TOTAL ECONOMY

Table 2. Kaldor-Verdoorn sectoral coefficients, augmented model

Austria		AGR	IND	CON	SER	TOT	MAN
$\dot{p}_{-1}$		-0.105	-0.072	-0.121	-0.379	-0.351**	0.029
	s.e.	(0.161)	(0.175)	(0.168)	(0.156)	.1613475	(0.174)
$\dot{y}$		0.324	0.599***	0.015	0.073	0.216***	0.786***
	s.e.	(0.251)	(0.095)	(0.185)	(0.083)	(0.067)	(0.109)
$\dot{y}_{-1}$		0.420	0.065	0.001	0.054	0.108	-0.020
	s.e.	(0.254)	(0.141)	(0.172)	(0.083)	(0.075)	(0.177)
η		0.673*	0.619***	0.013	0.092	0.240***	0.788***
	s.e.	(0.342)	(0.129)	(0.239)	(0.091)	(0.074)	(0.166)
I/Y		-0.599**	0.043	1.875***	-0.029	0.058	0.010
	s.e.	(0.289)	(0.101)	(0.572)	(0.128)	(0.117)	(0.127)
R^2		0.190	0.553	0.307	0.161	0.318	0.611
Obs.		38	38	38	38	38	38
Belgium		**AGR**	**IND**	**CON**	**SER**	**TOT**	**MAN**
$\dot{p}_{-1}$		-0.086	0.349***	-0.194	0.122	0.198	0.095
	s.e.	(0.175)	(0.126)	(0.167)	(0.159)	(0.139)	(0.187)
$\dot{y}$		0.447	0.191	0.015	0.103*	0.172***	0.218*
	s.e.	(0.338)	(0.102)	(0.185)	(0.053)	(0.049)	(0.132)
$\dot{y}_{-1}$		-0.152	-0.424***	-0.017	-0.061	-0.198***	-0.481***
	s.e.	(0.328)	(0.106)	(0.179)	(0.057)	(0.057)	(0.150)
η		0.271	-0.357	-0.001	0.048	-0.033	-0.291
	s.e.	(0.429)	(0.269)	(0.219)	(0.090)	(0.104)	(0.283)
I/Y		0.041	-0.076	-0.140	0.024	0.212***	1.846
	s.e.	(0.099)	(0.076)	(0.219)	(0.052)	(0.057)	(1.122)
R^2		0.074	0.425	0.053	0.152	0.596	0.535
Obs.		39	39	39	39	44	21
Finland		**AGR**	**IND**	**CON**	**SER**	**TOT**	**MAN**
$\dot{p}_{-1}$		-0.196	0.275*	0.072	0.070	0.209	0.244
	s.e.	(0.163)	(0.153)	(0.162)	(0.164)	(0.168)	(0.152)
$\dot{y}$		0.134	0.801***	0.010	0.215***	0.405***	0.907***
	s.e.	(0.330)	(0.167)	(0.198)	(0.061)	(0.081)	(0.187)
$\dot{y}_{-1}$		0.214	-0.445**	-0.393*	0.061	-0.069	-0.516**
	s.e.	(0.326)	(0.204)	(0.197)	(0.069)	(0.103)	(0.224)
η		0.291	0.490*	-0.412	0.297***	0.425***	0.517
	s.e.	(0.365)	(0.327)	(0.333)	(0.089)	(0.135)	(0.344)
I/Y		-0.348	-0.142	-2.761**	0.088	0.092	0.113
	s.e.	(0.427)	(0.306)	(1.133)	(0.084)	(0.144)	(0.429)
R^2		0.066	0.468	0.201	0.385	0.511	0.456
Obs.		41	41	41	41	41	41
France		**AGR**	**IND**	**CON**	**SER**	**TOT**	**MAN**
$\dot{p}_{-1}$		-0.522***	0.245	0.160	-0.186	0.171	0.141
	s.e.	(0.154)	(0.174)	(0.162)	(0.164)	(0.154)	(0.171)
$\dot{y}$		-0.353	0.474***	0.245	0.180*	0.324***	0.522***
	s.e.	(0.746)	(0.150)	(0.218)	(0.101)	(0.112)	(0.163)
$\dot{y}_{-1}$		0.693	-0.049	0.253	0.261**	0.208	-0.089
	s.e.	(0.766)	(0.171)	(0.221)	(0.107)	(0.126)	(0.184)
η		0.223	0.562**	0.593*	0.372***	0.643***	0.504**
	s.e.	(0.677)	(0.239)	(0.319)	(0.111)	(0.176)	(0.231)
I/Y		0.615	-0.504	-3.291*	0.174	-0.162	-0.467
	s.e.	(0.939)	(0.561)	(1.416)	(0.167)	(0.427)	(0.604)
R^2		0.281	0.345	0.369	0.364	0.394	0.297
Obs.		38	37	38	38	38	38
Germany		**AGR**	**IND**	**CON**	**SER**	**TOT**	**MAN**
$\dot{p}_{-1}$		-0.018	0.044	0.343*	0.151	0.304	0.183
	s.e.	(0.233)	(0.199)	(0.189)	(0.180)	(0.231)	(0.205)
$\dot{y}$		1.904*	0.922***	0.363*	0.080	0.332***	1.221***
	s.e.	(1.062)	(0.156)	(0.124)	(0.061)	(0.046)	(0.195)
$\dot{y}_{-1}$		-0.569	-0.552**	-0.228*	0.207	-0.055	-0.802**
	s.e.	(1.096)	(0.244)	(0.113)	(0.046)	(0.083)	(0.329)

η		1.311	0.387*	0.205	0.338**	**0.398*****	0.512
	s.e.	(1.747)	(0.298)	(0.297)	(0.141)	**(0.107)**	(0.443)
I/Y		-0.783	0.479	-0.801	0.409**	**0.367***	0.590
	s.e.	(1.301)	(0.432)	(0.806)	(0.166)	**(0.213)**	(1.051)
R^2		0.185	0.790	0.452	0.705	**0.795**	0.793
Obs.		23	23	23	23	**23**	23
Italy		**AGR**	**IND**	**CON**	**SER**	**TOT**	**MAN**
$\dot{p}_{-1}$		0.088	-0.178	0.285	0.168	**0.058**	-0.177
	s.e.	(0.168)	(0.154)	(0.155)	(0.151)	**(0.160)**	(0.150)
$\dot{y}$		0.103	0.697***	0.350**	0.285***	**0.367*****	0.687***
	s.e.	(0.287)	(0.195)	(0.160)	(0.070)	**(0.093)**	(0.210)
$\dot{y}_{-1}$		0.0215	-0.018	-0.031	0.019	**0.005**	-0.124
	s.e.	(0.283)	(0.219)	(0.169)	(0.081)	**(0.109)**	(0.232)
η		0.136	0.576***	0.446	0.365***	**0.394****	0.478*
	s.e.	(0.484)	(0.239)	(0.326)	(0.117)	**(0.150)**	(0.271)
I/Y		0.000	0.469	0.000	-0.407*	**0.178**	0.268
	s.e.	(0.036)	(0.825)	(0.001)	(0.228)	**(0.211)**	(0.219)
R^2		0.015	0.306	0.214	0.348	**0.439**	0.364
Obs.		43	43	43	43	**44**	43
Netherlands		**AGR**	**IND**	**CON**	**SER**	**TOT**	**MAN**
$\dot{p}_{-1}$		0.163	0.433***	0.449***	0.156	**0.532**	0.312*
	s.e.	(0.143)	(0.157)	(0.155)	(0.164)	**(0.146)**	(0.165)
$\dot{y}$		-0.117	0.462***	0.091	0.089*	**0.157*****	0.507***
	s.e.	(0.205)	(0.126)	(0.161)	(0.055)	**(0.048)**	(0.120)
$\dot{y}_{-1}$		-0.097	-0.308**	-0.208	-0.026	**-0.149**	-0.279*
	s.e.	(0.204)	(0.144)	(0.157)	(0.056)	**(0.054)**	(0.143)
η		-0.256	0.272	-0.212	0.075	**0.016**	0.332
	s.e.	(0.355)	(0.322)	(0.400)	(0.095)	**(0.162)**	(0.253)
I/Y		0.406	0.137	1.709	0.291**	**0.346**	0.333
	s.e.	(0.147)	(0.588)	(1.219)	(0.121)	**(0.239)**	(0.530)
R^2		0.244	0.435	0.240	0.342	**0.596**	0.442
Obs.		44	44	44	44	**44**	44
Spain		**AGR**	**IND**	**CON**	**SER**	**TOT**	**MAN**
$\dot{p}_{-1}$		0.040	0.294	0.242	0.276	**0.576*****	0.223
	s.e.	(0.185)	(0.175)	(0.204)	(0.188)	**(0.175)**	(0.174)
$\dot{y}$		1.042**	0.122	-0.769	0.003	**0.032**	0.118
	s.e.	(0.478)	0.124	(0.402)	(0.070)	**(0.060)**	(0.131)
$\dot{y}_{-1}$		-0.532	-0.046	0.679	0.116	**0.109***	-0.088
	s.e.	(0.475)	(0.122)	(0.377)	(0.066)	**(0.057)**	(0.126)
η		0.532	0.107	-0.119	0.165	**0.334**	0.039
	s.e.	(0.589)	(0.205)	(0.640)	(0.125)	**(0.209)**	(0.202)
I/Y		-0.094	0.012	-0.070	-0.071	**-0.067**	-0.095
	s.e.	(0.515)	(0.087)	(0.118)	(0.043)	**(0.060)**	(0.087)
R^2		0.166	0.109	0.301	0.330	**0.620**	0.125
Obs.		33	33	33	33	**33**	33
Sweden		**AGR**	**IND**	**CON**	**SER**	**TOT**	**MAN**
$\dot{p}_{-1}$		0.260	-0.152	-0.191	0.059	**0.214**	-0.138
	s.e.	(0.231)	(0.235)	(0.240)	(0.229)	**(0.196)**	(0.241)
$\dot{y}$		0.318	1.206***	0.730**	0.128*	**0.381*****	1.547
	s.e.	(0.402)	(0.256)	(0.276)	(0.073)	**(0.083)**	(0.294)
$\dot{y}_{-1}$		0.253	-0.347	-0.116	-0.006	**-0.144**	-0.414
	s.e.	(0.424)	(0.354)	(0.289)	(0.079)	**(0.110)**	(0.438)
η		0.772	0.746***	0.515	0.129	**0.301****	0.996***
	s.e.	(0.783)	(0.336)	(0.332)	(0.110)	**(0.148)**	(0.389)
I/Y		-0.158	-0.826	-2.411***	-0.244	**-0.003**	0.381
	s.e.	(0.545)	(0.795)	(0.649)	(0.169)	**(0.004)**	(0.770)
R^2		0.163	0.705	0.637	0.282	**0.522**	0.685
Obs.		22	22	22	22	**34**	22

$\dot{p}$ = growth rate of labour productivity (dependent variable)
$\dot{y}$ = growth rate of autonomous demand (short run effect)
I/Y = investment ratio (gross fixed capital formation/gross output)
η = KV long-run coefficient, as $(\dot{y} + \dot{y}_{-1})/(1 - \dot{p}_{-1})$
Standard error (s.e.) in parentheses; *, **, and *** denote levels 0.1, 0.05, and 0.01 of significance

AGR = primary sector; IND = industrial sector; CON = construction; SER = services;
TOT = total economy; MAN = manufacturing (sub-sector of IND)
Notice that AGR + IND + CON + SER = TOTAL ECONOMY