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DRIVERS OF REGIONAL ECONOMIC DEVELOPMENT: TECHNOLOGICAL CHANGE VERSUS MARKET DISTORTIONS IN GALICIA 1967-2020

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Abstract

Wedge-Growth Accounting for Galicia, a small regional economy, reveals that the efficiency wedge —which can reflects technological innovation and adoption or efficiency improvements— was the main driver of per capita output growth along the whole period analysed: the efficiency wedge fuelled strong per capita output growth until the mid-1970s and then it drove the growth slowdown. However, our results suggest that market distortions and frictions may have played a significant role in accounting for the evolution of labour and the functional distribution of income. In particular, the firm labour wedge —which can reflect markups, unionization or matching frictions— almost exclusively drove the evolution of the functional distribution of income. In none of the three major crisis experienced by the Galician economy from 1967 to 20203 did the investment wedge —which can reflect the costs of investment or distortions in the capital markets— play a significant role, but the efficiency wedge and the household labour wedge —which can reflect taxation, welfare policies, or mobility constraints— played an important role in the recessions, while the household labour wedge played a major role in the recoveries.

Keywords: Efficiency Wedge, Household Labour Wedge, Firm Labour Wedge, Investment Wedge, Resource Constraint Wedge, Output, Labour Share, Investment, Galician economic growth, Wedge-Growth accounting, Technical Change, Distortions and Frictions, Economic Development, Small Regional Economy.

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1 Introduction

The contribution of small TL3 regions to the aggregate growth of OECD countries in the period 1995-2007 was 2/3 of the total (Garcilazo and Oliveira-Martins 2015). Analyzing the forces driving their growth can be of great help in understanding aggregate growth. As Rodríguez-Pose (2016) points out, the economic literature increasingly considers regions or cities as a basic unit of analysis. Galicia is a small Spanish region of approximately 2.8 million inhabitants. Since the 1960s, it has undergone a profound economic transformation from a predominantly agricultural economy to a modern service economy and has gone through very different vicissitudes, with periods of economic expansion and others, fortunately shorter, of contraction.

Despite the importance of small regions, macroeconomic research on the forces driving economic growth has tended to focus on the analysis of national economies, at least those analyses using dynamic general equilibrium models as a conceptual framework. This paper aims to fill this gap. There may be differences between the aggregate and its components. Those related to the external sector are the most obvious, but it could also be the case that size matters for the intensity of innovative activities, for example.

We analyse the economic development of Galicia from 1967 to 2020 in order to identify its main driving forces, with the aim of drawing some lessons for regional economic growth and identifying some salient features that can guide future economic policy and research. Economic development and growth is a complex process (Skare and Tomic, 2015) guided by diverse forces whose importance should be evaluated to design the appropriate policies. To this end, we perform a Wedge-Growth Accounting (WGA) exercise.

The WGA procedure has two components. First, some wedges are measured using the data together with the equilibrium conditions of a prototype model. The prototype economy features five main macroeconomic decisions: production, functional distribution of income, the intratemporal choice between labour and leisure, the intertemporal choice

between consumption and savings and how to satisfy the resource constraint. Each decision is distorted by a wedge, respectively the efficiency wedge, the firm labour wedge, the household labour wedge, the investment wedge and the government consumption wedge. Here, we add other wedge, the population wedge, which distort the population growth. Second, the measured wedge values are then fed back into the prototype model, individually and in combination, to assess how much of the observed movements in output, labour and investment can be attributed to each wedge, individually and in combination. By construction, all six wedges account for all the variation in the data. Finally we interpret our results in light of political, economic, and social circumstances and changes.

The WGA approach is closely inspired by the *Business Cycle Accounting* (BCA) methodology developed by Chari et al. (2007) and Brinca et al. (2016) and applied to long-run growth by Hansen et al. (2021). Del Río and Lores (2023a) extend the BCA methodology to include the factorial distribution of income[1]. Unlike the BCA method, the WGA method uses the deterministic version of the neoclassical growth model, which is more suitable for dealing with transition economies and, therefore, for analysing economic development and growth. Del Río and Lores (2021, 2023b) carried out WGA exercises to analyse economic growth in the United States between 1954 and 2017 and economic development in Spain between 1850 and 2019. As in the present work, in their WGA exercises, Del Río and Lores (2021, 2023b) also match the functional distribution of income.

As far as we know, this is the first time that the WGA methodology has been used to analyse the evolution of a small regional economy and, in particular, of the Galician economy.[2] Some authors have performed traditional growth accounting exercises in which they compute the contribution to output growth of productive inputs and Total Factor Productivity (TFP) in the Spanish regions (see, for example, Jiménez 2003). Boscá et al. (2004) use a parametric framework based on the estimation of cost functions to

[1] Brinca et al. (2024) provide an excellent review of the literature BCA.

[2] Skare and Stjepanovic (2013) analyse the usefulness of a general equilibrium model for macroeconomic forecasting and management of a small economy such as the Republic of Croatia.

evaluate empirically the relevance of the presence of quasi-fixed and external inputs, non-constant returns to scale, and the degree of capacity utilization in the calculation of TFP growth for the private productive sector of Spanish regions over the 1980-1993 period. Badunenko and Romero-Ávila (2014) use a production frontier approach to decompose labour productivity growth along Spanish regional and sectoral dimensions into components attributable to technological change, technological catch-up, capital deepening and human capital accumulation.

Although Spanish regions have specialized and diversified based on their own capabilities (Boschma et al. 2013), national growth trajectories significantly shape regional growth paths (Webber et al. 2018). Vila et al. (2015) find that the processes of innovation and technological adoption in the Spanish regions are strongly interrelated across regions. Therefore, perhaps not so surprisingly, a small regional economy such as that of Galicia has many similarities with much larger economies such as Spain or even the United States.

First, we find that the firm labour wedge — which can reflect markups, unionisation or matching frictions— plays no relevant role in accounting for the evolution of production and resource allocation in the Galician economy over the period analysed. In particular, it does not play a role in explaining the dynamics of production and resource allocation during any of the economic crises experienced by the Galician economy. In this respect, the results are consistent with those of Karabarbounis (2014) according to which the firm labour wedge does not play a relevant role in accounting for the U.S. economic fluctuations, but, on the contrary, the household labour wedge presents a high cyclical correlation with output and investment in the United States.

However, secondly, we find that the firm labour wedge almost exclusively drives the evolution of the functional income distribution in the Galician economy, particularly the evolution of the labour share. Throughout the period analysed, the labour share has experienced strong oscillations, but not a clear decline, unlike in other OECD economies

(see del Del Río and Rebelo 2025). Neverthelesss, since the early 1990s, the Galician labour share has experienced a sharp decline, driven by the deterioration of the firm labour wedge. In this respect, our results are consistent with those focused on the United States, which find that markups —which are a potential component of the firm labour wedge— have recently increased considerably in this economy (see De Loecker et al. 2020). Minondo (2010) shows that there is also a positive relationship across Spanish regions between specialization in high-productivity exports and economic growth.

Thirdly, we find that the efficiency wedge —which reflects technological innovation and adoption or efficiency improvements— was the main driver of per capita output growth during the analysed period.[3] Until the mid-1970s, the excellent performance of this wedge sustained the high growth of per capita output. After this time, however, the growth rate of per capita output slowed significantly. This was due to the slowdown in growth of the efficiency wedge, which virtually stagnated between the mid-1970s and late 1990s before decreasing significantly. Consequently, the growth rate of per capita output also decreased. The slowdown in the growth of the efficiency wedge and the decrease in its contribution to economic growth is easily interpretable in the light of the convergence (Barro and Sala-i-Martin 1992) and technological catch-up (Bils and Klenow 2000, Nelson and Phelps 1966) literature. However, the decline of the efficiency wedge since the late 1990s is a more intriguing fact that has been previously reported in numerous studies for the Spanish economy as a whole (see, for example, Del Río and Lores (2023b)). Various explanations have been given for it: overinvestment in housing fostered by subsidies to the housing purchase (Díaz and Franjo 2016), low investment in intangible assets due to the prevalence of traditional sectors , the low weight of large firms, and the importance of micro enterprises (Pérez and Benages 2017), misallocation

[3]We ignore the differences between different types of technological progress. Molinari and Torres (2018) assess the role of different sources of technological change (neutral, embodied and increasing quality of labor services generated by human capital accumulation) as determinants of economic growth in the United States and some European countries. Ghazinoory et al. (2014) develop a model of measuring innovation performance of developing regions, based on regional statistics.

of production factors across firms due to cronyism (García-Santana et al. 2020) or due to imperfections of the credit market (Moral-Benito. 2018).[4] Faiña et al. (2020) find that TFP stagnation across Spanish regions was partially offset by the positive contribution to growth from infrastructure investments financed by European Union funds.

Finally, during the period analysed, the Galician economy has experienced three major economic crises: the Industrial Reconversion (1982-1986), the crisis of the early 1990s (1991-1994), and the Great Recession (2008-2013). In none of these crises has the investment wedge —which can reflect the costs of investment or distortions on the capital markets— played a significant role. However, the efficiency wedge as well as the household labour wedge —which can reflect taxes, welfare policies or mobility constraints— have played a major role in all of them. This is in line with the results of Chari et al. (2007), Brinca et al. (2016) and Del Río and Lores (2021, 2023a, 2023b) for the US and Spanish economies. We have also found that the recovery from all these economic crises has been driven primarily by the household labour market, which, in our view, indicates the enormous dependence of the Galician economy —and the Spanish one— on the circumstances that determine the functioning of its labour market.

The remainder of this paper is organized as follows. Section 2 describes the model, while Section 3 briefly describes the accounting procedure. Section 4 presents and discusses our findings for the Galician economy. Finally, section 5 concludes.

2 The Model

The prototype economy is a one-sector neoclassical growth model with labour and savings decisions and six exogenous wedges that represent the distortions in the equilibrium conditions: the efficiency wedge, A_t, the household labour wedge, $\pi_{h,t}$, the firm labour wedge, $\pi_{f,t}$, the investment wedge, $\pi_{x,t}$, the resource wedge, $\pi_{g,t}$, and the population

[4] Koch et al. (2021) provide structural estimates of TFP and document that most of the productivity decline in Spanish manufacturing in their sample could be attributed to firms that never used robots.

wedge, $\pi_{n,t}$. All wedges have been introduced into the model's equilibrium conditions so that an increase in them means a relaxation of the restrictions affecting the economy.

The equilibrium in the economy is therefore pinned down by:

(i) The production function,

$$y_t = A_t f(k_t, l_t), \tag{1}$$

where y_t is detrended output per capita at time t, k_t is detrended capital per capita a time t, and l_t is labour per capita at time t. The efficiency wedge, A, represents the detrended TFP. The detrending factor is $(1+\gamma)^t$, where $\gamma \geq 0$ is the rate of labour-augmenting technical progress.

(ii) The resource constraint,

$$y_t = \pi_{g,t}(c_t + x_t), \tag{2}$$

where c_t is detrended consumption per capita at time t and x_t is detrended investment per capita at time t. Considering that production is allocated to consumption (public and private), investment (public and private), and net exports, the resource wedge, π_g equals one plus the ratio of net exports to the sum of investment and consumption. Therefore, it increases when the degree of foreign openness increases.

(iii) The evolution law of population,

$$N_{t+1} = \pi_{n,t+1} N_t, \tag{3}$$

where N_t and N_{t+1} are population at t and $t+1$, respectively. The population wedge, π_n represents the divergence between the population at t and $t+1$;

(iv) The evolution law of detrended capital per capita accumulation which involves

investment adjustment costs

$$\pi_{n,t+1}\left(1+\gamma\right)k_{t+1}=x_t+\left(1-\delta\right)k_t-\Psi\left(\frac{x_t}{k_t}\right)k_t \tag{4}$$

where $\Psi'>0,\ \Psi''>0,\ \Psi(\delta k_t)=0$ and $0<\delta<1$ is the depreciation rate of capital.

(v) The representative firm hires capital to equalize its marginal productivity to their rental price (r_t), which implies that the output elasticity for capital,

$$\varepsilon_t=\frac{k_t f_k\left(k_t,l_t\right)}{f\left(k_t,l_t\right)}, \tag{5}$$

equals the capital share,

$$\varepsilon_t=r_t\frac{k_t}{y_t}. \tag{6}$$

Firms also hires labour to equal the wage rate to the marginal productivity of labour times the firm labour wedge, which means that the labour share equals the output elasticity for labour, $1-\varepsilon_t$, times the firm labour wedge, and

$$\pi_{f,t}(1-\varepsilon_t)=w_t\frac{l_t}{y_t}, \tag{7}$$

where w_t is the detrended wage rate. The firm labour wedge, π_f, equals the ratio of labour share to the output elasticity for labour.

(vi) The labour-income choice

$$-\frac{u_{l,t}}{u_{c,t}}=\pi_{h,t}w_t \tag{8}$$

where u_l and u_c are the derivatives of the utility function with respect to c and l. The household labour wedge, π_h, equals the ratio of the marginal rate of substitution between consumption and labour to the wage rate. If equation (7) is substituted into (8), we have $-u_{l,t}/u_{c,t}=\pi_{l,t}(1-\varepsilon_t)y_t/l_t$, where $\pi_{l,t}=\pi_{h,t}\pi_{f,t}$ is the labour wedge. Typically,

the literature calculates the labour wedge but does not decompose it into the firm and household wedges because the functional distribution of income is not matched. In the present paper, however, we perform this decomposition because, in addition to matching production and resource allocation, we also match the functional distribution of income.

(vii) The savings optimality condition

$$\frac{(1+\gamma)u_{c,t}}{\pi_{x,t}\left[1-\Psi\left(\frac{x_t}{k_t}\right)\right]}=\beta u_{c,t+1}\left\{A_{t+1}f_{k,t+1}-\frac{\Psi\left(\frac{x_{t+1}}{k_{t+1}}\right)-\Psi'\left(\frac{x_{t+1}}{k_{t+1}}\right)\frac{x_{t+1}}{k_{t+1}}-(1-\delta)}{\pi_{x,t+1}\left[1-\Psi\left(\frac{x_{t+1}}{k_{t+1}}\right)\right]}\right\} \tag{9}$$

where β is the discount factor and f_k is the derivative of the production function with respect to k. The investment wedge, π_x, represents the distortion between the returns to saving and investment.

The system of equations (1)-(9) characterizes the equilibrium of the economy.

3 The accounting procedure

Utility and production functions. The utility function is additive separable in labour and logarithmic consumption,

$$u\left(c_t,l_t\right)=\log c_t-\frac{l_t^{1-\nu}}{1-\nu},$$

where $-\frac{1}{\nu}$ is the Frisch elasticity of the labour supply. The production function is CES

$$f(k_t,l_t)=\left[\alpha k_t^{\rho}+(1-\alpha)\,l_t^{\rho}\right]^{\frac{1}{\rho}}$$

where $\alpha\in(0,1)$, and $\rho\in(-\infty,1]$. Therefore, the output elasticity for capital is given by

$$\varepsilon\left(\frac{k_t}{l_t}\right)=\alpha\left(\alpha+(1-\alpha)\left(\frac{k_t}{l_t}\right)^{-\rho}\right)^{-1} \tag{10}$$

We consider quadratic investment adjustment cost, such that

$$\Psi\left(\frac{x_t}{k_t}\right) = \frac{\phi}{2}\left(\frac{x_t}{k_t} - \Phi\right)^2$$

Parameters. In line with Cutanda and Sanchis-Llopis (2021), we set $\nu = -3$ to have a Frisch elasticity of 1/3. We set $\gamma = 0.0228$ which is the annual average growth rates of the Galician output per capita in the period $1967 - 2020$. The long-run population growth rate and the depreciation rate of capital are set $\pi_n = 1$ and $\delta = 0.0330$, which are the annual averages in the period. We set $\phi = 0.25/\Phi$ (where $\Phi = (1 + \pi_n)(1 + \gamma) - (1 - \delta)$) to obtain the elasticity of the price of capital with respect to the investment-capital ratio to be 0.25 (see Brinca et al. 2016). We choose $\rho = -0.388$ which is the estimated value for a CES production function of the Spanish economy in Del Río and Lores (2023b). $\alpha = 0.4294$ is chosen equal to the average capital share of the last 10 years for Galicia. Finally, we suppose an annual interest rate, $i = 0.05$, and the discount rate $\beta = (1 + \gamma)/(1 + i) = 0.9741$.

The BGP values for the wedges A_t, $\pi_{ht}, \pi_{ft}, \pi_{xt}$ and π_{gt} are calculated by solving the equation system (1)-(9) to reproduce the $1967 - 2020$ sample averages for labour, detrended output per capita, investment rate, consumption to output rate and labour share. Table 1 summarizes parameters and all BGP values.

To compute the wedges, we solve the equilibrium equation system (1)-(9) for k_{t+1}, A_t, $\pi_{h,t}$, $\pi_{f,t}$, $\pi_{x,t}$ and $\pi_{g,t}$ given an initial condition for capital[5], k_0 , and the observed paths of $\pi_{n,t+1}$, y_t, c_t, x_t, l_t and s_{lt} in the $1967 - 2020$ period as well as their assumed paths for $t > 2020$,

$$j_t = j_T \mathrm{e}^{-\iota(t-T)} + j\left(1 - \mathrm{e}^{-\iota(t-T)}\right)$$

where j_t is $\pi_{n,t+1}$, c_t, x_t, y_t or l_t at period $t \geq T$, $T = 2020$ and j is the constant calibrated value above. We set $\iota = 0.03$, which is around the speed of convergence estimated in most

[5]The initial capital stock is obtained such that $k_0/y_0 = 1.7$, the ratio capital/output estimated for Spain in 1967 by Prados de la Escosura (2022).

works (see Barro and Sala-i-Martin 1995). Our method allows us to compute converging paths of wedges from the initial period until infinity. In practice, we have computed 1000 periods. We use these values for the wedges in our experiments.

Finally, we perform simulations to see to what extent models with just one wedge or a combination of wedges can replicate observed data. The results of simulations with all but one wedge are referred to as non-wedge components.

To apply the accounting method for this period, we use the galician data from BDMORES2015 constructed by de Bustos et al. (2008). The data are available in Fundación Rafael del Pino. Population, L_t, is total population at time t. Labour at time t, l_t, is the activity rate at time t. Real output is computed deflating the nominal gross value added (GAV) by the implicit deflator of GDP ($Y_t = GVA_{N,t}/P_t$). Real investment is gross fixed capital formation at constant prices. Private consumption is household final consumption expenditure plus an imputation of final consumption expenditure of NPISHs (non-profit institutions serving households) plus final consumption of AA.PP. (public administrations). We have constructed this imputation to maintain the share in final consumption expenditure of NPISHs and AA.PP. consumptions measured for Spain after 1980. For the years prior to 1980 we have kept this shares constant at the average shares for 1980-1985. The BDMORES constructs labour income series by correcting the compensation of employees measure, so we construct the labour share (s_{lt}) by dividing labour income by GAV. We detrend real output, real investment and real consumption by $(1+\gamma)^t$.

We focus on the role played by wedges in the evolution of GDP per capita, investment per capita, and labour all variables in logs. We examine the extent to which each wedge contributed the evolution of these variables. For this purpose, we conducted non-wedge experiments. In this way:

(i) We obtain the evolution of the variables of interest if the corresponding wedge had not been present. Let $\mathbf{z}_{i,t}$ be the non-wedge component of the variable $\mathbf{y}_t$ due to wedge i (when wedge i is kept constant at its initial value).

(ii) We compute the contribution of a wedge i to the growth of variable $\mathbf{y}_t$ subtracting the non-wedge component from the variable (both in logs), $\log \mathbf{y}_{i,t} = \log \mathbf{y}_t - \log \mathbf{z}_{i,t}$.

If a wedge explains the totality in the evolution of a variable, then $\log \mathbf{y}_{i,t} = 0$ and its contribution is $\log \mathbf{y}_t$, but if a wedge explains nothing, then $\log \mathbf{y}_{i,t} = \log \mathbf{y}_t$ and its contribution is 0.

For the the contribution of a wedge i to the growth of each variable, we adapt the ϕ-statistic defined by Brinca et al. (2016) to intend to capture how closely a particular contribution tracks the underlying statistic. The ϕ-statistic is defined for each contribution of a wedge $i \in \{A, \pi_h, \pi_f, \pi_x, \pi_g, \pi_n\}$ of an observable variable $\mathbf{y}_t$ as

$$\phi_i^{\mathbf{y}} = \frac{1/\sum_t (\log \mathbf{y}_t - \log \mathbf{y}_{i,t})^2}{\sum_j \left(1/\sum_t (\mathbf{y}_t - \log \mathbf{y}_{i,t})^2\right)} = \frac{1/\sum_t (\log \mathbf{z}_{i,t})^2}{\sum_j \left(1/\sum_t (\log \mathbf{z}_{i,t})^2\right)},$$

where $\mathbf{z}_{i,t} \in \{l_{i,t}, y_{i,t}, x_{i,t}, s_{li,t}\}$ is the non-wedge component of a variable due to wedge i . The ϕ-statistic has the desirable feature that it lies in $[0, 1]$, sums to one across the five wedges, and when a particular wedge explains a variable perfectly, then its value is 1.

4 Accounting for output, labour, investment and labour share

In this section, we evaluate the contribution of each wedge to the evolution of output, labour, investment and labour share in the Galician economy between 1967 and 2020. We interpret the contributions of the wedges in light of the major economic events that affected the Galician economy during this period.

The evolution of the wedges is displayed in Figure 1. The efficiency wedge experienced a sharp increase from the late 1960s to the mid-1970s, a period that corresponds to the final stage of the Spanish growth miracle that began in the late 1950s (see (see Figure 1)). Despite experiencing a sharp decline in the early 1980s, the efficiency wedge

then grew slowly until 2000, and thereafter experienced a steep decline. The household labour wedge experienced a sharp decline until the late 1970s. Thereafter, it fluctuated sharply, but without experiencing a significant decline or increase. The firm labour wedge remained relatively stable throughout the period, with very small fluctuations. The investment wedge experienced a significant rise from the 1970s onward, particularly pronounced in the 1980s. The resource wedge increased from the 1970s to the early 1980s and then declined, returning to its initial values at the beginning of the 21st century. However, during the Great Recession, it experienced a sharp rise and stabilized from 2013 onward. The population wedge remained relatively stable, although it experienced significant decreases during the second half of the 1970s and the first half of the 1980s as well as during the Great Recession.

The evolution of output, labour, investment and labour share with their no-wedge components is displayed in Figures 2-5. The values of the ϕ-statistic for the wedge contributions to variables are displayed in Table 2.

4.1 Output

The evolution of Galicia's output per capita has gone through three distinct phases (see Figure 2). From 1967 to the mid-1970s there was a period of strong growth; between then and 2008, the year of the Great Recession, the Galician economy went through a long period of moderate and relatively stable growth in output per capita; and since 2008, the pace of growth in output per capita has been relatively slow. The first period corresponds to the end of the Spanish development miracle that began in the 1950s. Like the rest of the Spanish economy, the Galician economy subsequently slows its growth. The pace of growth becomes particularly slow after the Great Recession until 2020, the year in which our analysis concludes and in which, due to the effects of the COVID-19 pandemic and the measures implemented to combat it, GDP per capita even contracted.

Since 1967, the evolution of detrended output per capita has been mostly driven by

the efficiency wedge, which is reflected in the high value of the ϕ-statistic of the no-wedge component of output due to the efficiency wedge (0.695, see Table 2). The high growth until the mid-1970s is mainly due to the good performance of this wedge. The high contribution to the growth of output per capita of the efficiency wedge reflects the intense process of technological adoption, modernization and convergence that the Galician economy carried out during these years. However, the subsequent slowdown in growth after the mid-1970s is also due to the deteriorating performance of this wedge.This behaviour of the efficiency wedge is typical of transition economies. Initially, the rate of technological catch-up is very high, but it slows down over time as the developing country approaches the global technological frontier (Bils and Klenow, 2000, Nelson and Phelps 1966). Eventually, technological catch-up ceases, and the growth rate of the TFP matches that of the global technological frontier, meaning that the efficiency wedge stabilises.

Since the beginning of the 21st century, the efficiency wedge has even made a negative contribution to the growth of output per capita. The slowdown in the growth of the TFP —reflected in the decline of the efficiency wedge— is also a feature of the Spanish economy as a whole. Many economists have tried to decipher its causes. Most point to the misallocation of productive resources across sectors and firms due to imperfections in the credit market, cronyism, unbalanced business composition or inadequate tax incentives.

The contribution of the investment wedge to the growth of output per capita was positive but very small throughout the period analysed, while the contribution of the firm labour wedge to the growth of output per capita was negligible. This last result is consistent with the findings of Karabarbounis (2014) and Lores (2024), according to which the firm labour wedge was unimportant in explaining economic fluctuations in the U.S. and Spanish economies, although the household labour wedge it was.

Between the mid-1970s and the late 1990s, the household labour wedge significantly slowed down the growth of output per capita. It was the main force that hindered growth in these years. The deterioration in the household labour wedge over this period and the

resulting drag on growth could have been due to a number of reasons. In the 1970s and 1980s, Spain undertook significant labour market reforms, including the Statute of Workers' Rights (1980) and the General Law on Social Security (1977). These measures expanded labour protections but also increased the non-wage costs of employment, contributing to a widening household labour wedge. Spain's tax system underwent significant reforms during this period, with higher taxes imposed on both individuals and businesses to finance social programs and public spending. These higher taxes on labour increased the total cost of employment, contributing to the rise in the household labour wedge. Spain's labour market was characterized by rigid labour laws that made it difficult for employers to hire and fire workers, especially after the labour reforms of the 1980s. The combination of high severance payments and job protection laws made employers less willing to hire, which, in turn, led to higher non-wage costs, contributing to the household labour wedge. Spain's unemployment rate remained high throughout much of the 1980s and 1990s. As unemployment persisted, the government implemented various policies aimed at providing subsidies and benefits, which added further costs to the labour market and worsened the household labour wedge. The Spanish economy underwent significant structural changes during this period, with a shift from manufacturing and industrial jobs to service-based employment, and leading to growing regional disparities in Spain. These processes could aggravate the mismatch in the labour market and thus worsen the household labour wedge. During the 1980s, trade unions in Spain were particularly strong and negotiated higher wages and better working conditions. While this improved workers' living standards in the short term, it also increased the overall cost of labour and may have led to a worsening of the household labour wedge.

During the period analysed, the Galician economy experienced three economic crises: the industrial restructuring (1982-1986), the crisis of the early 1990s (1991-1994) and the Great Recession (2008-2014). In all three, the main driver of the downturn was the household labour wedge. In the first and the last, the efficiency wedge also played an

important role. However, this was not the case in the crisis of the early 1990s. The recovery from the industrial crisis of the 1980s and the Great Recession was mainly driven by the household labour wedge. However, the recovery from the crisis of the early 1990s was driven by the efficiency wedge. The results for Galicia are consistent with those obtained for Spain and the United States (Chari et al. 2007, Brinca et al. 2016 and Del Río and Lores 2021, 2023a, 2023b), according to which the most significant economic recessions in recent decades in these countries are associated with significant deteriorations in the efficiency and household labour wedges. However, the role of the investment wedge in these recessions was relatively small.

In the 1980s (1982-1986), the Galician economy underwent a process of industrial restructuring that affected key sectors such as steel, shipbuilding, mining, textiles, and construction materials. The main companies in these sectors (Siderúrgica del Atlántico, Astano, Astilleros Barreras, etc.) underwent drastic restructuring that led to the loss of thousands of jobs and changes in the economic and social structure of the region. As our analysis shows, the slowdown in per capita output growth caused by the industrial crisis was initially driven by the decline in the efficiency wedge and, subsequently, by the decline in the household labour wedge. In 1986, the year in which Spain joined the European Economic Community, economic recovery began, primarily driven by the improvement in the household labour wedge and, secondarily, by the improvement in the efficiency wedge.[6]

The Spanish recession of the early 1990s (1991-1994) was caused by a combination of global economic pressures, the internal need for fiscal consolidation to meet European Union criteria, and the bursting of a real estate bubble. Our analysis shows that in Galicia, the slowdown in per capita output growth during the crisis of the early 1990s

[6] Bermejo Carbonell and Werner (2018) analyse the impact of foreign direct investment on Spanish economic growth between 1984 and 2010 and find no empirical evidence that it stimulated Spanish growth, even after Spain joined the European Economic Community and the Euro. Our analysis suggests that, at least in the Galician case, there may have been other ways in which integration could have affected growth.

was driven by the household labour wedge. However, the recovery from the crisis was driven by the efficiency wedge. The household labour wedge continued to contribute negatively to per capita output growth until the late 1990s.

The improvement in the household labour wedge was mainly responsible for the expansion of detrended output per capita from the late 1990s until the Great Recession. However, in the late 1990s, the efficiency wedge began to contribute negatively to per capita output growth until the end of the analysed period. In the mid-1990s, the Spanish government implemented several economic reforms, including the privatisation of large state-owned enterprises, tax cuts and simplification of the tax system, measures to make hiring and firing more flexible, and decentralised collective bargaining, giving firms greater autonomy in labour decisions. In 1999, Spain adopted the euro as its currency. Our results suggest that these changes and reforms contributed positively to per capita output growth in the Galician economy by improving the household labour wedge, but they failed to have a positive impact on per capita output growth by improving the efficiency wedge.

The Great Recession was driven primarily by the worsening of the household labour wedge and secondarily by the decline in the efficiency wedge. The recovery from the Great Recession was almost entirely driven by the household labour wedge. The efficiency wedge played no role in the recovery; on the contrary, its negative contribution to output per capita growth continued. The primary role of the household labour wedge in the recovery from the Great Recession suggests that the Rajoy government's labour reform —a pivotal element in Spain's response to the Great Recession — aimed at making the labour market more flexible, reducing labour costs and improving competitiveness, contributed significantly to the recovery of the Galician economy in the following years.

During the Great Recession, the resource wedge helped slightly reduce the slowdown in per capita output growth, which suggests that the foreign sector contributed significantly to halting the economic decline. The Great Recession was a major turning point

in the internationalization of the Spanish economy. While the crisis presented significant challenges, it also led to a strategic shift towards global markets, diversification of investment, and increased exports. Spanish companies and institutions looked beyond the domestic market to safeguard their survival and growth, leading to a stronger presence in markets such as Latin America, Asia, and other parts of Europe. The internationalization efforts not only helped companies weather the crisis but also positioned them for future growth in the post-recession period.

4.2 Labour

From the mid-1970s to the 2000s, labour per capita fell sharply (see Figure 3). This decline only halted between 1986 and 1990, the years immediately following Spain's accession to the European Economic Community. Between 2000 and 2008, the year of the Great Recession, the Spanish and Galician economies experienced a period of economic expansion characterised by strong investment in housing and high leverage. During this period, Galician labour per capita experienced a significant increase. However, from 2008 onwards, labour per capita declined and returned to a level not far from that of the late 1990s. In 2013-2014, following Spain's severe debt crisis, a recovery in labour began and continued until 2020, the year of the COVID pandemic.

Both the decline in the early part of the period analysed and the subsequent fluctuations in labour per capita were almost entirely driven by the household labour wedge. This predominance is reflected in the high value of the ϕ-statistic, 0.639, of the no-wedge component of labour per capita due to the household labour wedge (see Table 2). The investment wedge has slightly slowed the decline in hours per capita since the early 1980s, and the effect of the efficiency wedge has been negligible. The resource wedge helped to slightly reduce the decline in labour per capita during the Great Recession. Therefore, our results suggest that the foreign sector also contributed significantly to mitigating the adverse effects of the Great Recession in terms of the labour variable.

The contribution of the firm labour wedge to the evolution of labour per capita was negligible throughout the period, as was the case with the evolution of output.

4.3 Investment

The efficiency wedge contributed positively to per capita investment growth until the late 1970s, but its positive effect was offset by the negative contribution of the household labour wedge (see Figure 4) from the mid-1970s. Thereafter, the investment wedge contributed significantly to per capita investment growth.

The decline in detrended investment per capita during the industrial crisis of the early 1980s was driven by the unfavourable evolution of three wedges: the efficiency wedge, the household labour wedge, and the resource wedge. Therefore, the results suggest that the foreign sector contributed to depressing the evolution of investment per capita. However, in the recovery, the investment wedge played a major role. The contraction of detrended investment per capita in the subsequent crisis of the early 1990s was mainly driven by the household labour wedge.

The expansion of per capita investment from the late 1990s to the Great Depression was driven primarily by the household labour wedge and secondarily by the resource wedge, suggesting that the economic reforms of the second half of the 1990s (labour market flexibility, privatizations, and tax cuts) had a positive effect on per capita investment, as did the adoption of the Euro in 1999. However, neither the economic reforms nor the Euro entry succeeded in getting the efficiency wedge to boost growth in per capita investment; rather, since the late 1990s, the wedge has contributed negatively to growth in per capita investment.

In the Great Recession, the combined effects of the efficiency, labour, and resource wedges led to a sharp decline in investment per capita, while the investment wedge helped to slow the decline. The recovery was driven by the household labour wedge.

4.4 Labour share

Over the period considered (1967-2020), the labour share has not shown a significant trend increase or decrease, although it has experienced large fluctuations (see Figure 5). The labour share increased during the Spanish economic miracle until the mid-seventies. Subsequently, the labour share declined during the transition and industrial crisis of the early 1980s, only to recover after Spain joined the European Economic Community until the crisis of the early 1990s. During the crisis of the early 1990s, the labour share fell sharply, from which it later partially recovered, but continued to fall from the late 1990s until 2018. Since then it has recovered, especially in 2020, the year of COVID-19.

The evolution of the labour share has been mostly driven by the firm labour share. The impact of the household labour wedge on the labour share has been negligible over the period. The investment and efficiency wedge have contributed very slightly to its increase.

5 Conclusion

We have conducted a quantitative macroeconomic exercise to interpret the recent economic history of Galicia. Our Wedge-Growth Accounting approach consists of computing wedges in the equilibrium conditions of the neoclassical growth model that allow matching the model and the data, and then simulating the model to compute the contribution of each wedge to economic growth. Our exercise enables us to ascertain the extent to which the economic development of a small European region —which was predominantly agricultural in the 1960s, but became a modern, industrial and service-based economy over the analysed period— has depended on technological transformations resulting from technological innovation and adoption as well as other institutional processes that influence the operation of markets for productive resources and goods. Our results show that technological change, driven by innovation and the adoption of technology, was the main

driver of per capita output growth. However, labour market regulations and policies appear to have played a central role in economic crises, sharp medium-term fluctuations in employment and the evolution of the functional distribution of income — particularly its significant decline since the early 1990s.

The Galician economy is a small regional economy, but our analysis shows that it has many similarities with larger national economies. When compared with the results of other works, our results show that the macroeconomic forces driving production, resource allocation and functional distribution of income in a small regional economy such as Galicia are very similar to those driving the national aggregate economy.

During the final years of the Spanish growth miracle, from 1967 to the mid-1970s, the Galician economy experienced a period of high growth in output and per capita investment, while labour per capita remained relatively stable. Growth was driven by the strong performance of the efficiency wedge. During this period, the labour share increased, driven by the strong performance of the firm labour wedge.

The firm labour wedge is irrelevant in accounting for the trajectory of production and resource allocation in the Galician economy over the period analysed, which is in line with the findings of previous studies, according to which the relevant part of the labour wedge in accounting for economic fluctuations is the household wedge. However, the firm labour wedge is mainly responsible for the evolution of the functional distribution of income in the Galician economy and, therefore, for the strong fluctuations that the labour share has experienced between 1967 and 2020, although, unlike other economies, in the Galician economy there is no significant drop in the labour share between 1967 and 2020. During this period, although with strong fluctuations, it has remained, on average, constant.

Beginning in the mid-1970s, growth in investment and output per capita slowed due to the negative contribution of the household labour wedge. The labour share experienced a significant decline until 1986, driven by the contribution of the firm labour wedge. During the industrial reconversion (1982-1986), the sharp reduction in output and investment

growth per capita, as well as the drastic drop in labour per capita, were due to the negative contribution of the efficiency wedge and the household labour wedge. The poor performance of the investment wedge also had a significant negative impact on investment per capita.

The deterioration in the household labour wedge over this period and the resulting drag on growth could have been due to a number of reasons, including the labour market reforms that expanded labour protections but also increased the non-wage costs of employment, the higher taxes imposed on both individuals and businesses to finance social programs and public spending, and the shortcomings of collective bargaining.

Entry into the European Economic Community in 1986 ended the industrial crisis of the 1980s and inaugurated a period of high growth in output and per capita investment that lasted until the economic crisis of the early 1990s (1991-1994). The growth in output and labour per capita in the second half of the 1980s was mainly due to the improvement in the household labour wedge. Growth in per capita investment was driven by improvements in the investment and resource wedges. The latter suggests that entry into the European Economic Community eased the financial constraints that hampered investment and enabled better exploitation of foreign markets. During this period, labour share experienced a significant recovery, driven by the firm labour wedge.

The crisis of the early 1990s (1991-1994) was driven primarily by a sharp deterioration in the labour wedge. The household labour wedge led to a sharp decline in labour per capita, while the firm labour wedge led to a sharp fall in labour share. The household labour share also played a major role in the slowdown in output growth and per capita investment during the crisis.

The economic expansion from the late 1990s until the Great Recession was underpinned by the strong positive contribution of the household labour wedge to growth in output, investment, and labour per capita. The improvement in the household labour wedge could be explained by the economic reforms of the late 1990s which cut taxes,

made labour relations more flexible, and led to the privatisation of large state-owned enterprises. However, during this period, the efficiency wedge continued to deteriorate, suggesting that these reforms failed to reverse the growth of the Galician economy's TFP. Joining the euro in 1999 also seems to have had a positive impact on the performance of the Galician economy, as our analysis shows that, from the late 1990s until the prelude to the Great Recession, the resource wedge made a significant positive contribution to the growth of investment per capita. Despite the economic reforms of the second half of the 1990s (or because of them, which could also be the case), the firm labour wedge deteriorated, leading to a decline in the labour share until 2018.

As in the United States and the Spanish economy as a whole, the Great Recession in Galicia was driven primarily by the efficiency and labour wedges. The resource wedge contributed slightly to reducing the slowdown in output growth and the fall in labour during the Great Recession, suggesting that Galician firms sought and, at least partially, found in foreign markets the remedy to the difficulties they were experiencing in the Galician market.

From our analysis, it follows that the Galician economy faces three major challenges. First, it must find economic policies that halt the decline in the efficiency wedge if it wants to enjoy sustained economic growth. Second, it must uncover the causes of the large fluctuations in its household labour wedge if it wants this growth to be both sustained and stable. Finally, it must examine the causes of the deterioration of the firm labour wedge in order to halt the prolonged decline in the labour share since the 1990s.

Finally, we would like to emphasise that Wedge-Growth Accounting is a first look at the determinants of the evolution of production, allocation and distribution of resources in an economy. Much work is still needed to explain the policies, as well as the technological and institutional changes, that enabled the economic transformation of a predominantly agricultural region into a modern economy. Many lines of future research therefore remain to be explored.

References

Badunenko, O., and Romero-Avila, D. (2014). Productivity growth across Spanish regions and industries: a production-frontier approach. *Regional Studies*, 48(7), 1242-1262.

Barro, R. J., and Sala-i-Martin, X. (1992). Convergence. *Journal of political Economy*, 100(2), 223-251.

Barro, R. J. and Sala-i-Martin, X. (1995). *Economic Growth*, McGraw Hill International Editions.

Bermejo Carbonell, J. and Werner, R. A. (2018). Does foreign direct investment generate economic growth? A new empirical approach applied to Spain. *Economic geography*, 94(4), 425-456.

Bils, M. and Klenow, P. J. (2000). Does schooling cause growth?. *The American Economic Review*, 90(5), 1160-1183.

Boscá, J. E., Escribá, J., and Murgui, M. J. (2004). Total factor productivity growth in Spanish regions: effects of quasi-fixed and external factors and varying capacity utilization. *Regional Studies*, 38(6), 587-601.

Boschma, R., Minondo, A., and Navarro, M. (2013). The emergence of new industries at the regional level in Spain: a proximity approach based on product relatedness. *Economic geography*, 89(1), 29-51.

Brinca, P., Chari, V. V., Kehoe, P. J. and McGrattan, E. R. (2016). Accounting for business cycles. In *Handbook of Macroeconomics* (Vol. 2, pp. 1013-1063). Elsevier.

Brinca, P., Costa Filho, J. R., and Loria, F. (2024). Business Cycle Accounting: what have we learned so far?. *Journal of Economic Surveys*, 38(4), 1276-1316.https://doi.org/10.1111/joes.12581

Cutanda, A. and Sanchis-Llopis, J.A. (2021). Joint estimation of intertemporal labour and consumption decisions: evidence from Spanish households headed by working men. *Eurasian Economic Review* 11, 611–629. https://doi.org/10.1007/s40822-021-00176-3.

Chari, V., Kehoe, P. J., and McGrattan, E. R. (2007). Business cycle accounting. *Econometrica*, 75(3), 781-836.

de Bustos, A. Cutanda, A. Díaz, A. Escribá, F.J. Murgui, M.J. and Sanz, M.J. (2008). La BD.MORES en base 2000: Nuevas estimaciones y variables, D-2008-02, Dirección General de Presupuestos, Ministerio de Economía y Hacienda.

De Loecker, J., Eeckhout, J., and Unger, G. (2020). The rise of market power and the macroeconomic implications. *The Quarterly Journal of Economics*, 135(2), 561-644.

del Río, F. and Lores, F. X. (2021). Accounting for US economic growth 1954–2017. *Economic Modelling*, 101, 105529. https://doi.org/10.1016/j.econmod.2021.105529

Del Río, F. and Lores, F. X. (2023a). Accounting for the role of investment frictions in recessions. *Economica*, 90, 360. https://doi.org/10.1111/ecca.12485.

del Río, F. and Lores, F. X. (2023b). Accounting for Spanish economic development 1850-2019. 121, 106200. *Economic Modelling*, https://10.1016/j.econmod.2023.106200.

del Río, F. and Rebelo, F. (2025). OECD Labour Share Trends: The Role of Factor Efficiency and Market Distortions. *Mimmeo*, University of Santiago de Compostela

Díaz, A. and Franjo, L. (2016), Capital Goods, Measured TFP and Growth: The Case of Spain, *European Economic Review*, 83(1), 19-39.

Faiña, A., Lopez-Rodriguez, J., and Montes-Solla, P. (2020). European Union regional policy and development in Spain: Capital widening and productivity stagnation over 1989–2010. *Regional Studies*.

García-Santana, M., Moral-Benito, E., Pijoan-Mas, J. and Ramos, R. (2020). Growing like spain: 1995–2007. *International Economic Review*, 61(1), 383-416.

Garcilazo, E. and Oliveira-Martins, J. (2015). The contribution of regions to aggregate growth in the OECD.*Economic Geography*, 91(2), 205-221.

Ghazinoory, S., Riahi, P., Azar, A., and Miremadi, T. (2014). Measuring innovation performance of developing regions: learning and catch-up in provinces of Iran. *Technological and Economic Development of Economy*, 20(3), 507-533.

Hansen, G.D., Ohanian, L.E. and Ozturk, F. (2021). Dynamic general equilibrium modeling of long and short-run historical events. Chapter 11, *Handbook of Historical Economics*, Academic Press, Pages 297-333, ISBN 978-0-12-815874-6,https://doi.org/10.1016/B978-0-12-815874-6.00019-8.

Jiménez, M. D. M. S. (2003). Efficiency and TFP growth in the Spanish regions: the role of human and public capital. *Growth and change*, 34(2), 157-174.

Karabarbounis, L. (2014). The labour wedge: MRS vs. MPN. *Review of Economic Dynamics*, 17(2), 206-223.

Koch, M., Manuylov, I. and Smolka, M. (2021). Robots and firms. *The Economic Journal* 131.638, 2553-2584.

Lores, F.X. (2024). Five Recessions in Spain: An Accounting Approach. Available at SSRN: https://ssrn.com/abstract=4930242

Molinari, B. and Torres, J. L. (2018). Technological sources of economic growth in Europe and the US. *Technological and Economic Development of Economy*, 24(3), 1178-1199.

Minondo, A. (2010). Exports' productivity and growth across Spanish regions. *Regional Studies*, 44(5), 569-577.

Moral-Benito, E. (2018). The microeconomic origins of the spanish boom. *Banco de Espana Occasional Paper* 1805.

Nelson, R. R. and Phelps, E. S. (1966). Investment in humans, technological diffusion, and economic growth. *The American Economic Review*, 56(1/2), 69-75.

Pérez, F. and Benages, E. (2017). The Role of Capital Accumulation in the Evolution of Total Factor Productivity in Spain. *International Productivity Monitor* 33, 24-50.

Prados de la Escosura, L. (2022). Capital in Spain, 1850-2019. *Cliometrica* 16, 1, pp. 1-28.https://doi.org/10.1007/s11698-020-00221-2.

Rodriguez-Pose, A. (1994). Socioeconomic restructuring and regional change: rethinking growth in the European Community. *Economic Geography*, 70(4), 325-343.

Skare, M. and Stjepanovic, S. (2013). How important are general equilibrium models for small open economies – a Case of Croatia. *Technological and Economic Development of Economy*, 19(2), 331-349.

Skare, M. and Tomic, D. (2015). Business cycle–growth nexus: A review. *Technological and Economic Development of Economy*, 21(3), 519-538.

Vila, L. E., Cabrer, B. and Pavía, J. M. (2015). On the relationship between knowledge creation and economic performance. *Technological and Economic Development of Economy*, 21(4), 539-556.

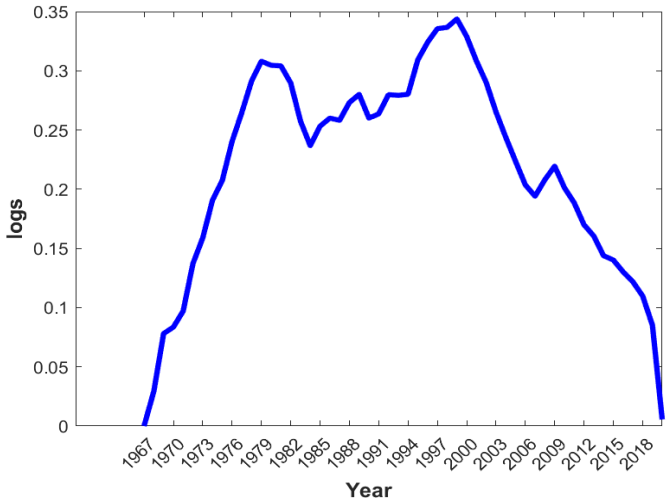
Webber, D. J., Healy, A., and Bristow, G. (2018). Regional growth paths and resilience: A European analysis. *Economic Geography*, 94(4), 355-375.

Table 1
Model Parameters and bgp Variables.

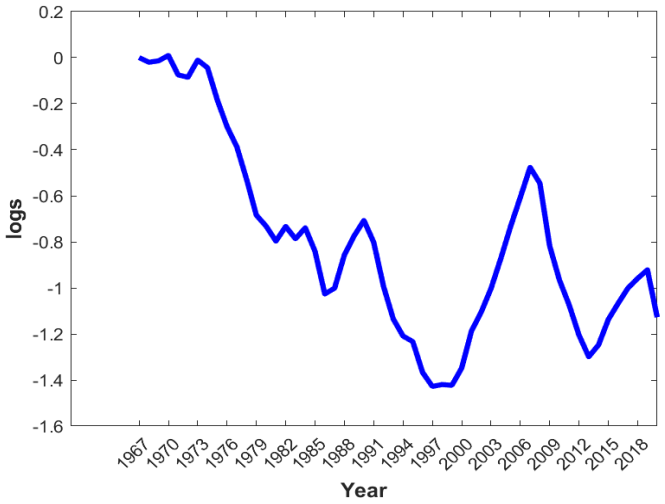
Parameter	**Description**	**Value**
γ	Growth Rate of Labour-Aumenting Technical Progress	0.0228
δ	Depreciation Rate of Capital	0.0329
ϕ	Adjustment Cost Paramenter	4.4803
Φ	Adjustment Cost Paramenter	0.0558
ρ	Production Function Parameter	-0.388
α	Production Function Parameter	0.4294
ν	Frisch Elasticity Parameter	-3
β	Discount Factor	0.9741
bgp **variables**		
A	Efficiency Wedge	5.6875
π_h	Household Labour Wedge	0.0258
π_f	Firm Labour Wedge	0.6584
π_x	Investment Wedge	0.4482
π_g	Resource Constraint Wedge	1.1534
π_n	Population Growth Rate	1
k/y	Capital-Output Ratio	3.5837
l	Labour per Capita	0.3856
x/y	Investment Rate	0.20
c/y	Consumption to Output Ratio	0.6670
s_l	Labour Share	0.5706

Table 2
ϕ-STATISTICS.

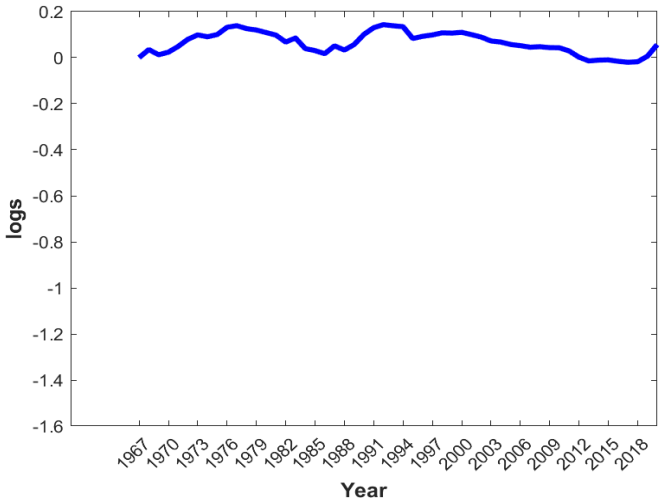
Variable	$\phi_A^{\mathbf{y}}$	$\phi_{\pi_h}^{\mathbf{y}}$	$\phi_{\pi_x}^{\mathbf{y}}$	$\phi_{\pi_f}^{\mathbf{y}}$	$\phi_{\pi_g}^{\mathbf{y}}$	$\phi_{\pi_n}^{\mathbf{y}}$
h	0.079	0.639	0.066	0.070	0.061	0.084
y	0.695	0.018	0.083	0.073	0.071	0.061
x	0.281	0.052	0.157	0.161	0.225	0.125
ls	0.114	0.104	0.110	0.478	0.096	0.099



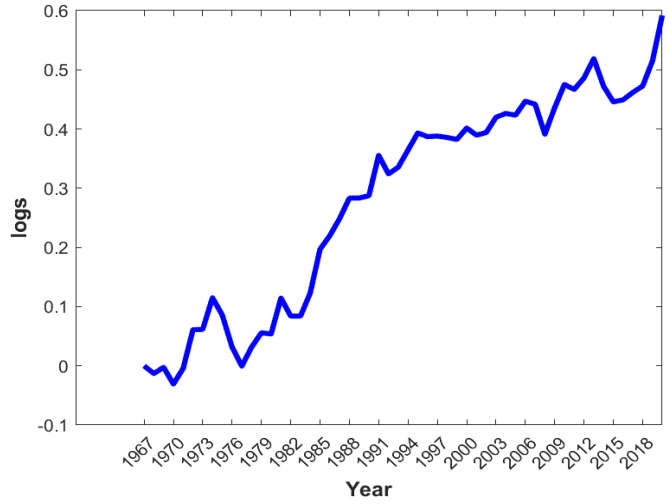
(a) Efficiency wedge.



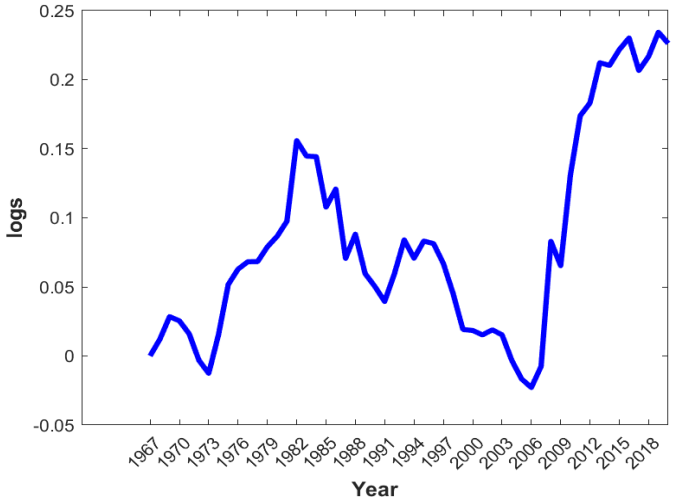
(b) Household Labour wedge.



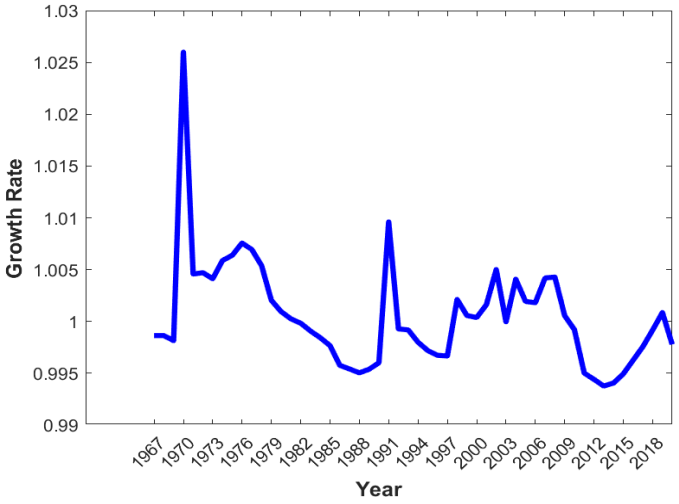
(c) Firm Labour wedge.



(d) Investment wedge.

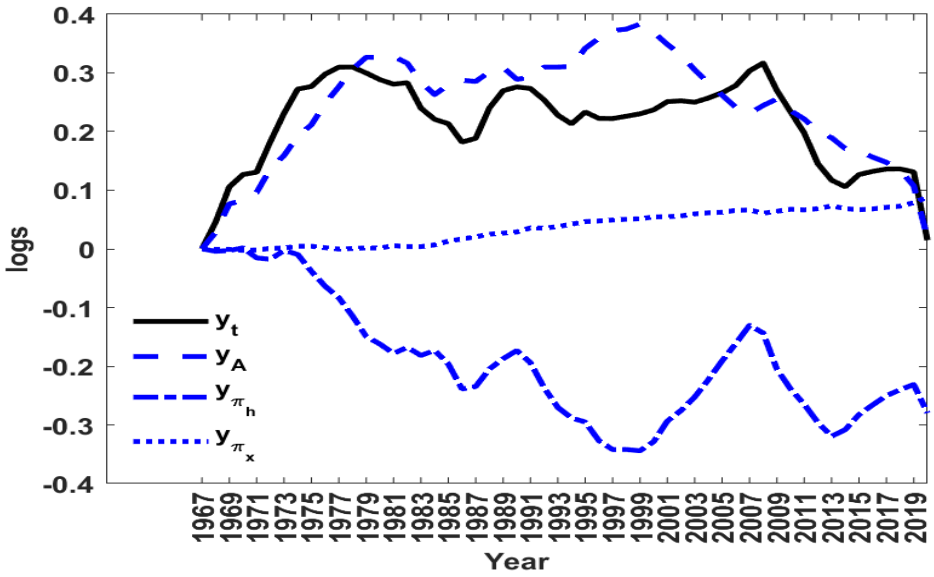


(e) Resource constraint wedge.

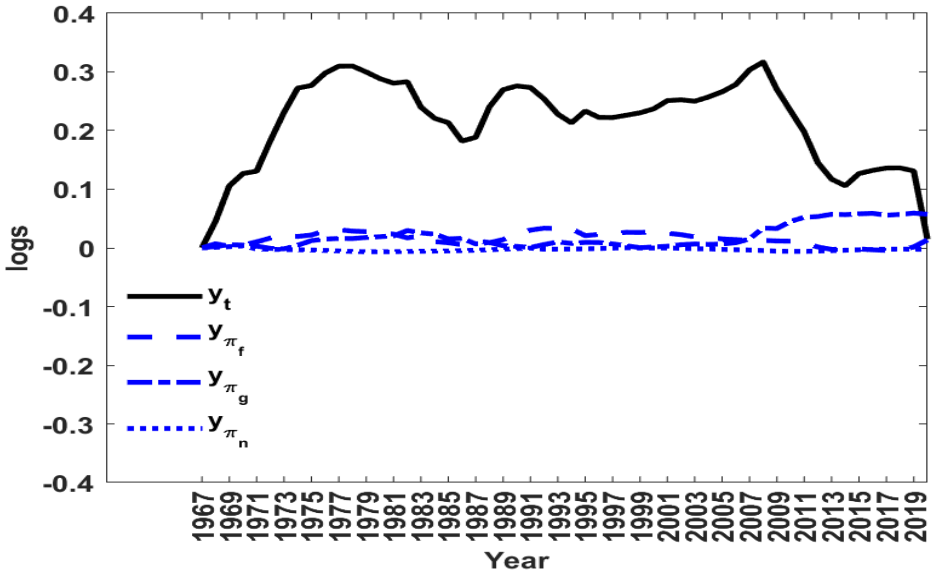


(f) Population Growth wedge.

Fig. 1: Wedges Paths.



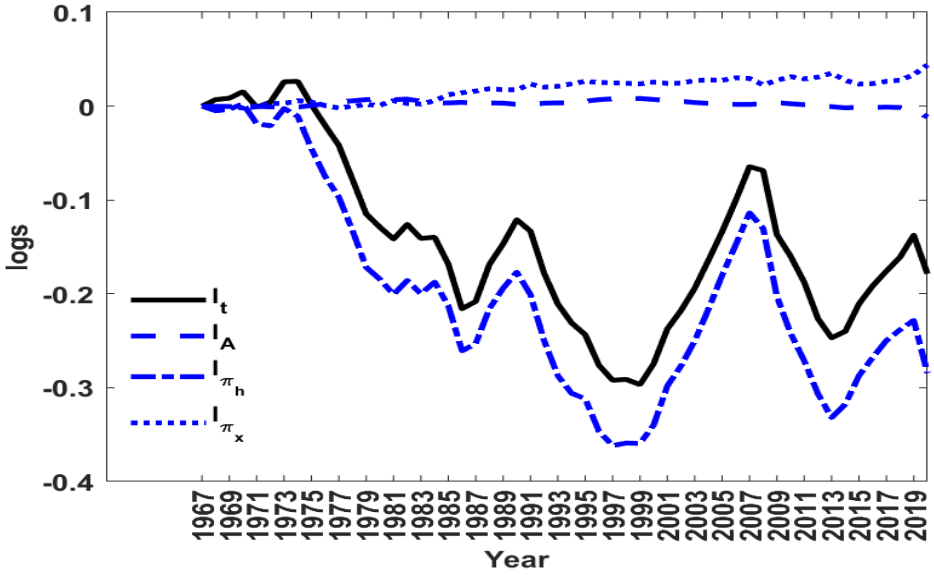
(a) Efficiency, Household Labour and Investment wedges contributions.



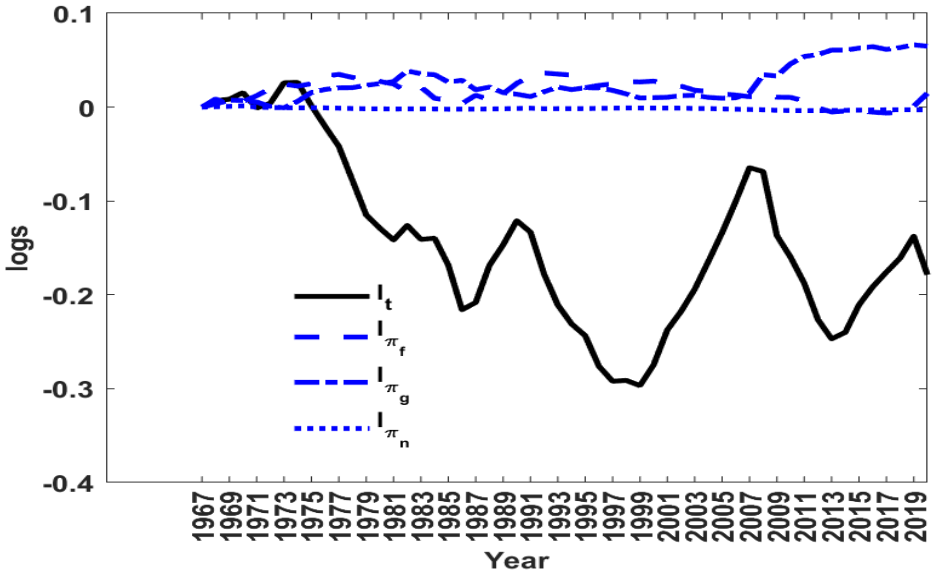
(b) Firm Labour, Resource and Population wedges contributions.

Fig. 2: Contribution of Wedges to Output.

Note: $\mathbf{y}_{i,t} \in \{l_{i,t}, y_{i,t}, x_{i,t}, s_{li,t}\}$ is the contribution of a wedge $i \in \{A, \pi_h, \pi_x, \pi_f, \pi_g, \pi_n\}$ to the growth of each variable $\mathbf{y}_t \in \{l_t, y_t, x_t, s_{lt}\}$, the corresponding observed same variable. The solid line is the corresponding observed variable $\mathbf{y}_t$.



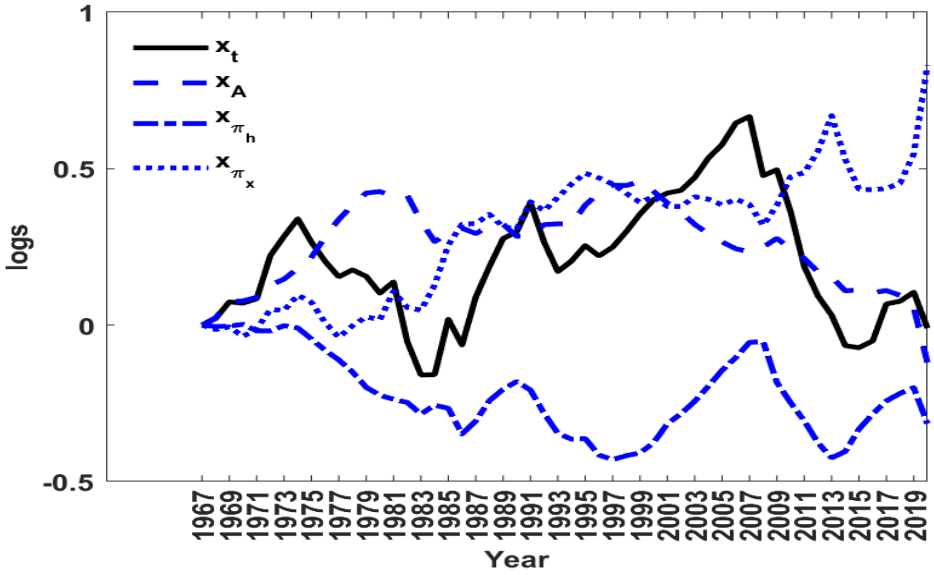
(a) Efficiency, Household Labour and Investment wedges contributions.



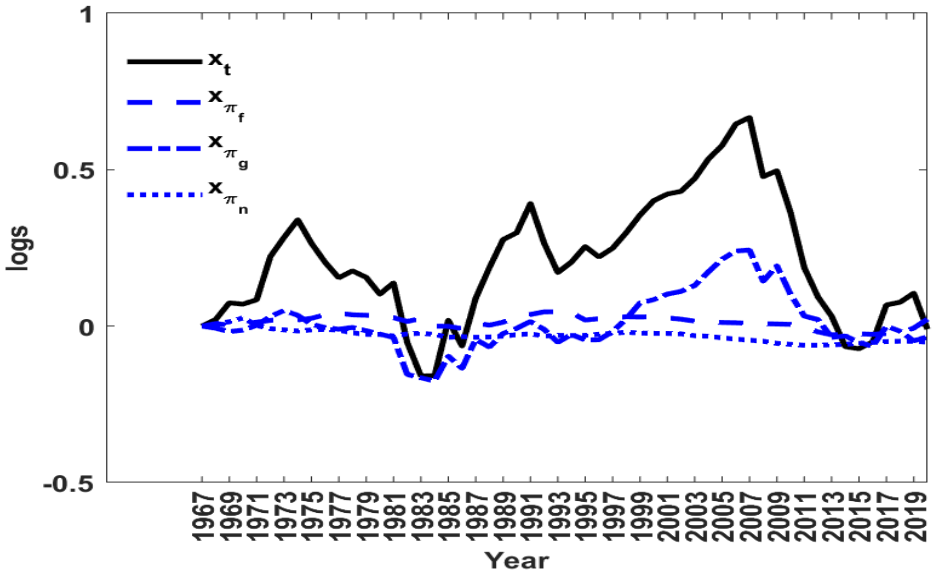
(b) Firm Labour, Resource and Population wedges contributions.

Fig. 3: Contribution of Wedges to Labour.

Note: $\mathbf{y}_{i,t} \in \{l_{i,t}, y_{i,t}, x_{i,t}, s_{li,t}\}$ is the contribution of a wedge $i \in \{A, \pi_h, \pi_x, \pi_f, \pi_g, \pi_n\}$ to the growth of each variable $\mathbf{y}_t \in \{l_t, y_t, x_t, s_{lt}\}$, the corresponding observed same variable. The solid line is the corresponding observed variable $\mathbf{y}_t$.



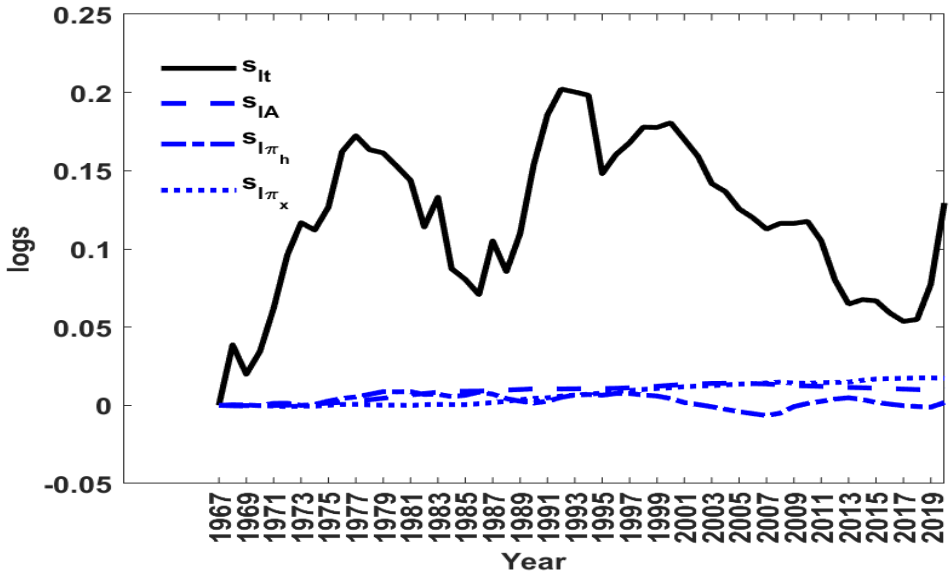
(a) Efficiency, Household Labour and Investment wedges contributions.



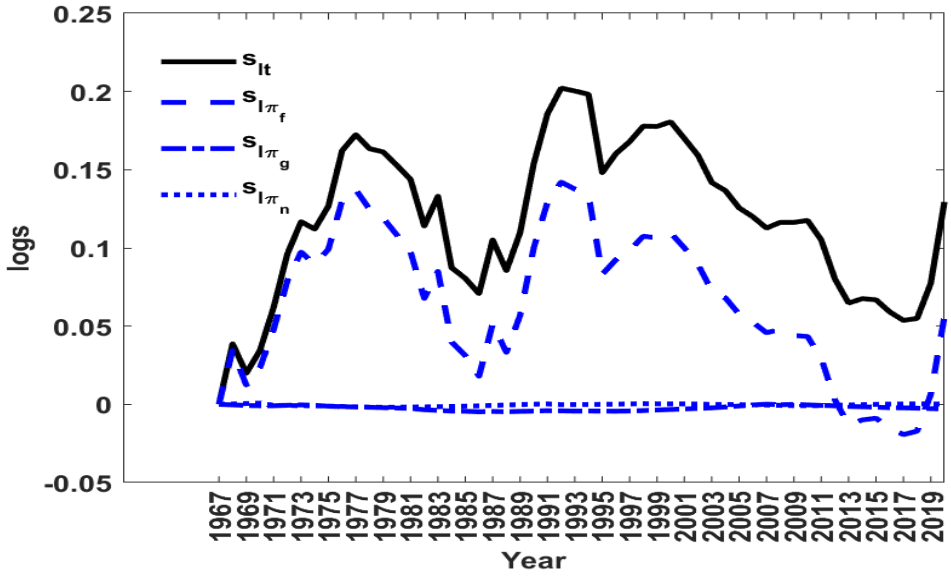
(b) Firm Labour, Resource and Population wedges contributions.

Fig. 4: Contribution of Wedges to Investment.

Note: $\mathbf{y}_{i,t} \in \{l_{i,t}, y_{i,t}, x_{i,t}, s_{li,t}\}$ is the contribution of a wedge $i \in \{A, \pi_h, \pi_x, \pi_f, \pi_g, \pi_n\}$ to the growth of each variable $\mathbf{y}_t \in \{l_t, y_t, x_t, s_{lt}\}$, the corresponding observed same variable. The solid line is the corresponding observed variable $\mathbf{y}_t$.



(a) Efficiency, Household Labour and Investment wedges contributions.



(b) Firm Labour, Resource and Population wedges contributions.

Fig. 5: Contribution of Wedges to Labour Share.

Note: $\mathbf{y}_{i,t} \in \{l_{i,t}, y_{i,t}, x_{i,t}, s_{li,t}\}$ is the contribution of a wedge $i \in \{A, \pi_h, \pi_x, \pi_f, \pi_g, \pi_n\}$ to the growth of each variable $\mathbf{y}_t \in \{l_t, y_t, x_t, s_{lt}\}$, the corresponding observed same variable. The solid line is the corresponding observed variable $\mathbf{y}_t$.