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Investigating causal relations between public Spending and economic growth in Europe

Gasto público y crecimiento económico en Europa: investigando sus relaciones de causalidad

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Abstract

The link between economic growth and the size of the public sector has fuelled one of the most wide-ranging debates in economic literature and the empirical evidence is far from conclusive. With different techniques that encompass both country-to-country causality analysis with VAR models and standard and grouped panels, we study this relationship for a sample of 25 countries from the 1960s to the present. Our contribution is fundamentally methodological, overcoming several pitfalls of the previous literature, namely, endogeneity, dynamic effects and common patterns. The results do not support the fulfilment of the Wagner's Law and a negative effect of public size on economic growth is highlighted.

Keywords: Economic Growth, Public Sector, VAR Model, Panel Analysis.

Resumen

La relación entre tamaño del sector público y crecimiento económico ha dado lugar a una ingente literatura, tanto teórica como empírica. Sin embargo, la evidencia está muy lejos de ser concluyente. Este trabajo tiene por objeto investigar dicha relación para una muestra de 25 países europeos desde la década de 1960 hasta la actualidad. A tal efecto, se aplican diversas técnicas que comprenden el análisis de causalidad individual con modelos VAR y modelos de datos de panel, tanto tradicionales como de efectos agrupados. Nuestra contribución es esencialmente metodológica, puesto que permite superar algunos de los principales escollos de la literatura anterior: la endogeneidad, los efectos dinámicos y la omisión de patrones comunes. Los resultados obtenidos no sustentan la ley de Wagner y destacan, para la muestra seleccionada, la existencia de un efecto negativo del tamaño del sector público sobre el crecimiento económico.

Palabras clave: Crecimiento económico, sector público, modelos VAR, modelos de datos de panel.

JEL classification: C22, C33, H50, 043.

1. Introduction*

The relationship between government size and economic growth has fuelled one of the most wide- ranging debates in economic literature. On the one hand, the so-called Wagner's Law establishes that economic growth, and the social transformations that come with it, will lead to an increase in governmental activity. The complexity of developed societies and the consideration of certain public services as high income elasticity goods could explain this positive relationship between the GDP per capita and the public expenditure-to-GDP ratio. On the other hand, the high level of public spending in European economies and the fall in GDP growth rates has opened a debate on the potential negative effects of public sector size on economic growth, which are based on two main premises: The effects of taxation on the system of incentives and the reduction in efficiency caused by rent-seeking activities. However, endogenous growth theories deem the public sector-economic growth relationship non-linear (Barro, 1990), depending on whether the positive effects of public spending on productivity are greater than the taxation distorting effects or not, a question also dependent on the time frame and the sample of countries (only developed countries, or else emerging and developing countries as well) selected for study. Empirical evidence on the public expenditure-economic growth relationship is far from conclusive. With respect to Wagner's Law, econometric studies have only found a positive relationship in certain countries and time periods. By contrast, the public sector size-economic growth relationship yields a negative sign in most studies. See Bergh and Henrekson (2011) for a literature overview.

Most of the empirical literature dealing with these matters presents methodological problems related to the adopted specification, the possible existence of endogeneity and reverse causality, and the econometric technique chosen (cross-section, panel data, cointegration...). However, one of the main weaknesses is due to the fact that the correlation observed in some studies does not necessarily imply the existence of causality in one direction or in the other. This paper aims precisely to verify the existence of causality, its direction, and the dynamics of the long-term public expenditure-economic growth interaction.

The rest of the paper is organized as follows. In the different subsections of Section 2 we present the data, describe the methodology and offer a first view

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of the results. In Section 3 go deeper into the analysis and implications of the results. Finally, in the section of conclusions we summarize the main contributions and results of the paper. An Appendix presents extra results.

2. DATA AND METHODOLOGY

2.1. DATA

We use a wide sample of European countries from 1960 to the present. It is made up of 25 countries including countries of the European Union, in its successive phases of enlargement, as well as outside it. We use the real GDP growth (*GDP*) and the ratio of total public spending over GDP (*PS*) to represent the rhythm of economic growth and the size of the public sector, respectively. The source of both variables is the OECD *Economic Outlook* and, although the sample period is 1960-2017, the start date is different for each country[1].

Figure 1 displays the evolution of the two variables during the period studied for each country. Overall, the public expenditure-to-GDP ratio grows from the 1960s until the beginning of the 1980s. However, there are great differences among countries. In 1981, public spending exceeded 50% of GDP in Austria, Belgium, Denmark, Ireland, The Netherlands, and Sweden, and was very close to that figure in France and Germany, whereas in Greece, Iceland, Portugal, and Spain was less than 40%.

In the late 1980s and the beginning of the 1990s, an average public spending rise may be observed, led by Scandinavian countries (Sweden, Finland, and Denmark). From then on, there was first a regressive trend, followed by a public sector stabilization which came to be disrupted by the advent of the Great Recession. The subsequent public spending adjustment and growth recovery led to France, Finland, Belgium, Denmark, and Norway being the countries with the biggest public sector size in 2017. At the other extreme we find Ireland, Switzerland, some Eastern European countries like Latvia, Czech Republic, Estonia, Slovakia and Poland, as well as the United Kingdom and Spain.

As a general rule, four Western European countries show a rising trend, only recently stabilized: Finland, France, Greece, and Portugal. By contrast, countries with high spending levels have stabilized these figures over the past twenty years: Austria, Denmark, and Italy. Some show a significant reduction of public expenditure relative to GDP in the past twenty years: Belgium, The Netherlands, Norway, and Sweden. Even countries with smaller public sectors, like Ger-

[1] The countries are the following: Austria (1961, 1960), Belgium (1961, 1964), Czech Republic (1994, 1995), Denmark (1964, 1964), Estonia (1996, 1995), Finland (1961, 1960), France (1961, 1964), Germany (1964, 1964), Greece (1964, 1954), Hungary (1992, 1995), Iceland (1961, 1964), Ireland (1964, 1964), Italy (1961, 1960), Latvia (1997, 1995), Luxembourg (1961, 1990), Netherlands (1961, 1964), Norway (1961, 1964), Poland (1991, 1995), Portugal (1961, 1964), Slovak Republic (1992, 1995), Slovenia (1996, 1995), Spain (1961, 1964), Sweden (1961, 1964), Switzerland (1965, 1960) and the United Kingdom (1961, 1964). In parenthesis we have displayed the starting date for *GDP* and *PS*, respectively.

many and Spain, follow the same path. According to the available information, since 1995, Eastern European countries also followed a downward trend in the first few years which later stabilized.

Growth rates show a downward trend in most countries if we consider a time frame from the 1960s on. This is more markedly so in the cases of France, Portugal, Spain, Greece, and Belgium, but also, more mildly, of Austria, Denmark, Finland, The Netherlands, and Norway. Other countries, on the contrary, kept their growth rates broadly stable, save for natural oscillations: Germany, Iceland, Ireland, Sweden, Switzerland, and the United Kingdom.

Thus, it seems that there is a relationship between the public sector size growth from the 1960s and 1970s and the fall in economic growth rates beginning in the mid-seventies and eighties, that is, a few years later, which explains the cumulative and long-term effects. Conversely, one may also interpret that economic growth gives rise to a bigger size public sector, although the results appear earlier.

Maps in figures 2 and 3 show the geographical distribution of the average GDP growth and the public spending ratio. The color scale reflects the different intensity of the two variables and allows us to have a first image of their magnitude. Finally, in Figures 4 and 5 we carry out a scatterplot of both variables average and a linear regression for the 1964-2017 period, including the selected countries from which there are data available (Figure 4), as well as for the 1995-2017 period for the full sample of countries (Figure 5), which represent the stylized facts about their relationship. A close examination of these figures allows us to identify a negative trend between both variables, more clearly showing in the full sample of countries examined between 1995 and 2017. Regressing *GDP* on *PS* for the entire period (1964-2017) and only Western European countries, the trend coefficient value is -0.06, with a t-ratio of -2.6, the proportion thus exceeding the significance threshold. In the enlarged sample of countries, now including those from Eastern Europe but only for the 1995-2017 period, coefficient value is even more negative, -0.12, with a t-ratio of -2.0, which is equally significant. Summing up this first aggregate picture, we find a negative relationship between both variables.

After this descriptive analysis, in the next section we will carry out a more formal econo- metric analysis both from the point of view of individual countries and jointly through a panel.

2.2. Methodology

Our empirical strategy comprises two stages. Firstly, we apply an individual analysis by country using VAR models that provide tools for analyzing causality between economic growth and public spending. Secondly, we carry out an analysis of panel data both in its standard version and in a more innovative one that allows us to group countries according to the intensity of the relationship of interest.

2.2.1. COUNTRY ANALYSIS

A simple way to analyse the dynamic relationship between real GDP growth and public spending ratio is the use of a standard VAR(p) model. Following Sims (1980) and Lutkepohl (2005), among many others, we define this model as follows:

$$Y_t = \mu + \sum_{i=1}^{p} \Psi_i Y_{t-i} + \varepsilon_t, t = 1, 2, ..., T \quad (1)$$

where $Y_t = (GDP_t, PS_t)'$ is a 2x1 vector composed of observations of the variables, Ψ_i ($i = 1, ..., p$) are 2x2 coefficient matrices, $\mu = (\mu_1, \mu_2)'$ is a 2x1 vector of intercept terms, $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t})'$ in which ε_{it}, ($i = 1, 2$) is an unobservable zero mean white noise vector of dimension T, and p is the parameter that determines the VAR dimension, chosen according to the SBIC criterion for each country. Denoting the lag operator by L, he model is specified as follows:

$$\begin{bmatrix} GDP_t \\ PS_t \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \end{bmatrix} + \begin{bmatrix} \psi_{11}(L) & \psi_{12}(L) \\ \psi_{21}(L) & \psi_{22}(L) \end{bmatrix} \begin{bmatrix} GDP_t \\ PS_t \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \quad (2)$$

For simplicity and to save space, the VAR estimation is not reported and we focus the analysis on two tools derived from the VAR specification: causality and impulse-response functions. Prior to the estimation of the VAR, we confirmed the absence of unitary roots in the variables *GDP* and *PS* and, therefore, the suitability of considering a stationary VAR[2].

The previous framework allows us to test the direction of causality. Following Granger (1969), a variable (or group of variables), z_1, is found to help predict another variable (or group of variables), z_2. Then, z_1 is said to Granger-cause z_2. We can test this hypothesis by simply studying whether the Ψ matrices are triangular, which is a remarkably visual test for a VAR(1). Additionally, a more formal Wald test is computed, where the null hypothesis is that z_1 does not cause z_2. More specifically, z_1 does not lead to z_2 if $E(z_{2t}|z_{2t-1}, z_{2t-2}, ...; z_{1t-1}, z_{1t-2}, ...) = E(z_{2t}|z_{2t-1}, z_{2t-2}, ...)$.

The results of the Granger causality analysis are presented in Table 1 and confirm an inconclusive pattern of causality within each country. We find that *GDP* influences *PS* in the case of Finland, France, Iceland, Ireland, Latvia, Portugal, Slovenia, Spain, Sweden and Switzerland. In the opposite direction, *PS* influences *GDP* in the case of Austria, Belgium, Denmark, Finland, France, Iceland, Italy, Portugal and Switzerland. Therefore, we find bidirectional causality for Finland, France, Iceland, Portugal and Switzerland.

Nevertheless the Granger-causality tests may not tell us the complete story about the interactions between the variables in a VAR system. It is of interest to know the response of one variable to an impulse in another variable in a

[2] The results of the unit root tests and the details of the estimation of the VAR system equations are available on request.

system that involves a number of further variables. Of course, if there is a reaction of one variable to an impulse in another variable we may say that the latter causes the former. For this, we employ impulse-response functions (IRFs), also called multiplier analysis, to capture the dynamics of the shocks. To obtain IRFs, we use a moving average representation of the VAR system, which is defined in the following expression:

$$Y_t = \begin{bmatrix} \nu_1 \\ \nu_2 \end{bmatrix} + \begin{bmatrix} \Theta_{11}(L) & \Theta_{12}(L) \\ \Theta_{21}(L) & \Theta_{22}(L) \end{bmatrix} \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \quad (3)$$

or, in matrix notation and in terms of the innovations of the structural model: $Y_t = \mu + \sum_{s=0}^{\infty} \Theta_{(}s)\varepsilon_{t-s}$

The coefficients of the succession of matrices $\Phi(s)$ represent the impact of a shock in the structural innovation on the variables of the VAR system over time. Results of IRF computations with a horizon of 20 years are displayed in the Appendix, where confidence intervals at 90% are computed according to Kilian's (1998) bootstrap-after-bootstrap method.

Starting with the response of *PS* to one impulse of *GDP*, we conclude that they are negative at the beginning of the shock in Greece, Ireland, Latvia, Luxembourg, Poland, Portugal, Slovakia, Slovenia and Switzerland; after around 5 years in Germany and during all the horizon in France; and, finally, it is positive in some periods in Iceland. On the contrary, if we analyze the responses of *GDP* to one impulse of *PS*, we find week but significant effects which are positive in Denmark, Finland, Luxembourg and Switzerland, and negative in Iceland, Portugal and United Kingdom. We also observe a high degree of uncertainty when the IRFs are non-zero[3].

In addition, we compute cumulative impulse-response functions (CIR), defined as $CIR = \sum_{h=0}^{\infty} IRF(h)$, which allow us to identify the same effects in the long run[4]. The results in Table 2 show that the effect of real GDP growth on public spending ratio is positive for most countries (15 in a sample of 25 countries) but not significant. We only find a significant and negative effect in France. In the opposite direction, from public spending ratio to real GDP growth, mostly CIRs are negative (17 in a sample of 25 countries) but not significant in any case.

Summing up, although we have found evidence of causality in both directions, it is not possible to identify a clear pattern and, in addition, the effects are diluted in the long term. The hypothesis of a common relationship will be explored in the following section using panel data techniques both standard and grouping patterns of heterogeneity.

[3] As is well known, the order of variables is relevant for IRF computation because the Cholesky decomposition requires triangulation. To test the robustness of the results, we have redone all calculations with the system in the inverse order: $Y_t = (PS_t, GDP_t)'$ and have also calculated the generalized IRF. The findings are the same, which is not surprising, given the results of casualty.

[4] The confidence intervals have been computed with the same bootstrap methodology as for the IRFs.

2.2.2. PANEL ANALYSIS

The equation for the standard fixed effects model is:

$$Y_{it} = \beta X_{it} + \alpha_i + u_{it} \tag{4}$$

where α_i, ($i = 1..n$) is the unknown intercept for each country (n country-specific intercepts), Y_{it} is the dependent variable, where i= country and t= time, X_{it} represents the vector of independent variables, β is a vector of coefficients and u_{it} are the error terms.

As the results obtained previously with the causality test are not conclusive, we estimate two equations that treat the *GDP* and *PS* variables as endogenous or exogenous, alternatively. We propose 4 variants of panel data models:

1. The first one is static, estimated with fixed effects; in this case the equations are:

$$PS_{it} = \beta GDP_{it} + \alpha_i + u_{it} \tag{5a}$$

$$GDP_{it} = \beta PS_{it-1} + \alpha_i + u_{it} \tag{5b}$$

2. The second is dynamic, estimated with fixed effects

$$PS_{it} = \beta_1 PS_{it-1} + \beta_2 GDP_{it-1} + \alpha_i + u_{it} \tag{6a}$$

$$GDP_{it} = \beta_1 GDP_{it-1} + \beta_2 PS_{it-1} + \alpha_i + u_{it} \tag{6b}$$

3. The third is dynamic, estimated with the Arellano and Bond (1991) method

4. The fourth is dynamic and deals with patterns of heterogeneity following the proposal of Bonhomme and Manresa (2015)

$$PS_{it} = \beta_1 PS_{it-1} + \beta_2 GDP_{it-1} + \alpha_{gt} + u_{it} \tag{7a}$$

$$GDP_{it} = \beta_1 GDP_{it-1} + \beta_2 PS_{it-1} + \alpha_{gt} + u_{it} \tag{7b}$$

where $g = 1, ..., G$ is the label of each group and G the total number of clusters of countries.

In the three first cases, we find negative and significant relationships between *GDP* and *PS* in both directions (see Table 3). Considering *GDP* as the endogenous variable, we obtain that the implied cumulative public spending effects are -0.22, -0.10 and -0.21, respectively. When we treat *PS* as the endogenous variable, these effects are -0.15, -1.00 and -2.66, respectively.

Nevertheless, when we apply the grouped fixed-effect approach, the conclusions change dra- matically. In the first case, when *GDP* is the endogenous variable, the long-run effect of *PS* is -0.04 and it is only significant at the 10% level and, when *PS* is the endogenous variable, the long-run effect of GDP is -1.33 but it is not significant.

Maps in figures 6 and 8 show the estimated classification of countries into groups for $G = 4$ when *GDP* and *PS* respectively is the endogenous variable. Furthermore, Figures 7 and 9 show the parameter estimates, α_{gt} , and average variables by groups over time. When *GDP* is the endogenous variable, we analyse the effect of the size of public sector on real GDP growth, we identify three small groups; group 2 is formed by Estonia, Iceland and Latvia; group 3 by Greece, Luxembourg, Slovakia and Slovenia; group 4 by Ireland; and a big group, 1, that contains the rest of the countries. While the behaviour of groups 1, and 3 is very similar, in group 4, the explosive recovery of economic growth after the Great Recession of Ireland is highlighted. Group 2 also shows an intense fall of economic growth in 1968 due to the behaviour of GDP in Iceland. Considering *PS* as the endogenous variable, we also find 4 groups; group 1 is formed by Iceland; group 2 by Ireland; group 3 by Greece and Slovenia; and group 4 by the rest of the countries. In contrast to the stable behaviour of *PS* in group 4, which is characterized by a mild growth path that slows down in the 1980s, the more rugged patterns of the rest of the groups stand out.

3. Results and discussion

The analysis of dynamic relationships between GDP growth and public spending based on panel data included in Table 3 reveals that Wagner's Law does not apply to this sample of European countries during the time period observed. In fact, economic growth elicits a reduction of the public expenditure-to-GDP ratio. Both the fixed-effects static model and the two dynamic models considered present negative coefficients, which, furthermore, show higher absolute val- ues in the dynamic models, a natural finding considering that they incorporate the long-term relationship dynamics. Long-term effects observed in the grouped fixed-effects model are also negative, though not significantly, and the algorithm forms a big homogeneous group and several small groups that behave as outliers with respect to the common pattern. These results differ from those obtained in other studies confirming the validity of Wagner's Law. The main differences are the time frame observed and the countries chosen for the sample. In our case, they are all developed countries with high per capita income levels, whereas studies confirming the validity of Wagner's Law include middle and low income developing countries in their sample and the time frame stretches further back. As a matter of fact, the most recent evidence regarding Wagner's Law yields mixed results (Barrios and Schaechter, 2008). As Arpaia and Turrini (2008) point out, the result of their estimates seems to suggest that the Wagner's Law is a phenomenon that mostly pertains to catching-up countries.

Focusing on the results obtained by country, the specification of a VAR model has enabled us to identify causality and the impulse-response functions. The joint long-term effects of economic growth on public expenditure are negative in ten countries and positive in fifteen, though only significant in the case of France. The results obtained using the VAR model are therefore ambiguous, as is to be expected from a sample including countries with relevant economic, social, and institutional differences. It is worth noting that, among the fifteen countries showing positive effects, as opposed to the results based on panel data, there are three Mediterranean and five Eastern European countries, where public sector development was slower than in Scandinavian countries and the rest of the continent. France exemplifies the case of a country where Wagner's Law does not apply. It is the country with the highest public expenditure-to-GDP ratio (56.3% in 2017). The evolution of this variable is one of continuous growth from 1964 to 1994, followed by a period of spending stability and, later, by a slight growth due to the Great Recession (Figure 1). At the same time, its GDP growth rate has been decreasing, the natural cyclical phases notwithstanding, from the 1960s to our days. As can be seen in the Appendix, the public spending ratio response to the GDP growth impulse is both negative and significant throughout the entire time frame, the cumulative impulse-response function being negative as well. Therefore, public sector development in France was apparently unrelated to economic growth during the period studied, rather being due to different factors, while the economy moved in the opposite direction. On the contrary, in a country like Italy, with a public expenditure-to-GDP ratio of 48.8% in 2017, the public spending trend was more closely linked to the economic evolution, so that *PS* decreasing at first only to become stable from 1992 on, consistently with the decreasing GDP growth rates registered since the 1960s. Both the impulse-response function (see Appendix) and the positive coefficient of the cumulative function (Table 2) also reflect this circumstance.

As far as public spending effects on economic growth are concerned, evidence from the first three estimates based on panel data confirm a negative cumulative effect of public expenditure on GDP growth in the countries included in the sample during the time frame established. And, to a less significant extent, the coefficient is also negative in the grouped fixed-effects model. It may thus be concluded that, given the level of development of European countries and the values of their PS/GDP ratios, the negative effects of public sector size increase on economic growth prevail over the positive ones. This result is consistent with most empirical studies, which reveal a negative relationship between public sector size and growth rates in OECD and EU countries (see Barrios and Schaechter, 2008).

At the country level, the joint long-term effects of public spending on economic growth were negative in seventeen countries and positive in only eight. In the group where negative effects of the public sector prevail we find some countries with a high public expenditure-to-GDP ratio, such as France, Finland, Belgium, Sweden, Austria and Italy, as well as others with a smaller public sector, such as Spain, the United Kingdom and Ireland.

Among the countries showing negative effects of the public sector size on economic growth, France and Italy again stand out on account of high coefficients of their cumulative impulse-response functions. In France, the dynamics of increasing public spending are among the most intense of the sample and, at the same time, decreasing GDP growth rates are registered. Something similar may be said of Italy, which presents decreasing growth rates after having increased its public spending, though more moderately. A positive effect of the public sector size on GDP growth may be observed, on the other hand, in Denmark, whose growth rates remain stable throughout the period studied while its public expenditure-to-GDP ratio was 51.9% in 2017. As Fournier and Johansson (2016) point out, the effects of public spending on growth do not only depend on the amount of the former, but also on the efficiency level of the public sector, so a spending increase may yield positive effects on growth provided there is an efficient public sector.

In conclusion, empirical results reveal that, in the period between the mid-1960s and the present day, the public expenditure-economic growth relationship in Europe has a sounder basis when this relationship is interpreted in terms of the effects of spending on growth. Conversely, for the same period, evidence of the effects of growth on public expenditure is ambiguous and contradicts the validity of Wagner's Law. It may therefore be argued that, given the current state of the European economy and the level of efficiency in the operation of public services, a selective reduction of public spending could increase the economic growth rate in most countries included in the sample. Naturally, the impact on GDP growth would differ from one country to another, depending on the current public spending level and public sector efficiency. Negative coefficients of cumulative impulse-response functions are especially high, in absolute values, in Spain, Italy, Latvia, Finland, France, Greece, Hungary, Portugal, and the United Kingdom; thus, arguably, the impact of a public spending reduction would imply expansive effects on growth rates in these cases. On the other hand, countries like Denmark, Norway, Switzerland, Czech Republic and Poland could increase the size of their public sectors without affecting their growth rates. See Fournier and Johansson (2016) for a detailed analysis of the public sector size-efficiency relationship and its effects on potential GDP.

4. Concluding remarks

This paper analyzes the elusive relationship between economic growth and the size of the public sector for a sample of 25 European countries, and issue that continues to be an ongoing debate in the literature. We apply a wide range of econometric tools that encompass both country- individual analysis and panel data models, which represents methodological contribution with respect to previous research.

Regarding the effect of economic growth on public size, we find a negative and scarcely significant effect, which contradicts the Wagner's Law. In the oppo-

site direction, the evidence is clearer and show a negative effect for most countries, which is confirmed in the panel framework. These results should be nuanced by the period of study and the degree of development of the countries considered, and we recommend a deeper research at microeconomic level. Considering the current situation of the European economy and the level of efficiency of the public sector, a selective reduction of public spending might increase economic growth in most countries.

REFERENCES

Arellano, M. and S. Bond, 1991. "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations." *Review of Economic Studies* 58(2), 277-297.

Arpaia, A. and A. Turrini, 2008. "Government expenditure and economic growth in the EU: long-run tendencies and short-term adjusted." *European Economy, Economic Papers* 300, February.

Barro, R., 1980. "Government spending in a simple model of endogenous growth." *Journal of Political Economy* 98(5).

Barrios, S. and A. Schaechter, 2008. "The quality of public finances and economic growth." *European Economy*, Economic Papers 337, September.

Bergh, A. and M. Henrekson, 2011. "Government size and growth: a survey and inter- pretation of the evidence." IFN Working Paper, No. 858, Research Institute of Industrial Economics.

Bonhomme, S. and E. Manresa, 2015. "Grouped Patterns of Heterogeneity in Panel Data." *Econometrica* 83(3), 1147-1184.

Fournier, J.-M. and A., Johansson 2016. "The effect of the size and the mix of public spending on growth and inequality." OECD Economics Department Working Papers, No. 1344, OECD Publishing.

Granger, C., 1969. "Investigating Causal Relations by Econometric Models and Cross Spectral Methods." *Econometrica* 37, 424438.

Lütkepohl, H. 2005. *Introduction to Multiple Time Series Analysis*. Springer-Verlag: Berlin.

Kilian, L., 1998. "Small-Sample Confidence Intervals for Impulse Response Functions." *Review of Economics and Statistics* LXXX, 218-30.

Sims, C., 1980. "Macroeconomics and Reality." *Econometrica* 48, 148.

Tables

Table 1: Causality real GDP growth and Public Spending ratio

	From *GDP* to *PS*		From *PS* to *GDP*	
Country	Test	Pvalue	Test	Pvalue
Austria	0.337	0.564	6.094	0.017
Belgium	1.581	0.214	4.653	0.036
Czech Republic	0.575	0.457	0.704	0.412
Denmark	0.207	0.891	2.464	0.075
Estonia	0.319	0.858	0.314	0.862
Finland	3.373	0.042	2.924	0.063
France	7.258	0.010	5.813	0.020
Germany	0.368	0.547	1.320	0.256
Greece	1.412	0.254	1.368	0.265
Hungary	0.559	0.697	1.393	0.305
Iceland	2.485	0.058	2.596	0.050
Ireland	4.898	0.005	1.060	0.376
Italy	2.241	0.117	5.031	0.010
Latvia	5.252	0.018	1.110	0.409
Luxembourg	1.613	0.223	1.443	0.268
Netherlands	0.022	0.884	0.104	0.748
Norway	0.240	0.626	0.032	0.859
Poland	1.455	0.287	2.359	0.124
Portugal	5.861	0.001	3.133	0.024
Slovak Republic	1.811	0.195	0.300	0.745
Slovenia	9.442	0.003	0.404	0.802
Spain	3.014	0.089	0.913	0.344
Sweden	4.588	0.037	0.812	0.372
Switzerland	6.429	0.018	7.141	0.013
United Kingdom	0.415	0.663	1.908	0.160

TABLE 2: CUMULATIVE IMPULSE-RESPONSE FUNCTIONS OF REAL GDP GROWTH AND PUBLIC SPENDING RATIO RELATIONSHIPS

	From *GDP* to *PS*	From *PS* to *GDP*
Country	cir	cir
Austria	6.08	-1.61
	(-1.67,11.68)	(-5.62,2.42)
Belgium	4.04	-1.28
	(-4.55,11.60)	(-4.67,2.59)
Czech Republic	0.05	1.62
	(-5.69,5.87)	(-20.51,25.12)
Denmark	-2.62	1.25
	(-8.32,4.13)	(-2.21,4.43)
Estonia	2.49	-0.89
	(-12.39,18.58)	(-58.44,52.52)
Finland	4.22	-2.14
	(-6.48,14.20)	(-6.90,4.60)
France	-4.82	-2.00
	(-7.74,-0.58)	(-3.08,0.59)
Germany	2.49	-1.15
	(-1.50,5.71)	(-3.83,1.78)
Greece	-2.23	-1.96
	(-6.66,2.60)	(-4.47,2.02)
Hungary	0.02	-1.90
	(-4.21,4.13)	(-17.33,13.22)
Iceland	2.80	-1.24
	(-0.44,5.02)	(-4.42,2.17)
Ireland	-0.97	-0.53
	(-5.37,3.64)	(-3.42,2.46)
Italy	8.81	-2.97
	(-2.17,17.18)	(-10.14,4.62)
Latvia	-0.52	-2.88
	(-8.67,7.56)	(-40.06,33.28)
Luxembourg	-0.78	0.59
	(-6.22,4.66)	(-13.22,14.60)
Netherlands	8.25	0.17
	(-3.67,15.36)	(-3.88,3.54)
Norway	-1.10	0.59
	(-6.76,5.21)	(-1.91,2.98)
Poland	1.32	0.76
	(-8.77,11.97)	(-9.61,11.71)

.../...

.../...

Portugal	1.67	-1.91
	(-1.34,4.36)	(-5.85,2.52)
Slovak Republic	0.09	-0.16
	(-6.73,7.01)	(-9.00,8.75)
Slovenia	-1.18	0.54
	(-15.86,11.62)	(-12.02,13.60)
Spain	4.49	-3.03
	(-5.90,11.67)	(-8.64,5.28)
Sweden	-0.37	-0.41
	(-7.97,7.71)	(-3.05,2.69)
Switzerland	-0.40	0.82
	(-1.78,1.09)	(-2.67,4.24)
United Kingdom	1.57	-1.61
	(-2.45,5.38)	(-5.49,2.97)

Table 3: Panel estimation

	GDPt	PSt	GDPt-1	PSt-1
		Static panel		
GDP		−0.22 (0.000)		
PS	−0.15 (0.000)			
		Dynamic panel (Fixed-effects)		
GDP			0.38 (0.000)	−0.06 (0.000)
PS			−0.11 (0.000)	0.89 (0.000)
	Dynamic panel (Arellano and Bond)			
GDP		−0.15 (0.000)	0.29 (0.000)	
PS	−0.40 (0.000)			0.85 (0.000)
		Grouped fixed effects		
GDP			0.43 (0.000)	−0.02 (0.088)
PS			−0.04 (0.385)	0.97 (0.000)

FIGURES

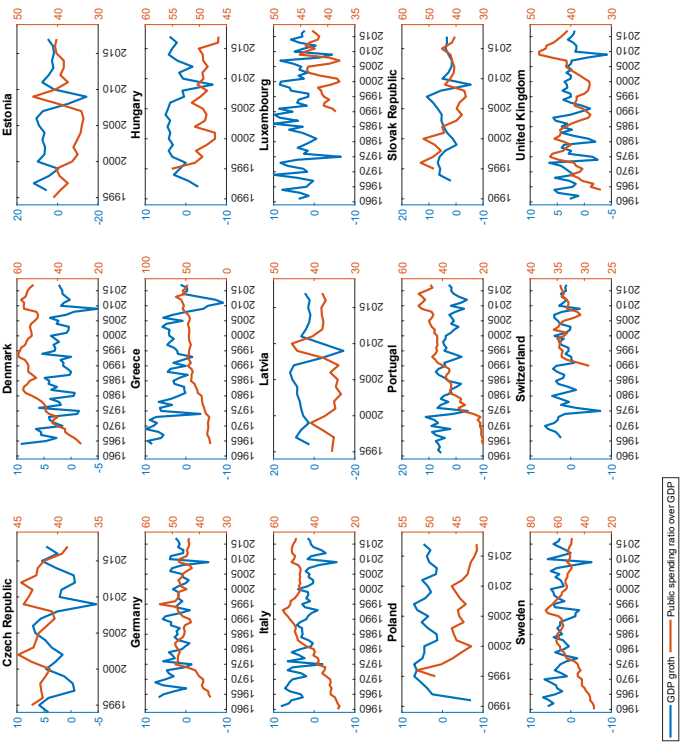


FIGURE 1: EVOLUTION OF REAL GDP GROWTH AND PUBLIC SPENDING OVER GDP.

SOURCE. OECD, ECONOMIC OUTLOOK.

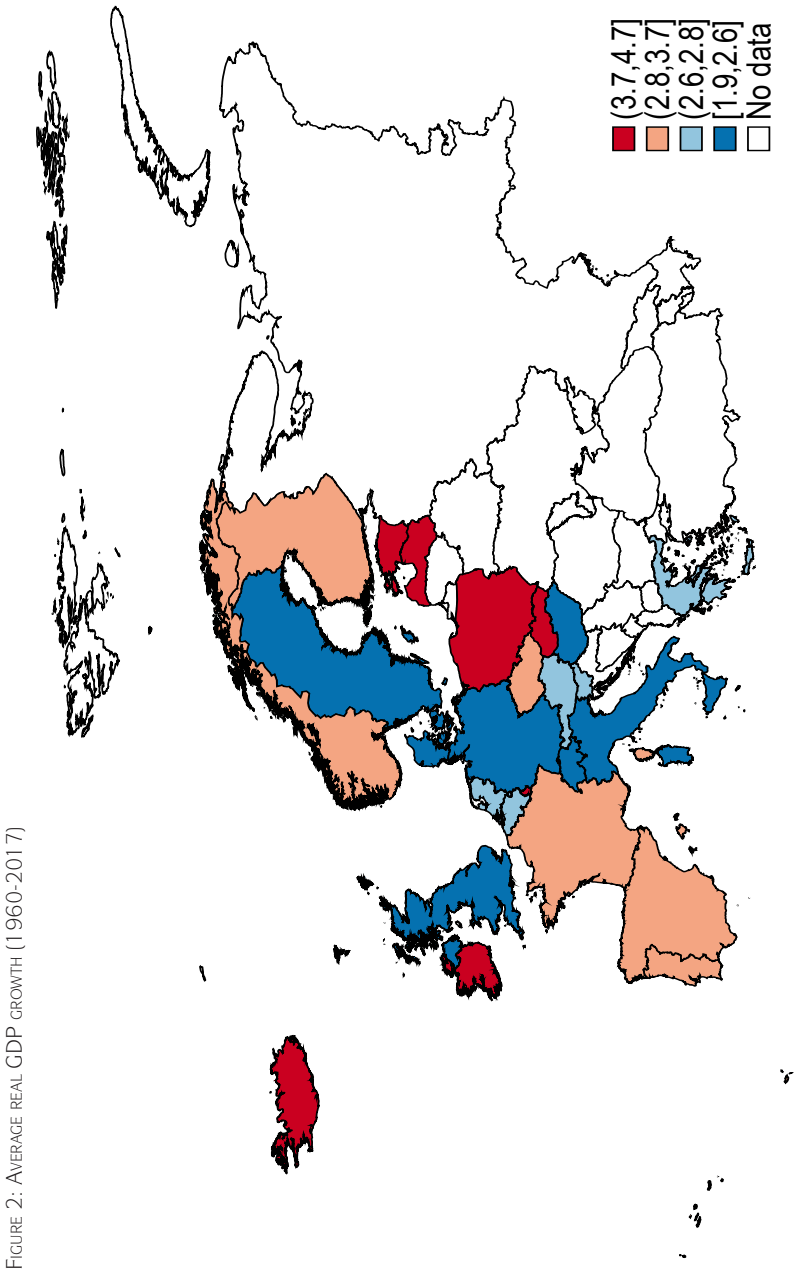
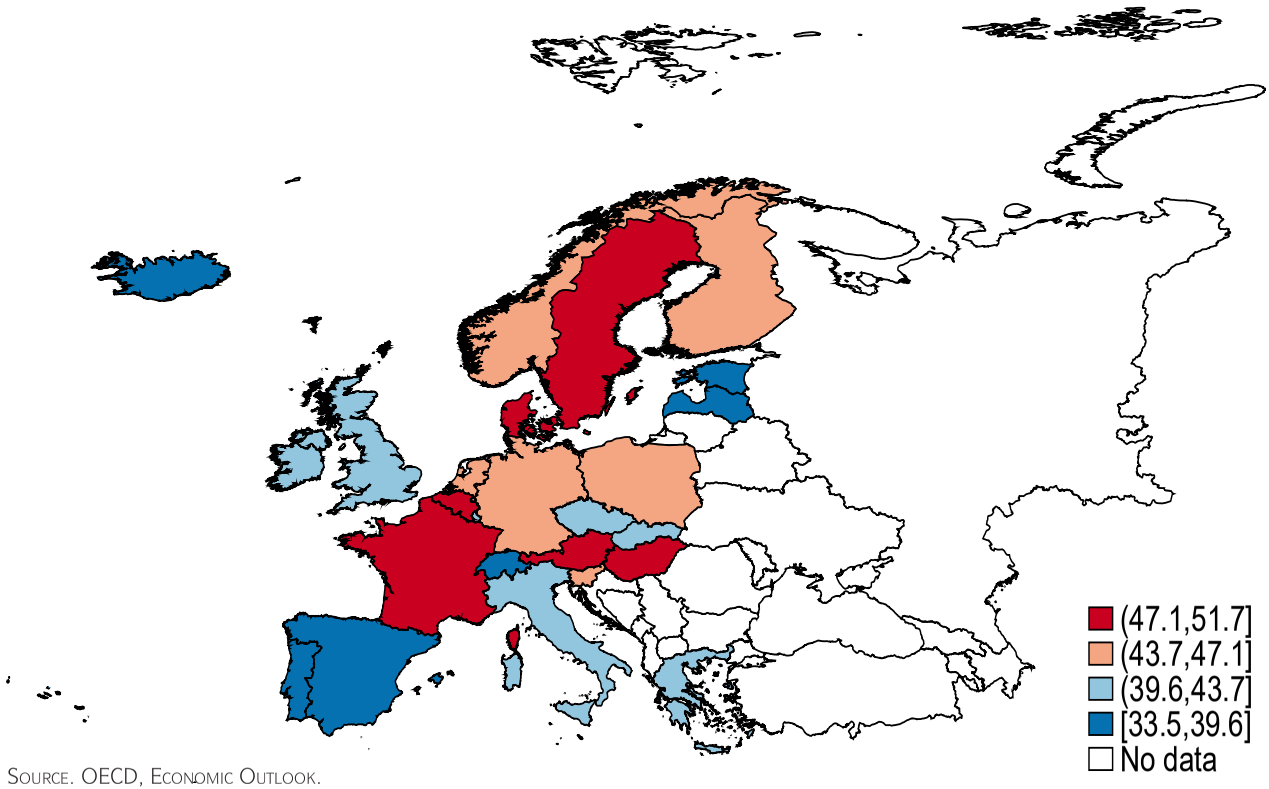


Figure 2: Average real GDP growth (1960-2017)

Source. OECD, Economic Outlook

Figure 3: Average Public Spending over GDP (1960-2017)



Source. OECD, Economic Outlook.

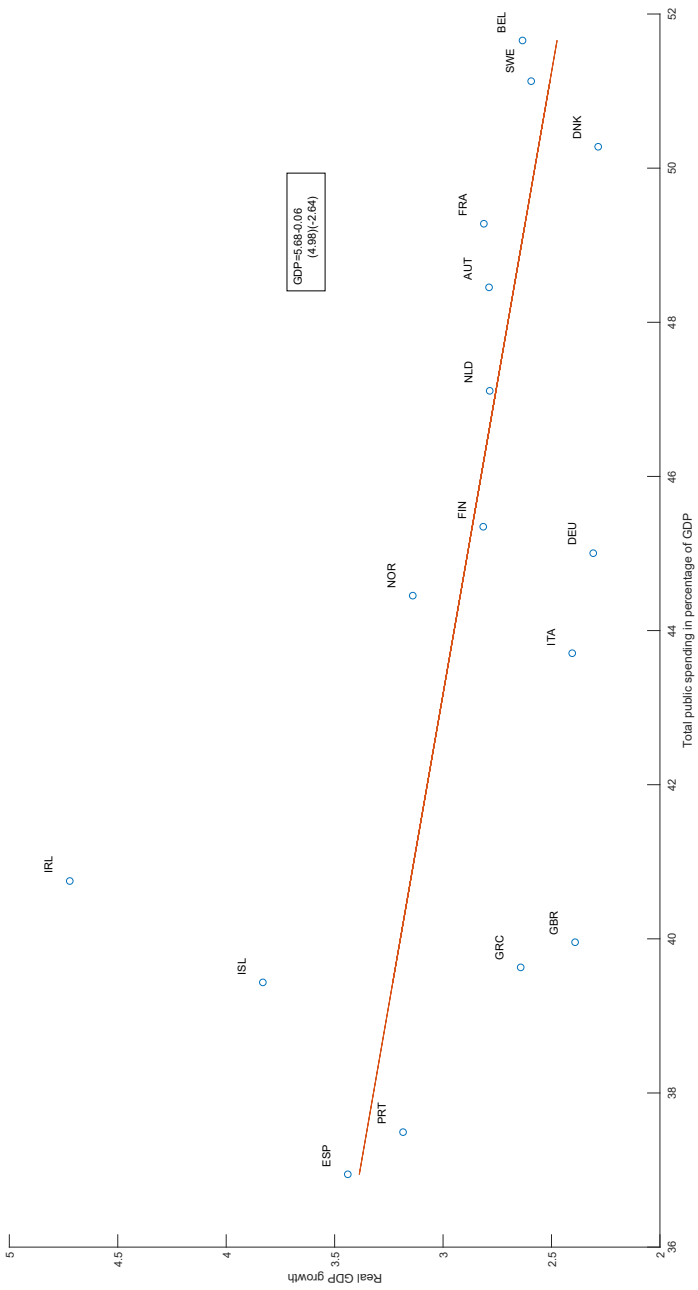


Figure 4: Relationship between real GDP growth and the Public Spending ratio (1960-2017), selected countries

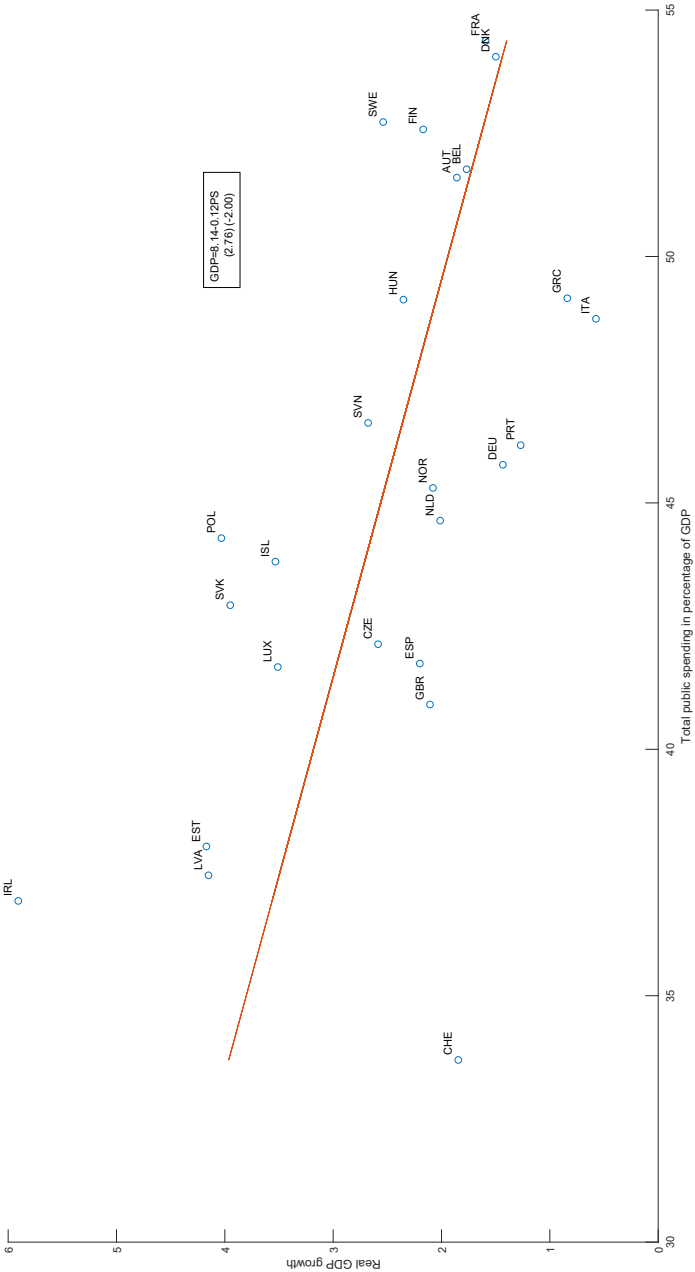


FIGURE 5: RELATIONSHIP BETWEEN REAL GDP GROWTH AND THE PUBLIC SPENDING RATIO (1995-2017)

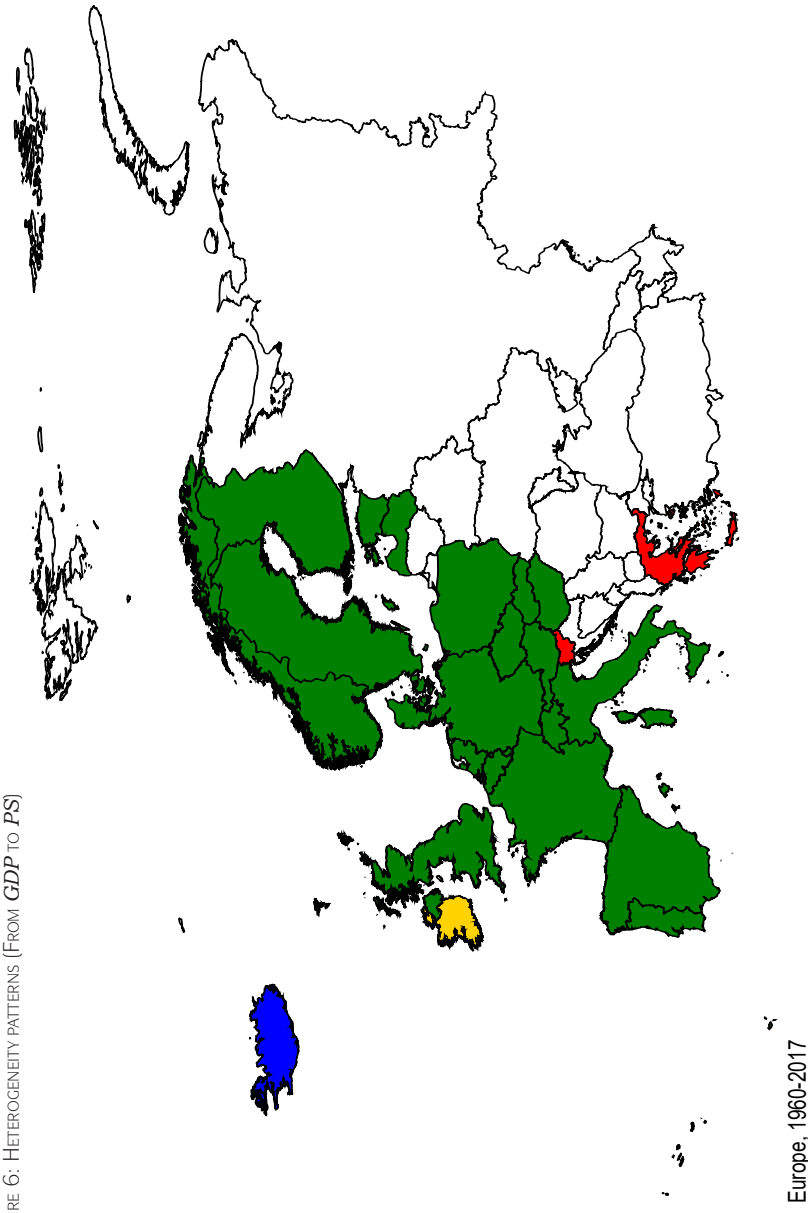
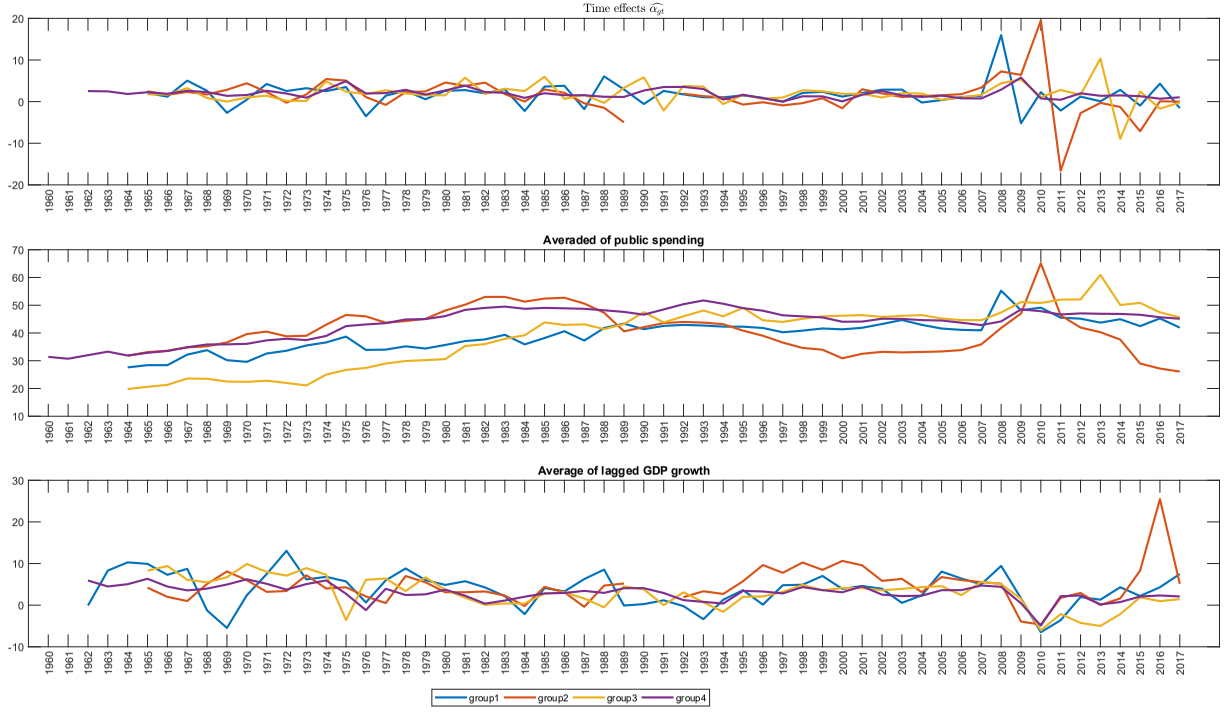


Figure 6: Heterogeneity patterns (From *GDP* to *PS*)

Figure 7: Heterogeneity patterns (From GDP to PS)



Note. Group 1 is formed by Iceland; 2 by Ireland; 3 by Greece and Slovenia; 4 contains the rest of the countries.

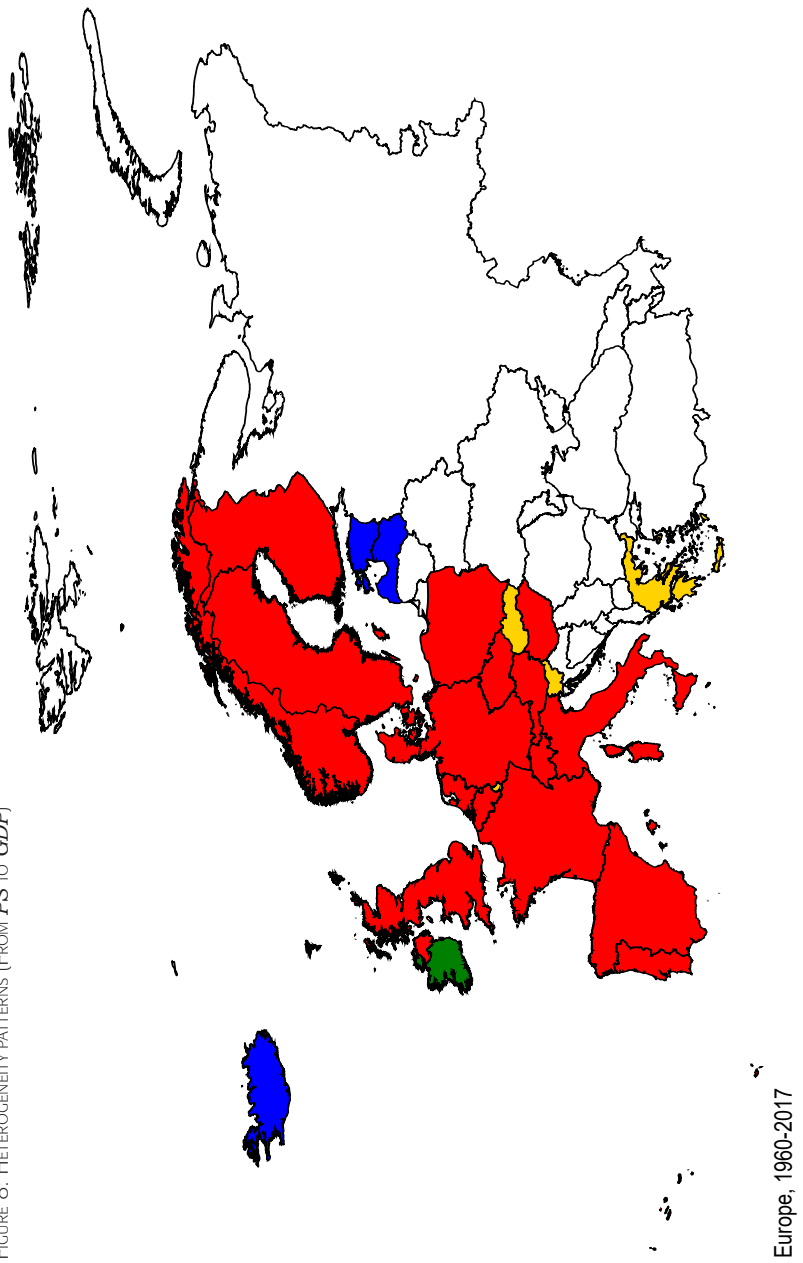
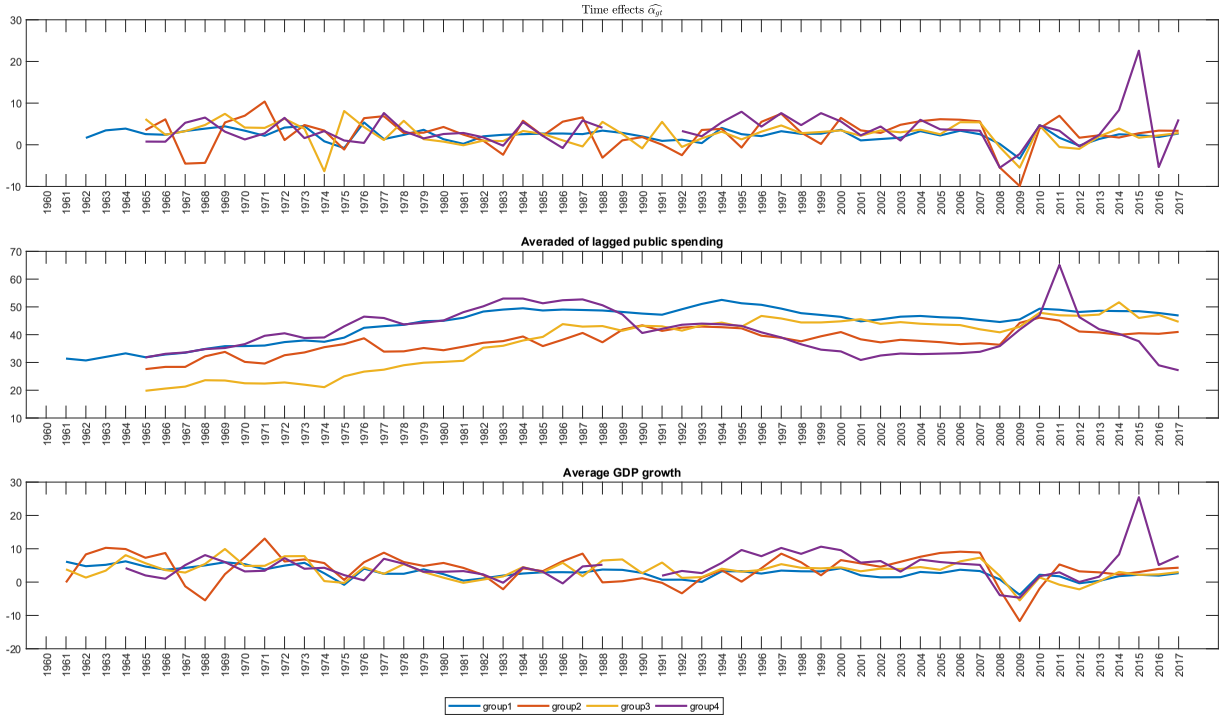


Figure 8: Heterogeneity patterns (From *PS* to *GDP*)

Figure 9: Heterogeneity patterns (From PS to GDP)



Note. Group 2 is formed by Estonia, Iceland and Latvia; 3 by Greece, Luxembourg, Slovakia and Slovenia; 4 by Ireland; and 1 contains the rest of the countries

Appendix

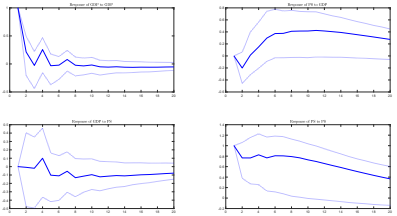


Figure 10: Impulse-response function Austria

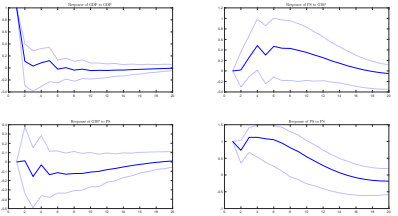


Figure 11: Impulse-response function Belgium

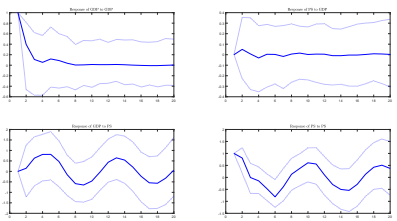


Figure 12: Impulse-response function Czech Republic

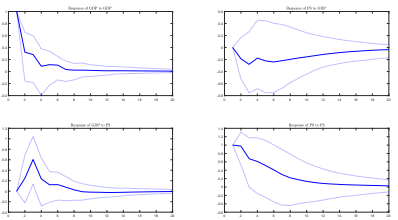


Figure 13: Impulse-response function Denmark

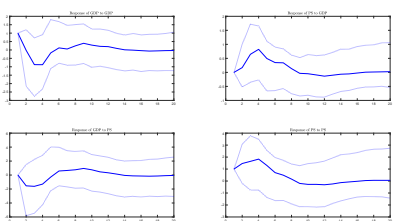


Figure 14: Impulse-response function Estonia

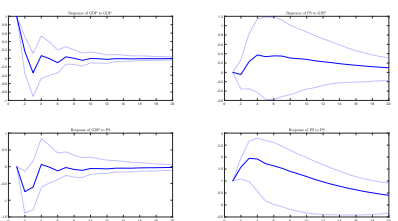


Figure 15: Impulse-response function Finland

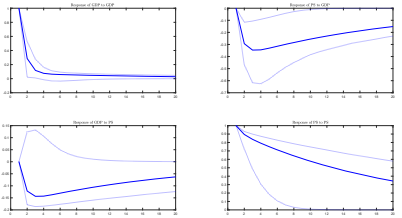


FIGURE 16: IMPULSE-RESPONSE FUNCTION FRANCE

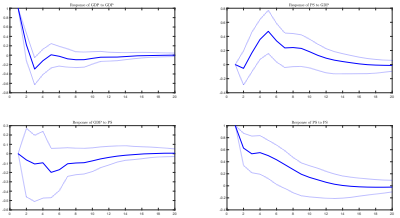


FIGURE 17: IMPULSE-RESPONSE FUNCTION GERMANY

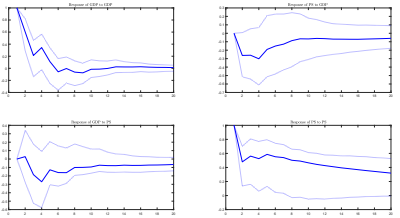


FIGURE 18: IMPULSE-RESPONSE FUNCTION GREECE

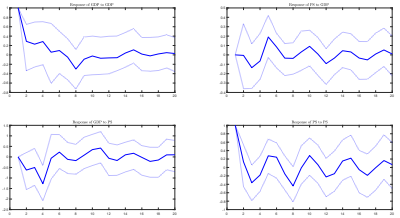


FIGURE 19: IMPULSE-RESPONSE FUNCTION HUNGARY

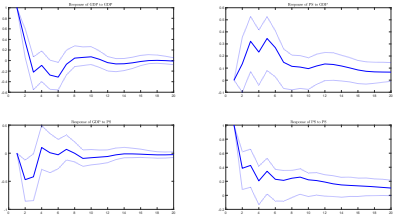


FIGURE 20: IMPULSE-RESPONSE FUNCTION ICELAND

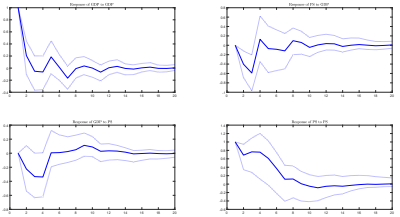


FIGURE 21: IMPULSE-RESPONSE FUNCTION IRELAND

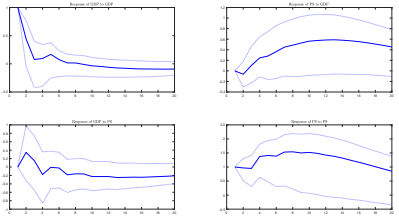


FIGURE 22: IMPULSE-RESPONSE FUNCTION ITALY

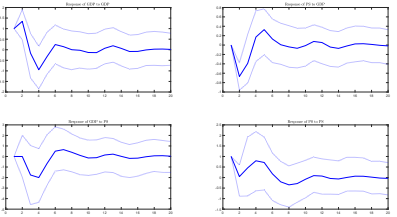


FIGURE 23: IMPULSE-RESPONSE FUNCTION LATVIA

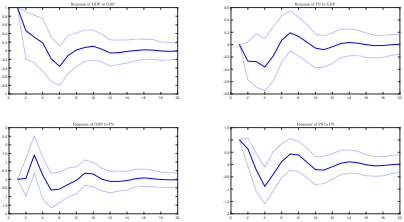


Figure 24: Impulse-response function Luxembourg

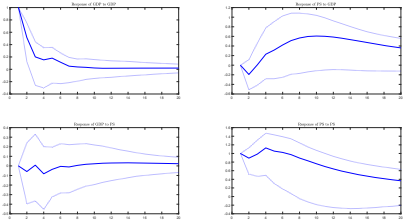


Figure 25: Impulse-response function Netherlands

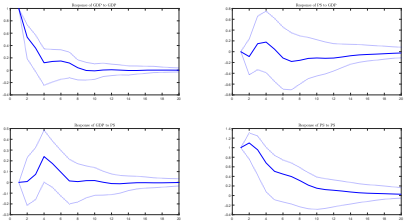


Figure 26: Impulse-response function Norway

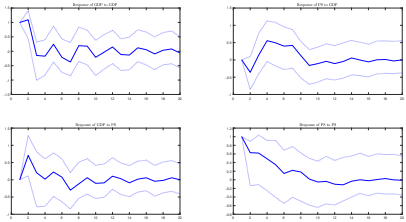


Figure 27: Impulse-response function Poland

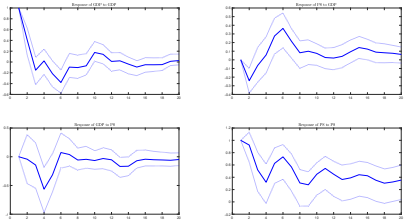


Figure 28: Impulse-response function Portugal

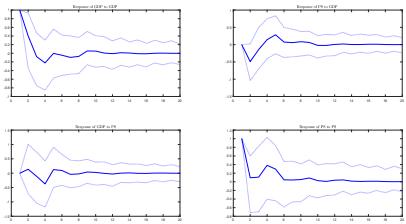


Figure 29: Impulse-response function Slovak Republic

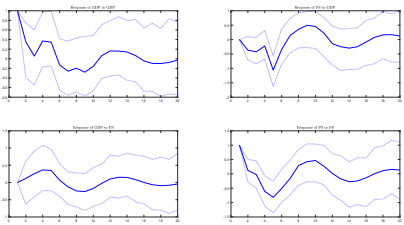


Figure 30: Impulse-response function Slovenia

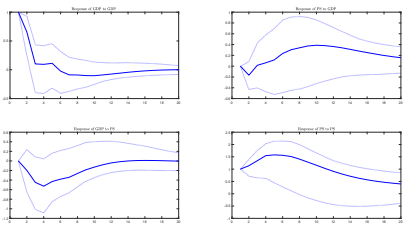


Figure 31: Impulse-response function Spain

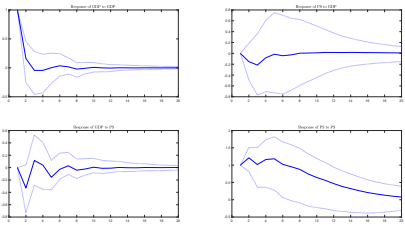


FIGURE 32: IMPULSE-RESPONSE FUNCTION SWEDEN

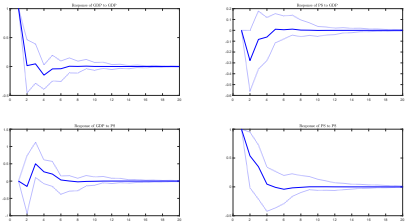


FIGURE 33: IMPULSE-RESPONSE FUNCTION SWITZERLAND

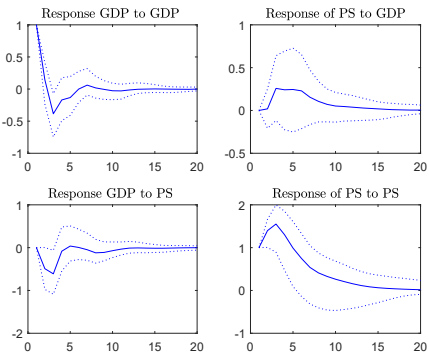


FIGURE 34: IMPULSE-RESPONSE FUNCTION UNITED KINGDOM