PANOECONOMICUS, 2017, Vol. 64, Issue 2 (Special Issue), pp. 189-222
Received: 22 July 2016; Accepted: 22 October 2016.
UDC 330.354:330.132/.133(4-672EU)
DOI: https://doi.org/10.2298/PAN1702189S
Original scientific paper

Irina Syssoyeva-Masson
CEMAFI International Association;
University of Savoy Mont Blanc, France
irina.syssoyeva-masson@univ-savoie.fr
irina_masson@hotmail.fr

João Sousa Andrade
Corresponding author
CEMAFI International Association;
University of Coimbra, Department of Economics, Group for Monetary and Financial Studies (GEMF), Portugal
jasa@fe.uc.pt

Acknowledgement: The authors would like to thank two anonymous referees for their valuable comments and suggestions to improve the quality of the paper. This paper was presented at the 13th International Conference Developments in Economic Theory and Policy, Department of Applied Economics, University of the Basque Country UPV/EHU, Bilbao, 1-3 June, and in a conference at the Faculty of Economics, University of Coimbra. The authors would like to thank the comments made in these conferences.

Are PIIGS so Different? An Empirical Analysis of Demand and Supply Shocks

Summary: This paper analyses responses to supply and demand shocks in PIIGS countries. We compare the results obtained for PIIGS with those of Germany and the USA, and also with those of France, which despite its government's efforts demonstrate relatively poor recent economic performance. The main objective of this paper is to establish whether it is still reasonable to consider PIIGS as a group apart. Our methodological strategy is based on the Okun Law (OL) which is incorporated in a Structural Vector Autoregression (SVAR) model with Blanchard-Quah (BQ) restrictions. We address two drawbacks that usually present in the OL: the interdependency problem and the non-stationarity problem. By using a non-parametric representation of OL, we identify the heterogeneity between countries. We build stable VAR models for each of the economies and use the BQ SVAR impulses to analyse the importance of contemporary and long-run effects of supply and demand shocks. The main conclusion of this paper is that it does not make any sense today to identify PIIGS as a separate group. Additionally, a country that stands out from our analysis is France. The question can thus be posed that if "PIIGS" signifies "countries with poor economic performances" then should not France also belong to this group?

Key words: Okun Law, Non-parametric representation, Stationarity, SVAR, Stability, Impulses.

JEL: C32, C51, E24, J21.

The acronym PIIGS is used to define a group of countries within the Euro zone, that share similar macroeconomic imbalances, these being: Portugal, Ireland, Italy, Greece, and Spain. These countries have been characterised, until recently, by large current account and budget deficits and also high rates of unemployment as the result of sluggish output evolution. For instance, in 2014 the unemployment rate was 14.1% in Portugal, 11.3% in Ireland, 12.7% in Italy, 26.5% in Greece, and 24.5% in Spain. As for economic growth, it ranges between 0 and -0.04% for the 2008-2014 period. For instance between 2007 and 2014 the "debt-to-GDP" ratio increased by 349% in Ireland, moving from 23.93% to 107.48%; by 179.61% in Spain, by 90.2% Portugal, by 73.16% in Greece, and by 32.71% in Italy (for more details see Appendix A). These countries also suffered a loss of competitiveness and, in the last few years, contrary to what would have been desirable, the unit labour costs gap with Germany has not been reduced. The question then arises: are PIIGS so different?

The main purpose of this paper is to answer this question, and ask whether PIIGS countries continue to face great difficulties in getting their economies back on their feet (i.e. especially in terms of reviving economic growth and reducing their unemployment rates).

To achieve this aim, we study the macroeconomic performance of PIIGS by analysing the supply and demand shocks adjustment dynamics of output and unemployment rate, and comparing these with the situation in two benchmark economies (Germany and the United States), and also with those of France. We include France in our sample since, despite not belonging to the PIIGS group, and much government effort, France remains unable to "reverse the unemployment curve" and to restore the desired rate of economic growth. In fact, France is a country that continues to demonstrate a relatively poor economic performance, i.e. slow economic growth (0% for 2007-2014), high and *continuously increasing* unemployment (8% in 2007 and 10.3% in 2014), and a general government *debt-to-GDP ratio* much higher than the *Maastricht debt ratio* threshold of 60% (95.56% in 2014). We believe it would be quite instructive and interesting to explore whether France's responses to demand and supply shocks are more similar to the responses by PIIGS or to those of Germany and the United States.

To do this, we assess the evolution of output and unemployment rate after supply and demand shocks in PIIGS, two benchmark economies, and France, and we then compare the degree of symmetry in the adjustment process to these shocks among the countries involved. We also analyse the speed of adjustment to shocks in these countries, thereby demonstrating whether the shock responses are synchronic or otherwise. The reactions to the demand shock are analysed in order to represent the intended actions of national governments to counteract the reduction in output and the increase in the unemployment rate, and economies' responses to these types of positive shock.

The core of our methodology relies on one of the pillars of empirical macroeconomics - the Okun Law (OL) that establishes a stable relationship between output growth and variations in the unemployment rate. This Law is also incorporated in forecasting for advanced countries, (Laurence Ball, João T. Jalles, and Prakash Loungani 2015), and is a practice that was not affected by the 2007-2009 economic crises (Jan-Christoph Rülke 2012). We incorporate the OL in a Structural Vector Autoregression (SVAR) model, with restrictions of the kind proposed by Olivier J. Blanchard and Danny Quah (1989), to produce a *pseudo* Blanchard-Quah model (PBQ), separately built for each country in our sample (PIIGS, France, Germany, and the USA) for the 1960-2014 period. In terms of our objective and the time-span of our data (1960-2014), special emphasis is placed on the stability of the estimated relations (Edward S. Knotek 2007; Robert J. Gordon 2010). Given the period under study, the question of stability is quite important (António Mendonça 2014; Jesús Ferreiro, Catalina Gálvez, and Ana González 2015). The Okun Law has been chosen to verify whether there is a tight relationship between output and unemployment in the countries under study, and also to check whether the joint behaviour of output and unemployment depends on the type of disturbance affecting the economy (i.e. demand or supply disturbances).

The Blanchard-Quah model (PBQ) is commonly used for the decomposition of economic shocks in supply and demand disturbances. We have opted for this model since it allows us to compare instantaneous and long-run effects of permanent supply and demand shocks on production and unemployment. Hence, we follow Blanchard and Quah (1989) and assume that that there are two sorts of disturbance that affect output and unemployment. The first one (demand disturbance) has no long-run effect on either unemployment or output. The second one (supply disturbance) has no long-run effect on unemployment, but may have a long-run (permanent) effect on output. We use the term *pseudo* to describe our model (PBQ) because our variable that represents "demand" (i.e. unemployment rate) is stationary after differentiation (i.e. stationary at the first difference) and, therefore, the effects on demand are permanent; however, demand shock will not have a permanent effect on the output *via* a shift in the supply curve. Therefore, our assumptions are different from those of Omar H. M. N. Bashar (2011), who supposes that the demand shock may have a permanent effect on the output level by indirectly shifting the aggregate supply curve in G-7 countries (i.e. in G-7, one-time positive aggregate demand shock increases the output level permanently).

Our empirical analysis has the following structure: (i) firstly, we apply modern ADF tests to test the presence of a unit root in the series under evaluation; (ii) secondly, we use the Variance Ratio (VR) test to examine the presence of long memory in output and unemployment series; (iii) thirdly, we use a SVAR model with a long-run restriction to assess the supply and demand shocks adjustment dynamics in PIIGS, two benchmark economies, and France.

We believe that our results will generate a better understanding of the fragility or robustness of PIIGS' economies (and France), and explain the difficulties encountered by them in their attempts to revive economic growth, reduce unemployment rate, and so more generally, restore (macro)economic stability. We are also confident about the usefulness of our results for the French economy that is still trying to reverse its unemployment curve.

The remainder of the paper is structured as follows. In Section 1 we present and comment upon our methodological strategy based on the Okun Law (OL), and briefly describe our empirical method, i.e. a Structural Vector Autoregression (SVAR) model, and *pseudo* Blanchard-Quah model (PBQ). In Section 2 we provide non-parametric representations of the OL for the economies under study, and analyse that statistical properties of our data (i.e. we test for the presence of a unit root [UR] in our series and verify the stability of our VAR models). In Section 3 we apply the BQ SVAR model to PIIGS, two benchmark economies, and France, and discuss the empirical findings; a final section concludes.

1. A Model Based on the Okun Law

1.1 The Okun Law: A Stable Negative Relation between Output Growth and Unemployment

Arthur M. Okun (1962b), has suggested measuring potential output as a function of the unemployment rate gap $(U_t - U_t^*)$:

$$Y_t^P = Y_t[1 + 0.032(U_t - U_t^*)], \quad (1)$$

where U_t and Y_t represent actual unemployment rate and output, Y_t^P the potential output, the value of U_t^* has been taken by Okun as a constant equal to 4%. "… that four percent unemployment is a reasonable target under existing labor market conditions" and the coefficient 0.032 was proposed by Okun and corresponds to a weighted average obtained by him for different periods (also cited in Clifford Attfield and Brian Silverstone 1998). When Okun developed his relationship model, the Council of Economic Advisers of Kennedy proposed a target of 4% for unemployment (Michael C. Lovell 2004), but it is also interesting to remember that William Vickrey, in his presidential address to the AEA in 1993, made the reference to a value of 1.5% (William Vickrey 1993).

This last value can be associated with the NAIRU concept, the natural rate of unemployment, or simply with the "Benchmark Unemployment Rate" (Lovell 2004). Originally, Okun (1962b) main purpose was to obtain a measure of potential output (Okun 1962a; George A. Kahn 1996). However, the results of his study became widely known as a "relation 3:1", which reflects the idea that the economy experiences a 1 percentage point increase in unemployment for every 3 percentage point decrease in GDP from its long-run level and *vice versa*. Similarly, a 3 percentage point increase in GDP from its long-run level is associated with a 1 percentage point decrease in unemployment. These findings were very appealing to economists and politicians. Gordon and Peter K. Clark (1984) proposed a relation of 2:1, which he uses in his well-known manual. And Donald G. Freeman (2000) obtained the same value for the USA for the period 1958-98 with quarterly data and eight regions, and for 1977-97 with annual data and all states.

This empirical regularity reported by Okun (1962a) became an empirical law called Okun's Law, which basically states the existence of a stable negative relationship between the unemployment rate and the output growth rate, i.e. *mutatis mutandis* a link between a reduction in unemployment and an increase in output (Martin F. J. Prachowny 1993). This has become a standard fixture in macroeconomics textbooks and used as a rule-of-thumb practice to relate changes in unemployment to changes in output growth. The OL was no more considered as a simple empirical relationship but as a "truly sturdy empirical regularity" and as one of the four main components of the core model of the macroeconomy (Alan S. Blinder 1997; Paramsothy Silvapulle, Imad A. Moosa, and Mervyn J. Silvapulle 2004). As described in the popular handbook of macroeconomics by Kevin D. Hoover (2001), this robust empirical generalisation "is one of the most reliable generalizations that macroeconomists have found" (Robert E. Hall and John B. Taylor 1988, p. 136).

1.2 The OL Specification

There are several specifications of the OL in the literature, these being: the "difference version", the "gap version", the "dynamic version" and, finally, the "production function version".

In fact, in his seminal paper, Okun (1962a) presented two empirical relationships linking the unemployment rate and real output. The first relationship ("difference version" of the OL) captures how changes in the unemployment rate vary simultaneously with changes in real output.

$$\Delta U_t = \alpha - \beta \cdot \Delta Y_t + \nu_t , \tag{2}$$

where ΔU are changes in the unemployment rate from one period to another; ΔY changes in real output. The coefficient β is expected to be negative, signifying that rapid economic growth is associated with a decrease in the unemployment rate and *vice versa* - slow economic growth is associated with an increase in the unemployment rate.

Okun's second relationship is known as the "gap version" of the OL, i.e. the relationship linking the level of the unemployment rate to the gap between potential output (Y_t^P) and actual output (Y_t^*):

$$U_t = \alpha + \beta (Y_t^P - Y_t^*) + e_t , \tag{3}$$

when Y_t^P - Y_t^* = 0, then unemployment rate will be equal to α, level of unemployment rate that is associated with full employment (according to Okun, approximately 4%).

As for other versions of the OL, the "dynamic version" suggests that both past and current values of output may affect the current level of unemployment; and the "production function version" of the OL is a sort of combination of a theoretical production function (A, K, L) and the "gap version".

In our VAR model, we use the "difference specification" that is the most well-known formulation of the OL. In fact, the "difference" and "dynamic" versions of OL are specifications that are used more often since these versions do not require strong assumptions concerning definition and computation of full employment and potential output (that are required for both the "gap" and production function, specifications of the OL). It should be noted that the β coefficient is very sensitive to the model specification, the dynamic structure, the method of estimation and the estimation of cyclical values (Moosa 1997). The conclusion is drawn by Jong Keun You (1979) that the method used to obtain the potential output is not relevant for model results.

It also should be noted that while estimating the model, some *efficiency* losses may occur where co-integration between unemployment rate (U) and output (Y) is present. Some authors (see for example, Jean-Claude Trichet 2006; Ho-Chuan Huang and Chih-Chuan Yeh 2013; Mary C. Daly et al. 2014 and Bilal Kargi 2014) have applied non-stationary panel and time-series methods to the OL. From now on we denote by g the growth rate of output, ΔY_t, and by dU the first difference of the unemployment rate, ΔU_t.

1.3 The OL Interdependency and Stability

The application of the *mutatis mutandis* principle raises *problems of interdependency* between variables that would certainly affect the stability of the relation. We now present some of these relationships which may affect the value of β: (1) relations between employment, labour force and unemployment in a dynamic context, characterising the supply and demand of labour (Christian E. Weber 1995; Leopold Sögner and Alfred Stiassny 2002); (2) variations in capacity utilisation (You 1979; Martin Watts and William Mitchell 1991); (3) variations in productivity (Kahn 1996; David Altig, Terry Fitzgerald, and Peter Rupert 1997) and its cyclical fluctuations (Thor Hultgren 1960); (4) changes in human capital and in working time (You 1979; Farzad Farsio and Stacey Quade 2003); (5) cyclical evolution in the participation rate (Anthony Thirlwall 1969; Jimmie R. Monhollon and William E. Cullison 1970; Thirlwall and Norman John Ireland 1970); in gender composition (Martin Boďa and Mariana Považanová 2015) or age composition (Luca Zanin 2014); (6) labour hoarding phenomenon (Thirlwall and Ireland 1970; Sögner and Stiassny 2002); (7) different protection policies of employees (Roger T. Kaufman 1988; Weber 1995; Moosa 1997; Blanchard 1999; Sögner and Stiassny 2002; Nicholas Apergis and Anthony Rezitis 2003) which ultimately may be the result of increased international competition or the attempt to reduce the gap between insiders and outsiders in the labour market; (8) and evolution of unemployment rate *hysteresis* (Knut Roed 1999; Sögner and Stiassny 2002; Dany Lang and Christian de Peretti 2009). Another problem (9) concerns the behaviour of the OL on the business cycle. The idea that the contraction phase of the cycle could be more abrupt than the expansion one was already raised by John Maynard Keynes (1936) and had been confirmed for output and unemployment among others by many researchers (see for example, Salih N. Neftçi 1984; Philip Rothman 1991; Allan D. Brunner 1997; Fatma Abdel-Raouf 2011; Daly et al. 2014; Costas Karfakis, Constantinos Katrakilidis, and Eftychia Tsanana 2014; Abbas Valadkhani and Russell Smyth 2015). Finally (10) we should consider the influence of the GDP composition, in terms of expenditures or output (Robert Anderton et al. 2014; Jurgita Pesliakaitė 2015).

While the use of dynamic modelling can solve some of mentioned above problems (Kahn 1996; Gordon 2010), it is quite difficult to solve all of them at once. When relevant interdependence is not explicitly considered, the serious problem of instability of estimates rises simply because there is no reason for a stable relation over time between the two variables. Several authors have identified different forms of the instability of β coefficient: temporal, long-term and cross-country (see for example, Gordon and Okun 1980; Paul Davenport 1982; Lester Thurow 1983; Gordon and Clark 1984; D. T. Nguyen and A. Mahinda Siriwardana 1988; Charles Adams and David T. Coe 1990; Jim Lee 2000; Farsio and Quade 2003). In fact, the model instability argument could be a reason for its empirical refutation. If the null of instability is rejected, we can conclude that either the omission of those relations does not affect the value of the OL parameters; or they are not important; or their effects are offset.

1.4 Econometric Estimation: Problems and Solutions

As already mentioned in the introduction, in order to analyse the supply and demand shocks adjustment dynamics in PIIGS, benchmark economies, and France, we have opted for a *pseudo* Blanchard-Quah (PBQ) SVAR model that we build for each economy.

The proposed econometric methodology avoids the occurrence of spurious regressions (see a list of empirical studies in Apergis and Rezitis 2003, and in

Silvapulle, Moosa, and Silvapulle 2004). For instance, if the natural rate of unemployment (U^*) in (1) is taken as a constant, it is very likely to have a regression in which a variable with a unit root, i.e. I(1), would be regressed on a stationary variable, i.e. I(0), that will definitely lead to a spurious regression. In other words, we would have an unbalanced equation [i.e. when I(1) is regressed on I(0)] (Gangadharrao S. Maddala and In-Moo Kim 1998), and the coefficient β would be wrongly taken as different from zero when actually it is not. Again, the "difference formulation" of the OL(2) implies the use of the Error Correction Model (ECM), since U and Y are supposed to be co-integrated in levels, i.e. CI (1,1), (Watts and Mitchell 1991). As emphasised by Gordon and Clark (1984), one of the biggest problems in empirical analyses is that usually we search for a value of β by using inappropriate models.

Indeed, if U and Y are co-integrated, the interpretation of the Okun coefficient is not at all obvious. Attfield and Silverstone (1998) proposed interpreting the original β coefficient in terms of the error (ECM) coefficient. However, this proposal ignores the interdependence between the variables in the Vector Autoregressive Error-Correction Mechanism (VECM) model as was argued by Soren Johansen (1995). Therefore, while analysing the impact of supply and demand shocks on output and unemployment, short and long-term interdependences between variables must be taken into account, as is actually done with the proposed SVAR.

1.5 A SVAR Model for Output and Unemployment

We follow Blanchard and Quah (1989) and propose a study of the OL based on a SVAR model. In this type of model, the problems of interdependence and those related to the dynamic structure of the model are explicitly solved.

In its simplest form, a SVAR model (Jörg Breitung, Ralf Brüggemann, and Helmut Lütkepohl 2004) is defined as:

$$A \cdot Y_t = A_1^* \cdot Y_{t-1} + \ldots + A_p^* \cdot Y_{t-p} + B \cdot \epsilon_t , \quad (4)$$

where A, A^* and B are coefficient matrices, Y and ϵ are vectors of endogenous variables and residuals respectively. The coefficient matrices A_i^*, with $i = 1,\ldots, p$, are the structural coefficients. The residuals are assumed to be white noise, $(0, I_k)$, where k is the number of endogenous variables. This equation can also take the following form:

$$Y_t = A^{-1} \cdot A_1^* \cdot Y_{t-1} + \ldots + A^{-1} \cdot A_p^* \cdot Y_{t-p} + A^{-1} \cdot B \cdot \epsilon_t . \quad (5)$$

The residuals are represented by:

$$u = A^{-1} \cdot B \cdot \epsilon_t \quad (6)$$

And its variance-covariance matrix by:

$$\sum_u = A^{-1} \cdot B \cdot B^T \cdot A^{-1^T} . \quad (7)$$

A SVAR model is characterised by the restrictions imposed on A and B. In the case of the BQ type model we have $A = I_k$ and the matrix of long-run (LR) effects $(I_k - A_1 - ... - A_p)^{-1} \cdot B$ is lower triangular. After some transformations, Blanchard and Quah (1989) used the first difference of output and a de-trended value of the unemployment rate, in this order. The first residual represents supply disturbances and the second one, demand disturbances. So, the model is identified with the above restriction and the long-run effects of demand disturbances are null.

By following Edward Gamber and Frederick Joutz (1993) and William J. Crowder (1995), and also by using the original notation from Blanchard and Quah (1989), we have for the following structural moving average (MA) process $Z_t = \begin{bmatrix} \Delta Y_t \\ U_t \end{bmatrix}$:

$$Z_t = A_0 \cdot e_t + A_1 \cdot e_{t-1} + ..., \quad \text{with} \quad E\left[e_t \cdot e_{t-1}^{'} \right] = I . \tag{8}$$

Z_t is supposed to follow a stationary and invertible process (see Marco Lippi and Lucrezia Reichlin 1993) for the presence of one additional constraint about this MA representation.

The reduced form of the VAR is given by:

$$B(L) \cdot Z_t = v_t \tag{9}$$

which is equivalent to the reduced form of MA representation:

$$Z_t = v_t + G_1 \cdot v_{t-1} + ..., \quad \text{with} \quad E\left[v_t \cdot v_{t-1}^{'} \right] = \Omega . \tag{10}$$

For the reduced and structural parameters we have the following relations: $v = A_0 \cdot e$ and $A_i = G_i \cdot A_0$ (Blanchard and Quah 1989) beyond $A_0 \cdot A_0^{'} = \Omega$, for the exact identification of their SVAR model. As already mentioned, demand innovations have no long-run effects on the level of output. This means that $A(1)$, the total impact matrix from (10) has a 0 in the upper right quadrant, corresponding to the null effect of demand on output.

There are two preliminary conditions for the use of the BQ model. Firstly, the variables in the model must be stationary, i.e. I(0); and secondly, special attention must be given to the stability of the VAR. Not only must the eigen values of the companion coefficient matrix of the VAR have modulus less than 1, but also each equation in the VAR must be considered as stable. Therefore, in order to identify the presence of structural instability in each equation of the VAR we have applied the CUSUM-of-squares test (R. L. Brown, J. Durbin, and J. M. Evans 1975).

For the above reason, in the next section, after a brief data description and non-parametric representation of the OL for PIIGS, benchmark economies, and France (that will allow for the identification of differences or similarities between the countries in our sample), we test the presence of a unit root (UR) in our series (and then, in the case of non-stationarity of our series, for co-integration), and verify the stability of our VAR models.

2. Data Statistical Analysis and Non-Parametric Representation of OL

2.1 The Data and Software Used

All data values were obtained from the AMECO[1]. *U* is the rate of unemployment; *Y* is the log of GDP, at 2000 prices in Mrd Euros; and *dU* and *g* are the first differences of *U* and *Y*. Countries are identified as: PRT for Portugal, IRE for Ireland, ITA for Italy, GRE for Greece, FRA for France, SPA for Spain, GER for Germany, and USA for the United States of America.

The software used is *R* (R Development Core Team 2015) and its packages "urca" (Bernhard Pfaff 2008), "vrtest" (Jae H. Kim 2014), and "pdR" (Ho Tsung-wu 2015). We have also used "JMulTi Time Series Analysis with Java" by Lütkepohl and Markus Krätzig (2004). Contrary to other VAR econometric packages, JMulTi proposes bootstrap simulations for the contemporary and long-run impact matrices.

2.2 Non-Parametric Representation of the OL for PIIGS, Benchmark Economies, and France

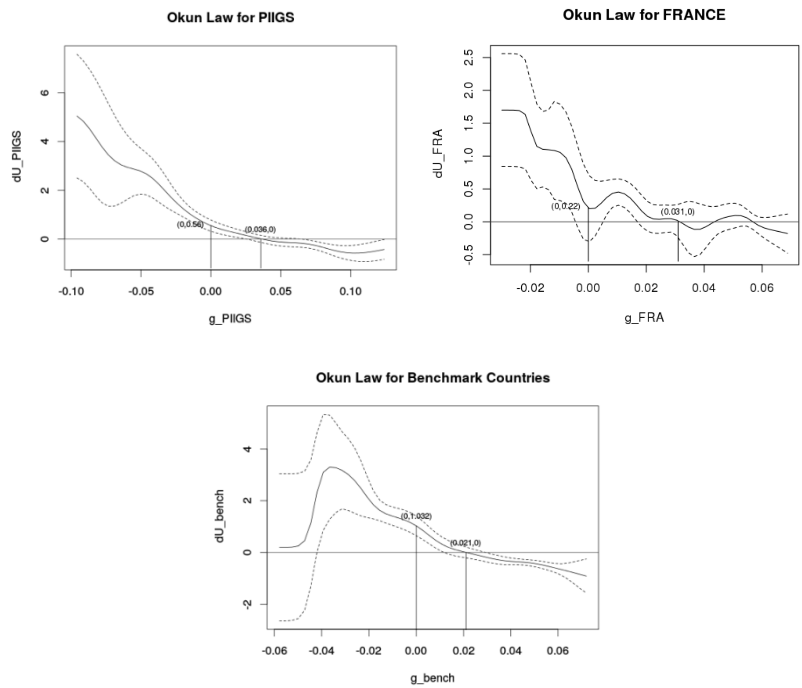
Figure 1 is graphical representations of the OL for these countries that allow us to highlight and analyse the heterogeneity that may exist between them all. We believe that there should be a clear difference between them. These figures are obtained by using the "np" package of Tristen Hayfield and Jeffrey S. Racine (2008).

What we can see from the figures presented below is that: firstly, France is not so different from PIIGS (i.e. the relationship between unemployment rate and output is quite similar in France and in PIIGS); secondly, there is no immediate increase in unemployment rate in PIIGS and France when the drop in growth rate occurs. More precisely, in the case of zero economic growth, the unemployment rate will increase by 0.56% in PIIGS and by 0.22% in France, whereas it will rise by 1.03% in the benchmark economies (Germany and the USA). However, in order to reduce the unemployment rate, these countries (PIIGS, but also France) must grow much faster than Germany and the USA.

The graphical representation of OL also suggests that in PIIGS, the unemployment rate will decrease only if the economic growth is superior to 3.6%; it might be higher than 3.1% in France, whereas, it should be above 2.1% in Germany and in the USA. This observed heterogeneity in the relationship between unemployment and growth rate is explained, at least partially, by the differences in labour market institutional arrangements (e.g. different degrees of flexibility of the labour market). The rigidity of the French labour market has been highlighted many times the European Commission, the OECD, and the IMF. Indeed, these institutions identify the

[1] **Annual Macro-Economic Database (AMECO).** 2016. Economic Databases. https://ec.europa.eu/info/business-economy-euro/indicators-statistics/economic-databases/ (accessed January 06, 2016).

rigidity of France's labour market as its major weakness, and recommend the implementation of measures to make employment contracts more flexible.



Note: The curve uses a local-constant estimator to the Kernel regression estimator and a least-squares cross-validation to select the bandwidth. The 95% confidence intervals were obtained by bootstrap simulation (n = 1000).

Source: Authors' estimations by using "np" package of (Hayfield and Racine 2008).

Figure 1 Non-Parametrical Representation of Okun's Law

2.3 Stationarity and Persistence Behaviour Analysis of the Variables

A. Unit Root (UR) Tests and Stationary Test

The presence of unit root in the unemployment rate is intimately linked to the *hysteresis* hypothesis and sometimes results are controversial (Roed 1999; Christian Dreger and Hans-Eggert Reimers 2009; Lang and De Peretti 2009; Ka Ming Cheng et al. 2012; De-Chih Liu, Chin-Hwa Sun, and Pei-Chien Lin 2012; Naveen Srinivasan and Pratik Mitra 2012, 2014; Kargi 2014; Fumitaka Furuoka 2015). Patrick Fève, Pierre-Yves Hénin, and Philippe Jolivaldt (2003) have criticised this one-variable test and have proposed a joint restriction test for unemployment and the wage equation. In fact, since the *hysteresis* paper by Blanchard and Lawrence H. Summers (1986), the existence of important differences in the behaviour of European and USA unemployment rates has been highlighted by many studies. The European unemployment rate does appear to contain a significant non-stationary component, i.e. it seems that with each recession episode, the EU's unemployment rate is pulled towards a higher level, from which it ultimately drifts away as the economy recovers, but however, without any visible tendency to move towards some constant long-run equilibrium value.

A parallel research path has been the application of non-linear unit root tests to the unemployment rate (Cheng-Hsun Lin, Nai-Fong Kuo, and Cheng-Da Yuan 2008; Cheng Feng Lee 2010; Tsangyao Chang 2011; Suleyman Bolat, Aviral K. Tiwari, and Ahmet U. Erdayi 2014; Tiwari 2014), but the results from these have also been controversial.

In order to investigate the stationarity in our series (*U* and *g*), we calculate a new generation ADF test, the Instrument Generating Function (IGF) of Yoosoon Chang (2002) with a constant and a trend whose null hypothesis is the presence of a unit root. The number of lags for IGF tests has been selected according to the *Bayesian information criterion (*BIC) (maximum of 5 lags). We do not apply the UR test to output (*Y*) series since it has been proved by many previous studies that *Y* series is not stationary.

The obtained results for unemployment, *U* and *dU*, (presented in Table 1 globally suggest the presence of a unit root in *U* series, I(1), for almost all countries. The only country for which the IGF test rejects the null is Ireland.

Table 1 Synthesis of Panel Unit Root Tests' Results for *U*, *dU* and *g*

	U		*dU*		*G*	
Country	IGFc	IGFt	IGFc	IGFt	IGFc	IGFt
GER	0.09	0.45	-4.60***	-4.95***	-3.92***	-4.06***
IRE	-2.35***	-2.56***	-2.41**	-2.45**	-3.21***	-3.25***
GRE	0.92	0.04	-1.98**	-2.03**	-1.46	-1.72*
SPA	-0.47	-0.47	-2.62***	-2.63***	-2.24**	-2.20**
FRA	-0.93	-1.15	-3.80***	-3.90***	-2.00**	-2.09**
ITA	-1.27	-1.28	-3.56***	-3.61***	-2.86***	-3.98***
PRT	-1.42	-1.53	-4.01***	-3.95***	-2.13**	-2.17**
USA	-1.44	-1.47	-0.97	-1.10	-3.64***	-3.66***

Note: The stars have the usual meaning: *** denotes the rejection of the null at the 1% significance level; ** denotes the rejection of the null at the 5% significance level; * denotes the rejection of the null at the 10% significance level.

Source: Authors' estimation.

If a series has a unit root, then its first difference is expected to be stationary. The results of UR tests for the *dU* series suggest its stationarity, I(0), for all countries, except for the USA (i.e. the results of the IGF tests indicate non-rejection of the null hypothesis for the USA).

As for the *g* series, the results suggest that, in overall, this variable is stationary, I(0), for all countries.

Because we have some doubts about the stationarity of the *U* series and many authors assume that the unemployment rate is stationary, we verify our results by applying two other UR tests to the *U* series. More precisely, we firstly use the BBC test of Frédéric Bec, Mélika Ben Salem, and Marine Carrasco (2004), and secondly we apply the George Kapetanios and Yongcheol Shin (2006), which is a comparable test to the BBC test. These tests allow a unit root process to be distinguished from a globally stationary three-regime self-exciting threshold autoregressive process (SETAR); the null hypothesis of both tests is the presence of a unit root. More precisely, we calculate the BBC test and the KapShin tests taking a constant and a constant and trend (Fabio di Narzo Antonio, Jose Luis Aznarte, and Matthieu Stigler 2009; Stigler 2010). These tests have been chosen since they have higher power in the presence of non-linear adjustment than standard unit root tests.

Table 2 presents the BBC and KapShin tests results. As we can see, globally, the obtained results confirm the presence of a unit root in the *U* series. More precisely, in sum, the BBC and KapShin tests fail to reject the null hypothesis of a unit root for any of the countries even at the 10% significance level. We have chosen $m = 5$ as the maximum for a search of the threshold delay (d) and for two thresholds based on the BIC criterion. With the values of these parameters we apply the test proposed by Mehmet Caner and Bruce E. Hansen (2001) to the rejection of the existence of 2 thresholds against the presence of only 1. The number of bootstrap simulations was 1,000.

Table 2 BBC and KapShin Results for U

Country	m, d	BBC-maxLM	KapShin		
			Sup Wsup	Ave Wavg	ExpAve Wexp
GER	3, 2	5.52	0.51	0.31	1.17
IRE	2, 1	11.70	0.28	0.16	1.08
GRE	5, 1	13.37	0.30	0.11	1.06
SPA	2, 1	6.40	0.40	0.18	1.09
FRA	2, 1	7.48	0.28	0.15	1.08
ITA	3, 1	7.37	0.77	0.46	1.26
PRT	2, 1	9.36	0.42	0.23	1.12
USA	3, 1	9.05	0.94	0.58	1.34

Note: *, **, *** normally indicate the rejection of the null of a unit root at the 10%, 5% and 1% significance level, respectively. Wsup, Wavg and Wexp state for Wald supremum, Wald average, and Wald exponential average statistics.

Source: Authors' estimation.

The standard unit root tests are designed to determine whether time series are level or first difference stationary. However, these tests do not have the ability to make a distinction between permanent, medium or short-run persistence. To have an idea of the persistence level characterising the data generating process of these variables, we next implement the variance ratio (VR) test, proposed by John H. Cochrane (1988) and Andrew W. Lo and Craig MacKinlay (1988).

B. The Inertia Measured by the Variance Ratio

The variance ratio (VR) test is widely used to study the persistence of economic and financial variables. The VR methodology consists of testing the Random Walk Hypothesis (RWH) against stationary alternatives, by exploiting the fact that the variance of random walk increments is linear in all sampling intervals.

In order to test the RWH, we take into account the precaution concerning the heteroscedasticity of data (Cochrane 1988; James D. Hamilton 1994). We calculate the adjusted values of $M_2(k)$ statistics for $k = 15$ years (Lo and MacKinlay 1988), expecting a value near zero when a variable is stationary. The results are presented in Table 3. $M_2(k)$ statistics are robust to heteroscedasticity and have non-normal disturbances.

As can be seen from Table 3, we cannot reject the null of random walk for all countries in our sample. For most of them, the value of M_2 for the *U* series is far from unity. In other words, the obtained results suggest a great level of inertia in the *U* series. The "longest" memory to shocks is observed for France and Germany, followed by Italy, Spain and Ireland. The results obtained for Portugal are more similar to those of the USA than to the results obtained for other "PIIGS" economies. As for Greece, the effects of shock are not as high as in Germany or France.

Table 3 Lo-MacKinlay Ratio M_2 - 15 years

Country	*U*	*dU*	*g*
GER	10.06	0.02	0.48
IRE	7.27	1.02	1.27
GRE	3.61	-4.22	1.17
SPA	7.96	0.23	0.83
FRA	10.93	0.56	2.79
ITA	8.64	-0.57	2.49
PRT	2.84	-0.35	0.99
USA	2.48	-1.25	-0.86

Note: H_0: Variance ratio is equal to 1 in a random walk.

Source: Authors' estimation.

As expected, *dU* has a very low inertia even when measured after 15 years. The absence of the long memory is also identified in *g*.

Based on the results obtained by the VR test, we cannot really separate the "PIIGS" group, and confirm the widespread idea that these countries are "different" from other developed countries.

C. Conclusion about Stability and Persistence

Our results suggesta stationary characteristic for *dU* and *g* and the presence of the long memory processes in the *U* series (i.e. the non-stationarity of the *U* series). However, special attention must be given to the results obtained for the *g* series for France and Italy. The above- mentioned characteristics of our variables will be retained for our further analysis.

3. The BQ SVAR Model Estimation

We have also tested for co-integration (C-I) (long-run relationship between *Y* and *U*) by using the Johansen C-I test (1991). In most cases, no evidence of any co-integrating vectors is found, with two exceptions (i.e. we found co-integrating relationships between output (*Y*) and unemployment (*U*) for Ireland and Italy).

Based on information from the UR and co-integration tests (i.e. non-stationarity of *U*, stationarity of *g* and *dU* and absence of co-integration between these variables in almost all countries of our sample) we continue our empirical analysis by estimating a PBQ SVAR model separately for each country. The optimal lag order for each model was chosen by the BIC criteria and in most cases it is equal to 1. The exceptions are the models for Greece and USA, where the optimal lag order is 2 (see Table 4).

The obtained results taken together are satisfactory. For all models, the absolute value of the eigenvalues of the reverse characteristics' polynomial lie inside the unit circle (the modulus of each eigenvalue of matrix A is strictlyless than 1), which indicates model stability. Autocorrelation of the residuals (AR) was tested by using the *Lagrange Multiplier* (LM) type test for autocorrelation with 1 lag (see Jurgen A. Doornik 1996).

Table 4 VAR Models

Country	VAR order	A roots	ARCH CS45	AR CS4
GER	1	0.81 / 0.58	47.37	0.31
IRE	1	0.65 / 0.22	55.96	5.96
GRE	2	0.8 / 0.8 / 0.66 / 0.39	55.35	3.14
SPA	1	0.72 / 0.43	36.8	5.72
FRA	1	0.70 / 0.40	34.76	10.59**
ITA	1	0.51 / 0.51	58.8*	6.68
PRT	1	0.50 / 0.50	55.66	3.32
USA	2	0.85 / 0.40 / 0.40 / 0.29	38.52	3.68

Note: ARCH and AR are multivariate tests with 5 and 1 lags. ARCH tests H_0: there is no ARCH effect present. For AR, H_0: absence of autocorrelation in residuals of order one. CS45 and CS4 should be read as Chi-Squared with 45 and 4 degrees of freedom. The stars have the usual meaning.

Source: Authors' estimation.

Table 5 Matrix of Contemporary and Long-Run Impacts of Supply and Demand Disturbances on Unemployment and Output

Country		Contemporaneous impact matrix		Log-run impact matrix	
		Supply	***Demand***	***Supply***	***Demand***
GER	*g*	0.020***	-0.008	0.029**	0.000
	dU	-0.209	0.620***	0.419	1.334***
IRE	*g*	0.023***	0.009	0.066***	0.000
	dU	-0.896***	0.702***	-2.616**	1.356***
GRE	*g*	0.034***	0.000	0.099***	0.000
	dU	-0.241	0.760***	-1.810**	1.172***
SPA	*g*	0.018***	0.001	0.066***	0.000
	dU	-1.008***	1.196***	-2.453**	2.124***
FRA	*g*	0.011***	-0.010***	0.050***	0.000
	dU	0.071	0.509***	-0.165	0.697***
ITA	*g*	0.021***	-0.008*	0.042***	0.000
	dU	0.017	0.575***	-0.362	0.900***
PRT	*g*	0.027***	-0.008	0.067***	0.000
	dU	-0.176	0.845***	-0.926*	1.192***
USA	*g*	0.013***	-0.014**	0.045**	0.000
	dU	-0.158	0.878***	-0.259	1.141***

Note: The stars have the usual meaning and were calculated by bootstrap simulation 1,000 times.

Source: Authors' estimation.

As we can see, we cannot reject the null of absence of autocorrelation in residuals of order one at the 5% significance level for France. Table 8 also presents the results of the autoregressive conditional heteroscedasticity (ARCH) tests (Robert F. Engle 1982) for each country. The results of these tests suggest that we cannot reject the null hypothesis of the absence of the ARCH effect for Italy at the 10% significance level.

Moreover, the figures of the CUSUM-squared tests and the eigenvalues of the companion matrix for the different models (see Appendix B) suggest that for almost all countries (except Greece and Portugal) there is no evidence against structural instability of the estimated models at the 5% significance level. As for Greece and Portugal, the results indicate that we have problems of instability of the coefficients in the second equation (*dU*) (Figures 3 and 7 of the Appendix B).

We conclude that the estimated VAR models are an appropriate representation for these economies and we build the SVAR model with the BQ restrictions from them obtaining what we have named the PBQ models. The following table summarises the results for the supply and demand shocks adjustment dynamics of output and unemployment rate. Figures provided in Appendix C report the impulse response functions on output and unemployment in the countries in our sample.

3.1 Short-Run Evaluation of Supply and Demand Shocks

Short-Run Evaluation of Supply Shocks

The results suggest that there appear to have been major differences in the capacity of countries to deal with the short-run supply shocks. The most important contemporaneous impact of a supply disturbance on output is in Greece (0.034), followed by Portugal (0.027), Ireland (0.023), Italy (0.021), Germany (0.020), Spain (0.018), USA (0.013) and France (0.011), see Tables 5 and 6.

An important element to take into account is the symmetry of shocks. For instance, in the case of a negative supply shock on output, its negative effects would be much higher in Greece (0.034) than in France (0.011). Conversely, in the case of a positive supply shock (e.g. recent decrease in oil prices), the positive effects on output would be much higher in Greece than in France.

In overall, the contemporary effects in the PIIGS group is higher than in the benchmark economies. Only Spain registers an effect lower than that of Germany but, nonetheless, higher than that of the USA.

Table 6 Contemporary Effects of Supply Shocks on Output

GRE	PRT	IRE	ITA	GER	SPA	USA	FRA
0.034	0.027	0.023	0.021	0.020	0.018	0.013	0.011

Source: Authors' estimation.

As for unemployment responses, two groups of countries emerge in terms of responses to this shock (see Table 9). They are significant and rather important in Spain (-1.008) and Ireland (-0.896), and they are not statistically significant in other countries of our sample (Germany, Greece, France, Italy, Portugal, and the United States).

Short-Run Evaluation of Demand Shocks

As can be seen from Table 7, for the majority of PIIGS demand shocks does not influence output, the only exception being Italy (-0.008). As for other economies, it does affect output in France (-0.010) and in the USA (-0.014) but not in Germany.

Table 7 Contemporary Effects of Demand Shocks on Output

ITA	FRA	USA
-0.008	-0.010	-0.014

Source: Authors' estimation.

Contemporary demand shocks are expected to have minor effects on the unemployment rate in PIIGS since the alleged rigidity on the labour market does not allow a fast reaction by that rate. Therefore, the contemporary effects should be minor if not null. However, what we can see from Table 8 is that, firstly, the effects of contemporary demand shocks are not null in all countries of our sample; and secondly, they are much lower in France (0.509) and Germany (0.620) than in Spain (1.196), Portugal (0.845), Greece (0.620), and Ireland (0.702). More precisely, the largest impact of the short-run demand shock on unemployment is observed in Spain (1.196), and the smallest one in France (0.509).

Table 8 Contemporary Effects of Demand Shocks on Unemployment

SPA	USA	PRT	GRE	IRE	GER	ITA	FRA
1.196	0.878	0.845	0.760	0.702	0.620	0.575	0.509

Note: One should keep in mind that negative demand shocks are evaluated as positive shocks on *dU*.

Source: Authors' estimation.

Once again, based on the obtained results, it is quite difficult to separate PIIGS from benchmark economies. As for France, the slowness of its adjustment could be explained, at least partly, by the rigidity of the French labour market.

3.2 Long-Run Evaluation of Supply and Demand Shocks

Long-Run Evaluation of Supply Shocks on Output

If we consider Italy, France, Germany and the USA as "more mature economies" the above argument applies also to responses to supply shocks. The response to supply (Table 9) should be lower in mature economies and higher in economies with lower levels of income due to the higher potential of growth in this last group which is exactly what is suggested by our results.

Table 9 Long-Run Effects of Supply Shocks on Output

GRE	PRT	SPA	IRE	FRA	USA	ITA	GER
0.099	0.067	0.066	0.066	0.050	0.045	0.040	0.029

Source: Authors' estimation.

The most important long-run impact of a supply disturbance on output is observed in PIIGS (except Italy), and then in France.

Long-Run Evaluation of Supply Shocks on Unemployment

As for the effects of supply shocks on unemployment in the long-run, our results suggest that for some countries in our sample these impacts are not significantly different from zero (Table 10).

Table 10 Long-Run Effects of Supply Shocks on Unemployment

IRE	SPA	GRE	PRT	USA
-2.616	-2.453	-1.810	-0.926	-0.259

Source: Authors' estimation.

Here again, the long-run effects of supply shocks are much higher in PIIGS economies (with the exception of Italy, but the coefficient is not significantly different from zero) than for our benchmark economy, the USA.

Long-Run Evaluation of Demand Shocks

The long-run impact matrix corresponds to the accumulated values of *g* and *dU*. In other words, it corresponds to the effects on output (*Y*) and unemployment (*U*). The long-run effect of a demand shock on output is null as a result of the model's constraints.

As for its impact on unemployment, the results are summarised in Table 11.

Table 11 Long-Run Effects of Demand Shocks on Unemployment

SPA	IRE	GER	PRT	GRE	USA	ITA	FRA
2.124	1.356	1.334	1.192	1.172	1.141	0.900	0.697

Source: Authors' estimation.

As we can see, only two countries in our sample, i.e. Italy (PIIGS group) and France, have an effect lower than that observed for the USA. Moreover, PIIGS have an effect higher than that of France. The obtained results confirm that demand policies are more effective for lower levels of income than for higher levels. At the same time, the results provide an additional explanation of why France faces so much difficulty in trying to reverse the unemployment curve.

The Time-Profile of Supply Shocks

After the above evaluation in terms of the importance of shocks, we compare the time profile of the evolution of the supply shocks effects (Table 12). The analysis of the speed of adjustment to shocks in these countries allows us to ascertain whether the shock responses are synchronic or not. The values in this table should be read as follows: e.g. for Portugal, 4 means that the effect on output 5 (4+1) years after the shock is less than 10% of its initial value. The number of years should be read carefully because of the stochastic nature of impulse responses.

Table 12 Time Profile of Supply Shocks (Years)

	On output	On unemployment
Portugal	4	6
Italy	3	5[(a)]
Ireland	5	5
Greece	4	4
Spain	7	4
Germany	(*)	(*)
USA	8	3
France	8	11[(a)]

Note: (a) As the value of the first impulse was positive, we take the second one that was already negative. (*) We have not included any number because after the second year of the initial shock the impulses have changed their signs.

Source: Authors' calculation.

As for the impact of the supply shocks on output, there is no clear difference between the USA and some European countries like France and Spain (they need 7-8 years to *absorb* the effects of the *supply shocks). As for other PIIGS countries, the impact is even lower than that observed for the USA (i.e. they need only from 3 to 5 against 8 years)*. In terms of unemployment, we can see that the speed adjustments in PIIGS are more or less homogenous (they need between 4 and 6 years to absorb this type of shock), and slightly higher than that of the USA (3 years). The speed adjustment in France, however, is extremely slow compared to that in the USA and PIIGS. This last finding (slowness of adjustment) can partly explain the current situation in France (e.g. the recent sluggish *economic growth* and continuously increasing unemployment rate). It can also be seen as a signal to the French government of the importance of accelerating the implementation of its structural reforms.

4. Conclusion

The main purpose of this paper has been to establish whether PIIGS, all of which continue to register sluggish growth rates and high levels of unemployment, are so much different from other developed economies. To achieve this aim, we built an empirical model based on the famous Okun Law - one of the pillars of empirical macroeconomics - that relates changes in the unemployment rate to changes in output growth. We assume that each economy has its own dynamics of output and unemployment. This condition may be assumed for Europe, as was confirmed by Roger Perman and Christophe Tavera (2007), but a different conclusion was confirmed by Mustafa Ege Yazgan and Hakan Yilmazkuday (2009) for the USA for the period 1978-2002. The results of the non-parametric estimation suggest that we can identify different patterns of OL for PIIGS, the benchmark economies, and France. However, this finding is not confirmed by the results of our subsequent analysis.

We confirm that the unemployment rate has a unit root and that the output growth is stationary. The VR test results confirm the high level of persistence of shocks in the unemployment rate. We differentiate the unemployment rate to make it stationary. A VAR model for each country was estimated with g and dU. Its order was chosen by the BIC criterion and they revealed that the VARS were stable and, in general, that we could not reject the null of constancy of coefficients as well as the absence of auto-correlation and ARCH behaviour of the errors. We estimate SVAR versions of these models with BQ long-run constraints.

The analysis of short-run shocks suggests: (a) the existence of high values of contemporaneous effects of supply shocks on output in the PIIGS group; (b) the general absence of effects of demand shocks on output; (c) the effects of demand shocks on unemployment are rather similar for all countries in our sample and do not give us any reason to differentiate a “PIIGS group”; (d) the worst result is obtained for France.

In terms of long-run effects, the results for demand shock on unemployment do not allow us to identify a “PIIGS group”; and once more, the worst result is obtained for France. As for the effects of supply shocks on output and unemployment, they indicate there is no reason to identify PIIGS as a group of countries with worse results than the benchmark economies. In fact, the time profile of supply shocks shows that it takes much longer to have positive effects on output in the USA and France than in PIIGS (Table 12). The more relevant information in terms of time profile is that pertaining to France (e.g. not only is the effect of a supply shock on unemployment not different from 0, but also it takes too much time to be absorbed [11 years]).

We conclude that in terms of our macroeconomic analysis there is no justification for identifying a "PIIGS group" when we compare the countries in that group with Germany, the USA, and France. The analysis of these eight countries allows us:

(i) to reject that identification. Instead, a country that stands out from our analysis is France. If "PIIGS" signifies "countries with poor economic performances" then France, given its recent performance, should also belong to this group;

(ii) to identify a country (France) whose economy reacts to demand and supply shocks in its own way with less elasticity and more slowly.

However, our results do not suggest that there is no need to continue to implement structural reforms in PIIGS, and especially those reforms that will help countries to make their labour market even more flexible, and those that will increase their competitiveness. Policies that will produce positive effects such as: "well-functioning labour markets"; "increasing competition"; "unlocking of business potential"; and "that help to diffuse innovation" (Trichet 2006) are recommended.

Our results also inform us of the current and future difficulties facing France. On the one hand, they indicate that the long-run effects of demand shocks on unemployment are the lowest in France; on the other hand, they suggest that the speed adjustment to supply shock on unemployment in France is the lowest one among all the countries of our sample.

References

Abdel-Raouf, Fatma. 2011. "Has Okun's Law Changed over Time, with Emphasis on the 2007-09 Recession?" *Proceedings of the Northeast Business & Economics Association*, January: 1-6.

Adams, Charles, and David T. Coe. 1990. "A Systems Approach to Estimating the Natural Rate of Unemployment and Potential Output for the United States." *IMF Staff Papers*, 37(2): 232-293. http://dx.doi.org/10.2307/3867290

Altig, David, Terry Fitzgerald, and Peter Rupert. 1997. "Okun's Law Revisited: Should We Worry about Low Unemployment." Federal Reserve Bank of Cleveland, Economic Commentary 15.

Anderton, Robert, Ted Aranki, Boele Bonthuis, and Valerie Jarvis. 2014. "Disaggregating Okun's Law: Decomposing the Impact of the Expenditure Components of GDP on Euro Area Unemployment." European Central Bank Working Paper 1747.

Apergis, Nicholas, and Anthony Rezitis. 2003. "An Examination of Okun's Law: Evidence from Regional Areas in Greece." *Applied Economics*, 35: 1147-1151. http://dx.doi.org/10.1080/0003684032000066787

Attfield, Clifford, and Brian Silverstone. 1998. "Okun's Law, Cointegration and Gap Variables." *Journal of Macroeconomics*, 20(3): 625-637. http://dx.doi.org/10.1016/S0164-0704(98)00076-7

Ball, Laurence, João T. Jalles, and Prakash Loungani. 2015. "Do Forecasters Believe in Okun's Law? An Assessment of Unemployment and Output Forecasts." *International Journal of Forecasting*, 31(1): 176-184. http://dx.doi.org/10.1016/j.ijforecast.2014.03.009

Bashar, Omar H. M. N. 2011. "On the Permanent Effect of an Aggregate Demand Shock: Evidence from the G-7 Countries." *Economic Modelling*, 28(3): 1374-1382. http://dx.doi.org/10.1016/j.econmod.2011.02.013

Bec, Frédéric, Mélika Ben Salem, and Marine Carrasco. 2004. "Tests for Unit-Root versus Threshold Specification with an Application to the Purchasing Power Parity Relationship." *Journal of Business and Economic Statistics*, 22(4): 382-395. http://dx.doi.org/10.1198/073500104000000389

Blanchard, Olivier J., and Lawrence H. Summers. 1986. "Hysteresis in Unemployment." National Bureau of Economic Research Working Paper 2035.

Blanchard, Olivier J., and Danny Quah. 1989. "The Dynamic Effects of Aggregate Demand and Supply Disturbances." *American Economic Review*, 79(4): 655-673.

Blanchard, Olivier J. 1999. *Macroeconomics*. New Jersey: Prentice Hall International.

Blinder, Alan S. 1997. "A Core of Macroeconomics Beliefs?" *Challenge*, 40(4): 36-44. http://dx.doi.org/10.1080/05775132.1997.11471984

Boďa, Martin, and Mariana Považanová. 2015. "Gender Asymmetry in Okun's Law in the Four Pigs Countries." *Procedia Economics and Finance*, 30(15): 111-123. http://dx.doi.org/10.1016/S2212-5671(15)01260-5

Bolat, Suleyman, Aviral K. Tiwari, and Ahmet U. Erdayi. 2014. "Unemployment Hysteresis in the Eurozone Area: Evidences from Nonlinear Heterogeneous Panel Unit Root Test." *Applied Economics Letters*, 21(8): 536-540. http://dx.doi.org/10.1080/13504851.2013.872755

Breitung, Jörg, Ralf Brüggemann, and Helmut Lütkepohl. 2004. "Structural Vector Autoregressive Modelling and Impulse Responses." In *Applied Time Series Econometrics*, ed. Helmut Lütkepohl and Markus Krätzig, 159-196. Cambridge, NY: Cambridge University Press.

Brown, R. L., J. Durbin, and J. M. Evans. 1975. "Techniques for Testing the Constancy of Regression Relationships over Time." *Journal of the Royal Statistical Society, Series B (Methodological)*, 37(2): 149-192.

Brunner, Allan D. 1997. "On the Dynamic Properties of Asymmetric Models of Real GNP." *The Review of Economics and Statistics*, 79(2): 321-326. http://dx.doi.org/10.1162/003465397556674

Caner, Mehmet, and Bruce E. Hansen. 2001. "Threshold Autoregression with a Unit Root." *Econometrica*, 69(6): 1555-1596. http://dx.doi.org/10.1111/1468-0262.00257

Chang, Tsangyao. 2011. "Hysteresis in Unemployment for 17 OECD Countries: Stationary Test with a Fourier Function." *Economic Modelling*, 28(5): 2208-2214. http://dx.doi.org/10.1016/j.econmod.2011.06.002

Chang, Yoosoon. 2002. "Nonlinear IV Unit Root Tests in Panels with Cross-Sectional Dependency." *Journal of Econometrics*, 110(2): 261-292. http://dx.doi.org/10.1016/S0304-4076(02)00095-7

Cheng, Ka Ming, Nazif Durmaz, Hyeongwoo Kim, and Michael L. Stern. 2012. "Hysteresis vs. Natural Rate of US Unemployment." *Economic Modelling*, 29(2): 428-434. http://dx.doi.org/10.1016/j.econmod.2011.11.012

Cochrane, John H. 1988. "How Big Is the Random Walk in GNP?" *Journal of Political Economy*, 96(5): 893-920. http://dx.doi.org/10.1086/261569

Crowder, William J. 1995. "The Dynamics Effects of Aggregate Demand and Supply Disturbances: Another Look." *Economic Letters*, 49(3): 231-237. http://dx.doi.org/10.1016/0165-1765(95)00680-E

Daly, Mary C., John Fernald, Òscar Jordà, and Fernanda Nechio. 2014. "Interpreting Deviations from Okun's Law." http://www.frbsf.org/economic-research/files/el2014-12.pdf.

Davenport, Paul. 1982. "Technical Change and Unemployment." *Journal of Post Keynesian Economics*, 1: 34-50.

Di Narzo, Antonio Fabio, Jose Luis Aznarte, and Matthieu Stigler. 2009. "TsDyn: Time Series Analysis Based on Dynamical Systems Theory." https://cran.r-project.org/web/packages/tsDyn/citation.html.

Doornik, Jurgen A. 1996. "Testing Vector Error Autocorrelation and Heteroscedasticity." http://www.doornik.com/research/vectest.pdf.

Dreger, Christian, and Hans-Eggert Reimers. 2009. "Hysteresis in the Development of Unemployment: The EU and US Experience." *Spanish Economic Review*, 11(4): 267-276. http://dx.doi.org/10.1007/s10108-009-9055-0

Engle, Robert F. 1982. "Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation." *Econometrica*, 50(1): 987-1007. http://dx.doi.org/10.2307/1912773

Farsio, Farzad, and Stacey Quade. 2003. "An Empirical Analysis of the Relationship between GDP and Unemployment." *Humanomics*, 19(3): 1-6. http://dx.doi.org/10.1108/eb018884

Ferreiro, Jesús, Catalina Gálvez, and Ana González. 2015. "Fiscal Policies in the European Union during the Crisis." *Panoeconomicus*, 62(Special Issue): 131-155. http://dx.doi.org/10.2298/PAN1502131F

Fève, Patrick, Pierre-Yves Hénin, and Philippe Jolivaldt. 2003. "Testing for Hysteresis: Unemployment Persistence and Wage Adjustment." *Empirical Economics*, 28(3): 535-552. http://dx.doi.org/10.1007/s001810200144

Freeman, Donald G. 2000. "Regional Tests of Okun's Law." *International Advances in Economic Research*, 6(3): 557-570. http://dx.doi.org/10.1007/BF02294972

Furuoka, Fumitaka. 2015. "Unemployment Hysteresis in the 'Nordic Kitten': Evidence from Five Estonian Regions." *Panoeconomicus*, 62(5): 631-642. http://dx.doi.org/10.2298/PAN1505631F

Gamber, Edward, and Frederick Joutz. 1993. "The Dynamics Effects of Aggregate Demand and Supply Disturbances: Comment." *American Economic Review*, 83(5): 1387-1393.

Gordon, Robert J., and Arthur M. Okun. 1980. "Postwar Macroeconomic Performance: The Evolution of Events and Ideas." In *The American Economy in Transition*, ed. Martin Feldstein, 101-182. Chicago: University of Chicago Press.

Gordon, Robert J., and Peter K. Clark. 1984. "Unemployment and Potential Output in the 1980s." *Brookings Papers on Economic Activity*, 1984(2): 537-568. http://dx.doi.org/10.2307/2534438

Gordon, Robert J. 2010. "Okun's Law and Productivity Innovations." *American Economic Review*, 100(2): 11-15. http://dx.doi.org/10.1257/aer.100.2.11

Hall, Robert E., and John B. Taylor. 1988. *Macroeconomics: Theory, Performance and Policy*. New York: W. W. Norton & Company.

Hamilton, James D. 1994. *Time Series Analysis*. Princeton: Princeton University Press.

Hayfield, Tristen, and Jeffrey S. Racine. 2008. "Nonparametric Econometrics: The np Package." *Journal of Statistical Software*, 27(5): 1-32.

Hoover, Kevin D. 2001. *The Methodology of Empirical Macroeconomics*. Port Chester, NY: Cambridge University Press. http://dx.doi.org/10.1017/CBO9780511613050

Huang, Ho-Chuan, and Chih-Chuan Yeh. 2013. "Okun's Law in Panels of Countries and States." *Applied Economics*, 45(2): 191-199. http://dx.doi.org/10.1080/00036846.2011.597725

Hultgren, Thor. 1960. "Changes in Labor Cost during Cycles in Production and Business." National Bureau of Economic Research Occasional Paper 74.

Johansen, Soren. 1995. *Likelihood-Based Inference in Cointegrated Vector Autoregressive Models*. Oxford: Oxford University Press.

Kahn, George A. 1996. "New Estimates of the U.S. Economy's Potential Growth Rate." *Contemporary Economic Policy*, 14(4): 1-16. http://dx.doi.org/10.1111/j.1465-7287.1996.tb00629.x

Kapetanios, George, and Yongcheol Shin. 2006. "Unit Root Tests in Three-Regime SETAR Models." *Econometrics Journal*, 9(2): 252-278. http://dx.doi.org/10.1111/j.1368-423X.2006.00184.x

Karfakis, Costas, Constantinos Katrakilidis, and Eftychia Tsanana. 2014. "Does Output Predict Unemployment? A Look at Okun's Law in Greece." *International Labour Review*, 153(3): 421-433. http://dx.doi.org/10.1111/j.1564-913X.2014.00018.x

Kargi, Bilal. 2014. "Okun's Law and Long Term Co-Integration Analysis for OECD Countries (1987-2012)." *Emerging Markets Journal*, 6(1): 39-47. http://dx.doi.org/10.5195/EMAJ.2016.97

Kaufman, Roger T. 1988. "An International Comparison of Okun's Law." *Journal of Comparative Economics*, 12(2): 182-203. http://dx.doi.org/10.1016/0147-5967(88)90002-9

Keynes, John Maynard. 1936. *The General Theory of Employment, Interest and Money*. London: Macmillan.

Kim, Jae H. 2014. "Vrtest: Variance Ratio Tests and other Tests for Martingale Difference Hypothesis." https://cran.r-project.org/web/packages/vrtest/index.html.

Knotek, Edward S. 2007. "How Useful Is Okun's Law?" https://www.kansascityfed.org/publicat/econrev/pdf/4q07knotek.pdf.

Lang, Dany, and Christian de Peretti. 2009. "A Strong Hysteretic Model of Okun's Law: Theory and a Preliminary Investigation." *International Review of Applied Economics*, 23(4): 445-462. http://dx.doi.org/10.1080/02692170902954775

Lee, Jim. 2000. "The Robustness of Okun's Law: Evidence from OECD Countries." *Journal of Macroeconomics*, 22(2): 331-356. http://dx.doi.org/10.1016/S0164-0704(00)00135-X

Lee, Cheng-Feng. 2010. "Testing for Unemployment Hysteresis in Nonlinear Heterogeneous Panels: International Evidence." *Economic Modelling*, 27(5): 1097-1102. http://dx.doi.org/10.1016/j.econmod.2010.03.010

Lin, Cheng-Hsun, Nai-Fong Kuo, and Cheng-Da Yuan. 2008. "Nonlinear vs. Nonstationary of Hysteresis in Unemployment: Evidence from OECD Economies." *Applied Economics Letters*, 15(11): 905-909. http://dx.doi.org/10.1080/13504850600949145

Lippi, Marco, and Lucrezia Reichlin. 1993. "The Dynamic Efftects of Aggregate Demand and Supply Disturbances: Comment." *American Economic Review*, 83(3): 645-652.

Liu, De-Chih, Chin-Hwa Sun, and Pei-Chien Lin. 2012. "Hysteresis Hypothesis in Unemployment and Labour Force Participation Rates: Evidence from Australian States and Territories." *Australian Economic Papers*, 51(2): 71-84. http://dx.doi.org/10.1111/j.1467-8454.2012.00423.x

Lo, Andrew W., and Craig MacKinlay. 1988. "Stock Market Prices Do Not Follow Random Walks: Evidence from a Simple Specification Test." *The Review of Financial Studies*, 1(1): 41-66. http://dx.doi.org/10.1093/rfs/1.1.41

Lovell, Michael C. 2004. *Economics with Calculus*. River Edge: World Scientific Publishing Company. http://dx.doi.org/10.1142/5523

Lütkepohl, Helmut, and Markus Krätzig, eds. 2004. *Applied Time Series Econometrics (Themes in Modern Econometrics)*. Cambridge, NY: Cambridge University Press.

Maddala, Gangadharrao S., and In-Moo Kim. 1998. *Unit Roots Cointegration and Structural Change*. Cambridge: Cambridge University Press. http://dx.doi.org/10.1017/CBO9780511751974.019

Mendonça, António. 2014. "The European Crisis and Global Economic Dynamics: Continental Enlargment versus Atlantic Opening." *Panoeconomicus*, 61(Special Issue): 543-569. http://dx.doi.org/10.2298/PAN1405543M

Monhollon, Jimmie R., and William E. Cullison. 1970. "Okun's Law and the Natural Rate of Growthh: Comment." *Southern Economic Journal*, 37(2): 231-232.

Moosa, Imad A. 1997. "A Cross-Country Comparisom of Okun's Coefficient." *Journal of Comparative Economics*, 24(3): 335-356. http://dx.doi.org/10.1006/jcec.1997.1433

Neftçi, Salih N. 1984. "Are Economic Time Series Asymmetric over the Business Cycle?" *Journal of Political Economy*, 92(2): 307-328. http://dx.doi.org/10.1086/261226

Nguyen, D. T., and A. Mahinda Siriwardana. 1988. "The Relationship between Output Growth and Unemployment: A Re-Examination of Okun's Law in Australia." *Australia Economic Review*, 21(1): 16-27. http://dx.doi.org/10.1111/j.1467-8462.1988.tb00533.x

Okun, Arthur M. 1962a. "The Gap between Actual and Potential Output (Proceedings of the American Statistical Association)." In *Problems of the Modern Economy*, ed. Edmund S. Phelps. New York: W. W. Norton & Company.

Okun, Arthur M. 1962b. "Potential GNP: Its Measurement and Significance." https://milescorak.files.wordpress.com/2016/01/okun-potential-gnp-its-measurement-and-significance-p0190.pdf.

Perman, Roger, and Christophe Tavera. 2007. "Testing for Convergence of the Okun's Law Coefficient in Europe." *Empirica*, 34(1): 45-61. http://dx.doi.org/10.1007/s10663-006-9025-9

Pesliakaitė, Jurgita. 2015. "The Impact of GDP Structure on the Stability of Okun's Law in Lithuania." *Monetary Studies*, 19(2): 88-94.

Pfaff, Bernhard. 2008. *Analysis of Integrated and Cointegrated Time Series with R*. 2nd ed. New York: Springer.

Prachowny, Martin F. J. 1993. "Okun's Law: Theoretical Foundations and Revised Estimates." *The Review of Economics and Statistics*, 75(2): 331-336.

R Development Core Team. 2015. *R: A Language and Environment for Statistical Computing*. Vienna: R Foundation for Statistical Computing.

Roed, Knut. 1999. "A Note on the Macroeconomic Modelling of Unemployment Hysteresis." *Applied Economic Letters*, 6(4): 255-258. http://dx.doi.org/10.1080/135048599353465

Rothman, Philip. 1991. "Further Evidence on the Asymmetric Behaviour of Unemployment Rates over the Business Cycle." *Journal of Macroeconomics*, 13(2): 291-298.

Rülke, Jan-Christoph. 2012. "Do Professional Forecasters Apply the Phillips Curve and Okun's Law? Evidence from Six Asian-Pacific Countries." *Japan and the World Economy*, 24(4): 317-324. http://dx.doi.org/10.1016/j.japwor.2012.05.002

Silvapulle, Paramsothy, Imad A. Moosa, and Mervyn J. Silvapulle. 2004. "Asymmetry in Okun's Law." *Canadian Journal of Economics*, 37(2): 353-374. http://dx.doi.org/10.1111/j.0008-4085.2004.00006.x

Sögner, Leopold, and Alfred Stiassny. 2002. "An Analysis on the Structural Stability of Okun's Law - A Cross-Country Study." *Applied Economics*, 34(14): 1775-1787. http://dx.doi.org/10.1080/00036840210124180

Srinivasan, Naveen, and Pratik Mitra. 2012. "Hysteresis in Unemployment: Fact or Fiction?" *Economics Letters*, 115(3): 419-422. http://dx.doi.org/10.1016/j.econlet.2011.12.070

Srinivasan, Naveen, and Pratik Mitra. 2014. "The European Unemployment Problem: Its Cause and Cure." *Empirical Economics*, 47(1): 57-73. http://dx.doi.org/10.1007/s00181-013-0746-x

Stigler, Matthieu. 2010. "Threshold Cointegration: Overview and Implementation in R." https://cran.r-project.org/web/packages/tsDyn/vignettes/ThCointOverview.pdf.

Thirlwall, Anthony. 1969. "Okun's Law and the Natural Rate of Growth." *Southern Economic Journal*, 36(1): 87-89.

Thirlwall, Anthony, and Norman John Ireland. 1970. "Okun's Law and the Natural Rate of Growth: Reply." *Southern Economic Journal*, 37(2): 232-234. http://dx.doi.org/10.2307/1056140

Thurow, Lester. 1983. *Dangerous Currents: The State of Economics*. Oxford: Oxford University Press.

Tiwari, Aviral K. 2014. "Unemployment Hysteresis in Australia: Evidence Using Nonlinear and Stationarity Tests with Breaks." *Quality and Quantity*, 48(2): 681-695. http://dx.doi.org/10.1007/s11135-012-9795-z

Trichet, Jean-Claude. 2006. "Structural Reforms in Europe." http://www.ecb.europa.eu/press/key/date/2006/html/sp060522_1.en.html.

Tsung-wu, Ho. 2015. "PdR: Panel Data Regression: Threshold Model and Unit Root Tests." http://www.imsbio.co.jp/RGM/R_package?p=pdR&d=R_CC.

Valadkhani, Abbas, and Russell Smyth. 2015. "Switching and Asymmetric Behaviour of the Okun Coefficient in the US: Evidence for the 1948-2015 Period." *Economic Modelling*, 50: 281-290. http://dx.doi.org/10.1016/j.econmod.2015.07.001

Vickrey, William. 1993. "Today's Task for Economists." *The American Economic Review*, 83(1): 1-10.

Watts, Martin, and William Mitchell. 1991. "Alleged Instability of the Okun's Law Relationship in Australia: An Empirical Analysis." *Applied Economics*, 23(12): 1829-1838. http://dx.doi.org/10.1080/00036849100000172

Weber, Christian E. 1995. "Cyclical Output, Cyclical Unemployment, and Okun's Coefficient: A New Approach." *Journal of Applied Econometrics*, 10(4): 433-445. http://dx.doi.org/10.1002/jae.3950100407

Yazgan, Mustafa Ege, and Hakan Yilmazkuday. 2009. "Okun's Convergence with the U.S." *Letters in Spatial and Resource Sciences*, 2(2): 109-122.

You, Jong Keun. 1979. "Capital Utilization, Productivity, and Output Gap." *The Review of Economics and Statistics*, 61(1): 91-100. http://dx.doi.org/10.2307/1924835

Zanin, Luca. 2014. "On Okun's Law in OECD Countries: An Analysis by Age Cohorts." *Economics Letters*, 125(2): 243-248. http://dx.doi.org/10.1016/j.econlet.2014.08.030

Appendix A

Table 1 presents some macroeconomic indicators (before crisis [2007] and after it [2014]) for PIIGS, France, Germany, and the USA. As we can see from this table, the macroeconomic situation in PIIGS and France, compared to those of Germany and the USA, is characterised by the important external deficits, sluggish economic growth, high levels of public deficit and debt and, nowadays, by the high levels of unemployment.

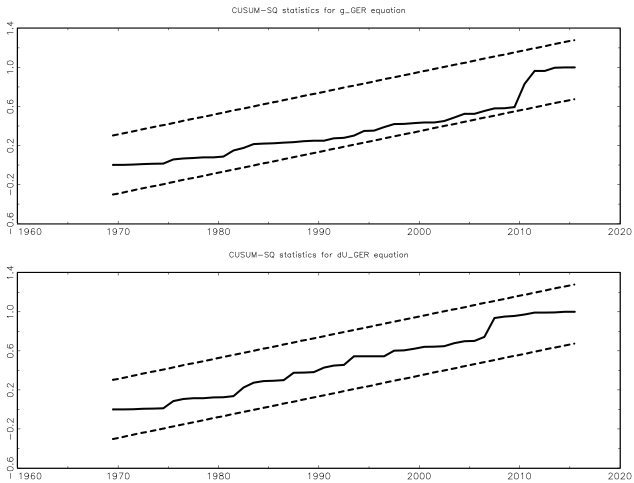
Table 1 Macroeconomic Indicators of PIIGS, France, Germany and the USA in 2007 and 2014

Country	d/Y	Debt/Y_{2007}	Debt/Y_{2014}	g(2001/07)	g(2008/14)	U_{2007}	U_{2014}
Portugal	-7.18	68.44	130.17	0.01	-0.01	9.1	14.1
Ireland	-3.88	23.93	107.48	0.05	0,00	4.7	11.3
Italy	-3.04	99.73	132.35	0.01	-0.01	6.1	12.7
Greece	-3.57	103.14	178.60	0.04	-0.04	8.4	26.5
Spain	-5.89	35.51	99.29	0.03	-0.01	8.2	24.5
France	-3.95	64.40	95.56	0.02	0.00	8	10.3
Germany	0.31	63.59	74.92	0.01	0.01	8.5	5
USA	-4.85	64.01	105.20	0.02	0.01	4.6	6.2

Note: d/Y: net lending(+) / borrowing(-): percentage of GDP; Debt/Y: gross general government debt percentage of GDP; g(2001/07) and g(2008/14): average growth of GDP per head from 2001 to 2007 and from 2008 to 2014; U: unemployment rate.

Source: AMECO.

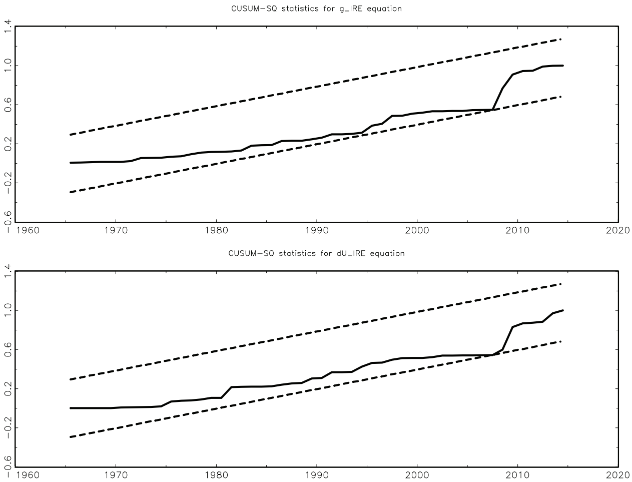
Appendix B



$$|Z^{-1}| = (0.16 \quad 0.72 \quad 0.62 \quad 0.62)$$

Source: Authors' estimation.

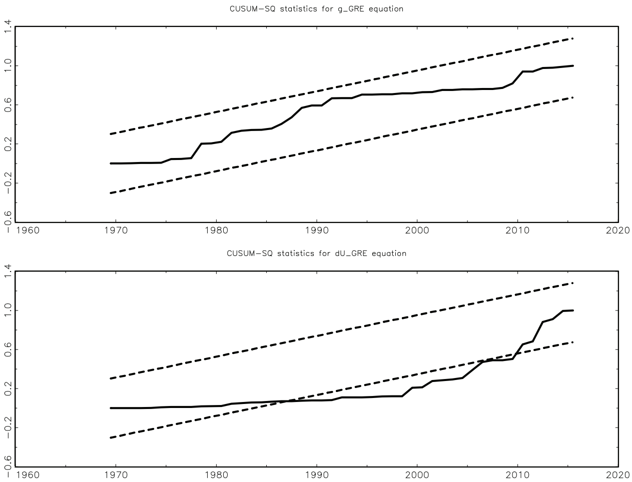
Figure 1 Tests of VAR Model Stability for Germany



$$|Z^{-1}| = (0.65 \quad 0.22)$$

Source: Authors' estimation.

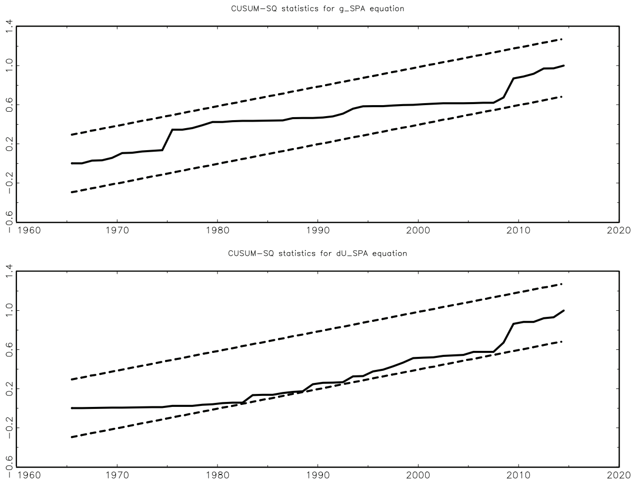
Figure 2 Tests of VAR Model Stability for Ireland



$$|Z^{-1}| = (0.8 \;\; 0.8 \;\; 0.66 \;\; 0.39\,)$$

Source: Authors' estimation.

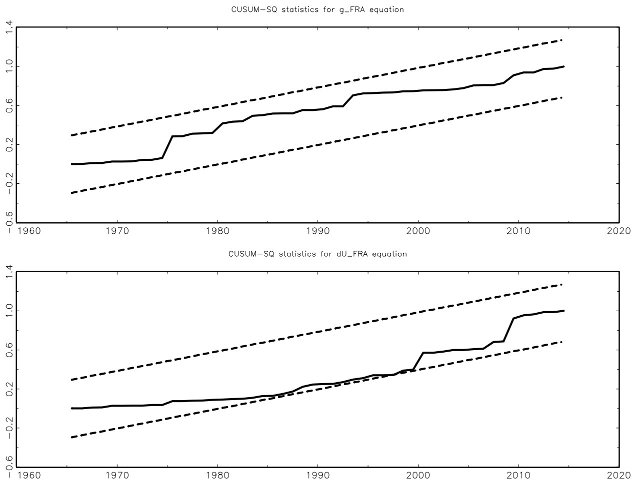
Figure 3 Tests of VAR Model Stability for Greece



$$|Z^{-1}| = (0.72 \quad 0.43)$$

Source: Authors' estimation.

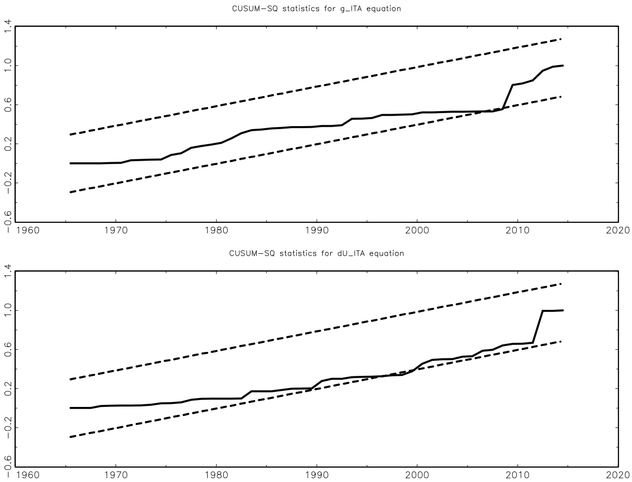
Figure 4 Tests of VAR Model Stability for Spain



$$|Z^{-1}| = (0.70 \quad 0.40)$$

Source: Authors' estimation.

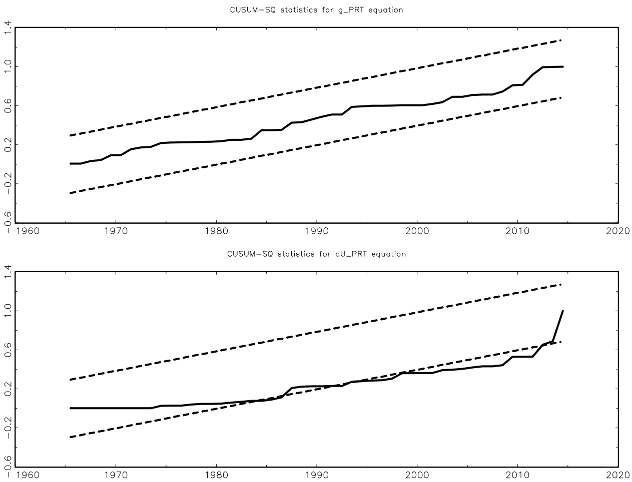
Figure 5 Tests of VAR Model Stability for France



$$|Z^{-1}| = (0.51 \quad 0.51)$$

Source: Authors' estimation.

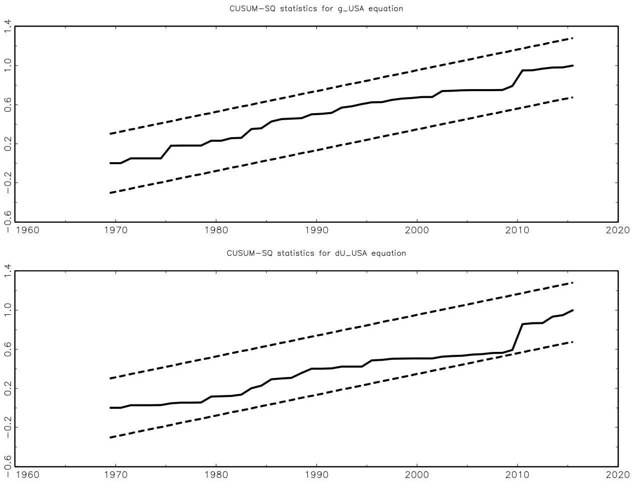
Figure 6 Tests of VAR Model Stability for Italy



$$|Z^{-1}| = (0.50 \quad 0.50)$$

Source: Authors' estimation.

Figure 7 Tests of VAR Model Stability for Portugal

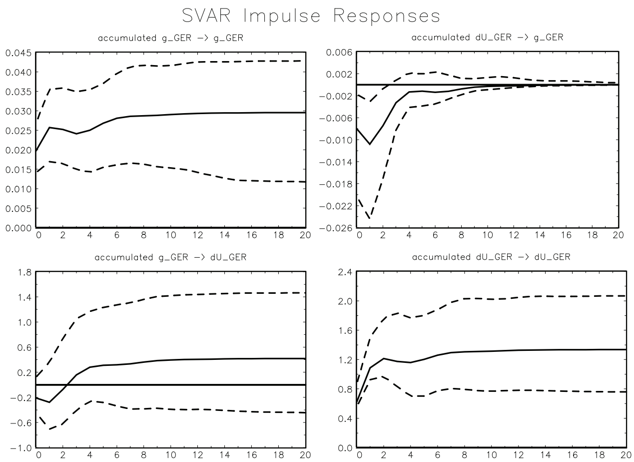


$$|Z^{-1}| = (0.85\ \ 0.40\ \ 0.40\ \ 0.30)$$

Source: Authors' estimation.

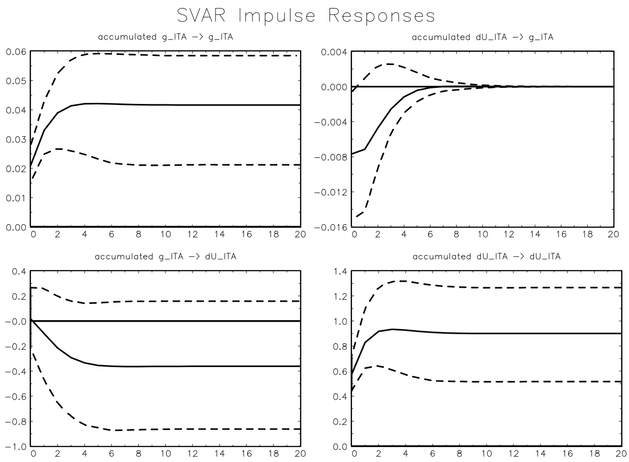
Figure 8 Tests of VAR Model Stability for USA

Appendix C



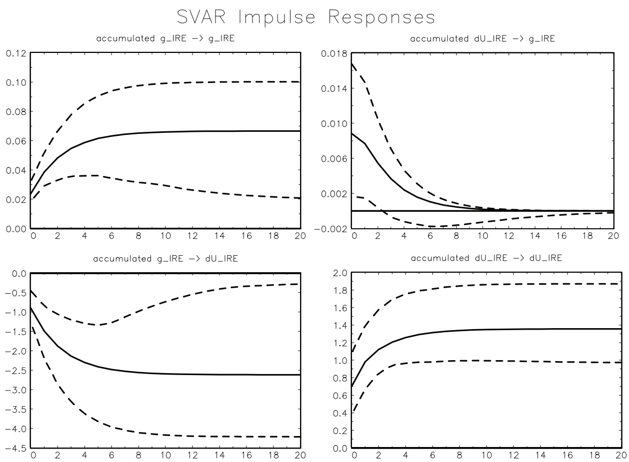
Source: Authors' estimation.

Figure 1 Germany: SVAR Impulse Responses



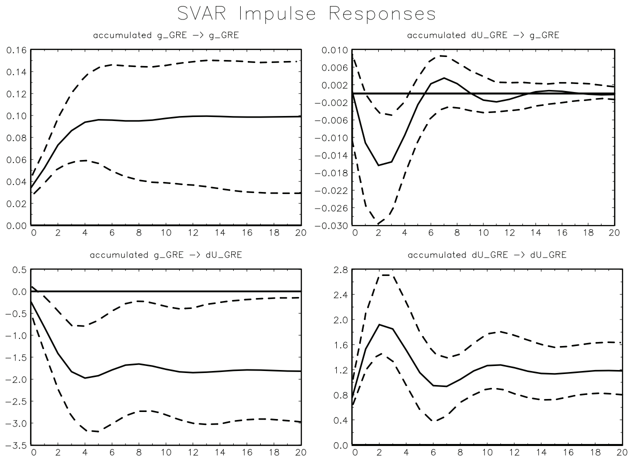
Source: Authors' estimation.

Figure 2 Italy: SVAR Impulse Responses



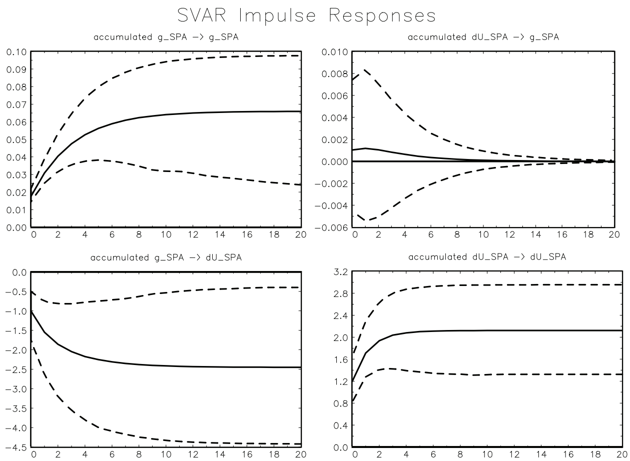
Source: Authors' estimation.

Figure 3 Ireland: SVAR Impulse Responses



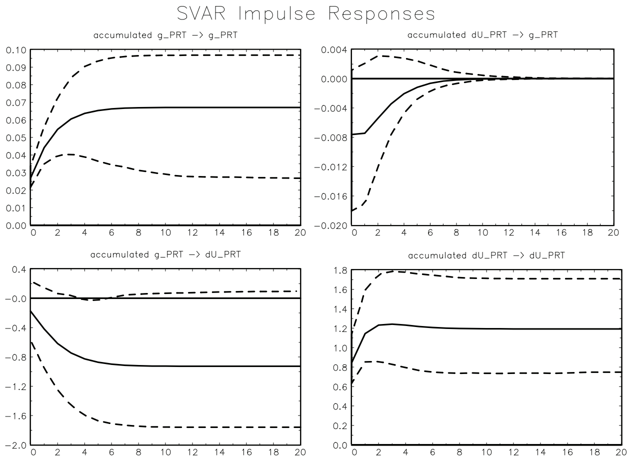
Source: Authors' estimation.

Figure 4 Greece: SVAR Impulse Responses



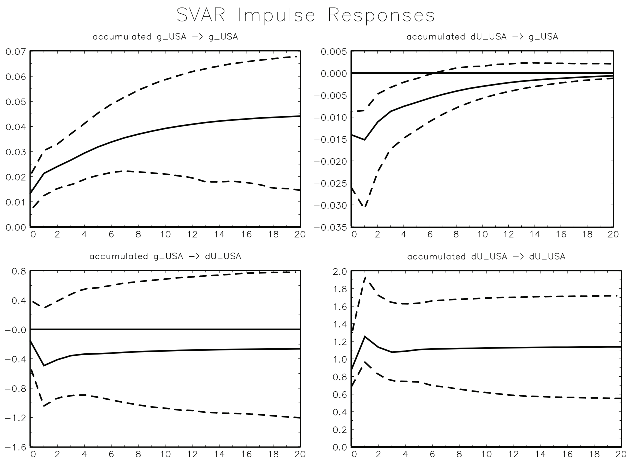
Source: Authors' estimation.

Figure 5 Spain: SVAR Impulse Responses



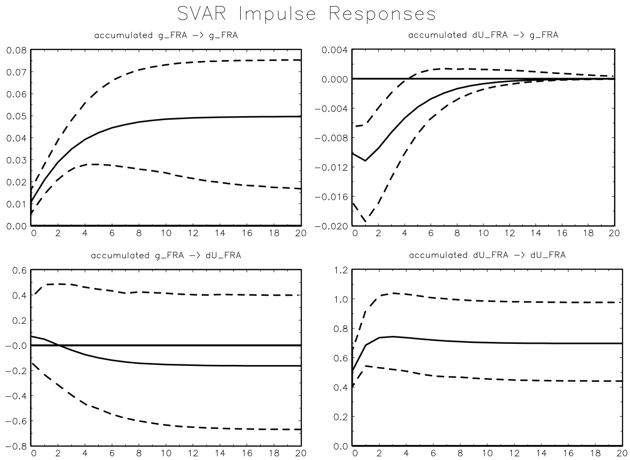
Source: Authors' estimation.

Figure 6 Portugal: SVAR Impulse Responses



Source: Authors' estimation.

Figure 7 USA: SVAR Impulse Responses



Source: Authors' estimation.

Figure 8 France: SVAR Impulse Responses