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The effects of Monetary Policy shocks across the Greek Regions

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Abstract

In this paper, we examine the impact of monetary policy shocks to the real economy by investigating the effects on different regions. Annual data for GDP, employment and investment from 13 peripheries in Greece are used for the period 1980 to 2009. By using an unrestricted VAR model and the impulse response analysis our results show that an interest rate shock affects the economic activity across regions differently. Furthermore in our investigation, we use a panel VAR model so as to investigate the dynamic variation of the impact of interest rates controlling also for time and cross regions fixed effects associated with specific time invariant regions' characteristics as well as with time variant characteristics attributed to the integration process of these regions. Therefore, these findings are very important to policy makers.

Key Words: Monetary policy, interest rate channel, Panel VAR, Impulse response function

1. Introduction

Monetary policy is structurally designed at the national level as a stabilisation policy, aiming mainly at controlling inflation. In theory there are a significant number of channels through which monetary policy affects economy (for an excellent review see Miskhin, 2009). However, identifying empirically the monetary policy transmission mechanism in an economy is not an easy task as Gertler and Gilchrist (1993a) argued. Moreover, few years later Bernanke (1995) by focusing on credit channel said that more empirical evidence should be provided on the crucial role of banks on the way that the monetary actions are transmitted to real variables. Banks' lending activity can affect significantly the final magnitude and accurate time of the monetary policy effect on the economy.

Although there is a significant strand of literature focusing on the bank lending channel (Gertler and Gilchrist, 1993b; De Bondt, 2004; Peersman, 2004) recently there are studies indicating the importance of the asset pricing channel (Yao and Zhang, 2005; Iacoviello and Minetti, 2008).

Given that interest rate becomes the dominant tool of conducting monetary policy in our days, in many studies interest rate shock in a VAR model is usually used as proxy of monetary policy action. The traditional effect of interest rate changes on macroeconomic variables (the known interest rate channel) is accomplished by asset prices reaction and or bank lending behaviour.

Empirically, most studies examine the effects of monetary policies in one country or across countries by assessing its transmission mechanism at the aggregate level and evaluating its impact mainly on the production and the price levels (for a detailed review see Guiso *at al.*, 1999). The measurement of the effect of monetary policy decisions has been addressed in a number of cross-country studies using large-scale simultaneous equations models or structural vector autoregressive (SVAR) models. See among others contributions in the literature by Dornbusch *et al.*, (1998), Cecchetti (1999), Carlino and DeFina (2000) and Ehrman, (2000). This type of analysis predicates a homogeneous and an undifferentiated effect at the national level, ignoring the fact that any national economy is composed by diverse interlinked regions with different economic characteristics and activities.

Moreover, disaggregating macro-variables is another aspect that should be taking into account seriously when studying monetary policy transmission mechanism data (Garretsen and Swank, 2003; Papadamou and Siriopoulos, 2012). Because aggregation may hide significant underlying dynamics of the series studied. In our work the regional dimension is

the criterion when disaggregating the data and investigating the interest rate channel across peripheries.

According to Marelli (1985), economic policies such as monetary policy may have effects on the spatial allocation of the economic activities and on their performance. This is attributed to the fact that the various regions of an economic entity differ a) in their productive capacities, technologies and localisation factors, b) in the behaviour of their economic agents, and finally c) in the direct implementation of national economic policies, particularly in the case of the decentralised administrative procedures (e.g. regional distribution of public expenditures). Therefore, asymmetries may arise from the transmission of national monetary shocks in specific regions (regional asymmetries), or among their respective productive sectors (sectoral asymmetries). Shocks of monetary policy hitting the national economy may have drastic effects in some regions and small or no effects in others due to the above mentioned differences. Furthermore, the impulses and the transmission system of uniform policies may have diverse distributional implications for each region. Consequently, assessing the regional impact of national economic policies such as monetary policy has now become more operational and reliable, and research has been directed to the study of possible asymmetric effects at a spatially disaggregated scale.

An early attempt to explore monetary transmission at the regional level was by Carlino and DeFina, (1998). Their study made use of SVARs to measure the international response to monetary policy in U.S. regions and found that monetary policy affects real income quite differently each of the eight major U.S. regions. In a later study, Carlino and DeFina, (1999) extended their analysis of the effects of monetary policy to the state level. Comparisons of states' responses to monetary policy actions reveal that an individual state's response is often quite different from the average response of its region and from the response of the other states in that region. However, they provide empirical evidence more on the interest rate channel rather than the credit channel. Georgopoulos (2009) found that a monetary policy shock negatively affects employment in primary based regions and, to a lesser degree in manufacturing-based regions. Further, Potts and Yerger (2010) examine the impact of monetary policy shocks across five separate Canadian regions. They report that U.S. monetary policy shocks have a discernible impact on Canadian regional economic activity, but the impact varies across regions.

Relevant studies have been conducted in Europe. For instance, Arnold and Vrugt (2004) studied the effects of monetary policy in the German regional output. Rodriguez-Fuentes (2005) and de Lucio and Izquierdo (1999) conducted a similar exercise for the Spanish

regions; While Dow and Montagnoli (2007) investigated the impact of monetary policy on the regional economic disparities in the UK and Scottish economies

Large regional and sectorial variation in monetary policy transmission attributed to industrial composition is found by Arnold and Vrugt, (2002) for Netherland. However, they argue that sectorial rather than regional effects account for the variation in interest rate sensitivity.

Another interesting study is the one conducted by Svensson (2012) that focused on the monetary policy effects on employment in 21 Swedish regions. indicates also differences. Significant differences across regions seem to stem from the interest and exchange rate channel, whereby regions with larger shares of employment in the goods sector and higher export intensity are adversely affected. Evidence for an exchange rate channel on US regions is also provided by Antzoulatos and Yang (1996).

Additionally, we have to mention at that point that all the above investigations of the transmission of monetary policy are based on the reduced-form VARs. The VAR model is specified, including all the given geographical units (or regions).

The novelty of our contribution in the literature is based on several dimensions. Firstly, we explicitly model and compare the importance of the Greek monetary policy shocks on the economic activity across the Greek regions. Secondly, several alternative measures of regional economic conditions are used in order to properly define the effects. Thirdly, and to the best of our knowledge, this study is the first testing regional effects of monetary policy in Greece. Previous studies investigating monetary policy transmission mechanism in Greece (Brissimis et al. 2001; Brissimis and Dellis, 2009) focus mainly on bank lending channel but on aggregate data not regional. While, Apergis and Rezitis (2003) investigates empirically the Okun's law on regional data for the case of Greece but he doesn't study monetary policy effects. Moreover, we adopt a panel VAR approach, which is becoming increasingly widespread in macroeconomic analysis (Beetsma *et al.* 2006, 2008, Almunia *et al.* 2010). The use of a panel VAR allows us to take advantage of the resulting large sample dimension, given the non-parsimonious nature of our model and the data frequency. Therefore our findings add to previous related U.S. and European regional literature.

The paper is organized as follows. Section 2 provides a brief review of regional monetary transmission mechanisms, while Section 3 gives an overview of the evidence in the literature. Section 4 presents the stylised facts of the Greek regions. Section 5 specifies the VAR and the Panel VAR models and presents data. Section 6 presents and analyses the empirical results; while, Section 7 concludes and discusses policy implications of our results.

2. Theoretical Underpinnings: Regional Transmission Mechanisms of Monetary Policy

As defined by Taylor (1995), the monetary transmission mechanism is the process through which monetary policy decisions are transmitted into changes in economic growth and inflation. In most empirical studies and using VAR methodologies, monetary policy decisions are modelled via changes in the short-term interest rates set by the central bank and their effects on the aggregate demand side through a large set of variables, including the real cost of capital, the real exchange rate, income, wealth, and credit availability (Arnold and Vrugt (2002)). Thorough surveys of the monetary policy transmission mechanisms at the national level that have been provided by Bernanke and Gertler (1995) and Mishkin (1996, 2009), so we will abstain from giving an overview here and instead, we will briefly present the factors which may give rise to diverse regional effects of monetary policy and we will provide a short literature review on relevant studies.

In the literature, two potential channels have been identified by which regional variation in the response to monetary policy shocks can arise (Carlino and DeFina 1998). The first channel is the interest rate channel and the exchange rate channel. Regional variations are due to different responses of regional output coming from interest-rate sensitive sectors. It is agreed that the degree of sensitivity to interest rate shocks differs across industries. Manufacturing and construction, for example, are more credit-dependent than either agriculture or services; hence, relatively industrialized regions are likely to be more affected by monetary policy shocks than their less industrialized counterparts (for a recent survey, see Ridhwan, et al. 2010). If this is the case, regions with a high proportion of interest-elastic industries may therefore be especially vulnerable to a tightening of monetary policy. Monetary contractions may reduce the demand for investment goods and (durable) consumer goods by increasing the real costs of capital to firms and consumers (see Taylor, 1995; Mishkin, 1996).

Furthermore, monetary policy shocks also affect other asset prices, such as exchange rates and equity prices (Arnold and Vrugt, 2002). Through the exchange rate channel, monetary policy affects competitiveness and net exports, especially in open economies. The higher relative interest rate (monetary tightening) induces a capital inflow, which causes the exchange rate to appreciate. Since the appreciation leads to price increase in export products, thereby an economy may face a loss of competitiveness due to a decline in the demand for exports and an increase in consumer spending, induced by the positive income effect. In the meantime, it also causes a fall in the (domestic) price level. Directly since it reduces the cost

of imported goods and the size of the mark-up; and indirectly since it worsens the competitive position of domestic firms (and hence net exports). Consequently, this mechanism suggests that regions with more export-intensive industries may be more responsive to monetary policy innovations (see, for example, Hayo and Uhlenbrock, 2000). Ber *et al.* (2001) find that export-intensive firms are cushioned from monetary policy shocks. When domestic interest rates are tightened, exporting firms are able to raise credit on foreign currency markets (where they have contracts and have built a reputation with local lenders) and so do not have to reduce investment. Their findings provide an alternative explanation for the exchange rate channel through which regions with a high degree of trade openness (export-intensive) are even less prone to monetary policy shocks.

The second channel of regional monetary transmission refers to the credit channel (Bernanke and Gertler, 1995). Regional differences in the composition and concentration of large and small firms and the sources of credit available to each could lead to different regional responses to monetary policy (Ridhwana *at al.*, 2011). Regional sensitivity to monetary policy depends on a concentration of firms with a certain size (broad credit channel) and the concentration of banks with a certain size (narrow credit channel). Larger firms have better access to external sources of finance, while small firms are largely dependent on conventional financial institutions, notably bank loans (Gertler and Gilchrist, 1993; Oliner and Rudebusch, 1996). Therefore, if a region has a high concentration of small firms, this region will also experience a relatively large negative impact on output as a result of a monetary contraction. The narrow credit channel arises due to regional variation in bank size (Kashyap and Stein, 2000). Given that larger banks have more alternative financial sources while small (rural) banks mostly resort to local financial markets, cross-regional differences in the bank size composition may lead to differential effects in response to national monetary contractionary policy.

All transmission channels described above relate to the effect of monetary policy on aggregate demand. We should note here that an alternative channel of regional monetary policy transmission is through the supply effect. Differential effects of monetary policy could therefore also be the result of regional differences in the supply curve, which may be caused by, for instance, regional differences in the flexibility and institutional features of labor and product markets; see De Grauwe (2000).

3. Data and Methodology

Our data sample consists by annual observations for the period 1980 to 2009 covering the following variables Real GDP, Total Employment, short term interest rate, Regional GDP, Regional Employment, Regional Household expenditure and regional investment. These data are collected by the EUROSTAT database.

As far as our methodology is concerned, and based on the influential work of Sims (1980) about the importance of VAR models in studying monetary policy effects, we establish a simple basic VAR model containing, the gross domestic product in constant prices, the employment, the short-term ‘policy’ interest rate proxied by the money market rate, and the regional variable about the economic activity. In our multivariate VAR model the speed and degree of adjustment of the regional economic activity variables due to an interest rate shock will be investigated. As regional economic activity proxies the regional GDP and the regional employment will be used for the 13 Greek regions. Moreover, the effect of the interest rate on regional household expenditure and regional investment that are the main parts of regional GDP will be also investigated. The VAR model captures the dynamic feedback effects in a relatively unconstrained fashion and is therefore a good approximation of the true data-generating process.

However, a model with significant number of variables and time lags would exhaust the number of degrees of freedom too much. Therefore, given the number of observation constraints in our times series context, we adopt the strategy followed by Gertler and Gilchrist (1993b), and Garretsen and Swank (2003) that estimate a series of separate VAR models including selections of variables.

We can express the basic VAR model one as follows:

$$Z_t = C + A(L)Z_{t-1} + e_t, \quad (1)$$

where $Z(t)$ is a column vector of the variables under consideration [$\log(\text{GDP})$, $\log(\text{Employment})$, R , $\log(\text{Regional GDP})$], C is the deterministic component comprised of a constant, A is a matrix of coefficients, the lag length in our model is one based on Schwarz and Hannan-Quin information criteria and $e(t)$ is a vector of random error terms. By construction, $e(t)$ is uncorrelated with past $Z(t)$ s.

Then second model includes the following variables with the following order in the column vector Z : [$\log(\text{GDP})$, $\log(\text{Employment})$, R , $\log(\text{Regional employment})$]. While the third

and fourth models under investigation are decomposing GDP to its main parts Household expenditure and Investment. Therefore model three includes in the column vector Z: $[\log(\text{GDP-Household Expenditure}), \log(\text{Household Expenditure}), \log(\text{Employment}), R, \log(\text{Regional Household Expenditure})]$; while model four includes $[\log(\text{GDP-Investment}), \log(\text{Investment}), \log(\text{Employment}), R, \log(\text{Regional Investment})]$. The order of the variables in these models is based on the assumption that central bank reacts to main macroeconomic variables by defining its policy rates and this might have significant effect also on regional activity variables.

In order to overcome any problems arising from the restrictive times series data sample we proceed to estimate impulse response in a Panel Vector Autoregressive (PVAR) framework. Our PVAR model consists by the following variables $[\log(\text{GDP}), \log(\text{Regional Household Expenditure}), \log(\text{Regional Investment}), \log(\text{Regional Employment}), R]$. By using Panel VAR techniques on our annual data gives us the benefits from both taking advantages of a VAR approach and panel data techniques. The VAR approach addresses the endogeneity problem by allowing the endogenous interaction between variables in the system, while the use of panel data techniques tackles the problem of data limitations, hence strengthening the validity of econometric results.

By using a panel VAR model allow us to investigate the dynamic variation of the impact of monetary policy controlling also for time and cross regions fixed effects associated with specific time invariant regions' characteristics as well as with time variant characteristics attributed to the integration process of these regions. However, the disadvantage of using PVAR techniques is the homogeneous slope parameters which must be assumed despite the fact that we can allow region specific heterogeneity using region fixed effects (Marattin and Salotti, 2010). In order to overcome this difficult in one degree, we estimated our PVAR model including the following variables $[\log(\text{GDP}), \log(\text{Employment}), R, \log(\text{Regional Household Expenditure}), \log(\text{Regional Investment}), \log(\text{Regional Employment})]$ in three different panels. The first panel categorizes peripheries based on common employment responses as where found by times series analysis in the first step of our methodology (see figure 4b). The second contains peripheries with significant response of household expenditure to interest rates (see figure 4c). While the last panel focusing on common significant investment reaction to interest rate (see figure 4d).

The typical structural form of our PVAR model is given by:

$$A_0 Z_{it} = A(L) Z_{it-1} + e_{it}, \quad (2)$$

where Z_{it} is an $(mx1)$ vector of endogenous variables; A_0 is an (mxn) with 1's on the diagonal and contains the parameters that capture the contemporaneous relations; $A(L)$ is a matrix polynomial in the lag operator L ; finally, e_{it} is the structural disturbance vector. Pre-multiplying equation (2) by A_0^{-1} , we obtain the reduced form that we can actually estimate:

$$Z_{it} = B(L)Z_{it-1} + u_{it}, \quad (3)$$

where $B(L) = A_0^{-1}A(L)$ and $u_{it} = A_0^{-1}e_{it}$ is the reduced form residual vector.

4. Empirical Results

4.1 Some Stylized Facts for the Greek Regions

Greece is divided into 13 NUTS II regions (periferia). Table 1 presents major economic indicators for the NUTS II Regions in Greece, for the year 2009, the values are expressed percentages of the national total. From the first glance in the table the figures reveal large disparities between regions. Based on the Table, the metropolitan region of Attiki, with 4.1 million inhabitants, contains over 36.33% of the national population (of just over 11 million). The Central of Macedonia in which belongs the other next largest metropolitan city (Thessaloniki) comes next, with 2 million people (17.31%), followed by 6 regions ranging population between 500,000 and 800,000 (Dytiki Ellada (6.58%), Thessaly (6.53%), Ipeiros (5.43%), Ionia Nisia (5.37%), and Dytiki Ellada (5.27%). The rest of the NUTS II regions are in the range of 198,000 to 400,000. The population of the dominant regions Attiki and Kentriki Makedonia, have been consolidated over the last two decades due to the fact that their suburbs and satellite cities or regions have been growing considerable (Petракos *et al*, 1999).

In 2009, per capita region product in the richest region (Attiki, 13,794) is twice as much of the poorest one (Dytiki Ellada, 6,4563). The share of employment is largest in regions with the largest cities, i.e. Athens, Thessaloniki). The share of Gross Value added in the Energy and Manufacturing sector ranges from 34.5 (Attiki) percent to 0.75 percent (Ionia Nisia), while the Gross Value added in Distribution, Hotel & Restaurants, Transport, Storage and Communications ranges from 62.58 percent (Attiki) to 1 percent (Dytiki Ellada). Investment ranges from 34 percent (Attiki) to 1.5 percent (Kentriki Makedonia). We can conclude here that there are large regional imbalances with the economic entity of Greece. Greece has a

number of peculiarities that affect the spatial allocation of economic activities resulting in regional imbalances. According to Petrakos and Psycharis (2003), Greece due to the existence of hundreds of inhabited islands and the limitations imposed by its mountainous territory is characterised by a highly fragmented physical and economic space. This fragmentation increases transportation and accessibility costs, hence requiring major investment in infrastructure and inhibiting the internal integration of the economy. Furthermore, limited accessibility to internal and external markets has created a productive structure dominated by small inward looking firms serving local markets and having limited capacity to adopt and compete in national and international markets. Partly of these conditions, Greek regions have low production structure.

4.2 Empirical Results of VAR models

As stated clearly in the previous section we will focus our investigation into the effect of monetary policy actions on regional economic data. This can be done by generating impulse response functions in our VAR models due to one standard deviation innovation in the money market rate.

However before getting into the analysis of impulse response functions we have to mention that unit root tests on all variables of our models provide evidence for I(1) processes¹ Following the fact that all of our VAR models estimated involve variables admitting stationary linear combinations², we estimate the VAR in levels rather than cointegrated VARs (arguments on this can be found in Sims et al 1990; Favero, 2001)³. Additionally, VAR in first differences provides no information on the relationship between the levels of the variables in the VAR, and it is this aspect on which economic theory is most informative.

As far as empirical findings are concerned, firstly the impulse response functions will be presented for the main four regions of Greece based on NUTS categories. Then by going further we disaggregate each region of the main four into its main peripheries. Therefore in our presentation of results three figures will follow based on geographical four regions'

¹ The augmented Dickey–Fuller and Phillips–Perron tests have been applied. Moreover, the Elliott et al. (1996) test and the modified Z tests of Perron and Ng (1996) have been applied because they have superior power and size properties compared with the first two.

² Cointegration tests based on the Johansen procedure are not presented for economy of space. However, they are available upon request from the authors.

³ Diagnostic tests (F-statistic versions of the Breusch–Godfrey test for autocorrelation and the ARCH test) on residuals from estimation of Eq. 1 do not indicate any problem concerning autocorrelation and heteroskedasticity issues.

distinction of Greece. Some details are needed about the way that these figures should be read it by the reader. For economy of space reasons we present only the effect of interest rate shock on our variables of interest⁴. In Figures 1 to 3 the first column indicate the effect of interest rate shock on aggregate regions (ie specific districts) while the rest columns present the effect by disaggregating data to several peripheries in one region. The first line presents the effect of a monetary policy shock on GDP variable, while second and third on household expenditure and investment respectively. The finally line reflects the effect on employment level.

As expected by theory a tightening monetary policy shock has a significant negative effect on aggregate gross domestic product and employment with a significant time lag. The effect on the latter seems to hold a little bit more than the former. But when analysis proceeds further by seeing the effects on peripheries' data the results are not uniform. By looking regional GDP reaction, in only five out of thirteen cases (AM, IP, IO, PEL, ATT) the regional GDP reacts negatively to an interest rate shock reaching its bottom approximately after six periods. However, in case of PEL and IO the bottom is reached faster indicating a different transmission mechanism compared to the others.

Moreover, an important investigation is to reveal the dynamics of the underlying parts of the peripheries GDP. Therefore analysis has been further employed on household and investment expenditure. As far as investment expenditure is concerned seven out of thirteen cases (AM, TH, IP, DE, SE, ATT) present as expected a statistical significant and long lasting negative reaction on increasing interest rate shocks. In case that household expenditure, is reduced also after a monetary policy tightening in six out of thirteen cases (AM, IP, IO, PEL, VAIG, AT). Some other general comments that we can do are the followings. In two peripheries (DE, SE) the effect of monetary policy contraction is mainly reflected only on investment and employment measures. Only in the IP periphery the effect of a positive interest rate shock is uniform across different measures of economic activity.

Looking at the time pattern of monetary policy transmission, two dimensions can be described. On the one hand the time it takes the impulses to reach the maximum effect, and on the other hand the time impulses to die out. More specifically, in Figure 4a the results for regional GDP responses indicate that there are two groups of peripheries. The peripheries where regional GDP reaching their bottom in less than three periods (IO, PEL) and theses reaching it between six to seven periods (AM, AT, IP). We have to mention at that point that

⁴ However, other responses that were in accordance to economic theory for the vast majority of our models are available upon request by the authors.

Athens and Thessaloniki, the two biggest cities of Greece in terms of population where economic activity is mainly concentrated belongs to ATT and AM peripheries respectively.

In the Fig. 4d all peripheries are rather homogeneous concerning investment responses to monetary policy shocks. Similarly picture can be drawn also in Fig. 4b that presents regional employment response pattern to interest rate shocks. However, there is a long-lasting effects that intensify much longer than in the KRIT and THE peripheries.

Another interesting point is the time pattern of investment response in figure 4d implies high level of concentration concerning the period that the effect reaches its maximum (in absolute terms) while the variability concerning the duration of the effect is also low.

Finally, a clear-cut result has been depicted in Fig. 4c where we portray the time pattern of regional household expenditure responses, drawing the conclusion that the IO, AM, VAIG peripheries present a quicker reaction that is short living compared to PEL, IP, ATT.

By looking the impulse response functions drawn by the estimation of the PVAR model it is clear the significant negative effect of monetary policy tightening on all economic indicators. This result confirms our findings by applying VAR models in each periphery and overcomes the problem of the low number of observation from times series analysis employed.

Greece has a number of peculiarities that affect the spatial allocation of economic activities resulting in regional imbalances. According to Petrakos and Psycharis (2003), Greece due to the existence of hundreds of inhabited islands and the limitations imposed by its mountainous territory is characterised by a highly fragmented physical and economic space. This fragmentation increases transportation and accessibility costs, hence requiring major investment in infrastructure and inhibiting the internal integration of the economy. Furthermore, limited accessibility to internal and external markets has created a productive structure dominated by small inward looking firms serving local markets and having limited capacity to adopt and compete in national and international markets. Partly of these conditions, Greek regions have low production structure.

7. Conclusions

Our paper by using VAR and PVAR models provides empirical evidence about interest rate channel on regional and peripheries data. The findings indicate that monetary policy effects across thirteen Greek peripheries are not uniform therefore data disaggregation is necessary

when analyzing policy induced shocks. On the one hand, there have peripheries that are not affected significantly by tightening or loosening monetary policies. This can be attributed to the existence of less sensitive to interest rate factors, sectors. On the other hand, there are other peripheries that present significant impulse responses to interest rate shocks. In this line also there is a fewer set of them that presents more uniform effects across various economic indices such as periphery's gross domestic product, household expenditure, investment, and employment. Between the various economic indices responses the employment shows the more common responses in all of the peripheries. In conclusion, our study adds to regional data literature by revealing interest rate channel in a small European country with significant differences in economic activity across peripheries. The main policy implication is that there no one size effect for Greek peripheries when conducting monetary policy.

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Table 1. Major Economic Variables for NUTS II Regions in Greece, 2009, (Percentages of the national Total)

Region	Population	GDP	Household Expenditure	Investment	Employment	GDP per capita - pps	GVA - Agriculture, Forestry and Fishing	GVA -Energy and Manufacturing	GVA - Construction	GVA -Financial Intermediation, Real Estate, Renting and Business Activities	GVA - Non-Market Services	GVA – Distribution , Hotel & Restaurants , Transport, Storage and Communications
Attiki (Att)	36,33	50,12	38,69	34,07	39,90	13.794,60	5,67	34,74	24,24	51,26	53,76	62,58
Kentriki Makedonia (KM)	17,31	13,77	16,69	14,93	17,01	7.951,87	18,72	16,02	21,66	15,52	12,82	10,55
Dytiki Ellada (DE)	6,58	4,10	6,17	6,17	5,84	6.236,20	11,11	5,16	4,45	4,09	4,34	2,65
Thessalia (Th)	6,53	4,68	6,22	6,60	6,06	7.172,81	11,60	7,29	6,34	4,29	4,68	2,90
Kriti (Kr)	5,43	4,84	5,60	6,76	5,47	8.920,10	9,48	2,71	5,62	4,51	5,04	4,88
Anatoliki Makedonia, Thraki (AM)	5,37	3,46	5,08	5,97	4,61	6.456,43	7,29	4,19	5,37	3,36	3,50	2,44
Peloponnisos (Pel)	5,27	4,29	5,08	3,98	5,33	8.138,74	10,32	7,32	7,83	3,99	3,37	2,67
Stereia Ellada (SE)	4,91	4,64	4,34	9,08	4,91	9.446,66	10,77	13,31	8,69	2,96	2,95	2,29
Ipeiros (Ip)	3,13	2,34	3,10	3,65	2,94	7.469,50	4,88	1,62	4,33	2,10	3,00	1,53
Notio Aigaio (NAig)	2,73	2,84	2,80	2,30	2,43	10.387,13	2,25	1,44	3,54	2,67	2,25	3,69
Dytiki Makedonia (DM)	2,60	2,05	2,49	3,32	2,16	7.900,14	3,83	4,87	3,57	1,84	1,69	1,01
Ionia Nisia (Io)	2,05	1,59	2,03	1,46	1,76	7.720,57	1,43	0,59	2,54	1,67	1,28	1,90
Voreio Aigaio (VAig)	1,76	1,28	1,71	1,72	1,61	7.278,96	2,65	0,75	1,82	1,73	1,31	0,90

Source: Own calculation based on Cambridge Econometrics data, 2009. North Greece (Voria Ellada-VE) includes KM, DM, AM. Central Greece (Kentriki Ellada – KE) includes IP, IO, SE, DE, PEL. Aegean Islands includes

Figure 1 Impulse Responses of Regional GDP, Household expenditure, Investment and Employment to interest rate shock for North Greece peripheries

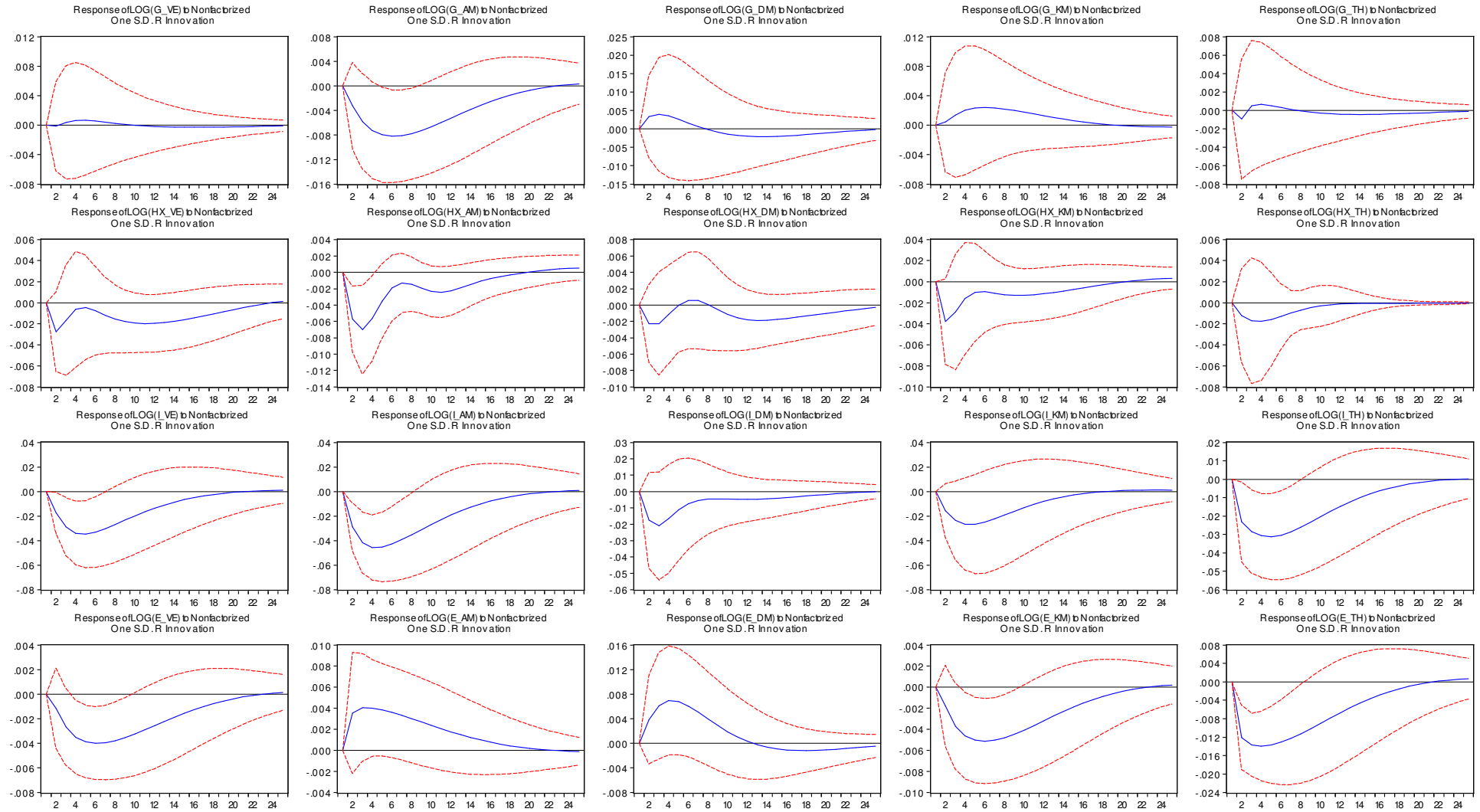


Figure 2 Impulse Responses of Regional GDP, Household expenditure, Investment and Employment to interest rate shock for Central Greece peripheries

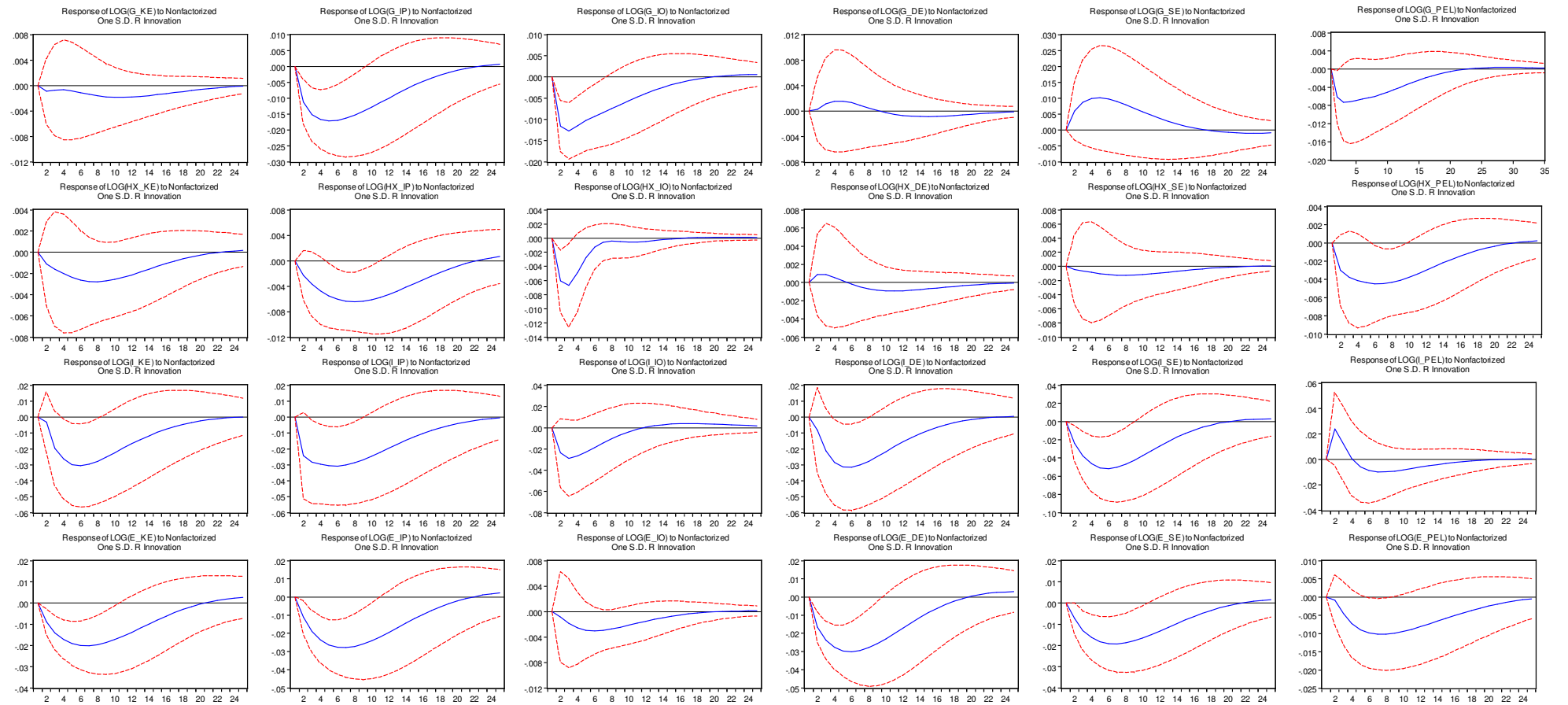


Figure 3 Impulse Responses of Regional GDP, Household expenditure, Investment and Employment to interest rate shock for South Aegean Islands and Attica

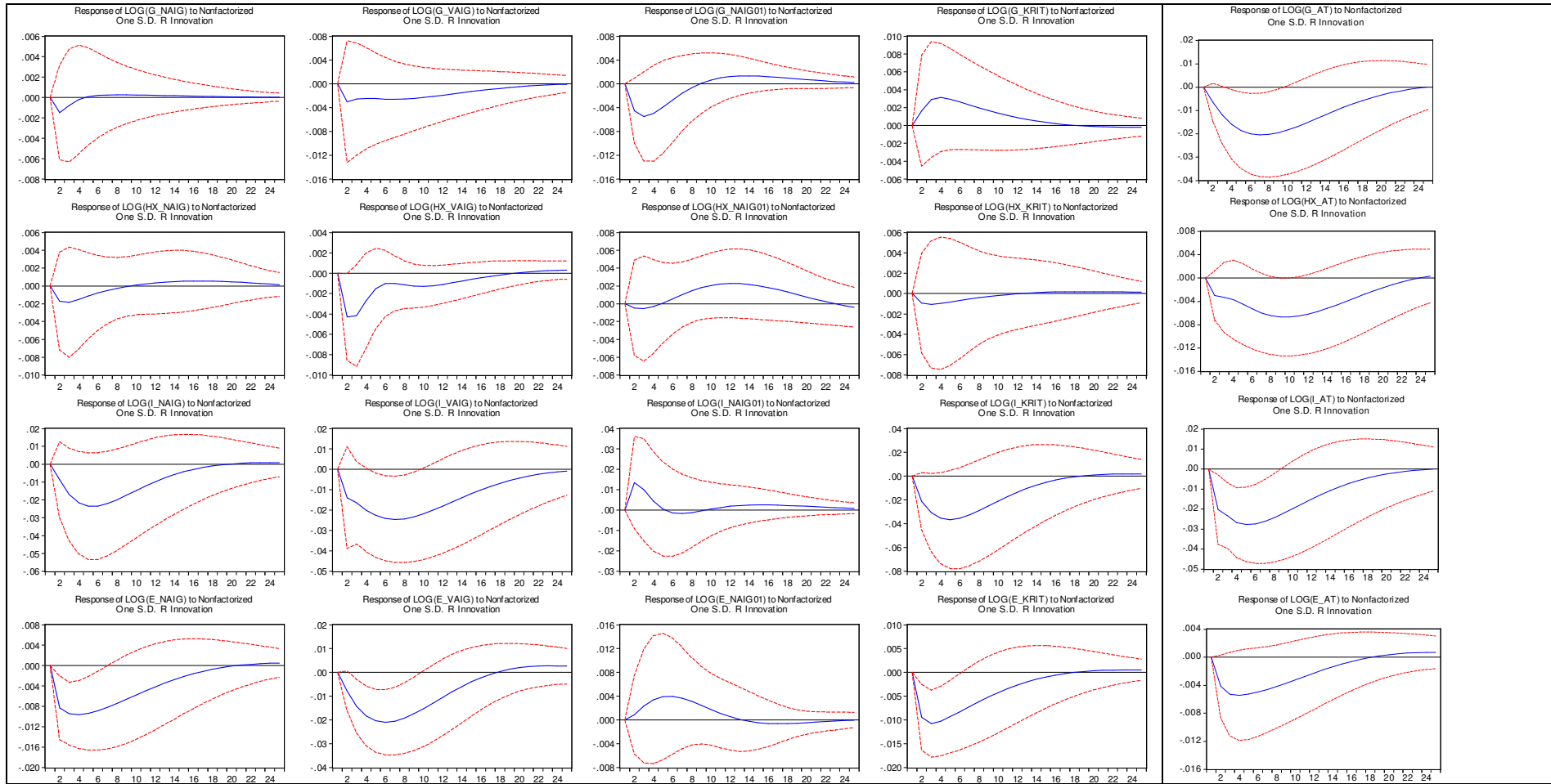


Fig. 4a. Time Pattern of Regional GDP Response on interest rate shock

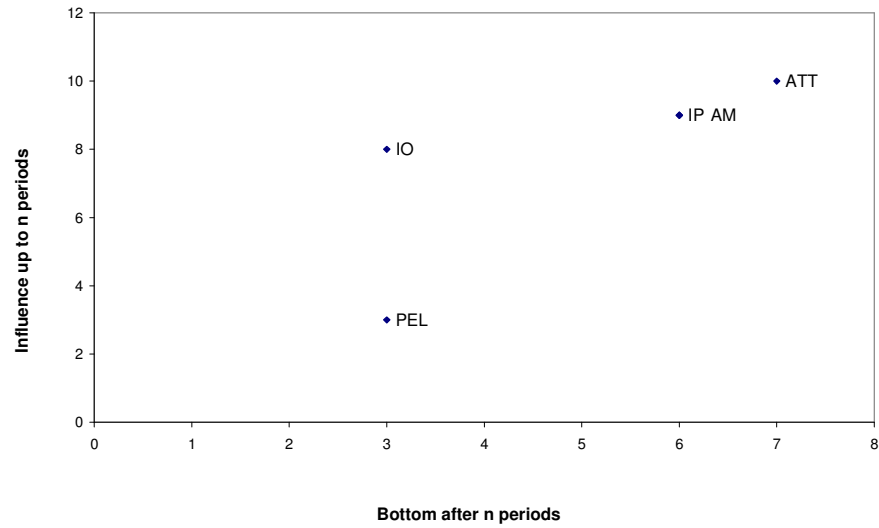


Fig. 4b. Time Pattern of Regional employment Response on interest rate shock

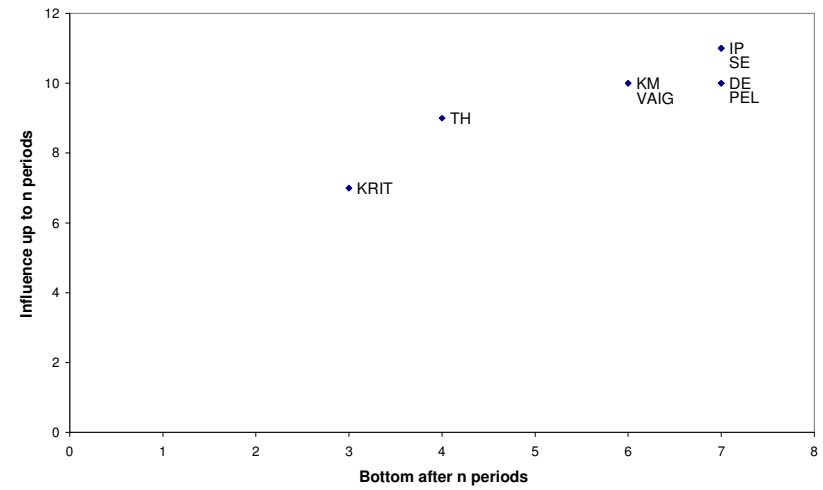


Fig. 4c. Time Pattern of Regional Household Expenditure Response on interest rate shock

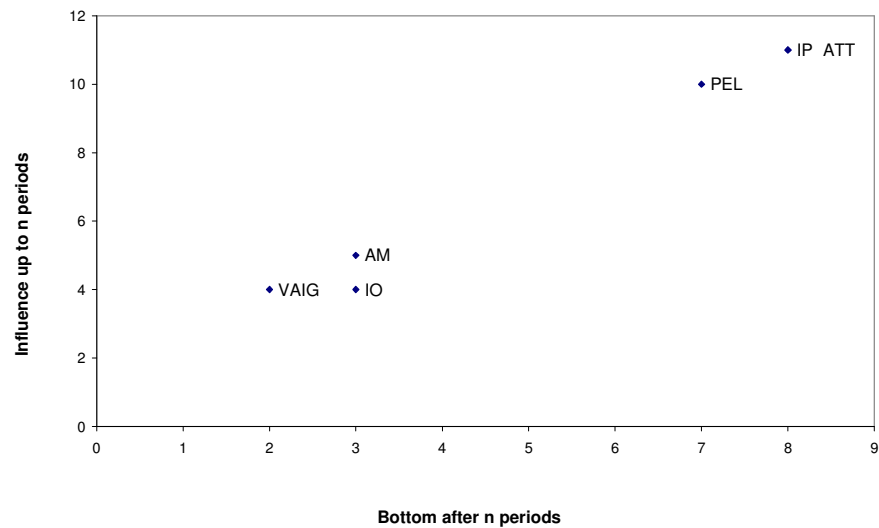


Fig. 4d. Time Pattern of Regional Investment Response on interest rate shock

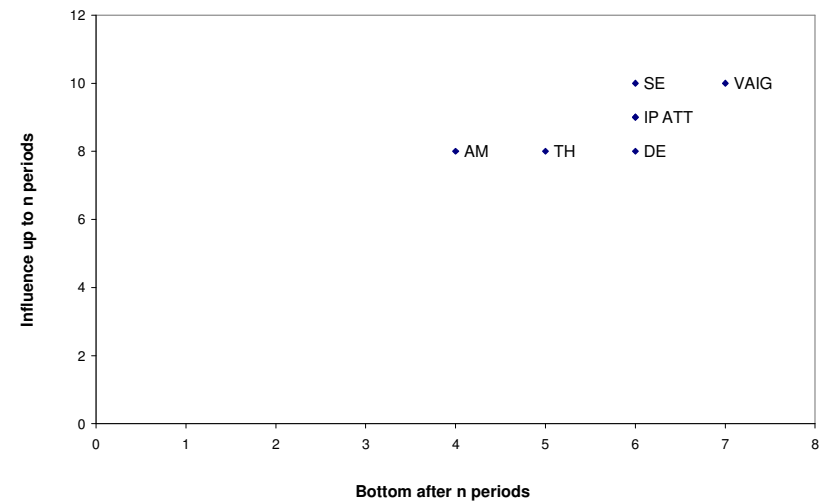


Figure 5a Peripheries included in the panel with significant Employment Reaction to interest rate shock from times series analysis

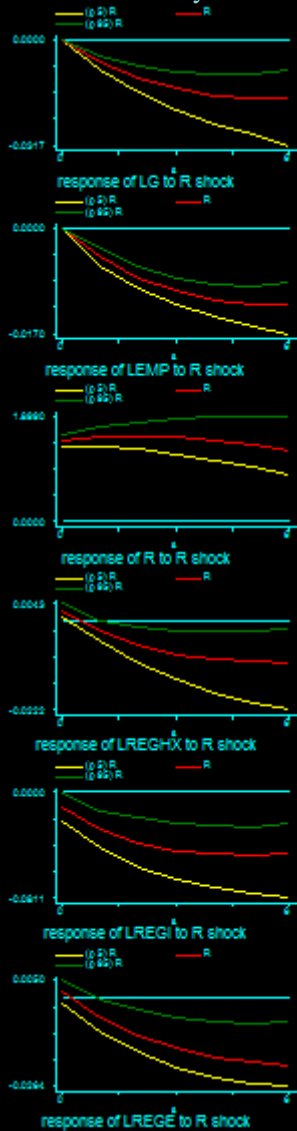


Figure 5b Peripheries included in the panel with significant Household Expenditure Reaction to interest rate shock from times series analysis

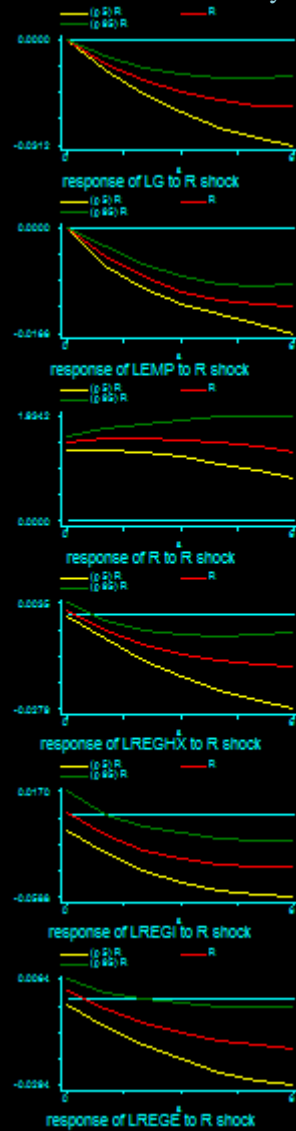


Figure 5c Peripheries included in the panel with significant Investment Reaction to interest rate shock from times series analysis

