THE IMPACT OF MONETARY SHOCKS ON REGIONAL OUTPUT: EVIDENCE FROM FOUR SOUTH EUROZONE COUNTRIES

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Abstract - *This paper quantifies the importance of Optimal Currency Area (OCA) criteria for the monetary policy transmission mechanism at the regional level. The study employs a Bayesian PVAR model to measure the impact of monetary policy shocks on regional output of 58 regions of four South Euro-Zone countries: Greece, Spain, Italy and Portugal over the period 1980-2009. The results provide evidence of different regional responses of regional GDP on monetary policy shocks. The policy's asymmetric effects are explained by employing the OCA framework.*

Key words - MONETARY POLICY, INTEREST RATE CHANNEL, PANEL VAR, OCA CRITERIA

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1. INTRODUCTION

Studying the Euro-Zone area, the monetary policy is structurally designed at the aggregate level as a stabilisation policy, aiming mainly at controlling the inflation of the area. Given the financial crisis, however, questions concerning the practical conduct of monetary policy in the European Monetary Union (EMU) are moving to the front of the policy debate. Problems are engendered from the weak regional capacity to cope with adjustment requirements of a common currency. In other words, there are doubts on whether Euro-zone regions can be characterized as members of an optimum currency area (OCA)? Conducting monetary policy in a common currency union assumes a homogeneous and an undifferentiated effect at all regions at the sub-national level, ignoring the fact that any regional economy may present different economic characteristics and activities, or it may be in a different phase of economic cycle compared to the others. Whether or not regions at the sub-national level of a currency union can meet the OCA criteria can affect significantly the final magnitude and accurate time of the monetary policy effect on these economies.

Mundell (1961) identifies a common set of OCA criteria the regions must fulfil when conducting countercyclical monetary policy for multiple regions: a) the regions must share similar business cycles, or b) have in place shock absorbers such as factor mobility, flexible prices and wages, national fiscal transfers and a diversified portfolio of sectors in their real economy. If the regions share the same business cycle then the targeted national monetary policy should be stabilising for all regions. If however, the regions experience dissimilar cycles, then the monetary policy will be destabilising for some regions, unless they have in place the above mentioned economic shock absorbers (Guiso et al, 1999; Beckworth, 2010).

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. A pioneered work by Carlino and DeFina (1998) by making use of structural VAR indicates that real income in each of the eight U.S. major regions is affected quite differently to a common monetary policy shock. Regional variations are due to different responses of regional output coming from interest-rate sensitive sectors. One year latter Carlino and DeFina (1999) extended their analysis of the effects of monetary policy to the state level. Their results for the U.S. states are in line with their previous work in regions.

Other studies also raise questions about the OCA status of the United States are those by Antzoulatos and Yang (1996), Owyang and Wall (2009), Partridge and Rickman (2005), and Crone (2005) who argue that asymmetric effect of monetary policy across regions may be attributed to a not-similar business cycle across US regions. In case of Canada 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) report that U.S. monetary policy shocks have a discernible impact on Canadian regional economic activity, but the impact varies across regions.

Additionally and among studies focusing on the regional effect of monetary policy in China, Cortes and Kong (2007) by using VEC-generated impulse response functions, found that coastal provinces responded more to shocks in monetary policy than inland provinces. Moreover, according to Jiang and Chen (2009) the regions with high productivity level responded more to the monetary policy shock.

Evidence against an optimum currency area has been also provided for Indonesia by Ridhwan et al. (2011). Cross-regional differential responses to monetary policy actions can be primarily explained by the region’s industrial composition (economic structure). They argue that manufacturing and construction are the most interest sensitive sectors (see also Ridhwan, 2010). Other significant sources of heterogeneity are the share of small firms and small banks in the regions. Evidence has been provided for the US case by Kashyap and Stein (2000).

Relevant studies have been conducted in Europe, also, but mainly investigating OCA criteria within a country. For instance, Hayo and Uhlenbrock (2000), Arnold and Vrugt (2004) studied the effects of monetary policy in the German regional output. Rodriguez-Fuentes (2005) and de Lucio and Izquierdo (2002) 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. Arnold and Vrugt, (2002) in case of Netherland argue that sectorial rather than regional effects account for the variation in interest rate sensitivity. Therefore particular attention should be given on the sectoral composition of each region. Svensson (2012) by investigating the effect of a monetary policy shock on employment in 21 Swedish regions found that regions with larger shares of employment in the goods sector and higher export intensity are adversely affected.

This paper contributes to the existing literature twofold. Firstly, treats regions of South Eurozone countries as members of Eurozone area and not within their national borders, in our effort to provide evidence whether these regions can be part of an OCA. According to Mundell (1961), a currency area should be a region, whose borders needed not necessarily coincide with the state borders. It may be beyond the state borders or within the borders. Secondly, by adopting a panel VAR approach, allows some degree of heterogeneity between impulse responses to a common monetary policy shock. The use of a panel VAR which is becoming increasingly widespread in macroeconomic analysis (Beetsma et al. 2006, Almunia et al. 2010), 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. We should note here, that there are alternative frameworks, such as large scale Bayesian VARs (e.g. Banbura et al, 2010), spatial econometric models (see Anselin, 2010), factor models (see e.g. Stock and Watson, 1989, 2003), and global VARs (see Dees et al., 2007 and Pesaran, et al., 2004), which can be used in such analysis[1]. We will limit however our analysis to just using a Baysian PVAR model and we will consider the application and comparison of the results for some of the above mentioned models to a future research.

This paper proceeds as follows: Section 2 employs a Bayesian Panel VAR model to estimate the effects of monetary policy shocks on regional output of 58 South European regions and presents the empirical results by analysing the impulse response functions obtained from the estimated model. The results show that the national monetary policy shocks do generate asymmetric effects across the 58 regions' economic activity. Section 3 attempts to explain these asymmetries using the OCA criteria. Section 4 concludes.

2. ESTIMATING THE REGIONAL EFFECTS OF MONETARY POLICY SHOCKS

2.1. The Empirical Model: A Bayesian Panel VAR model

In order to carry out the first part of our analysis, we estimate a Panel VAR model developed by Canova and Ciccarelli (2004), which is based on the Bayesian shrinkage estimators and predictors proposed by Garcia Ferrer et al. (1987), Zellner and Hong (1989), Zellner et al. (1991).

In general the model specification in the above studies is as follows:

$$y_{it} = A(L)y_{it-1} + \varepsilon_{it} \tag{1}$$

where y_{it} is $Gx1$ vector, $i = 1, \dots, N$; $A(L)$ is a matrix in the lag operator; $\varepsilon_{it} = \alpha_i + \delta_i + u_{it}$, where δ_t is a time effect; α_i is a unit specific effect; u_{it} a disturbance term. According to Canova and Ciccarelli (2004), two main restrictions characterize this specification. First, it assumes common slope coefficients. Second, it does not allow for interdependencies across units. With these restrictions, the interest is typically in estimating the average dynamics in response to shocks (the matrix $A(L)$). Canova and Marcet (1995), Pesaran and Smith (1997), instead, use a univariate dynamic model of the form:

$$y_{it} = \alpha_i + \rho_i y_{it-1} + x'_{it}\beta_i + v'_{it}\delta_i + \varepsilon_{it} \tag{2}$$

where y_{it} is a scalar, x_{it} is a set of k exogenous unit specific regressors, v_{it} is a set of h exogenous regressors common to all units, while, ρ_i, β_i, and δ_i are unit specific vectors of coefficients. Canova and Ciccarelli (2004) relax the above two restrictions and study the issues of specification, estimation and forecasting in a macro-panel VAR model, taking into consideration the Bayesian view of VAR analysis. Such an approach has been widely used in the VAR literature since the works of Doan et al. (1984), Litterman (1986), and Sims and Zha (1998) and provides a convenient framework where one can allow for both interdependencies and meaningful time variations in the coefficients. We should note here that the above mentioned VAR approach allows us to address the

[1] See Canova and Ciccarelli (2013) for the main features of the mentioned models and how they compare to the PVAR models.

endogeneity problem by allowing the endogenous interaction between the variables in the system. The model is specified as follow:

$$y_{it} = A_{it}(L)y_{it-1} + \varepsilon_{it} \quad (3)$$

Following Canova and Ciccarelli (2004), we adapt the so-called Minnesota prior to a panel VAR framework. The Minnesota prior, described in Litterman (1986), Doan et al. (1984), Ingram and Whiteman (1994), Ballabriga et al. (1998) among others, is a way to account for the near nonstationarity of many macroeconomic time series and, at the same time, to weakly reduce the dimensionality of a VAR model. Given that the intertemporal dependence of the variables is believed to be strong, the prior mean of the VAR coefficients on the first own lag is set equal to one and the mean of remaining coefficients is equal to zero. The covariance matrix of the coefficients is diagonal (so we have prior and posterior independence between equations) and the elements are specified in a way that coefficients of higher order lags are likely to be close to zero (the prior variance decreases when the lag length increases). Moreover, since most of the variations in the VAR variables are accounted for by their own lags, coefficients of variables other than the dependent one are assigned a smaller relative variance. The prior on the constant term, other deterministic and exogenous variables, is diffuse. Finally, the variance–covariance matrix of the error term is assumed to be fixed and known.

2.2. Data, Regional Characteristics and Model Estimation

2.2.1. The Data

The model is estimated for 58 regions of the 4 South European countries: Greece (GR–13 regions), Italy (IT–21 regions), Portugal (PT-5 regions), and Spain (ES-19 regions), using core macroeconomic variables. Table 1 in the appendix provides all the 58 regions per country and their notation. The sample spans the time period 1980-2009. This span of data includes two main structural changes such as joining the EURO as well as the financial crisis of 2007; therefore, dummy variables are employed to capture these events.

We retain the following variables in our empirical analysis: national GDP proxying national economic activity; regional GDP proxying regional economic activity calculated by deflating annual data on nominal GDP for each region during the period 1980-2009 with the national CPI. The use of national CPI is forced due to the unavailability of the regional price indices. We employ interest rates as an indicator of monetary policy; specifically, we utilize the money market interest rates. Finally, we employ the national inflation rate to account for aggregate supply shocks. All variables are extracted from the EUROSTAT database. National and regional GDP are expressed in logarithms.

2.2.2. Stylised Facts of the 58 Regions

Before we proceed with our econometric analysis, it is important to summarize some important stylized facts about the 58 regions. Tables 2.A to 2.D provide some basic economic indicators regarding the regions and the four countries respectively. More specifically, the above mentioned tables present the total gross value added and the value added of the five broad sectors [Agriculture (AGR), Energy & Manufacturing (ENM), Construction (CONS), Market Services (MS) and Non-Market Services (NMS)], as a percentage of GVA averaging over the period 1980-2009 in each country and in each region. Further, the tables report unemployment rates and relative manufacturing wages. From the first glance in the Tables, the figures reveal that the highest contributors sectors to GVA are the Markets Services in all four countries (Greece: 49.77%, Spain: 46.22%, Italy: 47.32% and Portugal: 44.86%) followed by Non-Market Services in all countries except Italy, in which the second largest sector is Energy and Manufacturing. Agriculture is the lowest sectoral contributor to GVA in all countries except in Greece, where Construction appears to be the lowest sectoral contributor to GVA. The more disaggregated view reveals striking differences among the sectors and among regions. In Greece, Attiki (ATT - 41.87%) is the region with the highest contribution to GVA followed by Kentriki Makedonia (KM - 15.25%). The regions with the lowest contribution to GVA are the Voreio Aigaio (VAIG - 1.49%), Ionia Nisia (IN – 1.69%) and Dytiki Makedonia (DM - 2.51%). In the case of Spain, Catalunia (CAT – 18.58%), Comunidad de Madrid (CDM – 16.91%), and Andalusia (AND – 13.56%) are the regions with the highest contribution to GVA, while Ciudad Autónoma de Ceuta (CADC – 0.16%), Ciudad Autónoma de Melilla (CADM - 0.15%) and La Rioja (LR) are the regions with the lowest contribution. In Italy, Lombardia (LOMB - 20.88%) and Lazio (LAZ – 10.35%) are the regions with the highest share to the national GVA, while Basilicata (BAS – 0.73%), Provincia Autonoma Bolzano-Bozen (PABB – 1.07%), and Provincia Autonoma Trento (PAT – 0.99%) have the lowest shares to national GVA. Finally, in the case of Portugal, Lisboa (LISB – 39.13%) and Norte (NORT - 30.01%) are the regions with the highest shares in GVA, while Algavre (ALGA – 3.87%) is the region with the lowest.

In terms of sectoral value added, across the 58 regions, Attiki (ATT-GR – 36.18%), Cataluna (CAT-ES – 24.72%), Lombardia (LOMB-IT- 28.37%) and Norte (NORT-PT – 40.43%) are the regions with the highest shares to national Energy and Manufacturing sectoral GVA. Regions such as Kentriki Makedonia (KM-GR – 17.88%), Andalucia (AND-ES – 23.90%), Lombardia (LOMB-IT – 11.03%) and Centro (CENTRO-PT – 34.48%) are the regions with the highest contribution to the national agricultural value added.

Observing the unemployment rates, out of the four countries, at the national level, Spain has the highest rate, while Portugal the lowest. At the regional level, regions which are observed to have the highest rates are Dytiki Makedonia (DM-GR-15.8%), Andalusia (AND-ES-23.7%), Calabria (CAL-IT-21.5%) and Alentejo (ALEN-PT-7.3%); while the lowest unemployment rates are observed in the regions of Kriti (KRI-GR-8.1%), Comunidad Foral de Navarra (CFDN-ES-7.7%), Provincia Autonoma Bolzano-Bozen (PABB-IT-2.9%), Centro (CENTR-PT-3.2%).

Finally, observing the Relative Manufacturing Wages across the 58 regions, we conclude that the Regions of Sterea Ellada (SE-GR-27.41%), Cataluna

(CAT-ES-67.59%), Piemonte (PIEM-IT-7.57%), and Norte (NORT-PT-8.85%) have the highest percentages, while regions such as Attiki (ATT-GR-7.90%), Ciudad Autónoma de Ceuta (CADC –ES-5.73%), Ciudad Autónoma de Melilla (CADM-ES-5.73%), Povincia Autonoma Bolzano-Bozen (PABB-IT-6.24%), Provincia Autonoma Trento (PAT-IT-6.24%), Veneto (VEN –IT), Alentejo (ALEN-PT-4.79%).

2.2.3. Model Estimation

In order to examine empirically how economic activity in each of the 58 regions responds to monetary policy actions, we obtain estimates of the monetary policy transmission mechanism in specific regions using the Bayesian PVAR model (discussed in section 2.1) expressed as follows:

$$z_{it} = (y_t^n, infl_t, r_t, y_{it}^r) \qquad (4)$$

where $i = 1,2,3,\dots,N$ indexes regions and $t = 1,2,3,\dots,T$ indexes time. y_t^n is the national real output; $infl_t$ is the national level of inflation rate; r_t is the short-term "policy" interest rate proxied by the money market interest rate, and y_{it}^r is the real regional GDP. In our multivariate VAR model, the speed and degree of adjustment of the regional economic activity variables due to an interest rate shock is investigated. The estimated model captures the dynamic feedback effects in a relatively unconstrained fashion, and is therefore a good approximation of the true data-generating process. 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) processes.[2] Following the fact that all of our VAR models estimated involve variables admitting stationary linear combinations[3], we estimate the Bayesian PVAR in levels rather than cointegrated VARs (arguments on this can be found in Sims and Zha 1998)[4]. 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. The model is estimated in RATS software.

2.3. Impulse Response Functions

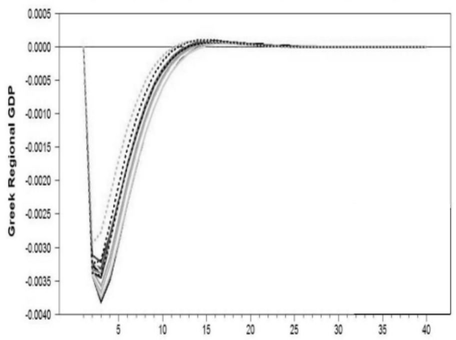
Once the model is estimated, we examine how a positive shock to the interest rate is transmitted to the regional economic activity, by examining the impulse responses of the 58 regions' GDP. Impulse responses (IRFs) give the dynamic responses of each variable to an innovation of this variable as well as of the other variables included in the VAR system. In our case, IRFs are used to

[2] 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.
[3] Cointegration tests based on the Johansen procedure are not presented for economy of space. However, they are available upon request from the authors.
[4] 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.

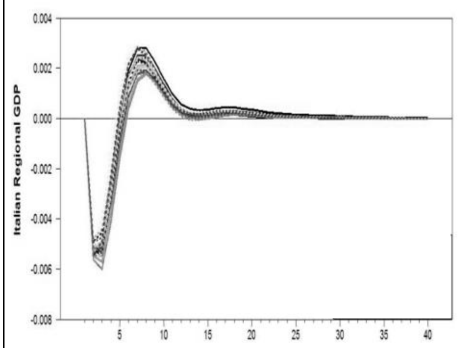
show the dynamic response of regional GDP to a standard deviation monetary policy shock. If there are statistically significant differences among IRFs, monetary policy is generating asymmetric regional effects.

Figure 1. Impulse Response Functions - PVAR

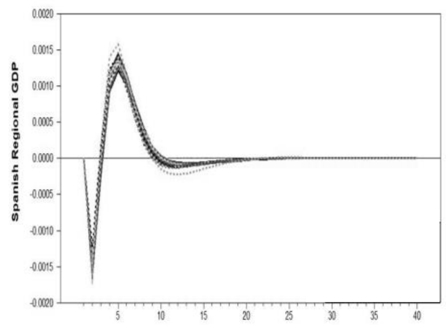
Graph (a). Greek Regions: Impulse responces of regional output to interest rate shocks



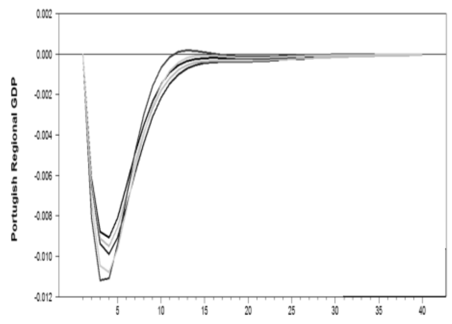
Graph (b). Italian Regions: Impulse responces of regional output to interest rate shocks



Graph (c). Spanish Regions: Impulse responces of regional output to interest rate shocks



Graph (d). Portugese Regions: Impulse responces of regional output to interest rate shocks



In Figure 1 (Graphs (a)–(d)), we present the impulse responses of regional output to a positive interest rates shock under standard Choleski decompositions (responses to one S.D. innovations) for each of the 58 regions. The IRFs of the 58 regions are grouped per country in each graph. In general, these figures show that positive monetary policy shocks have a negative impact on regional economic activity in all 58 regions, nonetheless the magnitude of the responses defers across regions. The impulse responses indicate that monetary policy shocks have their maximum impact on Greek regional output at the 3rd year in four out of thirteen regions, while the maximum impact occurs in the 2nd year for eight out of thirteen regions. In the case of Italy, the maximum impact occurs in the 2nd year in 19 out of 21 regions, while the maximum impact occurs in two out of 21 regions in the 3rd year. In the case of Spain, the maximum impact occurs in the 2nd year in all regions; whereas, in Portugal the maximum impact of the monetary shock occurs in the 4th year in all five regions. Furthermore, the magnitude of the responses is very different across regions of the four countries. Generally speaking, a restrictive monetary policy shock seems to affect significantly in magnitude and time Greece and Portugal, while recovery is much quicker for Spain and Italy.

To help summarize the information on the magnitude of the impulse responses across the four grouped regions, we construct tables 3 and 4.

Table 3. Statistics for the 12, 24 and 36 month response functions for 58 regions grouped by country

	IRFs_GR12	IRFs_GR24	IRFs_GR36	IRFs_ES12	IRFs_ES24	IRFs_ES36
Mean	-0.00328	-0.00341	-0.00297	-0.001437	5.16E-07	0.001117
Max	-0.002935 (DM)	-0.002776 (KM)	-0.002242 (KM)	-0.001226 (EXTR)	0.00017 (PVAS)	0.001399 (GAL)
Min	-0.003416 (KRI)	-0.003815 (KRI)	-0.003488 (KRI)	-0.001635 (RDM)	-0.000235 (EXTR)	0.000922 (CANT)
Std Dev.	0.00014	0.000271	0.000327	9.91E-05	0.000108	0.000114
Obs	13	13	13	19	19	19
National IRFs	-0.003272362	-0.004078	-0.004058	-0.001083	-6.733E-05	0.000845
	IRFs_IT12	IRFs_IT24	IRFs_IT36	IRFs_PT12	IRFs_PT24	IRFs_PT36
Mean	-0.005273	-0.005084	-0.002827	-0.001437	5.16E-07	0.001117
Max	-0.004774 (VEN)	-0.003988 (FVG)	-0.001353 (FVG)	-0.001226 (NORT)	0.00017 (NORT)	0.001399 (NORT)
Min	-0.005601 (SIS)	-0.00601 (BAS)	-0.004096 (BAS)	0.011223 (ALEN)	-0.015778 (ALEN)	0.015793 (ALEN)
Std Dev.	0.000259	0.000458	0.000594	0.000829	0.000993	0.000767
Obs	21	21	21	5	5	5
National IRFs	-0.004037	-0.004498	-0.003444	-0.002299	-0.003066	0.002926

Note: The abbreviations in the parentheses indicate the regions that experience the minimum and the maximum values of IRFs.

Table 3 reports summary statistics of the 12-month, 24-month and 36-month impulse responses for all regions grouped by country; while, Table 4 reports the IRFs at 12 months, 24 months and 36 months for each region. The regions are ranked in descending order according to the size of their decline, indicating each region's position relative to the national one.

Using the national value of the impulse response as a benchmark, we observe that for the Greek regions, the regional average decline in output is smaller than that of the national in all three periods; while in the case of Portugal, the average is much greater than that of the national in all three periods. In the cases of Italian regions, in the 1st and 2nd year, the national decline is smaller than that of the regional average, while in the 3rd year, the national becomes greater than that of the regional. In Spain and in all three periods, the national IRFs values are smaller than that of the regional average. Finally, the abbreviations in the parentheses of Table 3 present the regions that experience the minimum or the maximum IRFs values. More or less, there is a consistent pattern across the regions, which experience the minimum or maximum values of IRFs over the three periods.

Table 4. IRFs at 12, 24 and 36 months per region relative to the national ones

Greek Regions					
	IRFs 12 mon		IRFs 24 mon		IRFs36 mon
DM	-0.0034157	Greece	-0.0040785	Greece	-0.0040583
KM	-0.0034145	KM	-0.0038148	KM	-0.0034875
IP	-0.0034055	IP	-0.0037616	IP	-0.0034399
VAIG	-0.0033850	DM	-0.0036662	DM	-0.0032591
TH	-0.0033719	PEL	-0.0035753	PEL	-0.0031649
PEL	-0.0033345	TH	-0.0034457	TH	-0.0029620
SE	-0.0033247	VAIG	-0.0034300	DE	-0.0029546
Greece	-0.0032724	SE	-0.0033859	AMT	-0.0029362
AMT	-0.0032711	AMT	-0.0033835	VAIG	-0.0029295
NAIG	-0.0032391	DE	-0.0033697	SE	-0.0028970
IN	-0.0032341	IN	-0.0033167	IN	-0.0028670
DE	-0.0031961	ATT	-0.0032097	ATT	-0.0028112
ATT	-0.0031148	NAIG	-0.0031910	NAIG	-0.0026566
KRI	-0.0029345	KRI	-0.0027763	KRI	-0.0022418
Spanish Regions					
	IRFs 12 mon		IRFs 24 mon		IRFs36 mon
RDM	-0.0016348	PVAS	-0.0002352	Spain	0.0008459
PVAS	-0.0016168	RDM	-0.0001798	GAL	0.0009215
CANT	-0.0015685	GAL	-0.0001373	PVAS	0.0009226
CFDN	-0.0015318	CYL	-0.0000751	CYL	0.0009791
CDM	-0.0014861	AND	-0.0000695	RDM	0.0009826
AND	-0.0014624	Spain	-0.0000673	AND	0.0010638
CAT	-0.0014577	PDA	-0.0000459	PDA	0.0010759
CLM	-0.0014237	CFDN	-0.0000316	IB	0.0010879
CADC	-0.0014195	CDM	-0.0000177	CFDN	0.0011168
CANT	-0.0014123	IB	0.0000267	LR	0.0011266
CADM	-0.0014056	CV	0.0000289	CDM	0.0011302
IB	-0.0014034	CAT	0.0000326	CV	0.0011410
CV	-0.0014027	CLM	0.0000342	ARAG	0.0011423
PDA	-0.0014005	LR	0.0000351	CAT	0.0011691
GAL	-0.0013965	CANT	0.0000460	CANT	0.0011709
LR	-0.0013912	ARAG	0.0000569	CLM	0.0011781
CYL	-0.0013587	CADC	0.0000920	CADC	0.0011884
ARAG	-0.0013122	CADM	0.0001096	CADM	0.0012027
EXTR	-0.0012263	EXTR	0.0001696	EXTR	0.0012297
Spain	-0.0010835	CANT	0.0001703	CANT	0.0013992

Italian Regions					
	IRFs 12 mon		**IRFs 24 mon**		**IRFs36 mon**
VEN	-0.0056013	FVG	-0.0060097	FVG	-0.0040958
FVG	-0.0055989	ER	-0.0057039	ER	-0.0037505
PIEM	-0.0055905	LOMB	-0.0054224	Italy	-0.0034448
LOMB	-0.0055149	PIEM	-0.0053983	TOSC	-0.0033561
BAS	-0.0055045	BAS	-0.0053867	BAS	-0.0032262
ABRU	-0.0054948	VEN	-0.0053823	PAT	-0.0031769
ER	-0.0054612	UMBR	-0.0053367	UMBR	-0.0031189
VAMOL	-0.0054323	TOSC	-0.0053280	LOMB	-0.0030527
CAMP	-0.0053666	PAT	-0.0051821	PABB	-0.0030058
UMBR	-0.0053355	VAMOL	-0.0050918	VEN	-0.0029449
LAZ	-0.0052995	PABB	-0.0050886	PIEM	-0.0029043
PABB	-0.0051767	LAZ	-0.0050130	LIG	-0.0028507
TOSC	-0.0051702	LIG	-0.0050040	MOL	-0.0026657
PAT	-0.0051609	MOL	-0.0049059	SIS	-0.0026503
LIG	-0.0051586	ABRU	-0.0048917	LAZ	-0.0026375
MOL	-0.0050846	CAMP	-0.0048900	VAMOL	-0.0026105
PUG	-0.0049600	SIS	-0.0047252	MARC	-0.0023164
SIS	-0.0049177	MARC	-0.0045327	CAMP	-0.0022990
MARC	-0.0048656	Italy	-0.0044981	CAL	-0.0022974
CAL	-0.0047741	CAL	-0.0043992	ABRU	-0.0022226
Italy	-0.0040374	PUG	-0.0039881	PUG	-0.0013529
Portugish Regions					
	IRFs 12 mon		**IRFs 24 mon**		**IRFs36 mon**
ALEN	-0.0112231	ALEN	-0.0157778	ALEN	-0.0157926
ALGA	-0.0104898	ALGA	-0.0151281	ALGA	-0.0156184
CENTR	-0.0095630	CENTR	-0.0140369	CENTR	-0.0148846
LISB	-0.0093950	LISB	-0.0136734	LISB	-0.0143635
NORT	-0.0093230	NORT	-0.0134738	NORT	-0.0140301
Portugal	-0.0022997	Portugal	-0.0030668	Portugal	-0.0029264

For instance, in Portugal, the region which experiences the lowest IRF value is Norte (NORT) in all three periods, while the region that experience the highest IRF value over all three periods is Alentejo (ALEN). In the case of the Italian regions, Veneto (VEN) is observed to have the lowest value of IRFs in the 12-month period, while Sicilia (SIS) has the highest IRF value in the same period. Friuli-Venezia Giulia (FVG) and Basilicata (BAS) are the two regions that are observed to have the lowest and the highest values of IRFs respectively over the 24 and 36-month periods. In the case of the Greek Regions, the region of

Kriti (KRI) is observed to have the highest IRF value in all three periods, while Dytiki Makedonia (DK) has the lowest IRF value in the 12-month period and Kentriki Makedonia (KM) in the 24 and 36- month periods. Finally, the Spanish regions have a different pattern compared to the regions of the preceding countries. Different regions experience different values of IRFs in each of the three periods. More specifically, in the 12-month period, Extremadura (EXTR) has the minimum IRF value, while Region de Murcia (RDM) has the highest in the same period. In the 24-month period, Pais Vasco (PVAS) has the lowest IRF value and Extremadura (EXTR) has the highest. Finally, in the last period, the 36-month, Galicia (GAL) is observed to have the minimum IRF value and Canarias region (CANT) to have the greatest.

Summing up Table 4, we can report that among the Greek Regions, 6 regions perform better than Greece in the 1st year, while in the second and third year all regions perform better than Greece, having lower decline in their output. In Italy in the first year, output decline is greater than that of the national in all regions; while in the third year, the results are reverse for 19 regions. We observe a similar pattern in the Spanish regions. Finally, in Portugal, the decline in real economic activity is greater at the regional level than that of the national in all three periods.

We conclude this section by making two distinct points of the above empirical analysis: a) the monetary policy shocks do generate asymmetric effects across regional economic activity, and b) there is a pattern on the magnitude of the decline in regional economic activity: in the 1st year the regional decline is greater than that of the national, exception is Greece; while, in the third year the regional decline is smaller than that of the national, exception is Portugal.

3. EXPLAINING ASYMMETRIC MONETARY POLICY SHOCKS WITHIN AN OCA FRAMEWORK

Our general findings from the preceding Bayesian PVAR analysis have shown compelling evidence of differences in regional responses following monetary policy actions. Our results are consistent with many studies which also have documented disparities in the regional responses to monetary policy shocks. Carlino and DeFina (1998) show that certain Bureau of Economic Analysis (BEA) regions respond differently from the U.S. aggregate response to a monetary policy shock. Furthermore, while repeating the exercise for state-level data, Carlino and DeFina (1999) indicate substantial within- and cross-region variability. Additionally, Ridhawan *et al.* (2011) documented regional disparities in Indonesia; Arnold and Vurugt (2002) reported differential effects of monetary policy in Netherlands; Ahlefeldt et al. (2009) reported regional and sectoral asymmetries in Denmark and Sweden; Beskworth (2010) documents regional disparities of monetary policy transmission in the 48 USA states. Other papers [Mihov (2001), Hanson et al. (2006)] have shown that these regional asymmetries exist at varying levels of disaggregation, for different datasets, and various identifying restrictions governing the propagation of policy shocks.

Given the fact that monetary policy affects some regions of the country more than others, a review of the large stance of empirical studies examining how monetary policy may affect regions differently and why, reveal that certain regions of the country are consistently more affected by monetary policy than others due to the fact that those regions have a relatively high share of their economy in interest sensitive industries, i.e. manufacturing, which is more susceptible to negative monetary policy shocks. An interesting conclusion from the review of all these studies is that different mix of industries in the regions is the only convincing explanation of regional asymmetric responses to monetary policy shocks. Any traditional effect through a credit channel that may be operating at the national level is not reflected in the regional asymmetries (Crone, 2007). As pointed by Crone (2007), we should search for other reasons for these types of asymmetries.

In our study and following Beckworth (2010), we give a different direction to explaining regional asymmetries in the response to the monetary policy shock by using the OCA framework; since, very few studies have explained regional asymmetries of monetary policy shock through the perspective of the Optimal Currency Area (OCA) framework. The OCA is useful here because it provides criteria to determine whether multiple regions are best served by a single monetary union.

3.1. Shock Absorbers based on Optimal Currency Area (OCA) Theory

According to OCA theory (Mundel's (1961)), when authorities conduct a monetary policy in multiple regions, the regions must share similar business cycles or have in place economic shock absorbers in order to minimize the costs of a positive monetary shock. These absorbers are well defined within the OCA theory and they are the following:

a) High degree of labor mobility

The idea is that the cost of sharing the same currency would be eliminated if the factors of production, capital and labor, were fully mobile across borders. Since it is conventionally assumed that the real hurdle then comes from the lack of labor mobility. High factor market integration within a group of regions can reduce the need to alter real factor prices and the nominal exchange rate between countries in response to disturbances (Mundell (1961)). Trade theory has long established that the mobility of factors of production enhances both efficiency and welfare. Such mobility is likely to be modest in the very short run and could display its effect over time. The mobility of factors of production is limited by the pace at which direct investment can be generated by one region and absorbed by another. Similarly, labour mobility is likely to be low in the short run, due to significant costs for migration and retraining. Mobility, however, may increase in the medium and long run, easing the adjustment to permanent shocks.

b) Flexible wages and prices

When nominal prices and wages are flexible between and within regions contemplating a single currency, the transition towards adjustment following a shock is less likely to be associated with sustained unemployment in one region and/or inflation in another. This will in turn diminish the need for nominal exchange rate adjustments (Friedman, 1953). Alternatively, if nominal prices and wages are downward rigid some measure of real flexibility could be achieved by means of exchange rate adjustments. The loss of direct control over the nominal exchange rate instrument represents a cost (Kawai, 1987).

c) Budgetary transfers

Countries sharing a supranational fiscal transfer system to redistribute funds to a member country affected by an adverse asymmetric shock would also be facilitated in the adjustment to such shocks and might require less nominal exchange rate adjustments (Kenen, 1969). However, this would require an advanced degree of political integration and willingness to undertake such risk-sharing.

d) Economic Diversification

It is widely held that a diversified economy is less sensitive to the ups and downs associated with any particular industry because risk is spread more evenly across a number of industries. With diversification, even if some industries are suffering, other stronger industries will help the economy maintain healthy growth. The presence of many industries would be expected to offer opportunities for employment in growing sectors to compensate for employment losses in declining sectors (Kenen, 1969).

e) Similar Business Cycles

Finally, if the regions share the same business cycle then monetary policy, which typically targets the aggregate business cycle or an anchor region's business cycle, should be stabilizing for all regions. If, on the other hand, there are regional economic shocks generating dissimilar business cycles among the regions, then one monetary policy will be destabilizing for some of the regions unless the above mentioned economic shock absorbers are in place (Beckworth 2010).

In general, the greater the dissimilarity of a region's business cycle with the rest of the currency union the more important these economic shock absorbers become for the region to be a successful part of an OCA. Basically, how a region responds to countercyclical monetary policy relative to the other regions provides a summary measure of whether that region shares a similar business cycle with the rest of the monetary union or it has in place the appropriate economic shock absorbers to accommodate the shock. If some regions cannot comply with the above OCA criteria, an important question arises: Should have these regions been a part of a common currency area?

The objective of the second part of our empirical analysis is to answer the above raised question by investigating whether the absolute value of the asymmetric regional impulse responses to monetary policy shocks obtained from the Bayesian PVAR estimates, regardless of the sign, can be explained by the OCA criteria; this leads to the following empirical analysis.

3.2. Empirical Analysis

In order to explain the regional asymmetric effects of monetary policy evidenced in section 2 of our paper and using the OCA framework explained in Section 3.1, we employed the following data sets for all 58 regions: national and regional GDP; national and regional manufacturing wages; national and regional unemployment rates; national and regional sectoral output (sectors included: Manufacturing (MAN) and Non-Market services (NMS). The choice of the particular sectors is attributed to the fact that manufacturing is more susceptible to negative monetary policy shocks, since it is considered to be a high interest sensitive industry, while an industry such as the non-market services is a low interest sensitive industry, hence it is less susceptible to negative monetary policy shocks. The above data came from two different sources: OECD and EUROSTAT. The period analyzed is 1980-2009 and all the variables are in constant prices. From the above data, we computed the following main variables that were used in our OCA analysis.

Firstly, we computed the absolute values of the 12, 24 and 36-month impulse responses obtained from the estimated Bayesian PVAR model.

Secondly, we computed wage flexibility (Relative Manufacturing Wage-RMW) by taking the average percent deviation of a region's manufacturing wage from the national manufacturing wage for the period 1980-2009. The wage flexibility measures are rates of change relative to the national average, hence, they should have a mean of zero if they are perfectly flexible; while they will be downwardly sticky and less flexible compared to the nation, if wages are persistently higher than the national average.

Thirdly, we constructed the labor mobility variable (Unemployment Persistence-UP) by estimating the relative persistence in a region to an unemployment shock (Eichengreen, 1990; Beckworth, 2010). More specifically, we took the difference between the IRF 5 years out from 1 unit shock to a region's unemployment rate and a similar shock to the national unemployment rate over the period 1980-2009. In order to obtain the IRFs, we estimated a simple 1-lag autoregressive model for each region and each country. The larger the IRF 3 years out the greater the unemployment persistence is, hence the greater the labor immobility.

Fourthly, and in order to quantify the diversification of each region's economy, we constructed the shares of a region's economy (Relative Sectoral Share of a sector) in a particular sector minus the share of the national economy in that economic sector. The closer to zero this measure is for a regional economy, the closer it is to being diversified along the lines of the national economy. Even if all the sectors are investigated for economy of space reasons we present only the statistically significant ones (NMS, MAN).

Finally, we estimate a business cycle coincident indicator (CCI) measure in order to obtain the differences between the regions' and nations' business cycles. The variable is constructed as follows for each region and nation: we use annual observations of the GDP in constant prices covering the period 1980-2009. For the identification of the business cycle, we use the deviation cycle proposed by Lucas (1977), defined as a cyclical fluctuation in the cyclical component of a variable around its trend. The deviation cycle is identified by isolating the cyclical component from the trend component, and for this purpose, it is necessary to apply a specific de-trending technique, which transforms the non-stationary variable of regional output into a stationary one. There are a variety of filtering techniques to extract the cyclical components of the macroeconomic series. In our analysis, we use the Hodrick-Prescott filter (1997), which estimates the trend component by minimizing deviations from trend, subject to a predetermined smoothness of the resulting trend (de Haan et al. 2008).

Our model is empirically specified as follows:

$$AIRF(no.mon)_i = \alpha + \beta_1 RMW_i + \beta_2 UP_i + \beta_3 RS(MAN)_i + \beta_4 RS(NMS)_i + CCI_i + \varepsilon_i \quad (5)$$

where $i = 1,2,3,\dots,N$ indexes the number of regions; $AIRF(no.mon)_i$ are the absolute values of the impulse responses at 12-month, 24-month and 36 month period obtained from the estimated Bayesian PVARs; RMW_i is the relative manufacturing wage; UP_i is the unemployment persistence; $RSMAN_i$ is the relative manufacturing share; $RSNMS_i$ is the relative Non-Market Services share; CCI_i is the Coincident Correlation Indicator; ε_i refers to the disturbance term (which follows normal probability distribution with zero mean and constant variance).

The above model is estimated for the 58 observation, using the standard OLS method. All regressions were checked for heteroskedasticity using the Breusch-Pagan Test, and where evidence of heteroskedasticity found, the models were re-estimated using robust standard errors. The results are presented in Table 5.

We report two different versions of the estimated model to explain the 12-month, 24-month and 36-month AIRFs. The main four economic shock absorbers used in both versions are the wage flexibility, labor mobility, manufacturing diversification and non-market services diversification.

In the first model, the estimated equations with dependent variables AIRF-12mon, and AIRF-24mon, report statistically significant coefficients of the four economic shock absorbers and the signs are as expected. The higher the relative manufacturing wage (i.e. the lower the wage flexibility), the greater the unemployment persistence (i.e. the less is labor mobility) the greater are the absolute responses of the state economies to a negative monetary policy shock. However, what is really interesting and contributes to existing relevant literature is that the larger the share of non-market services and manufacturing relative to the national one, the smaller are the absolute responses of the regional economies to a negative monetary policy shock. For European countries the role of manufacturing is crucial in contrast to other countries such as USA or Canada.

Table 5. Using the OCA criteria a to explain the asymmetric effects of monetary policy shocks in the 58 regions

	Variables	(1) AIRF (12 month)		(2) AIRF (24 month)		(3) AIRF (36 month)	
		Coeff.	t-Stat	Coeff.	t-Stat	Coeff.	t-Stat
Model 1.	C	0.005693***	7.64	0.006323***	4.87	0.00491***	3.28
	RMW	0.007114***	4.52	0.010247***	3.95	0.006346***	2.21
	RSMAN	-0.007603***	-2.03	-0.01231**	-1.96	-0.008463	-1.36
	RSNMS	-0.011906***	-3.62	-0.020143***	-3.65	-0.015361***	-2.14
	UP	0.003001***	2.35	0.003894*	1.81	0.002755	1.32
	R^2	42.43%		35.38%		16.78%	
	Adj. R^2	38.09%		30.50%		10.50%	
Model 2.	C	0.005871***	7.67	0.006979***	5.43	0.00528***	3.72
	RMW	0.00703***	4.11	0.009936***	3.50	0.006171***	2.02
	RSMAN	-0.007088**	-1.95	-0.010401	-1.68	-0.007389	-1.10
	RSNMS	-0.011752***	-3.40	-0.019572***	-3.30	-0.01504***	-2.00
	UP	0.003149***	2.13	0.004441**	1.89	0.003063	1.49
	CIC	-0.00031	-0.31	-0.001148	-0.77	-0.000646	-0.53
	R^2	42.54%		35.98%		16.99%	
	Adj. R^2	37.02%		29.83%		9.01%	

*Note: ***, **, and * significant at 1%, 5% and 10% significance level respectively.*

Interestingly, the estimated coefficients on these variables and the overall explained variation get larger in the second period, while they become smaller in the 3rd period. In the 3rd period, manufacturing diversification and unemployment persistence becomes less statistically significant. An also interesting observation is that the R^2 decrease with the time horizon. These models explain between 42.43% at the 12-month horizon, 35.38% at the 24-month horizon and 16.78% at the 36-month horizon the corresponding AIRFs.

Further, we re-estimate the above models including the CCI variable (Model 2). Nevertheless, the correlation measure is negative as expected but statistically insignificant in all cases. Concerning the main four economic absorbers, still remain statistically significant and with the expected sign in the case where the dependent variable is the AIRF-12mon; however, the variables of manufacturing diversification and unemployment persistence become less statistically significant in the cases of AIRF-24mon and AIRF-36mon.

To summarize the above analysis, there are economically meaningful contributions made by all the OCA variables. Their importance, however, changes over the time period. Wage flexibility and labor mobility are more important during the first two horizons while the industry diversification variable and the correlation measure become more important during the latter two horizons. Overall, then, the OCA criteria appears to provide a good framework for understanding the asymmetric regional effects of the monetary policy shocks on South European countries. These findings suggest that some regions may have gained from having their own currency.

4. CONCLUSIONS

The recent Eurozone crisis reveals significant difference between North and South of Eurozone. It is implied by a number of economists that countries of South Europe could be possible to have their own common currency. Therefore an interesting question arises: Are South Euro-Zone regions best served by a single currency? This study tries to shed light on this direction by using annual data from 1980 to 2009 for the 58 regions of the four South EU-zone countries: Greece, Italy, Spain and Portugal.

A Bayesian Panel VAR model that includes real and monetary variables is employed in order to identify the responses of regional output to monetary policy. The results show that the monetary policy shocks do generate asymmetric effects across regional economic activity. Generally speaking, a restrictive monetary policy shock seems to affect significantly in magnitude and time Greece and Portugal, while recovery is much quicker for Spain and Italy. This can be characterized as a first sign that the birth of a new currency union covering all South European countries is not an easy task. Spain and Italy could be members of a new currency union but not with Portugal and Greece as can be implied by our analysis.

By analyzing further impulse response functions an interesting finding is that in the 1st year following the restrictive shock the regional decline is greater than that of the national (exception is Greece); while, in the third year the regional decline is smaller than that of the national (exception is Portugal). This result discloses a short lived regional asymmetry with possible implications for policy makers and economic agents.

In attempting to explain the evidenced asymmetries in monetary policy responses, we used the OCA criteria. The results showed that there are economically meaningful contributions made by all the OCA variables used. More specifically, our results indicate that the higher the relative manufacturing wage (i.e. the lower the wage flexibility), and/or the greater the unemployment persistence (i.e. the less is labor mobility) the greater are the absolute responses of the state economies to a negative monetary policy shock. Furthermore, what is really interesting and contributes to existing relevant literature is that the larger the share of non-market services and manufacturing relative to the national one, the smaller are the absolute responses of the regional economies to a negative monetary policy shock. Their importance, however, changes over the time period. Wage flexibility and labor mobility are more important during the first two horizons while the industry diversification variable and the correlation measure become more important during the latter two horizons.

Our results support the findings of Beckworth, 2010, who used the same framework analysis to examine the regional effects of US monetary policy shocks through the perspective of the optimal currency framework. He concluded that some regions may have been benefited from having their own currency.

In this paper, we argue that the South European Country regions constitute a puzzle from the standpoint of OCA criteria. Overall, in our analysis, the OCA criteria appear to provide a good framework for understanding the asymmetric effects of the monetary policy shocks in the South European Regions. The regions have successfully maintained a currency union despite their failure to meet a number of important OCA criteria.

The theory of optimum currency areas postulates that when authorities conduct a monetary policy in multiple regions, the regions must share similar business cycles or have in place the following economic shock absorbers in order to minimize the costs of a positive monetary shock: a) High degree of labor mobility; b) Flexible wages and prices; c) Budgetary transfers; and finally d) Economic diversification.

Our analysis suggests that:

a) Labor is relatively immobile in South European regions; labor mobility – that is geographically mobility – is unlikely to form a major mechanism of adjustment to asymmetric shocks within the South European Regions.

b) Real wages and prices have been inflexible between the South European Regions, which leads to the conclusion that wage-price flexibility may prove even less significant as a mechanism of adjustment to asymmetric shocks of a common monetary policy.

Given that fact these labour market rigidities remain, then fiscal redistribution adjustments will be the only instrument available to offset the consequences of asymmetries in shocks at the regional level resulting from a common monetary policy. Hence, fiscal policy instruments should play an active role in smoothing regional inequalities in the South European countries. Therefore, fiscal policies forcing wage flexibility and labor mobility by governments can serve as the economic absorbers needed in the occurrence of a negative economic shock. Moreover, in this path can help the increase of sectors like manufacturing and non-market services.

REFERENCES

Almunia, M., Benetrix, A., Eichengreen, B., O'Rourk, K.H., Rua, G., 2010. From great depression to great credit crisis: similarities, differences and lessons. *Economic Policy*, 25. 62, 219-265.

Antzoulatos, A.A. and Yang, J., 1994, Exchange Rate Pass-Through in U.S. Manufacturing Industries: A Demand Side Story, Working Papers, New York University.

Anselin, L., 2010. Thirty Years of Spatial Econometrics. *Papers in Regional Science*, 89, 3-25.

Arnold, J, Vrugt, E., 2002. Regional Effects of Monetary Policy in the Netherlands, *International Journal of Business & Economics*, 1(2), 123-134.

Arnold, I. J., Vrugt, E. B., 2004. Firm Size, Industry Mix and the Regional Transmission of Monetary Policy in Germany, *German Economic Review*, 5(1), 35-39.

Ballabriga, F.C., Sebastian, M., Valles, J., 1998. European asymmetries. *Journal of International Economics* 48, 233-253.

Banbura, M., Giannone, D., and Reichlin, L., 2010. Large scale Bayesian VARs, *Journal of Applied Econometrics*, 25, 71-92.

Beetsma, R., Giuliodori, M., Klaassen, F., 2006. Trade spill-overs of fiscal policy in the European Union: a panel analysis. *Economic Policy*, 121. 48, 639-687.

Beckworth, D., 2010, One nation under the fed? The asymmetric effects of US monetary policy and its implications for the United States as an optimal currency area. *Journal of Macroeconomics*, 32, 732-746.

Ben S. Bernanke & Mark Gertler, 1995. Inside the Black Box: The Credit Channel of Monetary Policy Transmission, *Journal of Economic Perspectives*, 9(4), 27-48.

Binder, M., Hsiao, C., Pesaran, M.H., 2000. Estimation and inference in short panel vector autoregressions with unit roots and cointegration. DAE Working Paper 0003, University of Cambridge.

Canova, F., 1995. VAR: specification, estimation, testing, forecasting. In: Pesaran, H., Wickens, M.R., (Eds.), *Handbook of Applied Econometrics*, Vol. 1. Macroeconomics. Blackwell, 73-138.

Canova, F., Marcet, A., 1997. The poor stay poor: non-convergence across countries and regions. UPF Working Paper 137.

Canova, F., Ciccarelli, M, A., 2004. T Forecasting and turning point predictions in a Bayesian panel VAR model. *Journal of Econometrics*, 120, 327-359.

Canova, F., Ciccarelli M (2013) Panel Vector Autoregressive Models: A Survey, European Central Bank, working Paper Series, 1507.

Carlino, G, DeFina R., 1998. The differential regional effects of monetary policy. *Review of Economics and Statistics*, 80, 572-587.

Carlino, G., DeFina R, 1999. The differential regional effects of monetary policy: Evidence from the U.S. *Journal of Regional Science* 9(2), 339-358.

Chamberlain, G., 1982. Multivariate regression model for panel data. *Journal of Econometrics* 18, 5-46

Chamberlain, G., 1984. Panel data. In: Griliches, Z., Intriligator, M.D. (Eds.), *Handbook of Econometrics*, Vol. 2. North-Holland, 1247-1318.

Cohen J., Maeshiro A. 1977. The significance of money on the State level, *Journel of Money, Credit & Banking* 9, 672-78.

Cortes, B. S., Kong, D. 2007. Regional effects of Chinese monetary policy. *The International Journal of Economic Policy Studies*, 2, 15-28.

Costa-i-Font, J., Tremosa-i-Balcells, R., 2002, Spanish Regions and the Macroeconomic Benefits of the European Monetary Union, Working Paper, Universitat de Barcelona.

Crone, T. 2005. An Alternative Definition of Economic Regions in the United States Based on Similarities in State Business Cycles, *The Review of Economics and Statistics*, 87(4), 617-626.

Crone, T. 2007, Pattern of regional differences in the effects of monetary policy.*Federal Reserve Bank of Philadelphia Business Review*, Q3, 9-19.

Dees, S, Di Mauro, F., Pesaran, H., Smith, V. 2007. Exploring the International Linkages of the Euro area: A Global VAR analysis. *Journal of Applied Econometrics*, 22, 1-38.

De Grauwe, P., 2000, *Economics of Monetary Union*, Oxford: Oxford University Press.

De Haan J, Inklaar R, Jong-A-Pin R, 2008. Will business cycles in the Euro area converge? A critical survey of empirical research. *Journal of Economic Surveys*, 22, 234-273.

De Lucio, J., Izquierdo, M. 2002. Local responses to a global monetary policy: The regional structure of financial systems. *Journal of Economic Studies*, 29 (3), 205-221.

Doan, T., Litterman, R., Sims, C., 1984. Forecasting and conditional projections using realist prior distributions. *Econometric Review* 3, 1-100.

Dow S., Montagnoli A., 2007, The regional transmission of UK monetary policy, *Regional Studies*, 41, 797-808.

Eichengreen, B., 1990, One Money for Euroep? Lessons from the US Currency Union, Working Paper 90-132, University of California at Berkeley.

Friedman, M., 1953. The case for flexible exchange rates. In: Friedman, Milton (Ed.), *Essays in Positive Economics*. University of Chicago Press, 157-203.

Garretsen H, Swank J. 2003. The bank lending channel in the Netherlands: the impact of monetary policy on households and firms. *De Economist* 151(1):35-51.

Garrison B. and Chang H., 1979, The effects of monetary forces in regional economic activity, *Journal of Regional Science*, 19, 15-29.

Garrison B. and Chang H., 1979, The effect of monetary and fiscal policies on regional business cycles, *International Regional Science Review*, 4, 167-80

Garcia Ferrer, A., Highceld, F., Palm, F., Zellner, A., 1987. Macroeconomic forecasting using pooled international data. *Journal of Business and Economic Statistics* 5, 53-67.

Georgopoulos, G. 2009 Measuring regional effects of monetary policy in Canada, *Applied Economics*, 41: 16, 2093-2113.

Guiso I., Kashyap A., Panetta F. Terlizzese D. 1999. Will a Common European Monetary Policy Have Asymmetric Effects? *Economic Perspectives*, 23(4). 56-75.

Hanson, M. S. Hurst, E. and Park. K. Y., 2006, Does monetary policy help least those who need it most? *Wesleyan Economics Working Papers*, 06,

Hodrick, R.J. and E.C. Prescott 1997, Postwar US Business Cycles: An Empirical Investigation, *Journal of Money, Credit, and Banking*. 29, 1-16.

Holtz-Eakin, D., Newey, W., Rosen, H., 1988. Estimating vector autoregressions with panel data. *Econometrica* 56, 1371–1395.

Hsiao, C., Pesaran, M.H., Tahmiscioglu, A.K., 1999. Bayes estimation of short run coeGcients in dynamic panel data models. In: Hsiao et al. (Eds.), *Analysis of Panels and Limited Dependent Variable Models*. In Honor of G.S. Maddala. Cambridge University Press, Cambridge, 268-296.

Ingram, B., Whiteman, C., 1994. Supplanting the Minnesota prior: forecasting macroeconomics series using real business cycles model prior. *Journal of Monetary Economics* 34, 497-510.

Jiang Y., Chen Z., 2009, Empirical analysis of regional effects of monetary policy in China by SVAR model, *Journal of Financial Research*, 346(4): 180-195.

Jiao J, Sun T., Liu X., 2006, Analysis of regional difference in the effect of monetary policy, *Journal of Financial Research*, 309(3): 1-14.

Kawai, M., 1992. Optimum currency areas. In : Newman, P., Milgate, M., Eatwell, J. (Eds.), *The New Palgrave Dictionary of Money and Finance*, 3, 78-81.

Kenen, P.B., 1969. The theory of optimum currency areas: an eclectic view. In: Mundell, R.A., Swoboda, A.K. (Eds.), *Monetary Problems of the International Economy*. University of Chicago Press, Chicago, 41-60.

Lindley, D.V., Smith, A.F.M., 1972. Bayes estimates for the linear model (with discussion). *Journal of the Royal Statistical Society B* 34, 1-41.

Litterman, R.B., 1986. Forecasting with Bayesian Vector Autoregressions - years of experience. *Journal of Business and Economic Statistics* 4, 25-38.

Lucas, R., 1977. Understanding business cycles, Stabilization of the domestic and international economy, Carnegie-Rochester Conference Series.

Marelli, E. 1985. Economic policies and their effects upon regional economies, *Papers in Regional Science*, 58(1), 127-139.

Mathur, K., Stein S., 1980, Regional Impact of Monetary and Fiscal Policy: An Investigation into the Reduced Form Approach, *Journal of Regional Science*, 20(3), 343-51.

Mathur, K., Stein S., 1983, Regional Impact of Monetary and Fiscal Policy: A Reply, *Journal of Regional Science*, 23(2), 263-65.

Mihov, I. 2001, Monetary policy implementation and transmission in the European Monetary Union, *Economic Policy*, 16(33):369-406.

Mundell, R. 1961. A Theory of Optimal Currency Areas, *American Economic Review* 51: 657-665.

Owyang, M. T., & Wall, H. J. 2009. Regional VARs and the channels of monetary policy. *Applied Economics Letters*, *16*(12), 1191-1194.

Papadamou, S., Siriopoulos, C., 2012. Banks' lending behavior and monetary policy: evidence from Sweden. *Review of Quantitative Finance and Accounting*, 38 (2) 131-148.

Partridge M., Rickman, S. 2005. Regional cyclical asymmetries in an optimal currency area: an analysis using US state data, *Oxford Economic Papers*, 57(3), 373-397.

Pesaran, M.H., Smith, R., 1996. Estimating long run relationships from dynamic heterogeneous panels, *Journal of Econometrics*, 68, 79-113.

Pesaran, H., Schuerman, T., Wiener, S., 2004. Modelling regional interdependencies using a global error-correcting macroeconomic model. *Journal of Business and Economic Statistics*, 22, 129-162

Potts, T. Yerger, D. 2010. Variations across Canadian regions in the sensitivity to U.S. Monetary Policy, *Atlantic Economic Journal*, 38, 443-454.

Ridhwan, M. M., de Groot, H. L.F., Rietveld, P., Nijkamp, P., 2011, The Regional Impact of Monetary Policy in Indonesia, *Tinbergen Institute Discussion Paper*, TI 2011-081/3, Amsterdam.

Ridhwan, M.M., De Groot, H.L.F., Nijkamp, P. and Rietveld, P. 2010. The impact of monetary policy on economic activity: Evidence from a Meta-Analysis. *Tinbergen Institute Discussion Paper*, 043/3.

Rodríguez-Fuentes, C. J. (2005), Credit Availability and Regional Development, *Papers in Regional Science*, 77(1), 63-75.

Sims, C., Zha, T., 1998. Bayesian methods for dynamic multivariate models. *International Economic Review* 39, 949-979.

Stock, J., H. Watson, M. W., 1989. New Indices of Coincident and Leading Indicators, in Blanchard, O. and Fisher, S. (eds.), NBER Macroeconomic Annual, 4.

Stock, J. Watson, M., 2003. Understanding Changes in International Business Cycle Dynamics. *Journal of European Economic Association*, 3, 968-1006

Svensson, E. 2012, Regional Effects of Monetary Policy in Sweden, Department of Economics, Lund University, *Working Paper 2012:9*, Lund.

Zellner, A., Hong, C., 1989. Forecasting international growth rates using Bayesian shrinkage and procedures. *Journal of Econometrics* 40, 183-202.

Zellner, A., Hong, C., Min, C., 1991. Forecasting turning point in international output growth rates using Bayesian exponentially weighted autoregression, time varying parameter. *Journal of Econometrics* 49, 275-304.

ANNEX

Table 1. The 58 regions under study grouped by country

Greek Regions		Spanish Regions		Italian Regions		Portugish Regions	
AMT	AMakedThraki	GAL	Galicia	PIEM	Piemonte	NORT	Norte
KKM	K Makedonia	PDA	Asturias	VAMOL	Valle d'Aosta	CENTR	Centro
DDM	DMakedonia	CANT	Cantabria	LIG	Liguria	LISB	Lisboa
TH	Thessalia	VAS	Pais Vasco	LOMB	Lombardia	ALEN	Alentejo
IP	Ipeiros	FDN	Navarra	PABB	Bolzan	ALGA	Algarve
IN	Ionia Nisia	LR	La Rioja	PAT	Trento		
DE	Dytiki Ellada	RAG	Aragón	VEN	Veneto		
SE	Sterea Ellada	CDM	Madrid	FVG	Friuli-Venezia		
PEL	Peloponnisos	CYL	CastillaLeón	ER	Emilia-Roma		
ATT	Attiki	CLM	CastillaManc	TOSC	Toscana		
VAIG	Voreio Aigaio	EXTR	Extremadura	UMBR	Umbria		
NAIG	Notio Aigaio	CAT	Cataluña	MARC	Marche		
KRI	Kriti	CV	Valenciana	LAZ	Lazio		
		IB	Illes Balears	ABRU	Abruzzo		
		AND	Andalucia	MOL	Molise		
		RDM	Murcia	CAMP	Campania		
		CADC	Ceuta	PUG	Puglia		
		CADM	Melilla	BAS	Basilicata		
		CANT	Canarias	CAL	Calabria		
				SIS	Sicilia		
				SARD	Sardegna		

Table 2.A. Economic Variables for NUTS II Regions in Greece, 2009 (% of total)

Region	GVA	AGR	EMAN	CONS	MS	NMS	UN	RMW
GR	**103076**	**8725**	**14375**	**7760**	**51304**	**20911**	**1.4**	
AMT	4.26%	9.53%	4.45%	6.24%	3.18%	3.84%	11.6	26.38%
KM	15.25%	17.88%	16.07%	17.18%	14.68%	14.29%	11.4	26.50%
DM	2.51%	3.87%	5.46%	1.00%	1.92%	1.91%	15.8	25.39%
TH	5.76%	13.56%	5.45%	7.62%	4.87%	4.21%	11.5	25.96%
IP	2.40%	3.80%	1.51%	2.17%	2.12%	3.20%	12.8	25.93%
IN	1.69%	2.17%	0.51%	1.88%	1.86%	1.80%	9.2	25.96%
DE	4.94%	9.85%	3.88%	5.18%	4.62%	4.28%	11.1	26.02%
SE	6.93%	9.33%	15.76%	11.11%	4.93%	3.20%	12.8	27.41%
PEL	4.87%	11.43%	5.99%	4.63%	4.06%	3.46%	8.4	25.77%
ATT	41.87%	4.26%	36.18%	34.00%	47.22%	51.24%	11.8	7.90%
VAIG	1.49%	2.30%	0.66%	3.80%	1.38%	1.15%	10.3	25.97%
NAIG	3.01%	2.64%	1.68%	1.19%	3.83%	2.74%	11.2	25.99%
KRI	5.03%	9.40%	2.39%	4.00%	5.32%	4.69%	8.1	25.60%

Table 2.B. Economic Variables for NUTS II Regions in Spain, 2009 (% of total)

Region	GVA	AGR	EMAN	CONS	MS	NMS	UN	RMW
ES	**507303**	**20503**	**102951**	**43414**	**234451**	**105984**	**14.5**	
GAL	5.51%	9.73%	5.61%	6.31%	4.87%	5.69%	15.0	14.03%
PDA	2.41%	1.75%	3.24%	2.83%	2.06%	2.32%	15.7	14.17%
CANT	1.28%	1.45%	1.43%	1.33%	1.21%	1.21%	13.9	14.23%
PVAS	6.45%	2.74%	9.79%	5.07%	5.65%	6.25%	12.5	14.07%
CFDN	1.71%	1.88%	2.57%	1.52%	1.37%	1.66%	7.7	14.13%
LR	0.77%	1.75%	1.08%	0.67%	0.62%	0.64%	8.6	14.27%
ARAG	3.20%	4.57%	3.91%	3.00%	2.85%	3.10%	8.8	14.10%
CDM	16.91%	1.01%	13.09%	15.04%	19.98%	17.64%	11.8	5.79%
CYL	5.85%	11.61%	6.11%	6.03%	5.07%	6.14%	13.5	67.39%
CLM	3.48%	9.94%	3.33%	4.40%	2.75%	3.60%	13.1	67.32%
EXTR	1.70%	4.76%	0.92%	2.48%	1.37%	2.27%	23.0	67.36%
CAT	18.58%	8.58%	24.72%	16.19%	18.64%	15.40%	10.9	67.59%

CV	9.69%	8.24%	10.45%	9.68%	9.89%	8.78%	12.9	67.35%
IB	2.38%	0.99%	1.00%	2.31%	3.31%	1.96%	8.8	67.37%
AND	13.56%	23.90%	9.01%	16.15%	13.17%	15.79%	23.7	67.33%
RDM	2.40%	4.61%	2.14%	2.59%	2.22%	2.53%	13.2	67.33%
CADC	0.16%	0.02%	0.06%	0.12%	0.11%	0.41%	23.0	5.73%
CADM	0.15%	0.04%	0.04%	0.14%	0.10%	0.38%	19.6	5.73%
CANT	3.83%	2.44%	1.50%	4.15%	4.75%	4.21%	14.4	21.88%

Table 2.C. Economic Variables for NUTS II Regions in Portugal, 2009 (% of total)

Region	GVA	AGR	EMAN	CONS	MS	NMS	UN	RMW
PT	**83856**	**3856**	**17241**	**5684**	**37616**	**19460**	**5.4**	
NORT	30.01%	27.55%	40.43%	34.37%	25.86%	28.00%	5.5	8.85%
CENTR	19.70%	34.48%	24.66%	17.50%	15.87%	20.44%	3.2	7.62%
LISB	39.13%	6.19%	26.39%	38.28%	47.89%	40.25%	6.8	5.18%
ALEN	7.30%	25.90%	7.46%	5.70%	5.44%	7.52%	7.3	4.79%
ALGA	3.87%	5.87%	1.06%	4.14%	4.94%	3.79%	5.1	4.92%

Table 2.D. Economic Variables for NUTS II Regions in Italy, 2009 (% of total)

Region	GVA	AGR	EMAN	CONS	MS	NMS	UN	RMW
IT	**957744**	**26234**	**224000**	**55794**	**453167**	**198549**	**9.6**	
PIEM	8.60%	6.79%	11.15%	7.41%	8.42%	6.72%	6.6	7.57%
VAMOL	0.27%	0.11%	0.17%	0.47%	0.26%	0.34%	4.5	6.81%
LIG	2.94%	2.15%	1.74%	2.40%	3.55%	3.17%	8.6	6.81%
LOMB	20.88%	11.03%	28.37%	17.23%	21.10%	14.25%	4.6	7.29%
PABB	1.07%	1.69%	0.68%	1.20%	1.21%	1.07%	2.9	6.24%
PAT	0.99%	1.13%	0.86%	1.15%	0.99%	1.08%	4.5	6.25%
VEN	9.06%	9.06%	11.77%	10.13%	8.57%	6.83%	5.2	6.24%
FVG	2.35%	2.49%	2.40%	2.43%	2.30%	2.39%	5.9	6.79%
ER	8.87%	10.77%	11.21%	8.20%	8.55%	6.87%	4.9	6.37%
TOSC	6.68%	5.23%	7.14%	5.48%	6.84%	6.30%	7.0	7.00%
UMBR	1.40%	1.76%	1.38%	1.53%	1.32%	1.52%	7.8	6.79%
MARC	2.54%	2.96%	2.99%	2.45%	2.37%	2.38%	6.4	6.82%
LAZ	10.35%	5.53%	5.18%	8.94%	11.84%	13.85%	9.8	7.07%
ABRU	1.86%	2.61%	1.87%	2.08%	1.70%	2.05%	9.2	6.80%
MOL	0.43%	0.75%	0.33%	0.69%	0.35%	0.59%	13.5	6.81%
CAMP	6.36%	7.12%	3.96%	7.63%	6.27%	8.83%	18.4	6.93%
PUG	4.61%	9.88%	3.19%	5.91%	4.28%	5.92%	12.2	6.91%
BAS	0.73%	1.58%	0.51%	1.26%	0.59%	1.01%	14.9	6.80%
CAL	2.18%	4.49%	0.89%	3.04%	2.10%	3.29%	21.5	6.77%
SIS	5.64%	9.65%	2.84%	7.17%	5.36%	8.47%	20.0	6.78%
SARD	2.18%	3.23%	1.36%	3.20%	2.02%	3.06%	16.8	6.80%

Notes and Abbreviations: GVA – Gross Value added, AGR –Agriculture, Forestry and Fishing; EMAN-Energy and Manufacturing; CONS- Construction; Market Services; Non-Market Services; UN-Unemployment Rate; RMW-Relative Manufacturing Wages. The Sectoral GVA are expressed as shares of the national totals. The sectoral GVA values are expressed in 2000 real terms; and the shares have been calculated after taking the averages over the period 1980-2009. National GVA is expressed in Levels - 2000m euros.

L'IMPACT DES CHOCS MONÉTAIRES SUR L'ACTIVITÉ PRODUCTIVE DES RÉGIONS : UNE COMPARAISON DE QUATRE PAYS DE LA ZONE EURO

Résumé - *Cet article utilise un modèle bayésien VAR afin de mesurer et comparer l'impact des chocs monétaires sur le PIB de 58 régions des pays du sud de la zone euro (Grèce, Espagne, Italie, Portugal) sur la période 1998-2009. Les résultats montrent la différence des réponses régionales aux chocs monétaires globaux.*

Mots-clés - POLITIQUE MONÉTAIRE, TAUX D'INTÉRÊT, PANEL VAR, ZONE EURO, PIB RÉGIONAUX