Applied Economics Letters, 2001, **8**, 299–303

Measuring monetary policy shocks in the European Monetary Union

RAMON TREMOSA-BALCELLS* and JORDI PONS-NOVELL‡

**Departament de Teoria Econòmica* and ‡*Departament d'Econometria, Estadística i Economia Espanyola, Universitat de Barcelona, Barcelona, Spain*

The paper tries to estimate whether a unique and centralized European monetary policy would have had similar or different effects across countries in the European Union. By estimating a vector auto-regression (VAR model), it is revealed that there are two different groups of countries with considerable differences in the response to changes in the monetary policy. Germany and the North-Central European countries would be less sensitive to these changes, whereas the Mediterranean countries (and Belgium) would be noticeably more sensitive to the mentioned variations.

I. INTRODUCTION

One of the most important changes in recent European economic history occurred in 1999, with a European Central Bank (ECB) starting its operations. The main attribute of the ECB is to centralize monetary policy and make it the same for all member countries. Monetary integration will be completed in three years with the adoption of a common currency.

The eleven countries which compose the European Monetary Union (EMU) constitute an economic area in which this unique monetary policy will affect the economies of each country differently. Thus, one of the most interesting questions to analyse and to try to estimate is how different these impacts between countries can be. It is well known that if there are substantial differences in responses to a homogeneous policy, the appearance of important asymmetric shocks will be one of the outcomes of the EMU.[1]

The literature of monetary transmission mechanisms is quite abundant, but there aren't many studies that establish comparisons between the responses of the different countries (or the responses of different regions that belong to the same country). Among these are Sims (1992), Gerlach and Smets (1995), Barran *et al.* (1996), Carlino and DeFina (1998a and 1998b) and Ehrmann (1998).

Ehrmann (1998) discusses the basic methodological issues that are involved in an empirical analysis of monetary policy and also the especial features of a comparative study. Estimates of the structural vector auto-regression for thirteen European countries are provided, with the finding of considerable heterogeneity in monetary policy transmissions (hoping that these differences will mainly disappear with the start of EMU).

Carlino and DeFina (1998a) examine whether monetary policy has similar effects across regions in the United States. Impulse response functions from an estimated structural vector auto-regression reveal that the Great Lakes region (Illinois, Indiana, Michigan, Ohio and Wisconsin) is noticeably more sensitive to monetary policy changes, while the Rocky Mountains region (Colorado, Idaho, Montana, Utah and Wyoming) is found to be much less sensitive.

The possibility of finding more differences in Europe is considerable because the economies of European countries are more heterogeneous than are the regional economies that comprise the United States (Bayoumi and Eichengreen, 1993; Carlino and DeFina, 1998b).

The remainder of the paper is organized as follows: Section II develops an empirical approach, the data and the unit-root tests. Section III comments on the empirical results and, finally, Section IV concludes.

* Corresponding author. E-mail: tremosa@eco.ub.es

[1] Countries should not form a currency union if they are subject to considerable asymmetric shocks.

II. EMPIRICAL APPROACH

The model

The analysis is focused on the dynamic behaviour of an $n \times 1$ covariance-stationary vector,

$$Z_t = [\Delta y_{1,t}, \Delta y_{2,t}, \ldots, \Delta y_{n-1,t}, m]'$$

where $\Delta y_{i,t}$ is the growth rate of GDP in country i at time t and m is a stationary variable, which measures the action of the monetary policy at time t. The dynamics of Z_t are represented by a VAR,

$$AZ_t = B(L)Z_{t-1} + e_t$$

where A is an $n \times n$ matrix of coefficients, which describes the contemporaneous correlations among the variables; $B(L)$ is an $n \times n$ matrix of polynomials in the lag operator L; and $e_t = [\varepsilon_{1,t}, \varepsilon_{2,t}\varepsilon_{n-1,t}, \ldots, \varepsilon_{m,t}]$ is an $n \times 1$ vector of structural disturbances.

Solving for Z_t produces the following reduced-form system:

$$Z_t = C(L)Z_{t-1} + u_t$$

where $C(L) = A^{-1}B(L)$ is an infinite-order lag polynomial, and $u_t = A^{-1}e_t$ describes the relationship between the model's reduced-form residuals and the model's structural residuals.

The hypothetical impacts of the global European interest rate (fixed by an hypothetical European Central Bank) are summarized using impulse response functions (Sims, 1980). These functions are calculated directly from the last equation as

$$Z_t = [I - C(L)L]^{-1}A^{-1}e_t = \Theta(L)e_t$$

in which

$$\Theta(L) = \sum_{l=0}^{L} \Theta_l L^l$$

and Θ_l is a $k \times k$ matrix of structural parameters.

Data

We have considered information about the European countries which integrates the European Union (excluding Luxembourg). To sum up, over thirty-seven years (1960–1997) we have employed the Gross Domestic Product expressed in levels, in millions of ECU, at constant 1990 prices. The Monetary Supply (as the quotient between the Gross Domestic Product and the currency's circulation velocity) and the different national interest rates, collected in the short run, have also been used. All these series have been transformed into logarithms (apart from the interest rate series, which are expressed in levels).

The study employs annual data for 37 years obtained from the statistics published by the *European Economy* (*Économie Européenne* 65/1998), which facilitates homogeneous economic series for all fourteen countries considered.

Table 1. *Augmented Dickey–Fuller test*

Country	Level*	Growth rate**
GDP		
Austria	−0.98	−2.96[b]
Belgium	−1.81	−3.14[b]
Denmark	−2.64	−4.40[a]
Finland	−1.77	−3.92[a]
France	−2.18	−3.38[b]
Germany	−2.32	−4.28[a]
Greece	−1.31	−3.27[b]
Ireland	−1.60	−3.74[a]
Italy	−1.09	−3.17[a]
Netherlands	−2.24	−2.95[b]
Portugal	−1.68	−3.41[b]
Spain	−2.09	−2.99[b]
Sweden	−2.20	−3.25[b]
United Kingdom	−2.90	−4.46[a]
Interest rate	−1.34	−4.89[a]

Notes: * Equations include an intercept and time trend.
** Equations include an intercept term.
[a] Indicates significance at the 1% level.
[b] Indicates significance at the 5% level.
Critical values are found in Fuller (1976).

A European global interest rate has been calculated year by year, considering the different national interest rates and also considering the weighting of every economy according to the global European Gross Domestic Product. This global interest rate is used to evaluate, hypothetically, the impact that a common and centralized European monetary policy would have had if it had been executed by a hypothetical European Central Bank in the period 1960–1997.

Unit-root tests

As the standard statistical theory applies, the variables used in the estimation must be stationary. The results of the Augmented Dickey–Fuller (ADF) unit-root test, which are presented in Table 1, show that stationarity is achieved by first-differencing. Thus, the VARs to be estimated include the stationary first differences of the log of national GDP and also for the interest rate.

III. RESULTS

Table 2 presents the point estimates for the impulse response of GDP generated by the monetary policy, so it is the result of a one-standard-deviation unanticipated increase in the European global interest rate. Figure 1 displays the cumulative impulse response derived from Table 2. For example, an increase in the European global interest

Table 2. *Impulse response of GDP growth*

Period	GER	BEL	DEN	GRE	SPA	FRA	IRL
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	−0.8189[a]	−0.6644[a]	−1.0709[a]	−1.4327[a]	−0.7393[a]	−0.6128[a]	0.0229
3	−1.0774	−1.5099[a]	−1.3136	−1.7647	−1.5625[a]	−1.2912[a]	−0.7175[b]
4	−0.8646	−1.8968[c]	−1.1091	−1.9126	−2.0042[c]	−1.6422[c]	−1.0847
5	−0.7710	−2.1767	−1.0411	−2.2516	−2.2252	−1.8329	−0.9338
6	−0.8274	−2.3697	−1.0921	−2.5366	−2.4061	−2.0042	−0.7526
7	−0.8541	−2.5866	−1.1154	−2.7223	−2.5672	−2.1654	−0.6970
8	−0.8352	−2.7222	−1.1044	−2.8847	−2.6848	−2.2865	−0.7097
9	−0.8257	−2.8417	−1.0348	−3.0321	−2.7628	−2.3707	−0.7400
10	−0.8313	−2.9161	−1.0370	−3.1518	−2.8179	−2.4338	−0.7599
Period	ITA	NL	AUS	POR	FIN	SWE	UK
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	−0.7865[a]	−0.5888[b]	−0.3569	−1.0705[b]	−0.7237[c]	−0.5005[c]	−0.9711[a]
3	−1.6617[a]	−1.2540[b]	−1.0238[b]	−1.9076[c]	−1.5884[c]	−0.8681	−1.6343[b]
4	−1.9999	−1.5584	−1.2674	−1.9184	−1.8527	−0.9255	−1.5938
5	−1.9925	−1.6516	−1.3375	−1.6627	−1.6772	−0.8923	−1.3181
6	−1.9477	−1.7160	−1.3749	−1.5606	−1.4838	−0.8954	−1.1849
7	−1.9615	−1.7828	−1.4246	−1.5953	−1.4354	−0.9154	−1.2193
8	−1.9938	−1.8290	−1.4562	−1.6375	−1.4727	−0.9223	−1.2892
9	−2.0086	−1.8521	−1.4706	−1.6439	−1.5093	−0.9199	−1.3137
10	−2.0079	−1.8641	−1.4770	−1.6343	−1.5174	−0.9184	−1.3000

Notes: Changes in log levels of the GDP from a one-standard-deviation unanticipated increase in the global interest rate change.
GER, Germany; BEL, Belgium; DEN, Denmark; GRE, Greece; SPA, Spain; FRA, France; IRL, Ireland; ITA, Italy; NL, The Netherlands; AUS, Austria; POR, Portugal; FIN, Finland; SWE, Sweden; UK, United Kingdom.
[a] Indicates significance at 1% level.
[b] Indicates significance at 5% level.
[c] Indicates significance at 10% level.

rate would result in a 0.8189% decrease in German GDP in the first period, and thus successively.

As it can be graphically appreciated, an increase of the interest rate reduces real growth, but not to the same intensity in all European countries. Thus, not all countries respond by the same magnitude. Germany, the largest economy in Europe, is less affected than others, and leads a group of countries with a similar behaviour: Denmark, Austria, The Netherlands (what has been called the 'DEM zone'). Sweden and Finland, and also The UK and Ireland, present impulse responses that are close to the German response. Another group of countries, the Mediterranean countries (with Belgium), show magnitudes of monetary policy effects quite different from the first group. In France, Italy, Spain, Belgium, Portugal and Greece the GDP is more responsive to monetary policy shocks than is German GDP.

A clear division of the EMU countries into two different groups, very well differentiated, is apparent: the Anglo-Saxon countries and the Latin countries. In the future these two groups of nations may be interested in opposite monetary policies: a monetary expansion might be useful for some countries but harmful for others, depending on each country's economic situation (and the same for a monetary contraction). Thus, these differences might make it difficult to maintain monetary union.

IV. CONCLUSIONS

This paper uses time-series techniques to examine whether monetary policy would have had asymmetric effects across countries in the EMU during the 1960–1997 period. Impulse response functions from an estimated structural VAR reveal a group of countries (led by Germany, basically North-Central European countries) which would be less sensitive to monetary policy changes. There is another group of countries (the Mediterranean countries and Belgium) in which those policy changes would be noticeably more sensitive than in the first group.

The existence of disparate responses reveals the difficulty of conducting a single European monetary policy for an area as large and as diverse as the EMU. The economies of the EMU are so heterogeneous as to seriously consider the existence of important, different effects of a unique European monetary policy. These differences might make it difficult to maintain monetary union.

ACKNOWLEDGEMENTS

Jordi Pons-Novell would like to acknowledge the support of the CICYT, Investigation Project SEC 1999/0432. The authors would like to thank Dr Josep-Lluís Raymond-

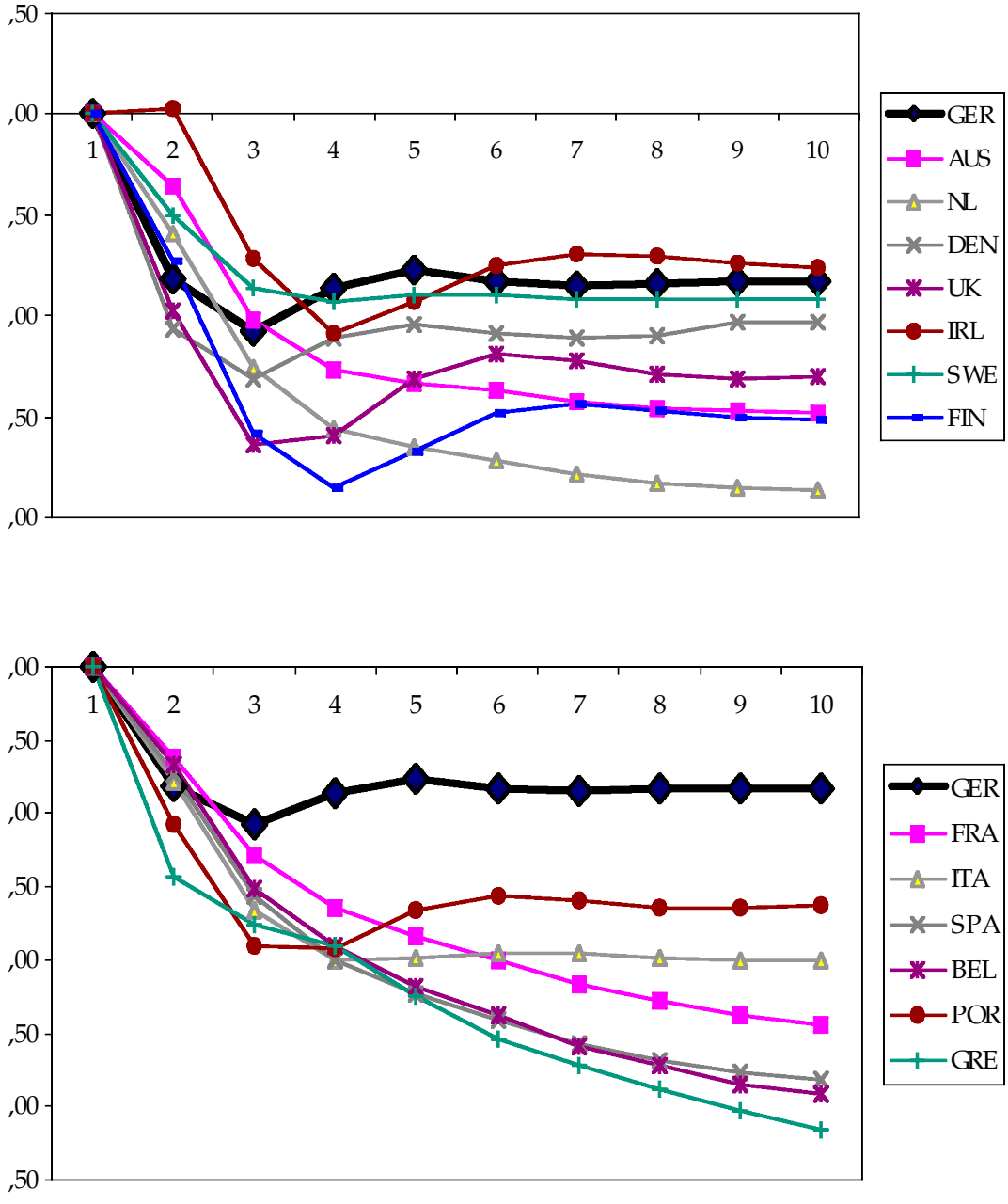

Fig. 1. *Cumulative impulse response of GDP growth*
Notes: Shocks constitute one-standard-deviation from unanticipated increases in the global interest rate.
GER, Germany; BEL, Belgium; DEN, Denmark; GRE, Greece; SPA, Spain; FRA, France; IRL, Ireland; ITA, Italy; NL, Netherlands; AUS, Austria; POR, Portugal; FIN, Finland; SWE, Sweden; UK, United Kingdom.

Bara, from the Autonomous University of Barcelone (U.A.B., Catalonia, Spain) for helpful suggestions.

REFERENCES

Barran, F., Coudert, V. and Mojon, B. (1996) The transmission of Monetary Policy in the European Countries, in S. Collignon (Ed.), *European Monetary Policy*, Pinter, London, pp. 81–111.

Bayoumi, T. and Eichengreen, B. (1993) Shocking aspects of European Monetary integration, in F. Torres and G. Francesco (Eds), *Adjustment and Growth in the European Monetary Union*, Oxford Cambridge University, pp. 193–229.

Carlino, G. and DeFina, R. (1998a) The differential regional effect of monetary policy, *The Review of Economics and Statistics*, **LXXX**, 572–87.

Carlino, G. and DeFina, R. (1998b) Monetary policy and the US States and regions: some implications for European

Monetary Union. Working Paper 98-17, Federal Reserve Bank of Philadelphia, July 1998.

Ehrmann, M. (1998) Will EMU Generate asymmetry? Comparing monetary policy transmission across European countries. European University Institute Working Paper, Florence, Italy. ECO, 98/28.

European Economy/Économie Européenne (1998) Comission Européenne Direction Générale affaires économiques et financières, No. 65/1998.

Fuller, W.A. (1976) *Time Series,* Wiley, New York.

Gerlach S. and Smets, F. (1995) The monetary transmissions mechanism: evidence from the G-7 countries. BIS Working Paper, No. 26.

Sims, C. A. (1980) Macroeconomics and reality, *Econometrica,* **48**, 1–48.

Sims, C. A. (1992) Interpreting the macroeconomic time series facts: the effects of monetary policy, *European Economic Review,* **36**, 975–1001.