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The Regional Effects of Monetary Policy in Europe

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Abstract

Since the inception of EMU, a common concern is that European monetary policy may have differential effects on EMU member countries. However, the reliance on cross-country evidence in the empirical literature risks overemphasizing the importance of cross-country differences in monetary transmission. This paper therefore takes a regional approach. Data from 58 European regions show significant cross-regional differences in the effects of monetary policy within the five largest EU countries. For all regions combined, I find a significant relationship between the impact of monetary policy and the industrial composition of regions, supporting earlier findings for the US. I conclude that at present the large European countries are regionally well-diversified enough to minimize the risk that ECB policy will produce a markedly different impact across countries.

• **JEL Classification:** E50
• **Key Words**: Monetary Transmission, Regional Effects, EMU

I. Introduction

Before Economic and Monetary Union (EMU) came into being, a major economic debate concerned the costs and benefits of monetary unification. Regarding costs, the absence or presence of asymmetric shocks became a well-researched issue, see OECD (1999). A broad consensus on whether asymmetric shocks constitute a major impediment to monetary union has, however, failed to emerge. Bayoumi and Eichengreen (1993) exemplify the pessimistic view that the presence of asymmetric shocks will entail severe costs, while Bini Smaghi and

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Vori (1993) represent a more optimistic viewpoint.

Now that EMU has become reality, attention has shifted away from asymmetric shocks towards the asymmetric *transmission* of uniform monetary policy shocks originating from the European Central Bank (ECB). The concern is that a common monetary policy might have differential effects on EMU member states, caused by differences in the monetary transmission mechanism. When one size doesn't fit all, this may complicate macro-economic management, as the ECB will have to weigh the varying consequences of its actions on EMU countries. More importantly, when ECB policy is seen to be incapable of addressing the economic needs of individual member states, this might erode political and public support for monetary union. For the ECB, it is therefore important to understand how interest rates affect the euro area and what it can do to mitigate any differential effects.

The literature dealing with monetary transmission in the euro area is surveyed in Favero and Giavazzi (1999), OECD (1999), De Grauwe (2000) and Eijffinger and De Haan (2000). Most empirical studies report differences in the monetary transmission across European countries, but a consensus on the ordering of countries according to the interest rate responsiveness of GDP is lacking. This could be attributed to the diversity in econometric methodologies which have been employed. For example, BIS (1995), Hughes Hallett and Piscitelli (1999) and Hughes Hallett, Piscitelli and Warmedinger (2000) use existing large-scale macro-economic (single or multi-country) models; Brittan and Whitley (1997) employ a small structural macromodel; Dornbusch, Favero and Giavazzi (1998) use reduced-form equations and Gerlach and Smets (1995), Barran, Coudert and Mojon (1997), Ramaswamy and Sloek (1997) and Ehrmann (1998) use structural vector autoregression models. In addition to the above-mentioned differences in ordering, Kieler and Saarenheimo (1998) question the statistical significance of the reported cross-country differences.

Empirical studies documenting differences in monetary transmission across European countries typically use country data. Exceptions are Ganley and Salmon (1997) and Hayo and Uhlenbrock (2000), who explore regional differences in monetary transmission within respectively the UK and Germany. Carlino and DeFina (2000) apply estimates from regional US data to the EMU. But these studies do not provide a comparison across multi-national EU regions. In contrast, the literature on asymmetric shocks includes regional EU evidence, see De Grauwe and Vanhaverbeke (1991) and De Nardis, Goglio and Malgarini (1996).

One of their findings is that the variability of output is much greater at the regional than at the national level. In that case, regional diversification within EU countries would mitigate the potential instability arising from asymmetric shocks.

The focus of much of the empirical literature on cross-country differences in monetary transmission is understandable. The lack of political integration in Europe implies that the nation state is still a force to be reckoned with. As discussed above, wide cross-country differences in the impact of monetary policy shocks may have political repercussions. Yet, solely relying on cross-country evidence carries the risk of overstating the importance of cross-country differences. Comparing these to regional differences within countries may put them in a different perspective. Suppose, for example, that some EMU countries have experienced a wide regional variation in the transmission of their monetary policy before EMU. This finding could result in a more balanced appraisal of the importance of cross-country differences in the EMU. A comparison of regional and national variation therefore makes sense in analyzing the transmission of ECB policy to the euro area.

This paper measures the impact of monetary policy shocks on regional GDP using data from 58 European regions. The estimates will be used to address three questions. First, I will examine regional variation in monetary transmission within EU countries. Next, I try to explain the regional effects of monetary policy. Building on the work of Carlino and DeFina (1998), I look whether the impact of monetary policy shocks is related to the industrial composition of regions. In addition, dummy variables are used to control for possible country factors. Third, I test whether the differential effects of monetary policy vary more within countries or between countries.

The organization of this paper is as follows. The next section offers a brief review of factors which may cause differential effects of monetary policy. Section III is the main part of this paper. It includes a discussion of the data, the methodology and the empirical results. Section IV concludes with some policy implications.

II. Factors Causing Differential Effects of Monetary Policy

The monetary transmission mechanism can be defined as the process through which monetary policy decisions are transmitted into changes in economic growth and inflation, see Taylor (1995). In empirical work, monetary policy decisions are nowadays modeled as changes in the nominal short-term interest rate controlled by the central bank.[1] Changes in the short-term interest rate affect a large set of variables, including the real cost of capital, the real exchange rate, income and wealth. These, in turn, affect aggregate demand. Below, I will briefly discuss factors which might be held responsible for a differential regional impact of monetary policy.[2]

A tightening of monetary policy may reduce demand for investment goods and (durable) consumer goods by increasing the real costs of capital of firms and consumers. Taylor (1995) provides a survey of this socalled interest rate channel. Regions may differ in their sensitivity to changes in the real cost of capital, for example due to a different industrial structure.

Apart from the real cost of capital, monetary policy shocks affect other asset prices, such as the exchange rate. Through the exchange rate channel, monetary policy influences competitiveness and net exports. Regional effects may arise in the presence of cross-regional variation in openness, see Dornbusch, Favero and Giavazzi (1998). A third channel is the equity channel of monetary transmission. It works either through Tobins q theory of investment demand or through a wealth effect on consumer demand, see Mishkin (1996). Regional differences in either Tobins q or in the distribution of wealth may cause regional effects.

A recent theory of monetary transmission focuses on the role of information problems in credit markets. This so-called credit view identifies two transmission channels: the bank lending channel and the balance sheet channel. The former channel looks at the ability and willingness of banks to provide loans, see Kashyap and Stein (1997). Monetary policy affects the economy through the supply of bank credit, as some borrowers (such as small firms) lack substitutes for bank loans. Regional differential effects arise when regions differ in the dependence on and availability of bank credit. The balance-sheet channel of monetary transmission works through the net worth and cash flows of firms. An expansionary monetary policy will raise both, thereby reducing asymmetrical information problems in credit markets. As a result, lending and investment spending may increase. The balance-sheet channel can also explain changes in consumer spending, see

[1]See Leeper, Sims and Zha (1996). An alternative measure would be money supply growth, but most central banks have abandoned monetary targeting due to money demand instabilities.

[2]For a comprehensive overview of the literature on the monetary transmission mechanism, see the surveys by Bernanke and Gertler (1995), Cecchetti (1995), Christiano, Eichenbaum and Evans (1998), Gertler (1988), Gertler and Gilchrist (1993) and Mishkin (1995, 1996).

Mishkin (1978). In the credit view, differential regional effects of monetary policy may be caused by cross-regional differences in financial structure, measured by e.g. the proportion of small banks and small firms in an economy, the health of the banking sector, the availability of non-bank funding and the amount of collateral, see Kashyap and Stein (1997) and Dornbusch, Favero and Giavazzi (1998). Other contributions to the literature on the credit channel in Europe are Borio (1996), De Bondt (1998), Favero, Giavazzi and Flabbi (1999), MacLennan, Muellbauer and Stephens (1998) and Mojon (1999b).

The speed of interest rate adjustment also matters. Though not a separate channel, the speed of adjustment will determine how fast a change in interest rates will work its way through the transmission channels. For Europe, many studies have identified large cross-country differences in the adjustability of interest rates, see Borio (1996), Barran, Coudert and Mojon (1997), Kashyap (1997), De Bondt (1998) and Mojon (1999a). Ceteris paribus, the impact of monetary policy shocks will be stronger in countries or regions where the interest rates on debt contracts adjust more rapidly to monetary tightening by the central bank.

All transmission channels described above relate to the effect of monetary policy on aggregate demand. The final effect on output and prices is the result of the interaction of supply and demand. Differential effects of monetary policy could therefore also be the result of regional differences in the supply curve, caused by e.g. differences in the flexibility and institutional features of labor and product markets, see OECD (1999) and De Grauwe (2000).

Empirical work by Carlino and DeFina (1998), Ganley and Salmon (1997) and Hayo and Uhlenbrock (2000) has shown that differential regional effects of monetary policy inside respectively the US, the UK and Germany, can be explained by regional differences in industrial composition. Economic activities differ with regard to their cyclical nature. For example, highly leveraged manufacturing companies will be more sensitive to changes in the real cost of capital, in international competitiveness and in bank credit constraints than government services like health care or education. Industrial composition is thus a useful measure to explain differential effects of monetary policy, though one should be careful not to associate it exclusively with one of the transmission channels described above.

III. Empirical Evidence

The empirical approach consists of two steps. First, the regional effects of

Table 1. Regional Classification

Code	Region	Code	Region
Belgium		Greece	
BE1	Reg. Bruxelles-Cap.	GR1	Voreia Ellada
BE2	Vlaams Gewest	GR2	Kentriki Ellada
BE3	Région Wallonne	GR3	Attiki
		GR4	Nisia Aigaiou, Kriti
Germany			
DE1	Baden-Württemberg	Italy	
DE2	Bayern	IT1	Nord Ouest
DE3	Bremen	IT2	Lombardia
DE4	Hamburg	IT3	Nord Est
DE5	Hessen	IT4	Emilia-Romagna
DE6	Niedersachsen	IT5	Centro
DE7	Nordrhein-Westfalen	IT6	Lazio
DE8	Rheinland-Pfalz	IT7	Abruzzo-Molise
DE9	Saarland	IT8	Campania
DE10	Schleswig-Holstein	IT9	Sud
		IT10	Sicilia
		IT11	Sardegna
Spain			
ES1	Noroeste		
ES2	Noreste	Netherlands	
ES3	Madrid	NL1	Noord-Nederland
ES4	Centro	NL2	West-Nederland
ES5	Este	NL3	Noord-Holland
ES6	Sur	NL4	Zuid-Nederland
ES7	Canarias		
		United Kingdom	
France		UK1	North
FR1	Ile de France	UK2	Yorkshire/Humberside
FR2	Bassin Parisien	UK3	East Midlands
FR3	Nord-Pas-de-Calais	UK4	East Anglia
FR4	Est	UK5	South East
FR5	Ouest	UK6	South West
FR6	Sud-Ouest	UK7	West Midlands
FR7	Centre-Est	UK8	North West
FR8	Méditerranée	UK9	Wales
		UK10	Scotland
		UK11	Northern Ireland

monetary policy are estimated using a panel regression of real economic growth on the monetary policy indicator and several control variables. Second, the regional effects are related to industrial composition in a cross-section regression.

The regional classification used is Eurostat's NUTS1 classification. Regional GDP data are taken from the economics accounts in Eurostats regional statistics database. The sample consists of 8 EU countries: Belgium, Germany, Spain, France, Greece, Italy, The Netherlands and the United Kingdom.[3] The sample period runs from 1979 to 1995, with the exception of Spain and Greece, where the sample starts in 1980. EU countries lacking sub-national data at the NUTS1 level (Denmark, Luxembourg, Sweden and Ireland) were dropped from the sample. Finland, Austria and Portugal were left out because of their short sample size.[4] This leaves 58 regions which are listed in Table 1.

A. The First Step: Panel Evidence

The dependent variable in the panel regressions is regional real economic growth. Eurostat's GDP data are in Ecu's. They have been converted into real GDP by first converting the data into national currencies and next deflating the resulting series by the national price indices (CPI). The end result is an annual series for real GDP growth (Δy).

The panel model uses four explanatory variables. First, following Carlino and DeFina (1998), Ganley and Salmon (1997) and Hayo and Uhlenbrock (2000), the nominal short-term interest rate (i) - measured by the call money rate (line 60B IFS) - is used as our indicator of the monetary policy stance. This approach implies that we estimate the link between the monetary policy instrument and output without explicitly modeling the transmission channels discussed in section II. Thus the monetary transmission process remains a black box.

The remaining three explanatory variables are used to control for other macro-economic factors. First, the lagged growth rate (Δy_{t-1}) is used to pick up auto-correlation in the real growth series. The second control variable is the inflation rate (π). Third, the OECD's general government structural deficit (d) is used as a

[3]The sample period was considered too short for the East German states of Brandenburg, Mecklenburg-Vorpommern, Sachsen, Sachsen-Anhalt and Thüringen, where the sample starts in 1992. Berlin was left out because of the distortionary effect of German unification; the French overseas departments (Départments dOutre-Mer) were left out because of their non-European character.

[4]For Finland and Austria, the Eurostat GDP data start in 1988. GDP data for the Portugese regions of Madeira and the Azores start in 1990.

[5]This measure calculates the government deficit as a percentage of potential instead of actual GDP. It is adjusted for the influence of the business cycle and therefore better reflects the stance of fiscal policy than the actual government deficit as a percentage of GDP. The data have been taken from successive issues of the OECD's Economic Outlook.

Table 2. Unit Root Tests

	i	Δi	π	$\Delta\pi$	d	Δd
Belgium	–2.15	–3.70**	–2.07	–3.27**	–1.82	–3.96**
Germany	–3.64**		–2.44	–3.49**	–1.92	–2.53
Spain	–1.77	–3.68**	–0.73	–3.06**	–1.02	–4.70***
France	–2.08	–4.29***	–1.02	–3.10**	–1.26	–4.72***
Greece	–1.71	–2.26	–3.23**		–1.97	–3.5**
Italy	–1.90	–3.50**	–1.40	–3.99***	–0.33	–2.82*
Netherlands	–2.79*	–4.66***	–1.75	–3.74***	–1.98	–2.88*
United Kingdom	–2.44	–3.61**	–1.80	–3.88***	–2.21	–2.92*

Note: Augmented Dickey Fuller (ADF) unit root test with 1 lag. *; significant at a 10% level **; significant at a 5% level, and ***; significant at a 1% level.

measure of the fiscal policy stance.[5] The data on interest rates, inflation rates and deficits are all national.

The unit root tests in Table 2 determine whether the independent variables will enter the panel regressions in levels or in first differences. For most countries, the levels of the interest rate, the inflation rate and the deficit contain a unit root. The exceptions are the German interest rate and the Greek inflation rate. The Augmented Dickey Fuller (ADF) statistic for the German interest rate is –3.65, which is significant at a 5% level. For the inflation rate in Greece, the ADF statistic is –3.23, which is also significant at a 5% level. In all other countries the ADF statistics for the levels are insignificant at a 5% level. Therefore, the independent variables will enter the regressions in first differences, with the exception of the German interest rate and the Greek inflation rate.

The data set is not ideal to do an extensive econometric time-series analysis, comparable to e.g. the vector autoregressions of Carlino and DeFina (1998) and Ganley and Salmon (1997). The brief sample period and the low data frequency limit the degrees of freedom. The econometric model is therefore kept simple. For each of the 8 EU countries, the following model was estimated to measure the impact of monetary policy on the regional economies:

$$\Delta y_{i,t} = \alpha_i + \beta_{1,i}\,\Delta i_{t-1} + \beta_2\,\Delta y_{i,t-1} + \beta_3\,\Delta\pi_{t-1} + \beta_4\,\Delta d_{t-1} \quad (1)$$

In equation (1), real GDP growth in region i ($\Delta y_{i,t}$) is modeled as a function of the lagged change in interest rate (Δi_{t-1}), the lagged growth rate in region i ($\Delta y_{i,t-1}$), the lagged change in inflation ($\Delta\pi_{t-1}$) and the lagged change in the structural government deficit (Δd_{t-1}). A pooled estimation is conducted using Seemingly Unrelated Regression (SUR).[6] The pooled estimation allows for fixed effects (α_i).

Table 3. Panel Regressions Results

Country	Region	Interest Rate		Statistics		Control Variables		
		Coefficient	t-value			Factor	Coefficient	t-value
Belgium	BE1	–0.52	1.92	adj. R^2	0.24	$\Delta y(-1)$	0.31	2.38
	BE2	–0.75	2.57	DW	1.70			
	BE3	–0.33	0.98	# obs	45			
				Wald	2.71*			
Germany	DE1	–0.85	3.23	adj. R^2	0.34	$\Delta y(-1)$	0.23	5.87
	DE2	–0.56	2.17	DW	2.25			
	DE3	–0.97	3.20	# obs	150			
	DE4	–0.68	2.40	Wald	17.00***			
	DE5	–0.69	2.42					
	DE6	–0.61	2.53					
	DE7	–0.74	3.48					
	DE8	–0.54	2.16					
	DE9	–0.68	2.73					
	DE10	–0.62	2.03					
Spain	ES1	0.57	2.01	adj. R^2	0.23	$\Delta y(-1)$	0.25	3.01
	ES2	–0.20	1.50	DW	1.74	$\Delta \pi(-1)$	–0.65	2.81
	ES3	–0.13	0.80	# obs	98			
	ES4	0.24	1.74	Wald	5.13***			
	ES5	0.02	0.12					
	ES6	0.03	0.11					
	ES7	–0.08	0.41					
France	FR1	–0.14	0.56	adj. R^2	0.10			
	FR2	–0.55	2.01	DW	2.00			
	FR3	–0.63	3.27	# obs	128			
	FR4	–0.80	3.02	Wald	5.58***			
	FR5	–0.39	1.47					
	FR6	–0.13	0.53					
	FR7	–0.29	1.21					
	FR8	0.00	0.01					
Greece	GR1	–1.34	4.28	adj. R^2	0.38			
	GR2	–1.07	3.88	DW	1.68			
	GR3	–0.56	2.04	# obs	56			
	GR4	–1.15	2.70	Wald	2.87**			
Italy	IT1	–0.71	4.13	adj. R^2	0.26	$\Delta y(-1)$	0.28	8.51
	IT2	–0.67	4.29	DW	2.08	$\Delta d(-1)$	–0.59	5.39
	IT3	–0.82	5.51	# obs	165	$\Delta \pi(-1)$	0.27	4.03
	IT4	–0.74	4.06	Wald	15.43***			
	IT5	–0.44	4.12					
	IT6	–0.28	1.16					

Table 3. Continued

Country	Region	Interest Rate		Statistics		Control Variables		
		Coefficient	t-value			Factor	Coefficient	t-value
	IT7	–0.78	4.30					
	IT8	–0.18	0.78					
	IT9	–0.72	2.47					
	IT10	–0.05	0.15					
	IT11	–0.26	0.85					
Netherlands	NL1	–0.71	0.76	adj. R^2	0.16	$\Delta y(-1)$	0.52	4.97
	NL2	–0.28	1.20	DW	1.92			
	NL3	–0.47	2.37	# obs	60			
	NL4	–0.49	1.44	Wald	1.17			
United Kingdom	UK1	–0.46	2.00	adj. R^2	0.34	$\Delta y(-1)$	0.34	6.79
	UK2	–0.44	2.09	DW	2.01	$\Delta d(-1)$	–0.16	2.02
	UK3	–0.56	2.86	# obs	165			
	UK4	–0.54	2.32	Wald	2.07***			
	UK5	–0.40	1.48					
	UK6	–0.43	2.27					
	UK7	–0.61	3.28					
	UK8	–0.63	3.30					
	UK9	–0.43	1.53					
	UK10	–0.24	1.26					
	UK11	–0.15	0.75					

Note: *; Wald test significant at a 10% level **; Wald test significant at a 5% level, and ***; Wald test significant at a 1% level

Since our objective is to analyze differential regional effects of monetary policy, the coefficients on $\Delta i_{t\text{-}1}$ are cross-section specific ($\beta_{1,i}$). In order to economize on the use of degrees of freedom, all other coefficients (β_2, β_3 and β_4) are identical across regions.

Table 3 contains the results of the panel regressions. For each country, first the region-specific interest rate coefficients and their t-values are listed, followed by several regression statistics, including a Wald test on the equality of the region-specific interest rate coefficients. Finally, the coefficients and *t*-values of the control variables $\Delta y_{i,t-1}$, $\Delta \pi_{t-1}$ and Δd_{t-1} are reported. These have been included in the panel regression when significant at a 5% level.

For 53 out of 58 regions, $\beta_{1,i}$ has the theoretical negative sign, whereby an increase in the interest rate reduces real economic growth. In 34 out of 58 cases, $\beta_{1,i}$ is significant at a 5% significance level. Spain stands out as the country with

Table 4. Diagnostic Tests

	Jarque-Bera	p-value	Q-stat (2)	p-value	Chow (1988)	p-value
BE1	0.04	0.98	3.40	0.18	1.85	0.20
BE2	0.49	0.78	1.08	0.58	0.88	0.44
BE3	0.17	0.92	0.09	0.96	0.76	0.49
DE1	0.14	0.93	1.87	0.39	0.08	0.93
DE2	0.45	0.80	2.22	0.33	0.02	0.98
DE3	1.68	0.43	2.93	0.23	0.32	0.73
DE4	1.74	0.42	1.86	0.40	0.42	0.67
DE5	0.32	0.85	2.62	0.27	0.10	0.91
DE6	1.38	0.50	1.10	0.58	0.31	0.74
DE7	0.99	0.61	3.15	0.21	0.11	0.90
DE8	0.15	0.93	2.13	0.35	0.18	0.84
DE9	0.07	0.97	3.84	0.15	0.05	0.95
DE10	0.33	0.85	1.64	0.44	0.23	0.80
ES1	0.03	0.98	0.33	0.85	1.68	0.23
ES2	1.56	0.46	3.22	0.20	0.20	0.82
ES3	0.58	0.75	3.58	0.17	0.35	0.71
ES4	8.74	0.01***	0.10	0.95	0.19	0.83
ES5	0.31	0.86	1.23	0.54	0.06	0.94
ES6	0.35	0.84	1.67	0.43	0.36	0.71
ES7	0.07	0.96	1.23	0.54	6.75	0.01***
FR1	1.05	0.59	2.04	0.36	0.10	0.91
FR2	0.65	0.72	0.04	0.98	0.03	0.97
FR3	1.02	0.60	1.71	0.42	3.44	0.07
FR4	0.97	0.62	4.28	0.12	0.56	0.59
FR5	0.48	0.78	1.58	0.45	0.11	0.90
FR6	0.73	0.69	0.27	0.87	0.43	0.66
FR7	3.62	0.16	2.53	0.28	0.63	0.55
FR8	1.52	0.47	0.38	0.83	0.00	1.00
GR1	0.55	0.76	0.23	0.89	1.42	0.29
GR2	0.21	0.90	1.42	0.49	2.52	0.13
GR3	1.18	0.55	2.04	0.36	1.00	0.40
GR4	3.26	0.20	0.94	0.63	0.12	0.89
IT1	0.69	0.71	1.89	0.40	1.37	0.29
IT2	0.29	0.87	2.57	0.28	0.67	0.53
IT3	0.55	0.76	1.41	0.50	1.05	0.38
T4	1.42	0.49	1.88	0.39	0.36	0.71
IT5	1.21	0.55	1.17	0.56	0.51	0.61
IT6	1.14	0.57	0.20	0.90	3.00	0.09*
IT7	0.22	0.90	1.64	0.44	1.14	0.36
IT8	1.17	0.56	1.97	0.37	1.24	0.33
IT9	7.87	0.02**	1.32	0.52	0.49	0.62
IT10	1.74	0.42	4.55	0.11	2.05	0.18
IT11	1.33	0.51	0.42	0.81	0.77	0.49

Table 4. Continued

	Jarque-Bera	p-value	Q-stat (2)	p-value	Chow (1988)	p-value
NL1	3.44	0.18	1.45	0.48	1.34	0.30
NL2	0.28	0.87	0.20	0.91	0.14	0.87
NL3	0.54	0.76	0.89	0.64	1.51	0.26
NL4	0.92	0.63	0.27	0.87	0.23	0.98
UK1	1.27	0.53	4.87	0.09*	1.37	0.29
UK2	0.48	0.79	0.37	0.83	1.01	0.40
UK3	0.17	0.92	4.84	0.09*	3.15	0.08*
UK4	2.21	0.33	3.55	0.17	1.84	0.20
UK5	1.38	0.50	0.18	0.91	1.70	0.23
UK6	1.10	0.58	3.25	0.20	2.39	0.14
UK7	1.25	0.54	3.24	0.21	1.50	0.26
UK8	1.41	0.50	0.85	0.66	3.88	0.14
UK9	1.02	0.60	2.22	0.33	1.63	0.24
UK10	0.64	0.73	4.30	0.12	0.79	0.48
UK11	1.32	0.52	4.63	0.10*	0.17	0.85

Note: *; significant at a 10% level **; significant at a 5% level, and ***; significant at a 1% level

the worst results for the interest rate coefficients, regarding both their signs and significance. The Wald statistics indicate that in the five largest countries the hypothesis that the $\beta_{1,i}$'s are identical across regions is rejected at a 1% significance level. The evidence for differential regional effects is weaker for Greece and Belgium, where the Wald statistic is significant at respectively 5% and 10%. For the Netherlands, the hypothesis that the $\beta_{1,i}$'s are identical cannot be rejected even at a 10% significance level. The finding that the regional variation in the effects of monetary policy is stronger in the larger countries seems plausible. Table 3 also shows that the model fit differs between countries, with France and the Netherlands having the lowest and Germany, Greece and the United Kingdom the highest adjusted R^2.

Table 4 reports the results of diagnostic tests on the residuals of the panel regressions. The Jarque-Bera test is used to check for non-normality; the Ljung-Box Q-statistic tests for residual autocorrelation at lag 2. Finally, Chow's breakpoint test was used to test for a structural break.[7] The breakpoint was put at

[6]In the presence of lagged endogenous variables, the SUR estimates using generalized least squares may not be consistent. However, the results from the SUR estimation do not deviate from the results of ordinary least squares for all regions separately.

[7]The Chow test is applied to the ordinary least squares estimates for the regions separately.

1988, which is in the middle of the sample period. Both the test statistics and their p-values are reported. Out of 174 test statistics, three are significant at a 5% level. The diagnostic tests therefore do not indicate any serious misspecification.

For countries where the lagged endogenous variable enters the panel regression a distinction can be made between a short-term and a long-term interest rate coefficient. The long-term interest rate coefficient ($\beta_{1,i,LT}$) is calculated as $\beta_{1,i}/(1-\beta_2)$. For countries where β_2 does not significantly differ from zero, the long-term coefficient equals the short-term coefficient.

B. The Second Step: Cross-section Evidence

In the second step I try to explain regional variation in interest rate coefficients. Data limitations make it hard to precisely attribute any differential effects to the factors discussed in section II. For example, regional measures for the bank lending or balance sheet channel are unavailable. Given these limitations I will proceed as follows. First, regional data from Eurostat's community labor force survey are used to measure the importance of industrial composition for monetary transmission. The measure used is the share of the labor force working in industry (LFI) for 1997. The LFI measure has been calculated as the number of people working in industry as a percentage of the total labor force (working in either agriculture, industry or services). This measure differs from the one in Carlino and DeFina (1998), who use the share of manufacturing industry in regional GDP. Second, all factors which are likely to be the same within countries but different between countries - such as institutional features of labor and product markets, the legal system (see Cecchetti (1999)) and presumably also many aspects of financial structure - are captured by country dummy variables.

In the second step, the interest rate coefficients are used in the following cross-section regression:

$$\beta_{1,i,j}=\gamma+\delta_1\ LFI_{\ i,j}+\Sigma_j\ \delta_{2,j}\ dum_{\ j} \tag{2}$$

Equation (2) has been estimated both for the short-term and the long-term interest rate coefficients using their point estimates.[8] In equation (2), $LFI_{i,j}$ denotes the regional share of the labor force working in industry in region i of country j.

[8]Some of the estimated interest rate coefficients are close to and insignificantly different from zero. Rather than dropping these observations from the sample or treating them as unobserved, I take the view that regions which are insensitive to monetary policy shocks convey useful information and should be included in a model which is used to explain variation in interest rate sensitiveness.

Table 5. Cross-section Regressions Results

A: Short-term interest rate coefficient						
	EU8		**EU4**		**EMU3**	
	coefficient	t-value	coefficient	t-value	coefficient	t-value
Constant	–0.11	0.64	0.11	0.68	0.13	0.72
LFI	–1.79	3.60	–2.47	5.16	–2.54	4.64
DUMFR	0.23	2.31	0.20	2.39	0.19	2.17
DUMIT	0.12	1.35	0.10	1.37	0.10	1.25
DUMUK	0.18	1.96	0.15	2.06		
DUMES	0.68	6.53				
DUMBE	0.00	0.01				
DUMNE	0.03	0.22				
DUMGR	–0.55	4.04				
Adj. R^2	0.63		0.52		0.55	
# obs	58		40		29	
B: Long-term interest rate coefficient						
	EU8		**EU4**		**EMU3**	
	coefficient	t-value	coefficient	t-value	coefficient	t-value
Constant	–0.12	0.54	0.12	0.55	0.13	0.54
LFI	–2.39	3.73	–3.13	5.02	–3.12	4.58
DUMFR	0.41	3.12	0.37	3.43	0.37	3.28
DUMIT	0.11	0.94	0.09	0.91	0.09	0.87
DUMUK	0.14	1.14	0.11	1.11		
DUMES	0.88	6.55				
DUMBE	–0.09	0.46				
DUMNE	–0.35	2.06				
DUMGR	–0.41	2.34				
Adj. R^2	0.62		0.55		0.61	
# obs	58		40		29	

The hypothesis is that industry is of a more cyclical nature than services or agriculture. As the interest rate coefficients are negative, this translates into the null hypothesis that δ_1 has a negative sign. Equation (2) also allows for country-specific effects through the use of country dummy variables dum_j with coefficients $\delta_{2,j}$. As discussed above, the country dummies may capture all institutional differences between the European countries affecting monetary transmission.

Table 5 contains two sets of cross-section regression results, one for the short-term interest rate coefficient (panel A) and one for the long-term interest rate coefficient (panel B). Results are reported for the complete cross-section of 8 EU countries (EU8), for the four largest countries (EU4: Germany, France, Italy and the UK) and for the three largest EMU countries (EMU3: Germany, France and

Table 6. One-way Analysis of Variance

A: Short-term interest rate coefficient					
	Groups	Number	Sum	Mean	Variance
DE	10	–6.93	–0.69	0.018	
FR	8	–2.92	–0.37	0.078	
IT	11	–5.64	–0.51	0.078	
UK	11	–4.87	–0.44	0.022	
Source	SS	DF	MS	F	p-value
Between groups	0.552	3	0.184	3.895	0.017
Within groups	1.701	36	0.047		
Total	1.884	39			
B: Short-term interest rate coefficient adjusted for differences in LFI					
Groups	Number	Sum	Mean	Variance	
DE	10	1.11	0.11	0.030	
FR	8	2.47	0.31	0.025	
IT	11	2.34	0.21	0.035	
UK	11	2.92	0.27	0.017	
Source	SS	DF	MS	F	p-value
Between groups	0.205	3	0.068	2.552	0.071
Within groups	0.966	36	0.027		
Total	1.172	39			
C: Long-term interest rate coefficient					
Groups	Number	Sum	Mean	Variance	
DE	10	–9.00	–0.90	0.030	
FR	8	–2.92	–0.37	0.078	
IT	11	–7.84	–0.71	0.150	
UK	11	–7.39	–0.67	0.050	
Source	SS	DF	MS	F	p-value
Between groups	1.289	3	0.430	5.497	0.003
Within groups	2.815	36	0.078		
Total	4.104	39			
D: Long-term interest rate coefficient adjusted for differences in LFI					
Groups	Number	Sum	Mean	Variance	
DE	10	1.19	0.12	0.050	
FR	8	3.91	0.49	0.018	
IT	11	2.28	0.21	0.068	
UK	11	2.49	0.23	0.038	
Source	SS	DF	MS	F	p-value
Between groups	0.654	3	0.218	4.793	0.007
Within groups	1.638	36	0.045		
Total	2.292	39			

Italy).

The cross-section results show that the coefficient of LFI is both of the right negative sign and significantly different from zero at a 5% level. This is true for both the short-term and the long-term interest rate coefficients. The dummy coefficients give the size of the country-specific effects after controlling for the effect of LFI, with Germany as the benchmark country (without dummy variable). A positive (negative) coefficient on a country dummy indicates that, after controlling for industrial composition, regions in that country have a less (more) negative interest rate coefficient than regions in the benchmark country and are thus less (more) interest rate sensitive than regions in the benchmark country.

The EU8 estimates for the short-term interest rate coefficients show that the Spanish and French dummy coefficients are positive and significantly different from zero. In contrast, the dummy for Greece is significantly negative. For Belgium, the Netherlands and Italy, the dummy coefficients are close to and insignificantly different from zero at a 10% level. Between these three countries and Germany, country-specific differences in the monetary transmission mechanism are unlikely to be very important. The United Kingdom is a borderline case with a positive dummy coefficient which is just significant at a 5% level. Restricting the sample to the EU4 or EMU3 country groupings leads to a more negative and more significant estimate of the LFI coefficient and to only small changes in the estimates of the dummy coefficients. The stronger results for the LFI measure in these sub-samples can be attributed to the exclusion of Spain. As discussed above, the Spanish panel regression yielded bad results.

The results for the long-term interest coefficients, reported in panel B of Table 5, should be interpreted more cautiously, as the long-term coefficients are affected by sampling uncertainty surrounding both the short-term coefficients and the coefficients on the lagged growth rate. Yet, the significant negative relationship between the interest rate coefficient and the LFI measure remains intact. Comparing panel A to panel B, the differences in the dummy coefficients reflect differences in the estimates of the coefficient of the lagged growth rate in Table 3.

Finally, Table 6 reports the results of a one-way analysis of variance on the interest rate coefficients for Germany, France, Italy and the UK. The aim is to test whether the means of the interest rates coefficients in these four countries are equal. In that case, country-specific differences in monetary transmission would be unimportant. The analysis of variance is done for two sets of interest rate coefficients: the original estimates and the estimates adjusted for differences in industrial composition. The adjustment consists of substracting δ_1 $LFI_{i,j}$ from each region's interest rate coefficient, with δ_1 set equal to –2.47 for the short-term coefficients and to –3.13 for the long-term coefficients, conform Table 5. The purpose of this adjustment is to filter out any cross-country differences due to differences in industrial composition.

Panel A in Table 6 shows that, without controlling for differences in industrial composition, the hypothesis that the means of the short-term interest rates coefficients are equal in these four countries can be rejected at a 5% significance level. Once we control for differences in the LFI measure, however, the F-statistic drops from 3.90 to 2.55 and the null hypothesis can no longer be rejected at a 5% level, as panel B shows. Based on this outcome, cross-country differences in monetary transmission do not appear to be very important. This finding corroborates the evidence in BIS (1995), Brittan and Whitley (1997), Dornbusch, Favero and Giavazzi (1998) and Taylor (1995). Note that in contrast to the dummy approach in Table 5, which is used to test for the significance of individual country effects, the analysis of variance boils down to a joint test of the significance of country effects in Germany, France, Italy and the UK.

Panels C and D in Table 6 reveal that for the long-term interest rate coefficients, controlling for industrial composition has a less dramatic impact; the null hypothesis of equal means is rejected at a 1% significance level both before and after adjustment for differences in LFI. One should bear in mind, however, that the results for the long-term interest rate coefficients are strongly influenced by the zero coefficient on the French lagged growth rate in the panel regression. Given the above-mentioned higher sampling uncertainty surrounding the long-term coefficients, these results are less reliable than the results for the short-term coefficients.

IV. Conclusions and Policy Implications

An empirical analysis of monetary transmission in 58 European regions leads to the following conclusions. First, within most of the countries analyzed here, there are significant regional differences in the transmission of monetary policy. Relying on cross-country evidence to examine the monetary transmission process in Europe therefore constitutes a simplification and risks overemphasizing the importance of cross-country differences. Second, there appears to be a significant relationship between the regional impact of monetary policy and the proportion of the labor force working in industry. This finding supports the US evidence on the importance of industrial composition for monetary transmission. Third, country-specific dummy variables, which proxy for the more institutionally-determined differences in monetary transmission, are important for Spain, Greece and France.

In contrast, between Germany, Belgium, the Netherlands and Italy, country-specific differences in the monetary transmission mechanism are unlikely to be very important. Finally, an analysis of variance for Germany, France, Italy and the UK shows that after adjusting for differences in industrial composition, the between-countries variation in the short-term interest rate coefficient is not significantly larger than the within - countries variation.

The regional mix of employment in agriculture, services and industry thus determines the regional transmission of monetary policy. At present, at least the large European countries are well - diversified enough to minimize the risk that ECB policy will produce a markedly different impact across countries. The risk that regional differential effects of monetary transmission give rise to national instability and tensions in the EMU is therefore small, see Gros and Thygesen (1998). This may change, as has been pointed out by Krugman (1993). Increased specialization within an integrated Europe could result in a more heterogeneous industrial structure, as producers flock together to reap the benefits of greater geographic concentration. This could increase the differential regional effects of monetary policy. In contrast, regional differences in transmission which are the result of institutional differences between EU countries - such as cross - country differences in taxation, law, regulation of markets and financial structure - are likely to be further reduced in the process of European integration. Breaking down these institutional barriers will take time, as will the process of industrial specialization. But note that these two developments will have an opposite impact on monetary transmission. Whereas the former will reduce any differential effects of monetary policy, the latter will increase them.

Following the Krugman (1993) argument, suppose that in the future the cross-country disparities in monetary transmission will increase as a result of industrial specialization. What would the policy implications of such a development be? In most Western countries, the industrial composition results from the free choice of private sector agents, not government planners. Regional effects of monetary policy caused by differences in industry mix are therefore hard to eradicate through direct government intervention. However, governments can try to compensate regions through fiscal policy. The wisdom of such a policy will depend on the welfare effects. Economic theory tells us that economic agents who voluntarily take on more risk should be compensated by a higher return. In the context of monetary transmission, one would expect industries which disproportionately suffer from the impact of monetary policy to compensate employers and employees for taking on this risk. For example, job security is higher as a civil servant than as a employee in the car industry, but pay will be less. If there indeed appears to be such a risk-return relationship, the case for fiscal compensation is weak.

When differential regional effects of monetary policy are the result of industrial composition, there is little governments can or should do. However, to the extent that a uniform transmission of ECB policy is still hampered by institutional differences between EMU countries, the first-best solution would be to further harmonize the institutional features of the European economies.

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