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MONETARY POLICY AND THE U.S. STATES AND REGIONS: SOME IMPLICATIONS FOR EUROPEAN MONETARY UNION

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Abstract

Under the European Monetary Union (EMU), member countries will be subject to common monetary policy shocks. Given the diversity in the economic and financial structures across the EMU economies, these common monetary shocks can be reasonably expected to have different effects. Little is known about what differences might arise, however, given the absence of any historical experience in Europe with a common currency.

An alternative approach is to draw upon the historical experience of monetary policy's impacts on sub-national regions in the United States. Like the countries of the EMU, U.S. states and regions differ in industry mix and financial composition, while at the same time they employ a common currency. Thus, the lessons learned from the U.S. experience provide valuable information about the potentially varied effects of a common monetary policy across EMU economies.

Carlino and DeFina (1998, 1999) found considerable variability across sub-national economies in the United States from a common monetary policy shock. These differences were found to result primarily from cross-regional differences in industry mix. In this paper, we use these findings to construct an index that ranks EMU countries by their likely sensitivity to a common monetary shock. The index indicates that countries fall into one of three groups: Finland, Ireland, and Spain are likely to be most responsive to monetary policy shocks; France, Italy, and the Netherlands, by contrast, will have a relatively small response; and Austria, Belgium, Portugal, Germany, and Luxembourg are likely to have a response close to the EMU average.

1. INTRODUCTION

The European Monetary Union (EMU) faces numerous economic and political challenges. Among them is the likelihood that the economies of member countries will respond differently to the (common) actions of the European Central Bank. This paper seeks to draw lessons for the EMU by studying the size and sources of differential responses to monetary policy shocks in the U.S. states and regions.[1]

A number of recent studies have examined the effects of monetary policy within specific European countries, although these findings have limited value for the issue at hand. In part, the shortcomings stem from the completely different arrangements under which policy actions have been executed, that is, 11 different countries with 11 different regimes. It is now understood that the impacts of a given country's monetary policy actions on its own and other economies is a function of expectations engendered by existing policy regimes. As regimes change, so can expectations, thus reducing the relevance of the historical experience for policy analysis (Lucas, 1976). Moreover, the majority of studies do not consider feedback effects across countries that result from country-specific monetary policy shocks. Country A's monetary policy shocks directly affect country A, and because of product and factor flows between country A and country B, country A's monetary policy indirectly affects country B. The omission of such linkages from a policy analysis of the EMU, given its current and anticipated structure, is serious.

An alternative approach which mitigates these problems entails analyzing the regional effects of monetary policy in the United States. Like the countries that make up the EMU, the U.S. states are physically diverse, with a broad range of industries, firm size distributions, and banking structures. The states together represent a common-currency union subject to common policy shocks. Studying how monetary policy differentially affects sub-national economies and why provides at least broad guidance on the likely experience for the EMU.

In Carlino and DeFina (1999), we studied how monetary policy affects real personal income in each of the 48 contiguous states. The analysis used structural vector autoregression models (SVARs) estimated over the period 1958:1 to 1992:4; these models explicitly allowed for feedback among regions. Impulse response functions from the estimated SVARs revealed a broad pattern in which state real personal income tended to fall after an unanticipated increase of one percentage point in the federal funds rate. Nonetheless, differences in state responses are evident and, in some cases, substantial.

The estimated differences permitted us to identify state-specific attributes that underlie the varying state-level responses. Several theoretically motivated variables were investigated using a cross-state model, and, of these, measures capturing differences in industry mix were significantly correlated with a state's response to monetary policy shocks. The possible impacts of banking and financial structure were also examined, but their impact was less clear.

This paper uses these earlier findings to construct an index, using EMU country data, that indicates the relative sensitivity of a country to common monetary policy shocks. The measure indicates that income in Finland, Ireland, and Spain will respond to monetary policy shocks with a magnitude that exceeds the average response by at least one standard deviation. The responses of France, Italy, and the Netherlands, by contrast, are smallest, each more than one standard deviation below the EMU-wide average response. Austria, Belgium, Portugal, Germany, and Luxembourg are likely to have responses close to the EMU average. This suggests that even if all 11 EMU member countries were at the same phase of the business cycle, Europe's central bank would still have to confront regional disparities in its stabilization policy. Differences in the way a common monetary policy affects output across countries mean that the cost of disinflation, for example, will be distributed unequally across EMU countries, suggesting that setting a common monetary policy may be quite contentious.

2. SOURCES OF EMU DIFFERENCES IN THE EFFECTS OF MONETARY POLICY

Monetary theory suggests several reasons why monetary policy actions can differentially affect sub-national economies. These include state differences in the mix of industries, in the number of large versus small firms, and in the number of large versus small banks.

*The Role of Industry Mix***.** At the national level, both the timing and impact of monetary policy actions differ across industries. In part, these differences arise because of varying interest sensitivities in the demand for products. Housing, cars, and other durable manufactured goods have historically been more responsive to interest rate changes than, say, nondurable goods and consumer services. In a similar vein, differences in an industry's response can depend on whether its output constitutes a necessity or a luxury and the extent to which demand for the industry's output is linked to foreign trade and, thus, the health of foreign economies.

Carlino and DeFina (1999) provide data showing that industry mix has differed widely across states. Similarly, as seen in Table 1, industry mix varies noticeably across EMU countries. Consider, for example, the share of real GDP accounted for by the interest-sensitive manufacturing and construction sectors. Manufacturing's share runs from a high of 31 percent in Germany to a low of 18 percent in the Netherlands. The percent manufacturing is at least one standard deviation ($\pm$ 3.6) above the mean (23.7 percent) in Germany and Portugal, while the percent manufacturing is one standard deviation below the mean in the Netherlands. The percent manufacturing for the remaining eight countries is within one standard deviation of the mean. The share of real GDP accounted for by construction, another interest-sensitive sector, runs from a high of about 7.5 percent in Spain and Finland to a low of 4.7 percent in Ireland. The percent construction is at least one standard deviation ($\pm$ 0.9) above the mean (5.9 percent) in Spain and Finland, while the percent construction is one standard deviation below the mean in Ireland. The percent construction for the remaining eight countries is within one standard deviation of the mean. Thus, there is enough variation across EMU economies in percent of a country's GDP accounted for by manufacturing and construction for the interest rate channel to have asymmetric effects across these countries. The remaining sector shares shown in Table 1 exhibit comparable cross-country variability.

Asymmetries in Credit Channel. Recent theoretical work on possible credit channels for the transmission of monetary policy actions to economic activity suggests that state differences in the mix of large versus small firms and large versus small banks could lead to different state responses to monetary policy.[2] A study by the Bank for International Settlements (1995) documents vast differences in the institutional aspects of the payments systems for 10 European countries. Kashyap and Stein (1997) point out that monetary policy is likely to have a relatively larger impact on countries having comparatively many bank-dependent firms and a relatively large percentage of small banks. The credit channel will be weakest in countries with a relatively low percentage of small banks and comparatively few bank-dependent customers. Dornbusch, Favero, and Giavazzi (1998) point out that, with the exception of the United Kingdom, the credit channel is more likely to be important in Europe, where banks provide the bulk of firms' credit. In contrast, financing in the U.S. (and in the U.K.) is much less bank-centered because capital markets play a central role in the financing of firms.

Table 2 presents evidence on the percent of total employment accounted for by a country's small firms. Because of the way data are reported, small firms are defined as having either fewer than 250 employees in 1992 for eight countries and fewer than 200 employees in 1992 for the remaining countries. (Please see notes to Table 2 for details.) Table 2 shows that the small firm variable differs markedly across European countries. In Italy, Portugal, and Spain, at least 74 percent of workers are employed by these firms; the number is about 20 percentage points less in Finland, Belgium, France, and Germany.

Following Kashyap and Stein (1997), we use the share of total assets of all credit institutions controlled by the three largest commercial banks (three-firm concentration ratio) as our bank-size variable. We refer to this variable as CR3. As Table 2 shows, in Luxembourg, Austria, Germany, and Italy, small banks appear to control a significant porportion of assets. Conversely, in Finland, Ireland, and the Netherlands, large banks appear to control a significant proportion of assets.[3]

3. LITERATURE REVIEW

Some researchers have investigated the effects of monetary policy on economic activity in various European countries using "large" econometric models, while other researchers provide evidence from "small" econometric, or VAR, models. Since this paper uses VAR techniques, we briefly review the cross-country evidence on monetary policy provided by the small econometric models.[4] A recent study using the VAR approach by Ramaswamy and Sloek (1997) found that the full effect of an unanticipated contraction in monetary policy on output in Austria, Belgium, Finland, Germany, the Netherlands, and the United Kingdom takes roughly twice as long to occur and is twice as deep as in Denmark, France, Italy, Portugal, Spain, and Sweden. Another VAR study by Barran, Coudert, and Mojon (1996) found that the decline in output from an unanticipated tightening of monetary policy bottomed out about10 quarters after the shock in Germany, about 8 quarters in the United Kingdom, and 6 quarters in France. Using VAR techniques, Gerlach and Smets (1995) found that while the effects of monetary policy shocks were not vastly different across the countries in their study, they were somewhat larger in Germany than in France or Italy.

Britton and Whitley (1997) use the Bank of England's Small Stylised Dynamic Model to simulate the transmission mechanism for monetary policy. Similar to the Gerlach and Smets (1995) study, Britton and Whitley's (1997) study found that differences in the transmission of monetary policy among the countries they studied were not very large, although they found that the output response to interest rate shocks was greatest in Germany or France and smallest in the United Kingdom.

Dornbusch, Favero, and Giavazzi (1998) used a small model of six European countries and found that the impact effect of a monetary policy shock (changes in short-term interest rates) has a lag of 8 months in Italy, Spain, Sweden, and the United Kingdom, 9 months in Germany, and 12 months in France. The impact effect is relatively largest in Sweden and Italy. The impact effect in Germany, France, and the United Kingdom is about one-half as large as it is for Sweden and Italy. The impact effect in Spain is about one-third that of Sweden and Italy. They find the lagged effect of monetary policy (two years after the policy shock) is also highest in Sweden and Italy. The lagged effect is relatively lower and quite similar for Germany, France, and Spain.

In sum, while these studies tend to disagree on an individual country's responsiveness to monetary policy shocks, they are in general agreement that sensitivity to these shocks will differ across European countries. While it is hard to draw conclusions from these studies about how specific countries react to monetary policy shocks, there seems to be consensus that Germany is likely to be among the more responsive countries.

4. EMPIRICAL APPROACH

We use an indirect approach to modeling the effects of common monetary policy shocks on EMU economies based on the methodology developed and described in Carlino and DeFina (1998, 1999). First, the effects of monetary policy shocks on real per capita income for the U.S. states are estimated using structural vector autoregression (SVAR) models. Next, these estimated state policy responses are used in a cross-state regression model designed to determine the size and significance of the various channels for monetary policy. Finally, we use the estimated coefficients from the cross-section regression model to weight the data in Tables 1 and 2 describing differences in industrial and financial structure across the EMU countries and construct an index that indicates the relative sensitivity of each of these economies to common monetary policy shocks.

The U.S. Model. Economic activity in the 48 contiguous states is modeled using SVAR methodology that accounts for feedbacks among all system variables in describing the effects of policy shocks. Formally, we study the dynamic behavior of 48 state-level, 13 x 1 covariance-stationary vectors:

$$Z_{s,t} = [\Delta x_{s,t}, \Delta x_{r-s,t}, \Delta x_{r2,t}, \ldots, \Delta x_{r8,t}, \Delta c_{1,t}, \Delta c_{2,t}, \Delta c_{3,t}, \Delta m_t]',$$

where t indexes time, Δx_s is real income growth in state s, Δx_{r-s} is growth of real income in the

BEA region containing the state less the state's real income, Δx_{r2} through Δx_{r8} are growth in the real incomes of the other seven major BEA regions, Δc_1 through Δc_3 are three macroeconomic control variables, and Δm is a measure of monetary policy actions.

The dynamics of $Z_{s,t}$ are represented by:

$$(1) \qquad AZ_{s,t} = B(L)Z_{s,t-1} + e_{s,t} \ ,$$

where A is a 13 x 13 matrix of coefficients describing the contemporaneous correlations among the variables; B(L) is a 13 x 13 matrix of polynomials in the lag operator, L; and $e_{s,t} = [\varepsilon_{1,t}, \varepsilon_{2,t}, \cdots, \varepsilon_{13,t}]'$ is a 13 x 1 vector of structural disturbances, or primitive shocks, for each state. Thus, each of the system's variables, including the state's real income, can be influenced by its own idiosyncratic shocks and by shocks to all other variables. The matrices A and B(L) determine how shocks to each variable are transmitted through the system, both contemporaneously (the A matrix) and in subsequent periods (the B(L) matrix). To see this more explicitly, rewrite (1) as a reduced form:

$$(2) \qquad Z_{s,t} = C(L)Z_{s,t-1} + u_{s,t} \ ,$$

where $C(L) = A^{-1}B(L)$ is an infinite-order lag polynomial, and $u_{s,t} = A^{-1}e_{s,t}$ describes the relationship between the model's reduced-form residuals and the model's structural residuals.

*Impulse Response Functions***.** The standard way to summarize the dynamic impact of policy shocks on personal income growth is the cumulative impulse response function. Assuming the system's primitive innovations, e_t, are identified, impulse response functions, Z_t, are calculated directly from (1) as

(3)
$$Z_{s,t} = [I - C(L)]^{-1} A^{-1} e_{s,t} = \Theta(L) e_{s,t}$$

(4)
$$where: \quad \Theta(L) = \sum_{l=0}^{L} \Theta_l L^l,$$

and Θ_l is a k x k matrix of structural parameters. It is evident from (3) and (4) that the impulse responses reflect the dynamic interaction of all model parameters subsequent to a policy shock, $e_{s,t}$.

Estimation Procedure and Identification Restrictions. The elements of B(L) and A are estimated using Bernanke's (1986) two-step procedure. In the first step, OLS estimates of the reduced-form errors $u_t = A^{-1}e_t$ are obtained for the dynamic simultaneous equation model (2). Sufficient restrictions are then placed on the variance-covariance matrix of structural errors and on the matrix of contemporaneous correlations, A, to achieve identification. Given estimates of A, estimates of B(L) are derived from the relationship, $C(L) = A^{-1}B(L)$, where C(L) comes from the estimated reduced-form (2). Estimates of A also allow estimates of the structural errors, e_t, as implied by the relationship, $u_t = A^{-1}e_t$.

Two sets of standard restrictions are placed on the structural variance-covariance matrix:

- Structural shocks are assumed to be orthogonal (zero contemporaneous covariance).

- Variances of the structural shocks are normalized to unity.

These restrictions constrain the structural variance-covariance matrix to be an identity matrix.

Three sets of restrictions are placed on the matrix A. Each is motivated by practical consideration of time lags in the transmission of economic changes through sub-national and national economies:

- A state-specific shock affects only the state of origin contemporaneously, although it can spill over into other regions with a one-quarter lag.[5]
- Fed policy actions, shocks to core inflation, changes in the leading indicators, and changes in the relative price of energy are assumed to affect state income growth no sooner than with a one-quarter lag.
- Neither state income growth nor Fed policy actions contemporaneously affect changes in core inflation, in the leading indicators, or in the relative price of energy.

Residual changes in the federal funds rate represent the exogenous policy innovations (the $,_{m,t}$), which are needed to compute the impulse responses. Four lags of each variable are used in the estimation, a sufficient number to eliminate serial correlation in the errors.[6] Given these estimates, impulse responses are calculated using (3).

Variable Selection. State-level economic activity is measured using real personal income, calculated by deflating quarterly data on nominal personal incomes for each state during the period 1958:1 to 1992:4 with the national Consumer Price Index (CPI-U).[7] Use of the national CPI-U is forced by unavailability of state price indices.[8]

The federal funds rate was chosen as an indicator of monetary policy. Among the available choices, the case for using an interest rate appears most convincing both in light of actual Fed operating procedures and the most recent empirical evidence [see, for example, Leeper, Sims, and Zha (1996)].

Three variables are employed to control for macroeconomic influences on state economies and Fed policy decisions. The Bureau of Labor Statistics' "core" CPI (the official index less the effects of food and energy prices) captures underlying trends in the aggregate price level. The Conference Board's index of leading indicators is employed as a parsimonious way to include a variety of macroeconomic real-sector variables. Finally, to account for aggregate supply shocks, an energy price variable is included in the system. This variable is calculated as the Producer Price Index for fuels and related products and power relative to the total Producer Price Index. It is especially important to account for energy price shocks, given the large changes that occurred during the period studied.

Unit Root Tests. We conducted augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests applied to the levels and first-differences of the system's variables. All variables except the federal funds rate are expressed in logs. The unit root null cannot be rejected at conventional significance levels for any of the data series (in levels) using either the ADF or PP tests, although stationarity is achieved by first differencing. Thus, with the exception of the fed funds rate, log first differences of all variables are used to estimate the models.

5. EMPIRICAL RESULTS

Impulse Response Functions. Figure 1 shows the cumulative impulse responses for each state resulting from a one-percentage-point increase in the federal funds rate.[9] State responses are grouped by major BEA region and the weighted average of the state responses, labeled U.S., is included in each regional grouping as a benchmark.

Concerning the average response, real income exhibits a slight initial rise, followed by a substantial decline, subsequent to the policy shock. The maximum cumulative, or long-run, response occurs, on average, about eight quarters following the policy shock.[10] This general profile is similar to the estimated impact of monetary policy changes on the U.S. economy as reported in other studies [see, for example, Leeper, Sims and Zha (1996)].

The estimated state responses exhibit noticeable within-region and between-region variation at various horizons. For example, in the one to two quarters immediately following the policy shock, many states respond in ways that closely mirror the average response. Still, responses in a number of states, ones mainly located in the Plains, Southwest, and the Rocky Mountain regions, show considerable dispersion around the average. As the period after the shock lengthens, both within-region and between-region variation rise as the dynamics fully work through the system. In the long run, the real incomes in individual states generally settle down as they approach their new lower levels.

Among the states, Michigan has the largest response (2.7 percent), while five states (Arizona, Indiana, Michigan, New Hampshire, and Oregon) respond at least one-and-a-half times as much as the nation, on average. By contrast, four states (Louisiana, Oklahoma, Texas, and Wyoming) are found to be least sensitive, responding no more than half as much as the nation, on average. Moreover, across all states, the largest response (Michigan) exceeds the smallest (Oklahoma) by 2.73 percentage points.

6. WHAT CAUSED THE DIFFERENTIAL STATE RESPONSES TO MONETARY POLICY ACTIONS?

Section 2 identified three possible ways by which monetary policy actions could differentially affect *state* economies, including differences in the mix of industries, firm size, and bank size. How important are these factors in accounting for the different state responses to monetary policy innovations?

To answer the question, we regressed absolute values of the long-run state responses (the estimated cumulative responses about eight quarters following a policy shock) on state-level independent variables that proxy for the hypothesized explanatory factors. The shares of a state's GSP accounted for by each of eight major industry groupings are included to capture the interest rate channel. The percent of a state's firms (establishments) that are small, defined as the percent of a state's firms with fewer than 250 employees, is included to capture the possible effects of firm size. Data for the construction of the firm-size variable are taken from County Business Patterns. Three alternative variables are used to capture the effects of bank size -- the percent of a state's total loans made by the state's banks at or below the 90th percentile in assets nationally, the percent of a state's total loans made by the state's banks at or below the 90th percentile in assets nationally and not part of a bank holding company, and the three-bank concentration ratio. The Board of Governors Call Report data are used to construct the three bank-size variables. Because the estimated long-run responses represent average behavior during the sample period, averaging the data for the explanatory variables is appropriate. Data availability limited averaging to the period from the mid-1970s to the early 1990s. Averaging also minimizes the chance that the results depend on the data for a particular year and helps control for business-cycle dynamics.

Estimated parameters from four cross-state regressions are presented in Table 3. Models (1) - (3) contain the various explanatory variables described above. The banking variable in Model (1) is measured using all small banks, while the analogous variable in Model (2) excludes banks that are members of a holding company. Model (3) is similar to Models (1) and (2) except that the share of total assets of all credit institutions controlled by the three largest commercial banks in each state, CR3, is used as our bank-size variable. The CR3 variable is included in Model (3), since we used this variable in Table 4 as our proxy for a bank lending channel in European countries.

The regressions presented in Table 3 for Models (1) - (3) explain between 61 to 63 percent of the cross-state variation in cumulative responses. The percent of a state's GSP accounted for by the manufacture of durable goods and construction demonstrates positive and significant relationships to the size of a state's long-run response to Fed policy shocks; the percent of a state's GSP accounted for by its extractive industries and by the FIRE industries demonstrates negative and significant relationships. These results appear quite reasonable and are robust to the choice of the loan variable. The importance of the shares of durable-goods manufacturing and construction can be interpreted as evidence of an interest rate channel for monetary policy.

We find no evidence that cross-state variation in the mix of small versus large firms matters. States containing a larger concentration of small firms tend to be no more responsive to monetary policy shifts than states containing smaller concentrations of small firms. In contrast, we find some evidence that a state becomes more sensitive to a monetary policy shock as the percentage of small banks in the state goes down. The estimated coefficients on the small-bank variables are negative in models (1) and (2) and negative and significant in model (2). The CR3 (three-bank concentration ratio) variable is positive and significant, consistent with the finding that a state becomes more sensitive to a monetary policy shock as the percent of its small banks goes down. Thus, the findings of a negative sign on the small-bank variable and a positive sign on the

CR3 variable are *inconsistent* with the theory espoused by Kashyap and Stein (1994).[11] One possibility for the inconsistency is that a bank's asset size may be a poor indicator of its ability to adjust its balance sheet to monetary policy actions. For example, Peek and Rosengren (1995) suggest that bank capital is a better indicator--better capitalized banks have more and cheaper alternative sources of funds available. In addition, Kashyap and Stein (1994) point out that regional differences in the types of loans being made might also matter, a factor not controlled for in our study.

7. IMPLICATIONS FOR MONETARY POLICY UNDER EMU

We believe our research on the regional impact of monetary policy can illuminate the ways in which the EMU countries are likely to respond to common monetary policy shocks. The findings reported in the previous section of this paper suggest there may be important asymmetries in the response to monetary policy that are related to differences across countries in their industry mix and in their degrees of banking concentration (albeit in an unexpected direction.)

In this section we construct an index for the EMU countries that guages sensitivity to monetary policy. We use the percent manufacturing and bank-size variables given in Tables 1 and 2 weighted by the estimated value for these coefficients found using equivalent data in a cross-sectional regression model of U.S. states. Note that the small-firm variable is dropped from the EMU sensitivity index, since it was not found to be significantly different from zero in models (1) - (3). One problem in constructing this index is that we could not find a breakdown of manufacturing into durable and nondurable goods for the EMU countries. Thus, we re-estimated the cross-sectional model for the U.S. states using total manufacturing. The percent small-frim variable was not included as a regressor in Model (4). The results of the re-estimate are reported as

Model (4) in Table 3. The results reported for Model (4) are consistent with those found for the other models: the signs on the percent construction and the percent manufacturing variables are positive and significant; the signs on the coefficients for the percent mining and the FIRE variables are negative and significant; and the sign on the CR3 variable is positive and significant. Table 4 shows the predicted sensitivity of each EMU economy calculated by multiplying the estimated coefficients of Model 4 by the associated country-specific variables given in Tables 1 and 2. In the cases of Belgium, Portugal, and Italy, the national accounts data combined the mining and manufacturing sectors. To split these values into their constitutive parts, each country was assigned a share for mining equal to the average for the other countries with known values. The resulting share for mining was then subtracted from each country's combined mining and manufacturing share to obtain the estimated manufacturing share. Note that mining makes up a relatively small share of each country's GDP. Ireland's national accounts combined mining, manufacturing, electricity, water, and gas. To separate this combined share, we used the average shares of mining and electricity for the other countries and computed the manufacturing share as a residual. Finally, Italy's national accounts combine FIRE and services. This value was split using the average FIRE/services split of the other countries.

In broad terms, the EMU countries are likely to fall into one of three sensitivity groupings. Finland, Ireland, and Spain emerge as countries likely to be most sensitive to monetary policy shocks (at least one standard deviation above the mean), while France, Italy, and the Netherlands are likely to be least sensitive to common policy shocks (at least one standard deviation below the mean). The remaining countries (Austria, Belgium, Portugal, Germany, and Luxembourg) are likely to have responses not too far from the average. These rankings are a function of both the sizes of the estimated coefficients and the sizes of the associated industry share and banking variables. Thus, accounting for each country's outcome is somewhat complex and tedious and, in the interest of brevity, will not be undertaken in this article. Yet, the richness of the present analysis does lead to conclusions that differ from conventional wisdom. An example is the relatively moderate response predicted for Germany. Its high share of manufacturing has led various analysts to assume that Germany would be very sensitive to policy shocks. This turned out not to be so because, while manufacturing is a significant determinant of the policy response, construction's quantitative impact is much greater, and Germany historically has had a relatively small share of GDP arising from construction. Moreover, its three-bank concentration ratio is below the EMU average, which also pulls down its index value. Thus, the added complexity of the present analysis is fruitful in providing insights not available from simpler frameworks.

We do caution against taking our results too literally. Our index values required estimation for some missing data. More important, perhaps, certain features of EMU economies may cause responses to policy shocks different from those in the United States. Still, we believe that our conceptual framework is useful and that our results offer some broad guidelines for decision making.

8. CONCLUSIONS

This paper uses time-series techniques to examine whether monetary policy had symmetric effects across U.S. states during the 1958:1-1992:4 period. Impulse response functions from estimated structural vector autoregression models reveal long-run differences in policy responses that, in some cases, are substantial. The paper also provides evidence on the reasons for the measured cross-state differential policy responses. We find that the size of a state's long-run response to a monetary policy shock is positively related to the shares of manufacturing and construction, evidence of an interest rate channel for monetary policy. A state's concentration of small firms has no significant effect on the size of the state's policy response. Finally, a greater concentration of small banks is found to decrease the state's sensitivity to monetary policy shocks, contrary to predictions of Kashyap and Stein (1994).

We used the state level findings on various channels for monetary policy to predict how the EMU countries may respond to common monetary policy shocks. Our findings provide evidence that asymmetric state level responses to monetary policy shocks are related to a state's industry mix and degree of banking concentration. Using the percent of country real GDP accounted for by manufacturing and the three-bank concentration ratio for each of the EMU countries suggests that Finland, Ireland, and Spain will be most sensitive to monetary policy shocks, while France, Italy, and the Netherlands will be least affected. Austria, Belgium, Portugal, Germany, and Luxembourg are likely to have a relatively moderate response.

The asymmetric response to monetary policy shocks is likely to be greater across EMU countries than across U.S. states and regions. If monetary policy de-stabilizes some regions more than others in the U.S., worker migration will aid regional adjustments. It has been pointed out that unemployed southern Italians are unlikely to move to northern Italy, let alone to France or to Germany, where the language is different, to look for work. In addition, strong labor unions make wages in Europe less flexible than wages in the United States. Obstfeld and Peri (1998) find that interregional labor mobility is substantially higher in the U.S. and Canada than in Europe. Second, the automatic stabilizer feature of fiscal policy in the U.S. transfers income among U.S. states to buffer asymmetric shocks. The absence of “federal” fiscal transfers among EMU countries removes this stabilizing role. Sala-i-Martin and Sachs’s (1992) suggestion of the establishment of a common fiscal policy should be given serious consideration. It is often contended that the mix of industries is more similar across European countries than it is across the U.S. states, and this similarity should minimize the asymmetries in the responses to monetary policy shocks. This seems unlikely since the data presented in this paper show that the percent of a country’s real GDP accounted for by manufacturing (a highly interest-sensitive sector) differs widely across Europe. Differences in the way a common monetary policy affects output across countries mean that the cost of disinflation, for example, will be distributed unequally across EMU countries, suggesting that setting a common monetary policy may be quite contentious. Of course, these disadvantages must be compared with the possible economic and political advantages, such as reductions in transactions costs and exchange-rate uncertainty, of forming a common currency union.

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Table 1

Private Industry Shares of Gross Domestic Product (EMU countries, 1980-1990 period averages)[a]

Country	Agriculture	Mining	Manufacturing	Electricity, Gas, and Water	Construction	Wholesale and Retail, Restaurants and Hotels	Transport, Storage, and Communication	F
Spain	0.053	0.007	0.246	0.028	0.075	0.203	0.054	0
Portugal	NA	NA	0.276	0.038	0.053	0.191	0.065	0
Ireland	0.082	NA	NA	NA	0.047	0.105	0.052	0
Austria	0.033	0.008	0.232	0.030	0.062	0.177	0.062	0
Luxembourg	0.020	0.002	0.227	0.018	0.061	0.151	0.055	0
Germany	0.017	0.007	0.313	0.027	0.053	0.099	0.056	0
France	0.037	0.007	0.218	0.023	0.053	0.148	0.060	0
Italy	0.041	NA	0.237	0.048	0.061	0.189	0.055	0
Netherlands	0.042	0.050	0.183	0.018	0.053	0.140	0.062	0
Belgium	0.021	NA	0.213	0.043	0.052	0.167	0.078	0
Finland	0.066	0.004	0.223	0.024	0.076	0.116	0.070	0

[a]The sources of basic data used to compute industry shares are *Statistics Retrospectives,* OECD (1997) *Statistical Yearbook*. Each entry gives the percent of the indicated country's GDP originating in the list read as percent. The data are averaged over the years 1980 to 1990. The shares for each country do n government sector has been excluded. NA indicates that data were not available.

Table 2

Variables Capturing Possible Credit Channels of Monetary Policy

Country	3-Bank Concentration Ratio[a]	Percent Small Firm[b]
Germany	24.2	56.9
France	32.7	56.3
Italy	27.8	78.5
Austria	17.5	NA
Belgium	44.4	55.2
Finland	68.5	52.8
Ireland	76.2	NA
Luxembourg	17.0	63.6
Netherlands	59.0	60.7
Portugal	NA	79.4
Spain	33.7	74.1
Summary Statistics	Mean = 40.1 s.d. = 21.2	Mean =64.1 s.d. = 10.4

[a]Assets of all credit institutions in 3 largest commercial banks. Source: Barth, Nolle, and Rice (1997), Table 3.

[b]Percent small firms are defined as the percent of firms having either fewer than 250 employees in 1992 for Spain, France, Italy, Portugal, and Finland, and fewer than 200 employees in 1992 for the remaining countries. Source: Commission of the European Communities, *Enterprises in Europe, Fourth Report*, Brussels, Belgium (1996).

FIGURE 1: Cumulative Impulse Response of State Real Personal Income to Funds Rate Shock, Grouped by Major Region.

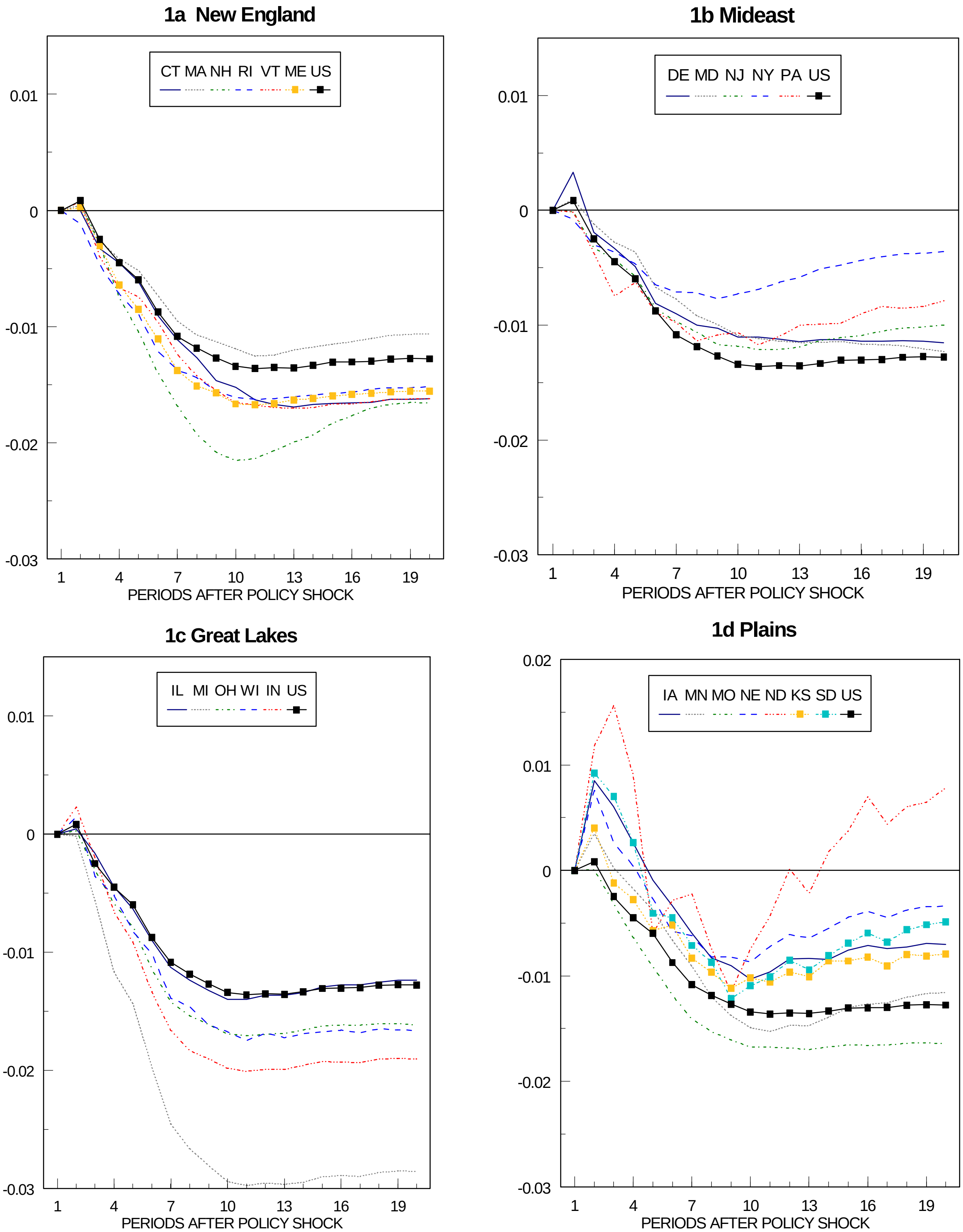

Figure 1: Continued.

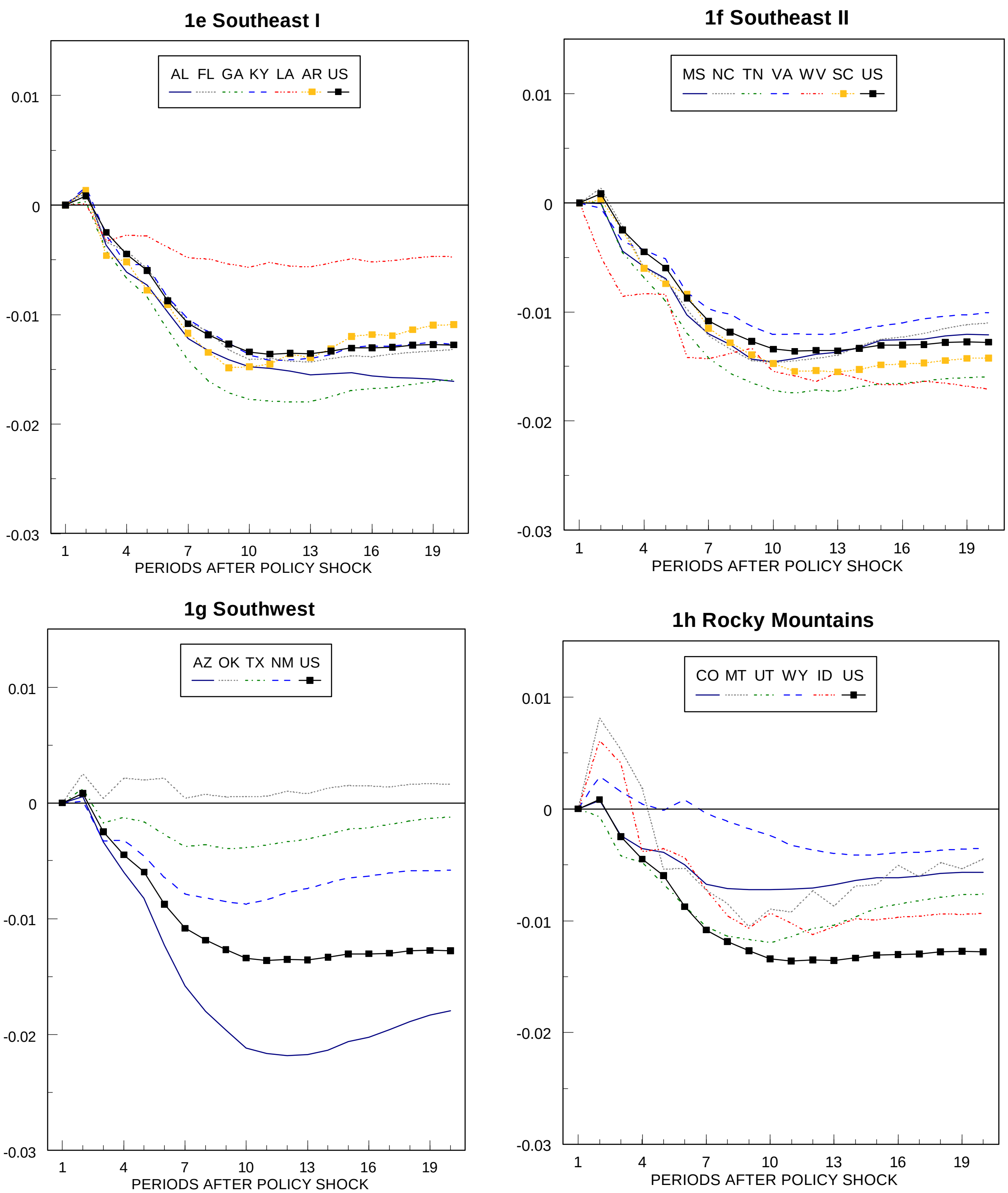

Figure 1: Continued.

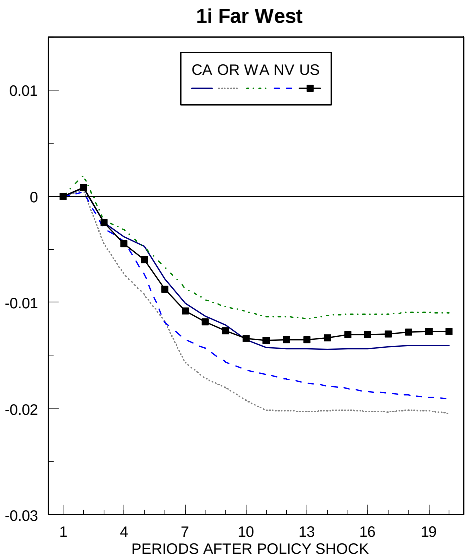

Table 3

Explaining Cross-State Variation in Policy Responses [a]

Variable[b]	Model (1)	Model (2)	Model (3)	Model (4)
Intercept	0.2179 (1.5218)	0.3194 (1.4867)	-0.5109 (1.5370)	-0.0850 (0.5377)
Percent Agriculture	-0.5071 (1.4005)	-0.3359 (1.3818)	-1.3299 (1.2862)	
Percent Mining	-3.4785 (1.7354)**	-3.2890 (1.7157)*	-3.1382 (1.6896)*	-2.6506 (0.9903)***
Percent Construction	20.9681 (8.2570)**	19.5034 (8.1240)**	20.4378 (7.9780)**	20.6794 (6.5358)***
Percent Durable Manufacturing	5.5628 (1.4791)***	5.5225 (1.4374)***	-5.0840 (1.4331)***	3.2977[C] (0.8985)***
Percent Non-Durable Manufacturing	-0.1964 (1.5781)	-0.0639 (1.5585)	0.3985 (1.5703)	
Percent Transportation	3.4391 (4.4016)	3.3139 (4.2550)	3.7056 (4.1956)	
Percent Wholesale Trade	-0.6849 (4.9399)	-0.3864 (4.8691)	0.5937 (4.8506)	
Percent Retail Trade	-3.0018 (7.6550)	-1.6932 (7.5837)	-1.8551 (7.4364)	
Percent FIRE	-5.0091 (2.7362)*	-5.2696 (2.7047)*	-3.8452 (2.6591)	-3.2960 (1.7315)*
Percent Small Firm	0.0064 (0.0109)	0.0047 (0.0107)	0.0046 (0.0105)	
Percent Small Bank Loans (all banks)	-0.0044 (0.0031)			
Percent Small Bank Loans (no holding co.)		-0.0076 (0.0042)*		
3-Bank Concentration Ratio			0.9000 (0.4187)**	0.7912 (0.4313)*
Adjusted R^2	0.6070	0.6191	0.6318	0.5471

[a]Standard errors in parentheses. *, **, and *** indicates that a null hypothesis of zero is rejected at the 10%, 5%, and 1% levels, respectively.
[b] Variables are averaged over the 1977 to 1990 period.
[C] Total manufacturing.

Table 4

Relative Sensitivity of GDP to a Monetary Policy Shock[a]
(EMU countries)

Country	**Index Value[b]**	**Difference From the Index Average**	**Standard Deviations From the Index Average**
Finland	2.3921	0.5977	1.8618
Ireland	2.2021	0.4077	1.2699
Spain	2.0506	0.2562	0.7980
Belgium	1.9162	0.1218	0.3793
Germany	1.8965	0.1021	0.3179
Portugal	1.8658	0.0714	0.2225
Austria	1.6163	-0.1781	-0.5548
Luxembourg	1.5232	-0.2712	-0.8449
Italy	1.4340	-0.3604	-1.1227
Netherlands	1.4236	-0.3708	-1.1551
France	1.4182	-0.3762	-1.1719
Average	1.79441		
St. Deviation	0.32103		

[a]Long-run GDP response to an unexpected one-percentage-point increase in short-term interest rates.

[b]The index value for each country is formed by multiplying the estimated coefficients from the cross-state U.S. regression (Table 3) by the values of the independent variables for each country. See the text for an explanation of data sources and assumptions used to construct the needed variables.

Endnotes

1.The 11 EMU members are Germany, France, Italy, Spain, the Netherlands, Belgium, Portugal, Finland, Ireland, Austria, and Luxembourg.

2. Relevant articles regarding the role of small firms in the credit channel include Bernanke and Blinder (1988), Bernanke (1993), Gertler and Gilchrist (1993), and Oliner and Rudebusch (1995). Kashyap and Stein (1994) argue for a bank lending credit channel. See Hubbard (1995) for a critical review of the credit channel view of monetary policy.

3.While we consider only the assets of all credit institutions controlled by the three largest commercial banks as our proxy for bank size, Kashyap and Stein consider this, as well as a number of other indicators of the size distribution of banks (e.g., five- and ten-firm concentration ratios). Kashyap and Stein find that the different size distribution statistics "paint a similar picture" regarding assets under the control of small versus large banks.

4. The Bank for International Settlements (1995) conducted a study to get evidence on the effects of monetary policy on various European countries using large econometric models. See Dornbusch, Favero, and Giavazzi (1998) for a review of this study.

5. This particular identifying restriction effectively deals with issues regarding spatial autocorrelation of the residuals. The restriction on the matrix A ensures that each region's shock is orthogonal to all other regions' shocks, thus eliminating any simultaneous equation bias. Nonetheless, the model allows for interregional feedbacks through the lag structure of the model.

6. Ljung-Box Q test statistics indicate that the null hypothesis of white noise errors cannot be rejected at the 5 percent level of significance for any of the system's equations. The choice of lag length was also addressed in a restricted way using the Akaike and Schwartz information criteria. That is, the number of lags of all variables in a particular equation was sequentially varied from one to eight. These criteria suggested that an optimal lag length was in the neighborhood of two to five quarters, depending on the equation. Thus, the choice of four lags appears appropriate on several grounds.

7. The SVAR is estimated using the growth in real personal incomes because the level of each state's real personal income is non-stationary. This point is addressed more fully below.

8. Consumer price indexes do exist for many of the metropolitan areas in the various states. We found that the individual metro area CPIs are cointegrated with the national CPI, so that they moved together during the 1958:1 to 1986:4 period. (The sample ends in 1986 because the BLS subsequently stopped reporting the CPIs for many MSAs.). We also found a high degree of correlation in consumer price inflation across these metropolitan areas as well.

9. The model treats increases and decreases of the federal funds rate symmetrically, so that an unexpected cut in the funds rate temporarily raises real personal income relative to what it otherwise would have been. Moreover, given data limitations, we ignore any possible structural changes that might have occurred during the estimation period.

10. Monte Carlo simulations (500 replications) performed on quarterly changes in each region's income growth indicate that these changes are significantly different from zero for the first eight quarters following a policy shock and insignificant thereafter. This result is also evident in the individual state cumulative responses shown in Figure 1, in that the effects of Fed actions tend to bottom out between 8 and 10 quarters after the shock.

11. If small banks largely make loans to small firms, this relationship would be captured by the small-firm variable. There is moderate correlation between the small-firm variable and the small- bank variable (simple correlation of 0.5). This correlation helps explain the lack of a positive response of the bank-size variable to changes in monetary policy but not the estimated negative effect.