

Regional effects of monetary policy in the U.S.: An empirical re-assessment

Pietro Pizzuto^a

^a *Department of Economics, Business and Statistics (SEAS), University of Palermo, Palermo, Italy;*

Mailing Address: Viale delle Scienze Building 13, 90128 – Palermo, Italy.

ORCID iD: 0000-0001-5055-8916; e-mail: pietro.pizzuto02@unipa.it.

Abstract

This paper provides an empirical re-assessment of the regional effects of monetary policy in the U.S. We use the narrative series of Romer and Romer (2004) as a measure of monetary policy shocks and impulse response functions estimated directly from a single equation spatial model. We find that monetary policy tightening leads to a persistent decrease in regional real personal income and employment, with asymmetric effects across regions that are magnified by spatial spillovers. The magnitude of the effects depends on the period under analysis and on the direction of the monetary policy shock. We also provide evidence of the existence of the interest rate and the housing market channels, although there is weak support for the presence of the credit channels at the regional level.

Keywords: Monetary policy shocks, Transmission channels of monetary policy, Regional asymmetries, BEA regions.

JEL Classification: E32, E52, R11, R12.

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1. Introduction

After the Great Recession, the interest on the role of monetary policy in influencing economic activity has increased (Dominguez-Torres and Hierro 2019; Ettmeier and Kriwoluzky, 2019) and the discussion on its asymmetric effects has prominently reemerged, in order to try to explain within-country heterogeneity (Beraja et al., 2019) and its distributional effects (Furceri et al., 2018).

Empirically, existing studies on U.S. regions (see Dominguez-Torres and Hierro 2019, for a broad review) have investigated the topic mainly using the federal fund rate (FFR) as indicator of monetary policy and vector autoregressive models (VARs), relying on the identifying assumption that policy innovations have no contemporaneous effects on macroeconomic variables. However, the accuracy of the estimates of the effect of monetary policy crucially depends on the validity of the measure adopted (Romer and Romer 2004), and the conventional measures of monetary policy have some flaws (endogenous and anticipatory movements). Also, existing studies have understated the role played by spatial effects. To the extent that changes in regional economic activity caused by monetary policy shocks may be transmitted to surrounding areas via the feedback between adjacent markets (i.e. financial and trade linkages), the exclusion or the partial inclusion of these spatial interactions may conduct to biased estimations (Brady, 2011 and 2014).

In addition, though the available empirical literature agrees on the regional asymmetric effects of the monetary policy shocks, very little is known on whether the regional effects have changed over time (Owyang and Wall 2009 is an exception) and, most importantly, there is a need to study in depth the effects resulting from opposing shocks (that is, contractionary versus expansionary shocks). The paper aims to fill these gaps, by focusing not only on income but by extending the analysis to employment and by providing new evidence on the transmission channels that work at the regional level.

2. The heterogenous impact of monetary policy shocks

To overcome some of the shortcomings identified in the previous section, a reduced-form empirical specification is used to examine the regional effects of monetary policy shocks. Our specification follows the local projection approach initially proposed by Jordà (2005) and then extended by Brady (2011, 2014) in order to take into account the spatial correlation. This method allows the direct estimation of Impulse Response Functions (IRFs) based on local projections of the effect of monetary policy shocks on the outcome variable and it is particularly suited to assess non-linearities in the dynamic response of the variable of interest in the aftermath of a shock. The inclusion

of the spatial component allows to take into account the spillover effects of policy changes. Particularly, to evaluate the impact of monetary policy shocks on regional personal income (and employment) we estimate the following equation for each future period k :

$$y_{t+k} - y_{t-1} = \alpha^k + \rho^k W \Delta y_t + \beta^k MP_t + \delta^k X_t + \varepsilon_t^k \quad (1)$$

for $k=0,1,\dots, 12$ (quarters)

where: y_t is our outcome variable;¹ W is the spatial weight matrix (according to the contiguity-queen approach); $W \Delta y_t$ is the spatial lag of the dependent variable; MP_t are monetary policy shocks as in Romer and Romer (2004); X_t are control variables such as: (i) past changes in the dependent variable to implicitly take into account short-term factors affecting change in personal income or employment that are potentially correlated with monetary policy shocks; (ii) past changes in monetary policy shocks to consider serial correlations in our measure of shock.

Equation (1) is estimated for each region separately. Impulse response functions (IRFs) of the effects of monetary policy shocks on the outcome variable are obtained using the estimated coefficient β^k . The confidence intervals are computed using the estimated standard errors of the same coefficients.

Our full sample estimation is for the period 1969Q3-2008Q4.² In order to evaluate whether the regional effects of monetary policy have changed over time, we re-estimate equation (1) for the pre-Volcker period (1969Q3-1978Q4) and for the Volcker-Greenspan period (1982Q1-2005Q4).³

Figure 1 shows the personal income and employment response to monetary policy shocks for the 8 U.S. BEA regions. Looking at the full sample results (panel (a)), it appears that unanticipated policy rate increases have a negative and persistent effect on real personal income and employment. In the former case, the negative effects are typically transmitted the first quarter after the occurrence of the shock. Similarly, for employment the contractionary effects take place after 4 quarters but the cumulative effects appear larger and even more persistent.

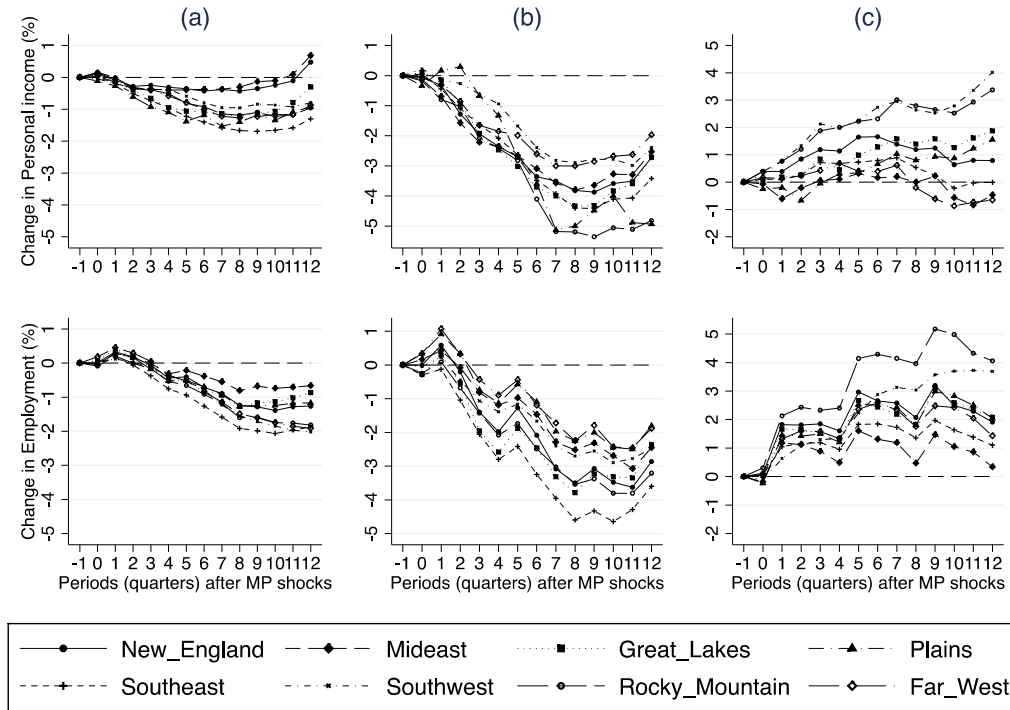
The maximum total contractionary effect is reached in Southeast followed by Plains and Far West in the case of personal income and by Southwest and Rocky Mountain in the case of employment.

¹ Data on personal income are taken from the Bureau of Economic Analysis while data on employment are taken from Bureau of Labor Statistics. Consistently with other studies (e.g., Carlino and DeFina, 1998 and 1999), nominal personal income is deflated with the National Consumer Price Index (CPI-U), due to the unavailability of price indices for BEA regions.

² The shocks are computed for the period up to 2008Q4, since the FFR reached the zero-lower bound afterward.

³ Consistently with Owyang and Wall (2009) and Romer and Romer (2004) we excluded the so-called “monetarist experiment” period (1979-1981) from the analysis due to the too scarce number of observations.

For these regions, an unanticipated policy rate increase of 100 basis points lead to a peak cumulative loss in real personal income above 1.5 percentage points, while the fall in employment reach about 2 percentage points three years ahead.



Note: estimates based on equation (1). In y-axis, the impulse response (β^k coefficient). In the x-axis, quarters after the shock.

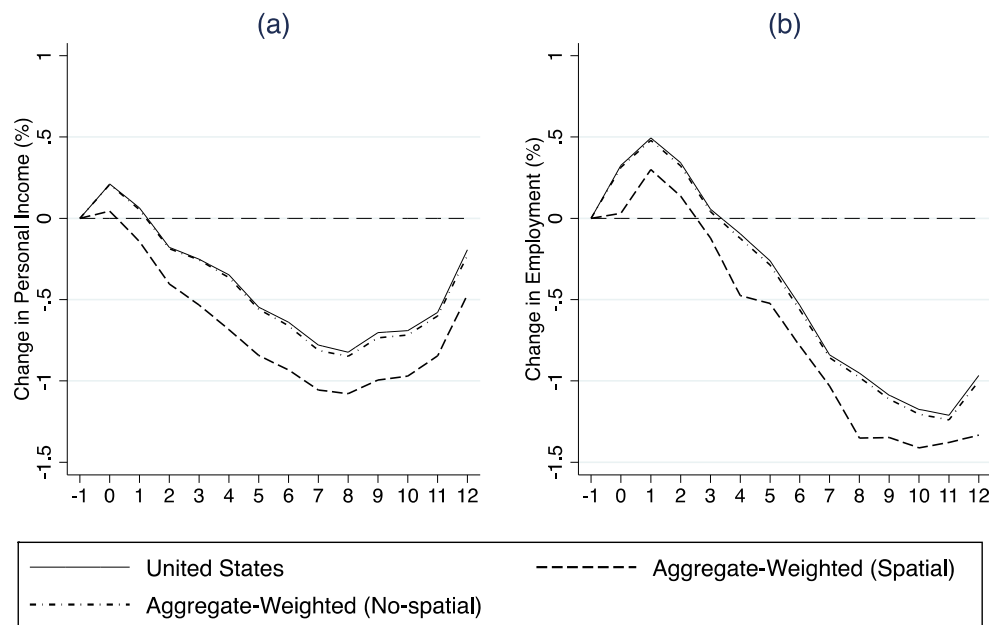
Figure 1. Impulse response functions to monetary policy shocks (regional real personal income and employment).

Estimations performed using the two subperiods previously identified suggest that the effects tend to be time dependent (Figure 1 – panels (b) and (c)). These results are in line with those of Owyang and Wall (2009), but unlike them (who show only the loss at trough), we are able to show the cumulative change over 12 quarters after the shock. We observe deeper and more-persistent recessionary effects in the pre-Volcker era (panel (b)), in which rules were the way of monetary policy conduction. Recovery usually does not occur before seven or eight quarters after the shock. Conversely, in the Volcker-Greenspan era (panel (c)) we observe shallower contractionary effects and greater heterogeneity in behavior, since several regions started to recover just two quarters after the shock, even though effects are in the majority of the cases not statistically significant.⁴ Therefore, our findings suggest that different monetary policy instrument may lead to different transmission mechanisms and effects.

⁴ We do not show confidence bands for brevity, but full graphs with 90 percent confidence bands are available upon request from the authors.

Regional vs. aggregate effects

The regional analysis that we propose seems to provide a much better understanding of the effects of monetary policy shocks relative to the use of aggregate data. Particularly, when accounting for spatial effects, it appears that the parts making up the whole don't sum up in any simple fashion. Rather, the fact that they interact with each other can generate different results. To investigate this point we repeat the analysis re-estimating equation (1) both on aggregate data and at the regional level excluding the spatial effects.⁵ Figure 2 shows the personal income and employment response to an unanticipated policy rate increase for the United States and the aggregate-weighted regional estimations.⁶ The aggregate and regional aggregate-weighted estimations tend to be very similar when excluding the spatial component from the estimation of equation (1) at the regional level. Conversely, the contractionary effects obtained with the regional aggregate-weighted spatial version tend to be larger than those previously identified, suggesting a distinctive role for the spatial interactions among regions.



Note: estimates based on equation (1). In y-axis, the impulse response (β^k coefficient). In the x-axis, quarters after the shock.

Figure 2. Impulse response functions to monetary policy shocks - aggregate and regional aggregate-weighted estimations.

⁵ By construction, the estimations performed on aggregate data do not include the spatial component.

⁶ The aggregate-weighted series are constructed using the IRF coefficients estimated at the regional level. We use the average shares of regional personal income to total (aggregate) personal income as weights. Specifically, the weights are as follows: New England, 0.06; Mideast 0.20; Great Lakes 0.17; Plains 0.07; Southeast 0.21; Southwest 0.09; Rocky Mountain 0.03; Far West 0.17.

Narrative monetary policy shocks vs. changes in Federal Funds Rate (FFR)

The effects obtained using the narrative series of Romer and Romer (2004) as a measure of unanticipated changes in the Fed's policy rates and accounting for spatial spillovers are not only statistically significant but also economically large. To compare our results with those produced in the previous literature we repeat the analysis using changes in the effective federal funds rate as measures of monetary policy shocks (both including and excluding, alternatively, the spatial effects).

Our results confirm that changes in the FFR have a long-lasting effect on regional real personal income and employment. At the same time, as expected, the effects are considerably smaller than those obtained by using narrative shocks: the average cumulative effect is in some cases half or one quarter of the baseline effect, and usually, it reaches the peak not before quarter 11 (instead of quarters 7-8) (Table 1). This may be due to better realized or expected economic conditions in the case of an increase in the policy rate, which tend to offset the contractionary effect of monetary policy shocks (Romer and Romer, 2004).

Average cumulative response (%)						
Personal Income				Employment		
Periods after the shock	MP shocks – Baseline	Changes in FFR	Changes in FFR	MP shocks – Baseline	Changes in FFR	Changes in FFR
	(with spatial effects)	(with spatial effects)	(without spatial effects)	(with spatial effects)	(with spatial effects)	(without spatial effects)
0	0.05	0.02	0.12	0.02	0.01	0.40
1	-0.14	-0.08	0.05	0.28	0.38	0.59
2	-0.39	-0.24	-0.11	0.12	0.29	0.52
3	-0.51	-0.28	-0.12	-0.12	0.15	0.36
4	-0.65	-0.42	-0.23	-0.47	-0.09	0.47
5	-0.82	-0.57	-0.40	-0.53	0.05	0.41
6	-0.90	-0.69	-0.54	-0.80	-0.18	0.19
7	-1.04	-0.84	-0.70	-1.06	-0.40	-0.07
8	-1.05	-0.91	-0.78	-1.39	-0.68	-0.04
9	-0.96	-0.96	-0.82	-1.41	-0.53	-0.12
10	-0.96	-1.06	-0.94	-1.49	-0.69	-0.29
11	-0.84	-1.14	-1.03	-1.47	-0.81	-0.49
12	-0.50	-1.08	-0.96	-1.45	-0.98	-0.36

Note: Estimates based on equation (1). Results display the average cumulative response of personal income and employment to changes in FFR or to monetary policy shocks and are expressed in percent.

Table 1. Average cumulative response to alternative monetary policy shocks (%) and the role of spatial effects.

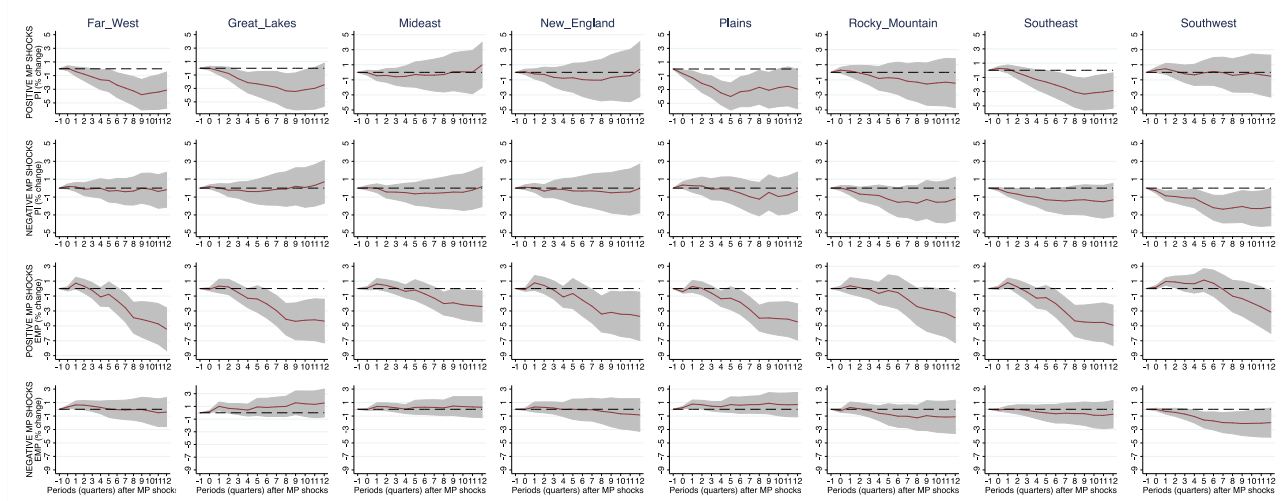
Positive vs. negative monetary policy shocks

Although the evidence has yet to be exhaustively addressed, there is a growing consensus in literature (i.e. Furceri et al. 2018 and references cited therein) that the effects of positive monetary

policy shocks on economic activity are larger than the effects of negative monetary policy shocks. Therefore, since the direction of the monetary policy shock may be relevant, to evaluate its regional effects we re-estimate the following version of equation (1):

$$y_{t+k} - y_{t-1} = \alpha^k + \rho^k W \Delta y_t + \beta_+^k D_t MP_t + \beta_-^k (1 - D_t) MP_t + \delta^k X_t + \varepsilon_t^k \quad (2)$$

where D is a dummy variable, that takes value one for positive monetary policy shocks and zero otherwise.



Note: estimates based on equation (2). In y-axis, the impulse response (β^k coefficient) and 90 percent confidence bands. In the x-axis, quarters after the shock. Rows 1 (positive shocks) and 2 (negative shocks) are for personal income while rows 3 (positive shocks) and 4 (negative shocks) are for employment.

Figure 3. The regional effects of monetary policy shocks – positive vs. negative shocks.

The results in Figure 3 suggest that the direction of monetary policy shocks does matter. A positive monetary policy shock (unexpected contractionary policy) leads to a statistically significant decrease both in regional personal income (2-3% after 8 quarters) and in employment (4-5% after 12 quarters). In contrast, the effects of negative monetary policy shocks (unexpected easing of policy) are not significantly different from zero in almost all cases.

3. Transmission channels of monetary policy

The literature on the monetary transmission mechanism provides several reasons why the effect of monetary policy can vary across regions. These include: (i) regional differences in the mix of

interest-sensitive industries since monetary contraction reduces the demand for capital and durables (industry-mix channel); (ii) differences in house market characteristics (housing market channel) since monetary policy shocks may generate heterogeneous responses of household's consumption through changes in house prices and residential investments as well as through changes in the cost of new mortgages and in the interest burden of any outstanding debt (Elbourne 2008; Garriga et al. 2017); (iii) differences in the mix of small versus large firms and banks (credit channels), since small firms usually face higher information and transaction costs to meet their credit needs (Bernanke and Gertler 1995), and small banks are more limited than large banks in their ability to find alternative sources of funding, and therefore to make loans (Kashyap and Stein 1994).

To investigate the role of each transmission channel we use an alternative specification that allows the interaction between policy changes and economic conditions:

$$y_{i,t+k} - y_{i,t-1} = \alpha_i^k + \varphi_t^k + \rho^k W \Delta y_{i,t} + \beta^k Z_{i,t} MP_t + \delta^k X_{i,t} + \varepsilon_{i,t}^k \quad (3)$$

for $k=0,1,\dots, 12$ (quarters), $i=1,\dots,8$ (regions)

where: α_i represents regions fixed effects, to control for unobservable regional specific factors which may affect changes in real personal income; φ_t are time fixed effects, included to take account of global shocks, such as changes in oil prices or in the global business cycle; $Z_{i,t}$ is the variable indicating the transmission channel (see Table 2).

Transmission channel	Variable	Source
Industry mix	% of Regional GDP accounted for by manufacturing durable goods	Bureau of Economic Analysis (BEA)
Broad credit channel	Employment accounted for by regional small firms (<250 employees)	Bureau of Labor Statistics (BLS)
Narrow credit channel	% of loans made by region's small banks	Federal Financial Institutions Examination Council (FFIEC)
Housing market channel	House Price Index (HPI) - All-Transactions Index (deflated by the National Consumer Price Index (CPI-U))	Federal Housing Finance Agency (FHFA)

Table 2. Data sources for transmission channels

Table 3 shows that contractionary effects of monetary policy tightening tend to be significantly larger in regions with higher manufacturing share (that is in line with previous studies), and also in regions with higher house prices, confirming the importance of the interest rate and the

housing market as key transmission channels.⁷ Conversely, there is weak support for the presence of the credit channels at the regional level.

	k=0	k=1	k=2	k=3	k=4	k=5	k=6	k=7	k=8	k=9	k=10	k=11	k=12
PERSONAL INCOME													
Manufacturing share	-0.2 (0.8)	0.1 (0.8)	0.2 (0.6)	-1.6* (0.7)	-3.1** (0.9)	-2.5* (1.2)	-0.8 (1.7)	0.3 (2.0)	-0.3 (2.3)	-0.4 (2.5)	1.2 (2.5)	3.4 (2.6)	4.6 (3.3)
Housing Mrkt. Chan. - HPI	0.1 (0.3)	0.2 (0.4)	0.2 (0.4)	-0.3 (0.5)	-0.6 (0.6)	-0.8 (0.8)	-1.2 (1.1)	-1.9 (1.3)	-2.2 (1.5)	-2.4 (1.8)	-3.1 (1.8)	-3.5* (1.7)	-3.6* (1.6)
Broad Credit Chan.	3.2*** (0.7)	2.9*** (0.8)	0.3 (1.2)	1.3 (2.8)	1.5 (4.2)	-2.4 (5.6)	-5.0 (6.3)	-8.0 (7.5)	-7.6 (8.2)	-8.1 (8.8)	-11.1 (7.8)	-13.1 (8.6)	-17.6 (10.7)
Narrow Credit Chan.	-0.4** (0.2)	-0.3 (0.2)	-0.2 (0.2)	-0.6 (0.4)	-0.7 (0.7)	-0.9 (0.9)	-0.9 (1.0)	-1.2 (1.2)	-1.1 (1.4)	-1.1 (1.5)	-1.2 (1.4)	-1.2 (1.6)	-1.7 (1.8)
EMPLOYMENT													
Manufacturing share	0.3 (1.0)	1.5 (1.0)	1.2 (0.8)	-0.2 (0.9)	-1.1 (1.3)	-0.2 (1.2)	-0.1 (1.3)	1.0 (1.8)	0.7 (2.4)	1.5 (2.6)	2.8 (2.5)	4.2 (2.6)	5.7 (3.3)
Housing Mrkt. Chan. - HPI	-0.2 (0.2)	-0.5** (0.2)	-0.7** (0.3)	-0.9** (0.3)	-1.4** (0.5)	-1.8** (0.6)	-2.0** (0.7)	-2.0** (0.8)	-2.3* (1.0)	-2.5* (1.1)	-3.1** (1.2)	-3.3** (1.2)	-3.5** (1.3)
Broad Credit Chan.	3.5*** (0.9)	1.9 (1.4)	0.3 (1.7)	1.6 (1.3)	4.7* (2.4)	1.0 (2.5)	-0.5 (3.2)	-2.2 (4.1)	-0.3 (5.9)	-2.6 (6.5)	-4.6 (5.7)	-6.3 (5.4)	-5.6 (6.8)
Narrow Credit Chan.	-0.4* (0.2)	-0.4 (0.3)	-0.3 (0.3)	-0.6* (0.3)	-0.8 (0.5)	-0.7 (0.6)	-0.6 (0.7)	-0.9 (0.8)	-1.3 (0.9)	-1.3 (1.0)	-1.1 (1.1)	-0.9 (1.1)	-1.1 (1.4)

Note: estimates based on equation (3). Only coefficients for impulse response functions (β^k) of the interaction term ($Z_{i,t}MP_t$) are showed. Robust-clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3. Transmissions channels of monetary policy

4. Conclusions

In this paper we provide new evidence on the regional heterogenous effects of monetary policy in the U.S. We show that the magnitude of the effects appear higher by using the narrative series of Romer and Romer (2004) as a measure of unanticipated changes in the Fed's policy rates and by accounting for spatial interactions among regions. Our results suggest that the effects depend on the period under analysis and on the direction of the monetary policy shock. While evidence for the existence of the interest rate and housing market channels is provided, there is weak support for the presence of the credit channels at the regional level.

⁷ Since housing variables may be contemporaneously affected by monetary policy changes, we re-estimated equation (3) using one-quarter lagged values of the house price index to check the robustness of our results. Results presented in Table A1 in the Appendix are qualitatively very similar and broadly unchanged with respect to those presented in the paper. When using the number of building permits on new privately-owned residential construction (per 100 km²) as alternative variable for the housing market channel, the importance of this channel in the transmission of monetary policy is confirmed for employment, while less conclusive results are found in the case of personal income.

Appendix

Table A1. Housing market channel – robustness checks

	k=0	k=1	k=2	k=3	k=4	k=5	k=6	k=7	k=8	k=9	k=10	k=11	k=12
PERSONAL INCOME													
Housing Mrkt. Chan. – HPI (lag)	0.1 (0.2)	0.2 (0.4)	0.1 (0.5)	-0.3 (0.5)	-0.7 (0.6)	-1.0 (0.9)	-1.4 (1.1)	-2.3 (1.4)	-2.4 (1.5)	-2.6 (1.8)	-3.4 (1.8)	-3.9* (1.7)	-4.1* (1.7)
Housing Mrkt. Chan. – Building Permits	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.1)	-0.1 (0.1)	-0.1 (0.1)	-0.0 (0.1)	-0.1 (0.1)	-0.1 (0.1)	-0.1 (0.2)	-0.1 (0.2)	-0.2 (0.2)	-0.3 (0.2)	-0.3 (0.2)
Housing Mrkt. Chan. – Building Permits (lag)	-0.0 (0.0)	-0.0 (0.0)	-0.0 (0.1)	-0.1 (0.1)	-0.1 (0.1)	-0.1 (0.1)	-0.1 (0.1)	-0.1 (0.1)	-0.1 (0.2)	-0.2 (0.2)	-0.2 (0.2)	-0.3 (0.2)	-0.3 (0.2)
EMPLOYMENT													
Housing Mrkt. Chan. – HPI (lag)	-0.2 (0.2)	-0.6** (0.2)	-0.9** (0.3)	-1.1** (0.3)	-1.7** (0.5)	-2.3** (0.7)	-2.4** (0.9)	-2.5** (1.0)	-2.7** (1.2)	-3.0* (1.4)	-3.6** (1.4)	-3.8** (1.4)	-4.1** (1.6)
Housing Mrkt. Chan. – Building Permits	-0.0 (0.0)	-0.1 (0.1)	-0.1 (0.1)	-0.1** (0.1)	-0.2* (0.1)	-0.2** (0.1)	-0.3** (0.1)	-0.3** (0.1)	-0.3** (0.1)	-0.3** (0.1)	-0.4** (0.1)	-0.4*** (0.1)	-0.4** (0.1)
Housing Mrkt. Chan. – Building Permits (lag)	-0.0 (0.0)	-0.1 (0.0)	-0.1* (0.1)	-0.2** (0.1)	-0.2** (0.1)	-0.3** (0.1)	-0.3*** (0.1)	-0.3*** (0.1)	-0.4*** (0.1)	-0.4*** (0.1)	-0.5*** (0.1)	-0.5*** (0.1)	-0.5*** (0.1)

Note: Estimates based on equation (3). Only coefficients for impulse response functions (β^k) of the interaction term ($Z_{i,t}MP_t$) are showed. Robust-clustered standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. One-quarter lagged values (lag) of the transmission channel variable are used to check for potential endogeneity issues. Building permits data concern the number of building permits on new privately-owned residential construction (per 100 km²) and come from the Building Permits Survey of the United States Census Bureau.

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