# Update to Figure 1 in "Macroeconomic Shocks and their Propagation"

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# Update to Figure 1 in "Macroeconomic Shocks and their Propagation"[*]

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**Abstract**

This note proposes an update to Figure 1 in "Macroeconomic Shocks and their Propagation" in the Handbook of Macroeconomics of 2016 (Ramey, 2016). Figure 1 of Ramey (2016) reports Impulse-Response Functions (IRFs) of variables of interest to a shock in the Federal Funds Rate, following the baseline and variations of the Vector Autoregression (VAR) models in Christiano et al. (1999). This note shows that, when using a time series for FED non-borrowed reserves that is not corrected for regulatory changes in reserve requirements, the results for the period 1983-07 are robust to the inclusion of monetary variables.

**JEL Classification**: E52, E58, E65.

**Keywords**: Central Bank, FED Reserves, VAR.

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Figure 1 in Ramey (2016) proposes a revisitation of the VAR models of Figure 3 in Christiano et al. (1999). I start by replicating Figure 1 in Ramey (2016), which reports a standard VAR with Cholesky decomposition, with three blocks of variables, ordered as follows (recursive assumption): (i) log of industrial production ("lip"), unemployment rate ("unemp"), log of consumer price index ("lcpi"), and log of commodity prices ("lcpi"), (ii) Federal funds rate ("ffr"), (iii) log of non-borrowed reserves ("lnbr"), log of total reserves ("ltr"), and log of Money 1 ("lm1").

Data for reserves is provided by the Economic Data Section of the Federal Reserve Bank of St. Louis (FRED). Specifically, non-borrowed reserves is the series BOGNONBR, which is corrected for regulatory changes in reserve requirements, and total reserves is the series RESBALNS.[1] For a description of the rest of the data, refer to Ramey (2016). All time series are at the monthly frequency and orthogonal IRFs are computed with 48 periods ahead. The model includes 12 lags and the constant. Confidence intervals are not reported for simplicity. Figure 1 reports the replication results.

The IRFs in Figure 1 are the same of the ones in Figure 1 of Ramey (2016). The IRFs of the full-specification model over 1965-95 (black line) behave as expected, with clear contractionary effects on industrial production, unemployment and prices. As Ramey points out, though, the model specifications covering 1983-07 present some issues, as the IRFs of the full-specification model over this period (blue line) imply expansionary effects on unemployment. The specification without money and reserves (red line) behaves more as expected, though it still presents a clear price puzzle.

With these results at hand, I run the model with an alternative time series for

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[1]They can be found, respectively, here and here.

Figure 1: Baseline
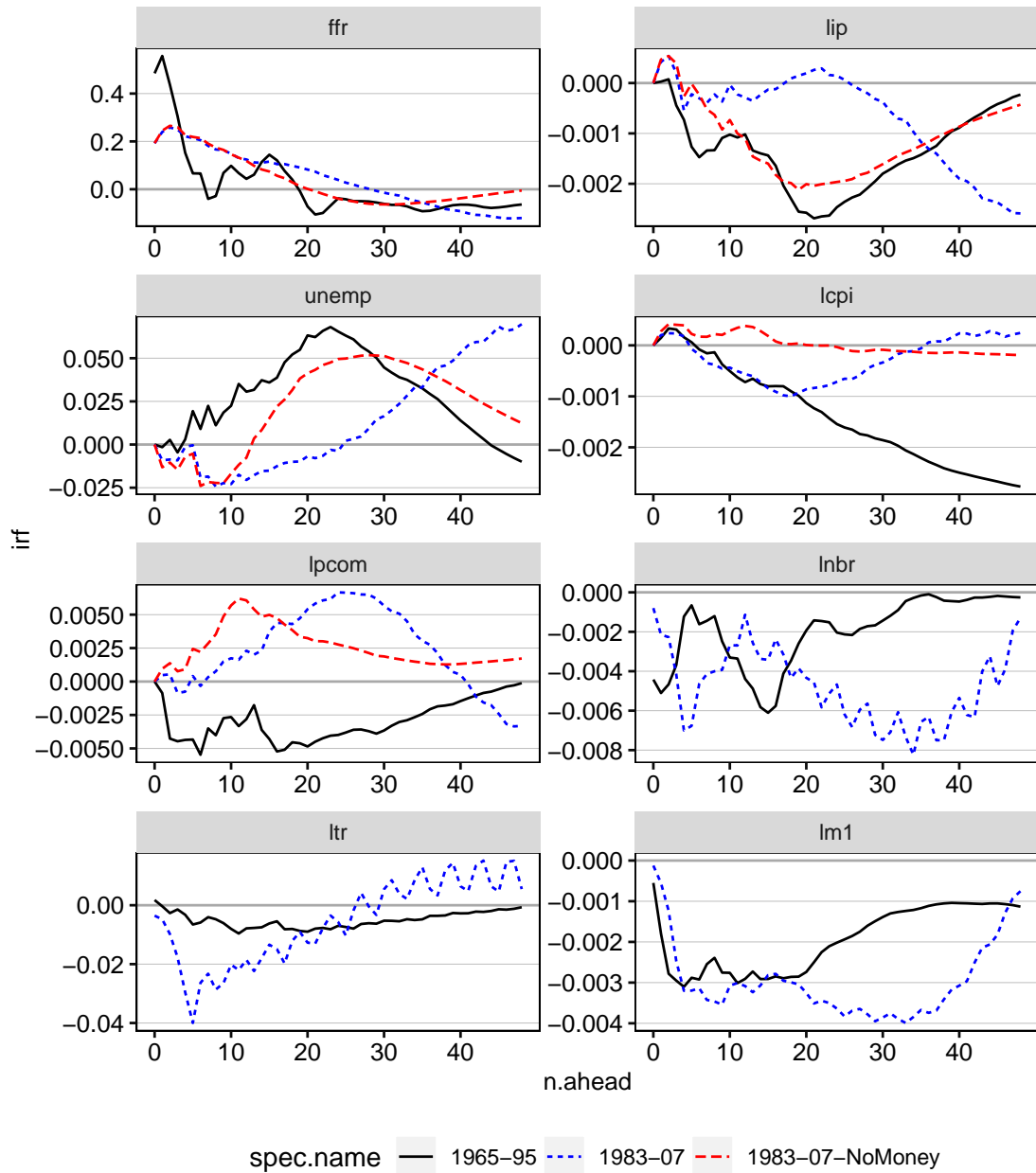


*Notes*: Replication of Figure 1 in Ramey (2016). The solid black lines are the IRFs for the full-specification model over 1965-95; the short dashed blue lines are the IRFs for the full-specification model over 1983-07; the long-dashed red lines are the IRFs for the model specification that omits money and reserves over 1983-07.

the FED non-borrowed reserves. In the baseline model of Figure 1, the series for the non-borrowed reserves (BOGNONBR) is corrected for regulatory changes in reserve requirements, while the series for total reserves (RESBALNS) is not. As one possible solution for this discrepancy, I consider an alternative time series for non-borrowed reserves that is not corrected for regulatory changes in reserve requirements, namely NONBORRES. In order to make this variable as similar as possible to the baseline, I consider it at net of vault cash eligible to satisfy reserve requirements (VAULT).[2] I construct the following variable:

- lnbr_alt = ln(NONBORRES - VAULT)

I thus run the model of Figure 1 by substituting "lnbr" with "lnbr_alt". Figure 2 reports the results.

The IRFs of the updated full-specification model over 1983-07 (blue line) follow closely the IRFs of the updated model without money and reserves over the same period (red line). As a result, also the "blue" model now shows contractionary effects on production and unemployment (though with a lag of some months), which is in line with standard economic theory. However, the price puzzle remains. Furthermore, both non-borrowed and total reserves in the blue model keep showing oscillations, though to a different degree than in Figure 1. Finally, the IRFs of the full-specification model over 1965-95 (black line) behave closely to the ones in Figure 1, with the exception of non-borrowed reserves, which now present a more stable path. As a robustness check, I consider an alternative variable for total reserves constructed with another FRED series for total reserves (not corrected for regulatory changes) called TOTRESNS, always at net of VAULT.[3] Figure A1 in

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[2]These variables can be found, respectively, here and here.
[3]The variable TOTRESNS can be found here.

Figure 2: Update
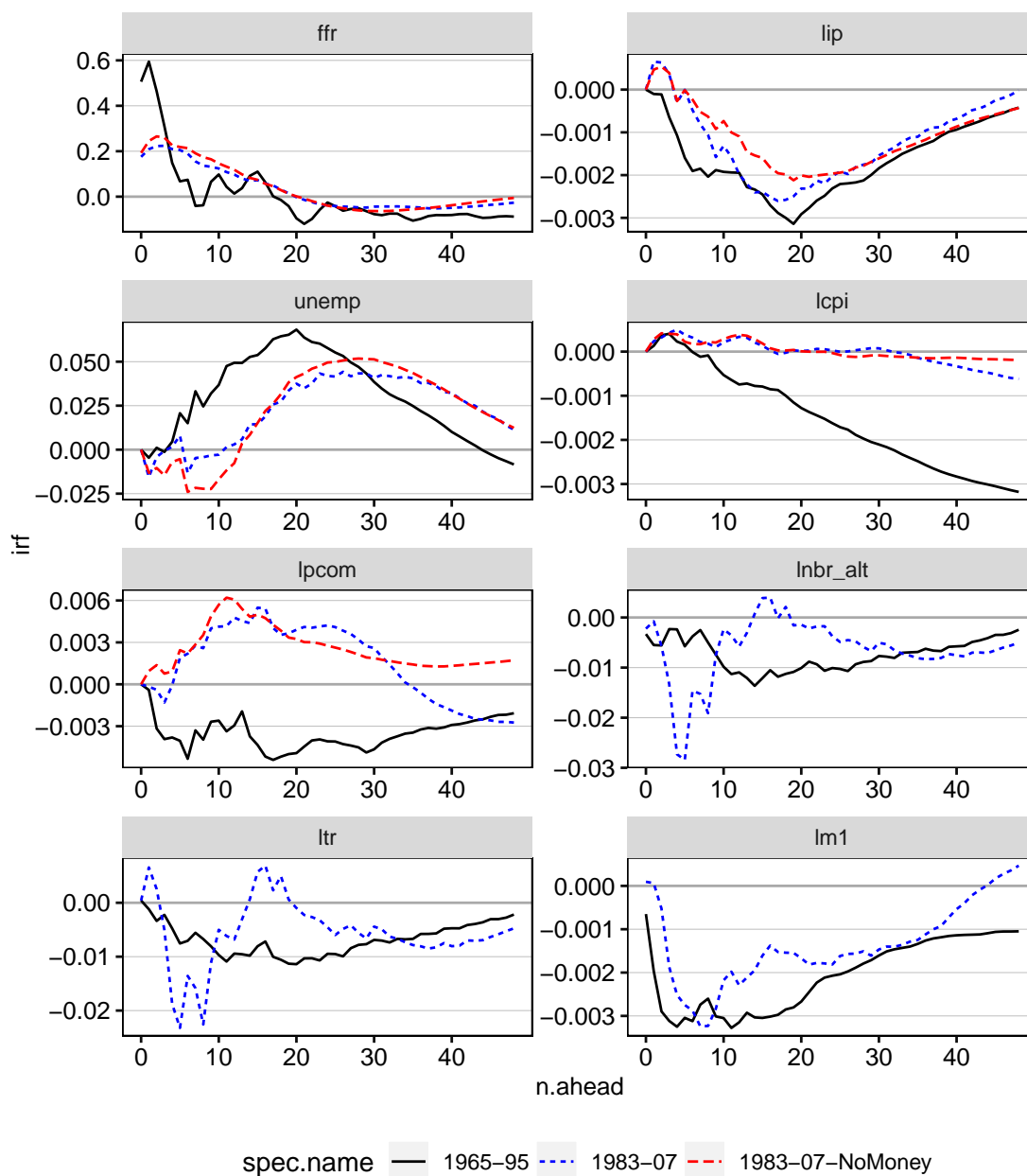
*Notes*: Updated version of Figure 1. The solid black lines are the IRFs for the full-specification model over 1965-95; the short dashed blue lines are the IRFs for the full-specification model over 1983-07; the long-dashed red lines are the IRFs for the model specification that omits money and reserves over 1983-07.

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the Appendix shows that results remain approximately unchanged.

Overall, these results show that the IRFs over the period 1983-07 are robust to the inclusion of monetary variables. They also confirm that the impact of FED's monetary policy on unemployment and prices is lower over 1983-07 than over 1965-95, which is in line with the findings reported by Ramey (2016).

# References

Lawrence J Christiano, Martin Eichenbaum, and Charles L Evans. Monetary policy shocks: What have we learned and to what end? *Handbook of macroeconomics*, 1: 65–148, 1999.

Valerie A Ramey. Macroeconomic shocks and their propagation. *Handbook of macroeconomics*, 2:71–162, 2016.

# Appendix

Figure A1: Robustness Check
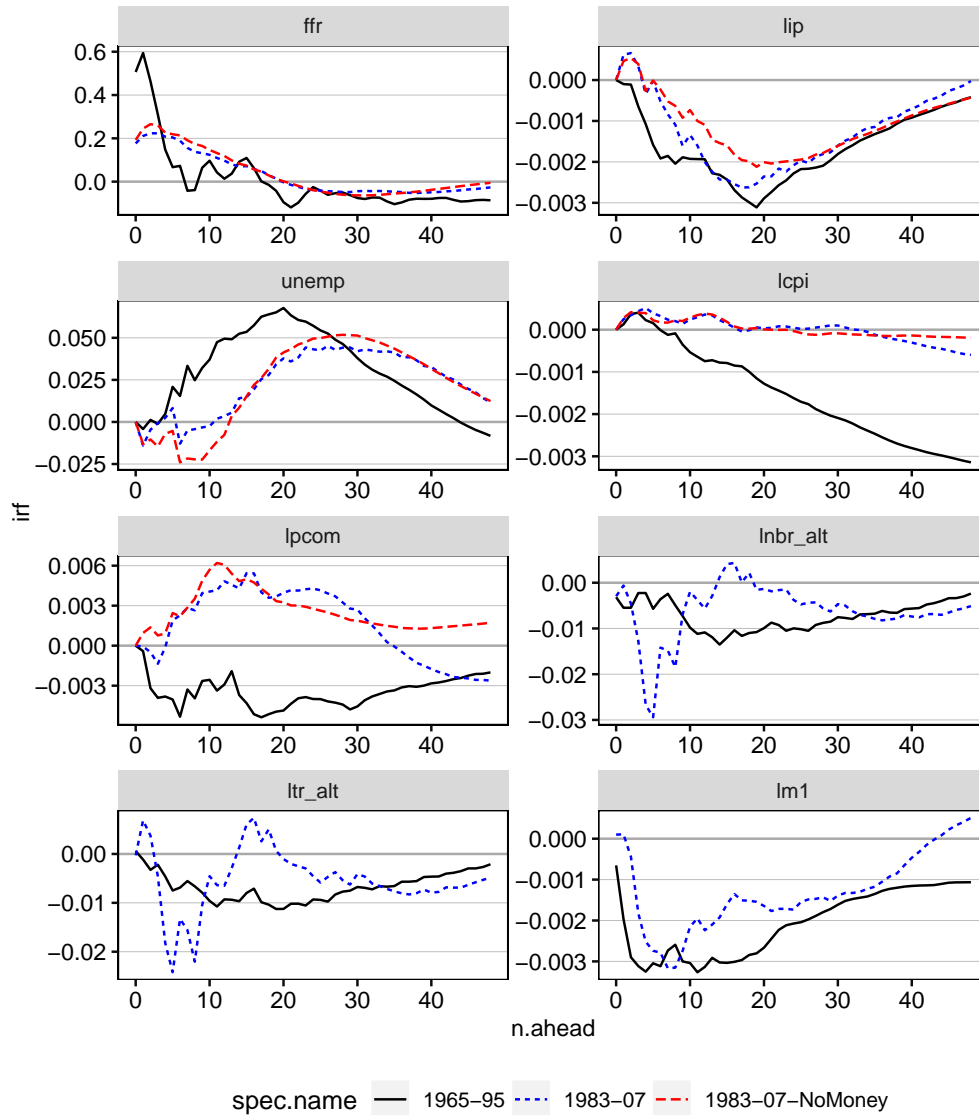
*Notes*: Robustness check for the updated version of Figure 1. The solid black lines are the IRFs for the full-specification model over 1965-95; the short dashed blue lines are the IRFs for the full-specification model over 1983-07; the long-dashed red lines are the IRFs for the model specification that omits money and reserves over 1983-07.