

Financial Innovation, Macroeconomic Volatility and the Great Moderation

Lorenzo Bencivelli, Andrea Zaghini

Bank of Italy, Research Department—Servizio Studi di Congiuntura e Politica Monetaria, Rome, Italy
Email: lorenzo.bencivelli@bancaditalia.it, andrea.zaghini@bancaditalia.it

Received April 23, 2012; revised May 29, 2012; accepted June 7, 2012

ABSTRACT

In the paper we propose an assessment of the role of financial innovation in shaping US macroeconomic dynamics. We extend an existing model by Christiano, Eichenbaum and Evans which studied the transmission of monetary policy impulses to business and corporate sector financing variables just before the Great Moderation period. By investigating the properties of the model over a longer time span we show that in the later period a change in the monetary policy transmission mechanism is likely to have occurred. In particular, we argue that the role of financial innovation has significantly altered the transmission of shocks.

Keywords: Great Moderation; Monetary Policy; Financial Innovation

1. Introduction

The Great Moderation period in the US has been broadly investigated but it is still a matter of lively discussions. The stylized facts are very simple and clear: the volatility and the persistence of many macroeconomic variables (first of all GDP and inflation) declined significantly since early 1980s. However, the reasons behind this change in business cycle dynamics are still unclear. The economic literature has provided three competing but non mutually excluding hypotheses: the “good luck” hypothesis (the economy was hit from less severe shocks), the “good policy” hypothesis (improved monetary policy management), the “changes in the structure” hypothesis (modifications in the functioning of the economy which have altered the transmission of monetary and other kind of shocks).

Recently a new branch of the literature has suggested that financial innovation may have played an important role in influencing the business cycle dynamics of the US economy. In particular, changes in firms’ and consumers’ behaviour, induced by significant financial improvements, have allowed private sector agents to better cushion themselves from the impact of interest-rate fluctuations. Within this new framework, our paper analyses the role played by net funds raised by the business sector. We build on an existing model proposed by Christiano, Eichenbaum and Evans in 1996 by extending their sample in order to include the whole Great Moderation period. Their model worked well in identifying monetary policy shocks and describing the interaction among real and financial variables over a period which includes only few years of the

Great Moderation era. By adding data till 2006 and by adequately splitting the sample we show: 1) that the model is not able to describe the dynamics of US economy over the enlarged period; 2) that the transmission of monetary policy shocks in an early and a late sub-sample differs significantly. In particular, the role of financial variables seems to have changed. Even not including data from the most recent financial crisis, in the second part of the sample financial variables emerge as the channel through which the shocks pass to the real sector of the economy.

The paper is structured as follows. Section 2 proposes a survey of the literature paying particular attention to the most recent contributions about the role of financial innovation; Section 3 introduces the model by Christiano *et al.* [1]. Section 4 deals with the estimation results over the two sub-samples; Section 5 provides a robustness analysis; Section 6 concludes.

2. The Economic Literature

Starting from the late 1990s, a large body of the empirical literature has examined the Great Moderation era in the US. A survey of the early contributions can be already found in Stock and Watson [2]¹. More recently, this lively literature has witnessed an acceleration due to the employment of new econometric techniques. As already mentioned, there are three main explanations of the declined volatility of US macroeconomic time series:

¹See Bernanke and Mihov [3], Kim and Nelson [4], McConnell and Perez-Quiros [5], Clarida *et al.* [6], Blanchard and Simon [7] among the early studies.

the “good luck”, the “good policy” and the “structural changes” hypotheses.

The “good luck” hypothesis is based on the assumption that macroeconomic shocks are drawn from a time-varying distribution. Over the Great Moderation years the US economy was simply hit by less severe shocks and in particular by smaller common international shocks (Stock and Watson [8]; Sims and Zha [9]).

The “good policy” explanation of the declined volatility is that the FED changed its monetary policy conduct improving its ability to tackle exogenous disturbances. By systematically responding more decisively to fluctuations in economic conditions, a credible monetary policy has since the early 1980s stabilized inflationary expectations via commitment to a nominal anchor (Lubik and Schorfheide [10]; Boivin and Giannoni [11]).

Finally, the “structural changes” hypothesis holds that various innovations induced by technological progress or financial innovations, might have altered the transmission mechanism of shocks as well as monetary policy impulses allowing the private sector to better withstand the impact of business cycle fluctuations (Giannone *et al.* [12]; Gali and Gambetti [13]).

Without the pretence of being exhaustive, we report in **Table 1** a classification of the empirical contributions on the Great Moderation with respect to the main empirical method employed and the hypothesis backed by the results.

One of the first and still broadly used methodology by empirical works is the sub-sampling. The properties of the US economy are investigated separately over two distinct periods. Even if the econometric techniques are often different (e.g., IRFs are estimated with VAR/FAVAR or derived from small scale models) the idea is to use the business cycle dynamics over a pre-Moderation sample to test the changes of the Great Moderation period. There is a relatively large consensus on the break having occurred in 1984. The early sample usually starts in mid-late 1950s and ends in late 1983 or in any of the four quarters of 1984. As for the closing date of the Great Moderation period, the latest available data is commonly

employed. However, at least as inflation dynamics are concerned, based on a review of econometric estimates of trend inflation and surveys on inflation expectations, Mishkin [14] argues that the process of disinflation and the re-anchoring of long-term inflation expectations was completed by the end of the 1990s². Recently more sophisticated econometric instruments were employed to assess the causes of the Great Moderation. In particular (structural) time-varying coefficient VAR and time varying regimes modelling are widely used.

As for the motivations of the declined macroeconomic volatility, from **Table 1** we can see that early works tended to support the “good luck” hypothesis while later studies point to the “good policy explanation” of the Great Moderation. Whereas, apart from the pioneering work of Kim and Nelson [26], the contribution pointing to a structural change in the economic framework are the most recent, regardless of the econometric technique employed.

Among the contributions which suggest that the structural changes witnessed by the US economy are the main cause of the Great Moderation, there are several studies backing the hypothesis that the change in the financial system is the most important one. In particular, this branch of the literature looks at several possible links between the working of financial markets and the real economic activity.

On the one hand, the *financial accelerator* and the procyclicality of the premia on credit are seen as the main theoretical tools to assess the process through which the financial system is supposed to transmit and amplify economic fluctuations³. On the other hand, *financial innovation* has been proposed as a possible source of moderation of business cycles. Changes in the way financial market operates have induced structural adjustments in firms’ and consumers’ behaviour, which in turn let the private sector better cushioning itself from the impact of interest-rate fluctuations and macroeconomic shocks. In particular, the coincidence of the Great Moderation in macroeconomic variables with an increase in the volatility of many financial variables (*financial immoderation*)

Table 1. Empirical literature.

	Good luck	Good policy	Structural changes
Sub-samples	De Blas [16]	Clarida <i>et al.</i> [6] Lubik Schorfheide [10] Boivin Giannoni [11]	Boivin <i>et al.</i> [17] Canova Gambetti [18] Gilchrist <i>et al.</i> [19]
Time-varying coefficients	Stock Watson [8] Primiceri [5] Justiniano Primiceri [20]	Cecchetti <i>et al.</i> [21]	Canova Gambetti [22] Gali Gambetti [13]
Time-varying regimes	McConnell Perez [5] Sims Zha [9] Korenok Radchenko [23]	Kim <i>et al.</i> [24]	Galvao Marcellino [25] Kim Nelson [4]

²For the welfare implication of the declined inflation rate over the Great Moderation period in the US see Calza and Zaghini [15].

³About the financial accelerator transmission mechanism see, for instance, Gertler and Lown [26].

has pushed the profession looking for possible explanations of the phenomenon. The link proposed goes indeed through the financial innovation. The underlying intuition is that transformations occurred in the financial market (financial innovation) have turned to opportunities for firms and households to smooth their investment and consumption plans, with the result that economic agents exploited more the financial instruments (financial immoderation), but the fluctuations in the main macroeconomic aggregates have moderated considerably (macroeconomic moderation). For instance, a change usually suggested by the literature to support the financial innovation hypothesis is the *democratization of the market* (Dyner *et al.* [27]), *i.e.* the agents participation to the market trading without intervention of institutional intermediaries brought about by newly developed technologies⁴.

Of particular interest is the empirical approach followed by Jermann and Quadrini [28], Gilchrist *et al.* [19] and Fuentes-Albero [29]. They start from the well known DSGE model for the US economy proposed by Smets and Wouters [30] and introduce some financial market frictions to account for spillovers from the financial system to the real activity. Following the line of research pioneered by Kiyotaki and Moore [31] and Bernanke *et al.* [32] which show that frictions in the credit market introduce a transmission mechanism which magnifies business fluctuations, they try to prove that the process of convergence toward a better functioning and almost frictionless financial market can yield more moderate fluctuations in the real variables, *i.e.* be the cause of the Great Moderation⁵.

According to Gilchrist *et al.* [21], the introduction of a financial accelerator mechanism *à la* Bernanke *et al.* [1] in the Smets and Wouters [34] framework, under the hypothesis that markets are imperfect, drives a wedge between expected return on capital and expected return demanded by the households (the lender). The authors show that over the period 1973-2008 this mechanism affects significantly business cycle fluctuations. In particular, an increase in external finance premium causes significant and protracted decline in investment spending and in output. Furthermore, Gilchrist *et al.* find that the financial stress is partly responsible for the sharp drop in output and investments spending in the mid Seventies. Conversely, the financial easing of the late Nineties provided a significant impetus to investments.

Looking at Flow-of-Funds data Jermann and Quadrini [28] document the increase in volatility of firms financial

flows. Specifically, the flows of debt and equity financing in the business sector displayed much greater variability from the second half of the 1980s. Because debt financing is negatively correlated to equity financing, these findings suggest that firms have become more flexible in the choice of the financial structure. In their model the driving forces of business cycles are productivity and credit shocks. The former is the standard productivity shock as in the typical real business cycle model. The latter is a shock that affects the enforcement of debt contracts, and therefore, the borrowing ability of firms (credit shock). Because of financial frictions, credit shocks are transmitted to the real sector of the economy through the effect they have on the production and investment decisions of firms. They show that credit shocks do contribute non-negligibly to the volatility of the major macroeconomic variables in the first sample period (1952-1983). In addition, they find that financial innovations can account for a large decline in real macroeconomic volatility and they can easily account for the full increase in the volatility of the financial structure of firms in the second sample period (1984-2006).

The paper by Fuentes-Albero [29] tries to reconcile the two empirical facts of the great moderation of macroeconomic variables and the great immoderation of financial variables on the path traced by Jermann and Quadrini [28] and Gilchrist *et al.* [19]. The goal being that of quantifying the relative role played by financial factors in shaping macroeconomic volatilities. The baseline model is again the one by Smets and Wouter [30] enriched with a financial accelerator mechanism (financial frictions). Differently from Gilchrist *et al.* [19] the author allows for two different financial shocks, one accounting for the *balance sheet channel*, the other for the *information channel*. The main empirical finding is a reduction in the average level of financial rigidities in the second sample (1984-2006). In particular, the estimated reduction in the size of the financial accelerator has two effects. On the one hand, it allows the model to account for 30% of the slowdown in the volatility of investment and the nominal interest rate. On the other hand, a smaller level of financial rigidity changes the propagation mechanism of financial shocks to the economy.

3. A Benchmark Model

In order to assess whether a change has occurred in the monetary policy transmission mechanism which is consistent with the Great Moderation timing and, in particular, if it can be related to some changes in the way private sector reacts to unexpected shocks, we build on the 1996

⁴Other transformations often quoted are the higher efficiency and speed of the spreading of information; the quick expansion of the market for high risk debt that has enlarged the participation to the market; the phasing out of the Regulation Q, which imposed a ceiling on the interest rate on deposits, with the consequence that when market rates were to rise above this level, funds were no longer available for the lenders, reducing the amount of resources for borrowers.

⁵For a different view on the role of the US financial structure see Den Haan and Sterk [33] who challenge the empirical evidence about financial innovation as a possible explanatory factor of the Great Moderation.

work by Christiano, Eichenbaum and Evans (CEE henceforth). The CEE paper is a very good starting point for two reasons: 1) it provides an empirical framework which worked well in identifying FED monetary policy impulses; 2) it assesses the implication of a monetary policy shock on business sector variables. In our empirical approach we mostly focus on the analysis of the impulse response functions (IRFs) derived from their model over different periods. We compare the IRFs over different time spans because there are several behavioural patterns that are almost unanimously acknowledged to closely describe the macroeconomic implications of a monetary policy shock. As put by Christiano *et al.* [34], every model which deals with the FED monetary policy ought to reproduce these well measured and well accepted effects of US monetary policy shocks. Thus if we find over a given period that the IRFs describe different patterns with respect to standard behaviours, this would suggest that the model is no more able to describe the short- to medium-run dynamics of the US economy. In turn this would suggest a structural change in the fundamental working of the US economy or more simply in a different reaction of the economy to a monetary policy shock.

In the work of 1996, Christiano and co-authors use two measures of monetary policy shocks (orthogonalized shock to Fed funds rate and orthogonalized shocks to non-borrowed reserves) in conjunction with Flow-of-Funds data to assess the impact of monetary policy on the borrowing and lending activities of different sectors of the economy. Our first step is to check whether the implications of the CEE model for the business (and corporate) sector are still valid over an enlarged sample which includes the whole Great Moderation period.

The CEE benchmark model is made of six variables which enter the VAR in the following order over the period 1960:Q1-1992:Q4: GDP, GDP deflator, a commodity price index (PCOM), non-borrowed reserves (NBRD), the Fed Funds rate (FFR), total reserves (TR). When the Fed Funds rate is specified as the monetary policy instrument, the ordering of the variables in the model and the Cholesky decomposition approach imply that the reaction function of the FED is such that when deciding about the optimal interest rate, not only the GDP in the current quarter but also the price levels and the commodity price index can be observed.

The first part of the CEE work is entirely devoted to the assessment of the business cycle properties of the 6-variable VAR. In addition, the authors verify the validity of the model by adding one at a time a variable whose reaction to monetary policy has to be tested. The results of the empirical investigation are in line with the expected textbook macroeconomic behaviours: a contractionary shock is associated with a decline in GDP, employment, retail sales, nonfinancial corporate profits and with an increase in unemployment and inventories. The GDP price

deflator declines after two years.

In order to look at different sectors of the economy, in the second part of their work, the authors, following the same methodology, add a seventh variable taken from the FoF accounts to the benchmark VAR. Their main result is that after a contractionary monetary policy shock net funds raised by the business sector rise for one year (2 to 4 quarters). One possible explanation put forward by the authors is that it is difficult for firms to quickly alter their nominal expenditures. Under these circumstances, if a contractionary monetary policy shock leads to a fall in firms' receipts at the beginning of a recession and a fall in net cash flow, say because of a fall in sales and a rise in inventories, then we would expect their net demand for funds to rise. According to this scenario, the observed eventual decline in net funds raised by firms reflects their ability to gradually reduce their nominal expenditures.

As a first step of our empirical investigation, we replicate the CEE model over the original time span (1960-1992) with the current data availability. Given the significant data revisions occurred after the publication of the paper (especially for the Flow-of-Funds data) it is worth checking whether the main conclusions are still valid. We use an increase in the Fed Funds rate as the contractionary monetary policy shock. Consistently with the original results, the shock determines a decline in GDP which reaches the maximum intensity after 7-8 lags, a decrease in the price index, which becomes significant after 2 years, a decline in non-borrowed reserves and a negligible effect at impact on total reserves⁶.

We also check the response of net funds raised by the business sector (BNET) and by the corporate sector (CNET) to a monetary policy shock. They are in line with the original model: a rise in the Fed Funds rate leads to an increase in BNET and CNET which is significant for the first 4 quarters. Again the interpretation suggested by Christiano and co-authors is still valid after the data revision.

The following step is to run the VAR model over the entire sample 1960-2006. **Figure 1** shows that while the response of non-borrowed reserves and total reserves seems to unfold in the expected way, it turns out that a contractionary monetary policy shock has no effect on prices, in addition the negative reaction of GDP appear to be permanent. These two responses clearly suggest that the model is not able to capture the dynamics of US economy over the whole period, in turn this is most likely due to the effect of the Great Moderation. Our point is that with original data till 1992 the model was still functioning reasonably well since just a limited number of years within the Great Moderation was covered by the sample.

⁶Impulse response functions available upon request. Note that the variable for non-borrowed reserves (NBRD) enters the VAR with a negative sign. We did so for consistency with CEE variables' definition.

Once the period is enlarged it fails to deliver the same good results.

In order to check whether a change in the monetary policy transmission mechanism has occurred (in particular with reference to the business sector variables), in the next section we split the sample into an early period, which ends before the Great Moderation, and a late period, which includes the whole Great Moderation era.

4. The Transmission of Shocks over Time

In this section we analyse and compare the IRFs derived from the CEE model over two sub-samples. In particular, following the broad consensus in the empirical literature, we set the break date and thus the start of the “late period” in the first quarter of 1984.

The monetary policy shocks obtained from the model estimated over the whole sample (1960Q1-2006Q4), the early period (1960Q1-1983Q4) and the late period (1984Q1-2006Q4) are reported in **Figure 2**. While the estimated shocks over the early sample appear to follow closely the pattern derived from the whole period, those of the late period show a much smaller size and different dynamics, especially during recessions. At first sight it thus seems that the exogenous monetary policy impulses can not be compared within a unique framework.

Figure 3 reports the impulse response functions to a contractionary monetary policy shock for the early sample. As expected the dynamics of US economy after an increase in the Fed Funds rate are well described by the 6-variable VAR proposed by Christiano *et al.* (1996), since just few years are left out with respect to the original sample. The monetary policy shock determines a temporary decrease in GDP, a persistent medium-run decline in prices (even though there is evidence of an initial price-puzzle) a decline in non-borrowed reserves and no effect total reserves.

We then look at the effect of the shock in the second half of the sample which includes the whole Great Moderation period (**Figure 4**). The striking result is the absence of a significant response by GDP. Even though the shock is by far smaller in the second sample than in the first one (around one third), the rest of the IRFs are in line with the common knowledge, only GDP dynamics are indeed puzzling. The monetary policy intervention has notwithstanding achieved the alleged target of a decline in inflation. It just seems that the standard Keynesian channel of monetary policy transmission which goes through a decline in GDP (via a crowding out of consumption durables and investment) is completely absent in the most recent period.

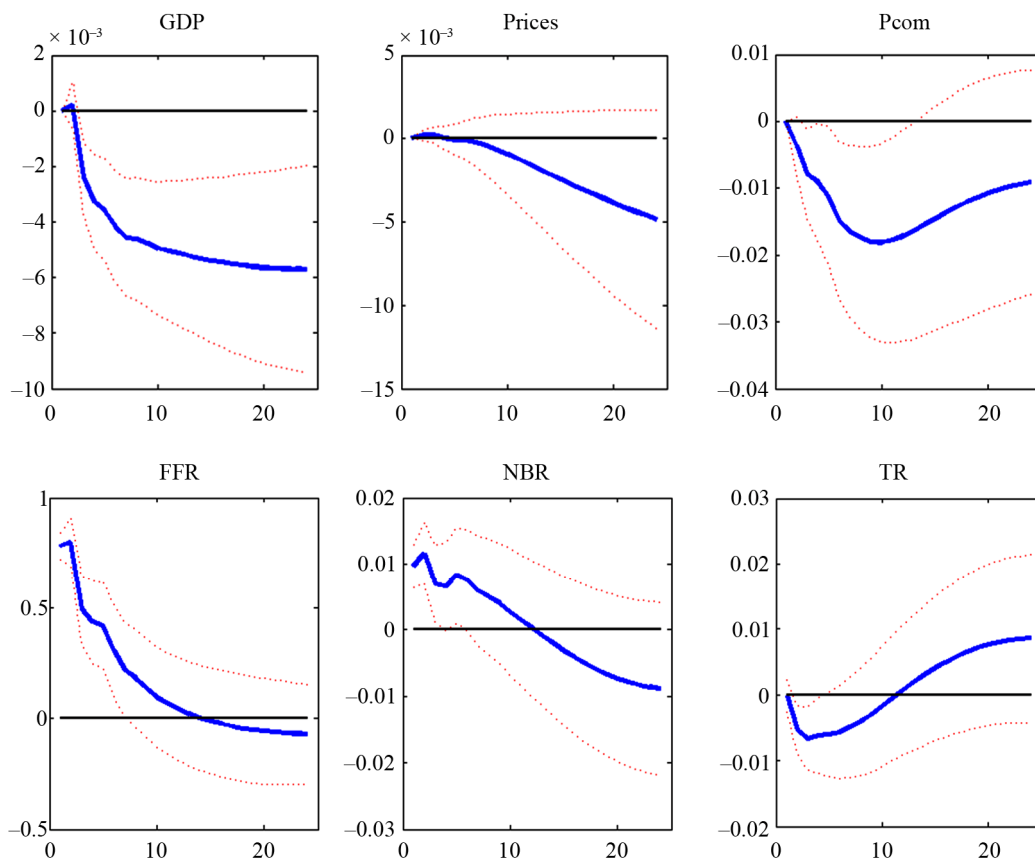


Figure 1. Monetary policy shock (1960-2006)—CEE model.

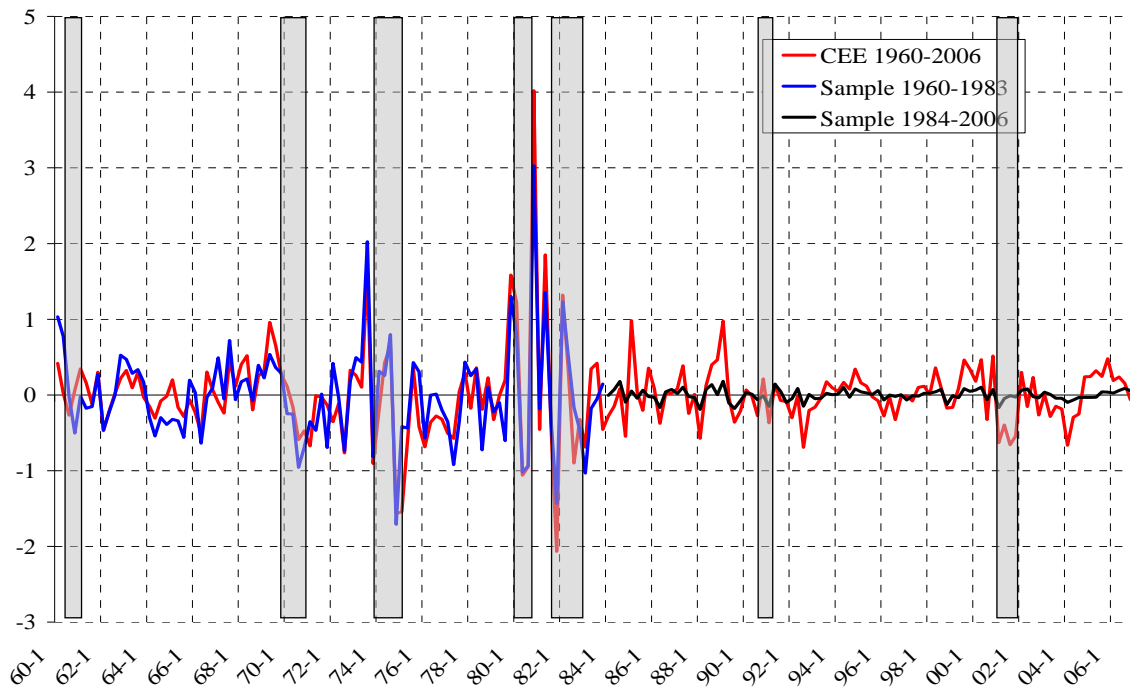


Figure 2. Monetary policy shock (1960-2006).

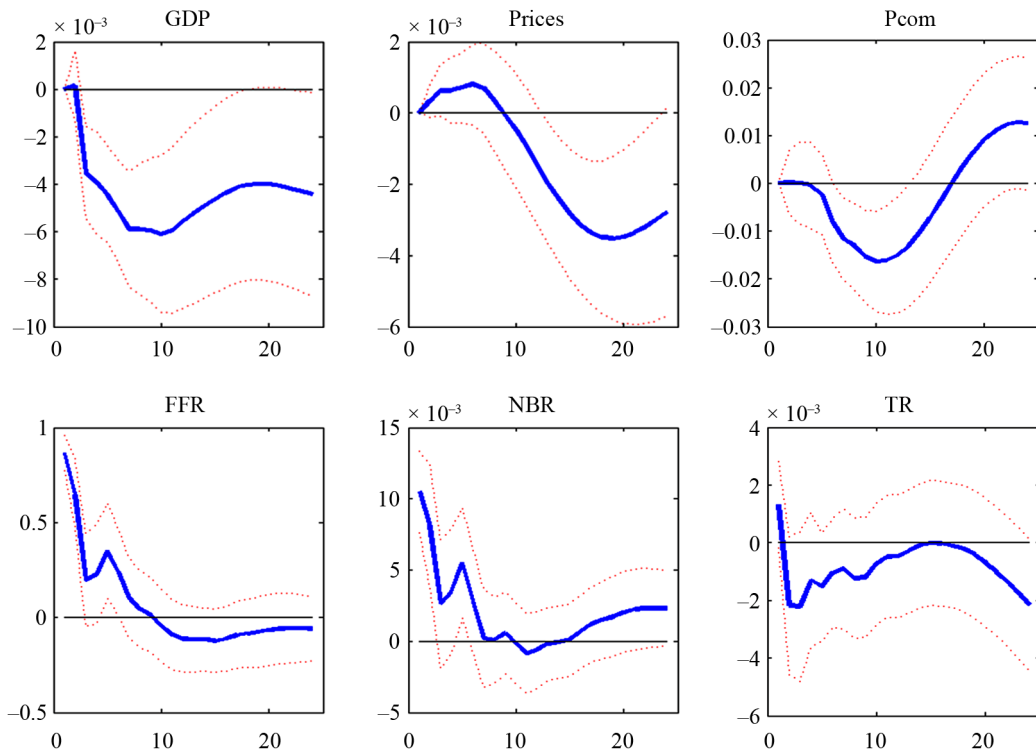


Figure 3. IFRs to a monetary policy shock (1960-1983)—CEE model.

A possible suggestion of the reason behind this circumstance can be found by the response of BNET (the net funds raised by the business sector) to a Fed Funds rate shocks. In the early period **Figure 5** shows that after the initial increase the business variable declines significantly,

while this is not true for the later period. This evidence suggests that a possible “business channel” of the monetary policy transmission that was working in the first part of the sample is not working in the second. In the early sample, an increase in the Fed Funds rate had an impact

on firms' financing condition which in turn, together with other channels, affected GDP dynamics. The effect is the one documented by Christiano *et al.* [1]: after a contractionary monetary policy shock net funds raised by business sector do not immediately decline because it is difficult for firms to quickly adjust nominal expenditure, however after few quarters firms are able to reduce their financing needs by curbing expenditures and thus pushing GDP downwards.

In the most recent sample this channel seems to have disappeared. The finding is consistent with the branch of empirical literature which suggests that financial innovation has induced a structural break able to mitigate business cycle fluctuations in a way coherent with the Great Moderation evidence. Changes in the business sector behaviour, induced by the sustained financial innovation of the last two/three decades, have allowed the private sector to insulate itself from the impact of interest rate fluctuations.

We also investigate the possibility that a change has happened in the transmission of the financial shock. **Figure 6** shows in the left hand side panel that in the early period a shock to the business sector variable has no effects on real economy: GDP is unchanged, as well as prices. Also the interest rate does not react, suggesting that financial variables were not a target of the FED policy. The

scenario changes in the second sub-sample (right hand side panel). In fact, in the most recent period there is a negative effect of the financial shock on real GDP, the reaction being statistically significant and persistent.

The existence of a channel through which a financial shock hits the real economy is even more relevant given that we did not include in our sample the latest financial crisis (one in which the propagation of financial turmoil to the real economy is commonly agreed to have been extremely strong). While firms are able to adjust to an interest rate shock so that the monetary policy impulse is not transmitted to the real economy, a shock on the financing condition has a direct effect on GDP.

5. Model Analysis and Robustness

In this section we propose an analysis of the contribution of monetary and financial shocks to the volatility of GDP and prices. In addition we also present a robustness check of the results of the previous section.

Table 2 shows the contribution of a monetary policy shock to the volatility of GDP and prices over the two samples. In the early sample (upper panel), the percentage of the forecast-error variance attributed to the Fed Funds shock reaches 20 per cent after 2 years and henceforth is stable around that share. The value is slightly smaller than

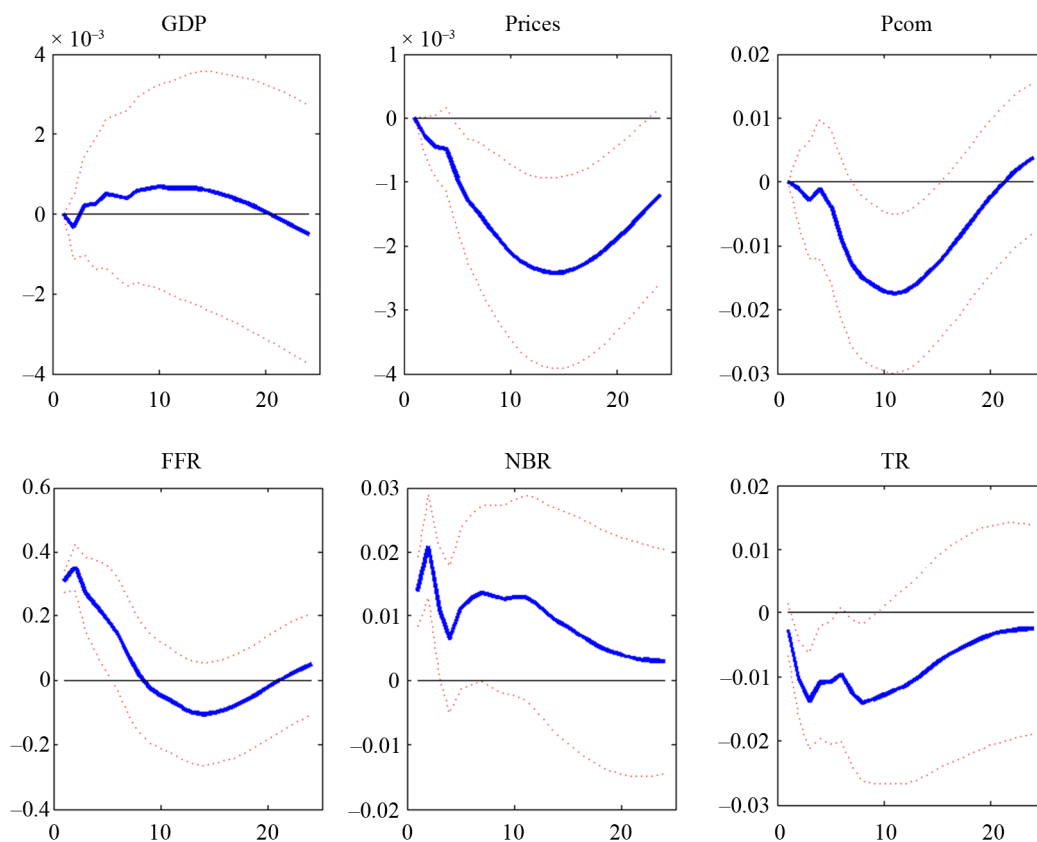


Figure 4. IRFs to a monetary policy shock (1984-2006)—CEE model.

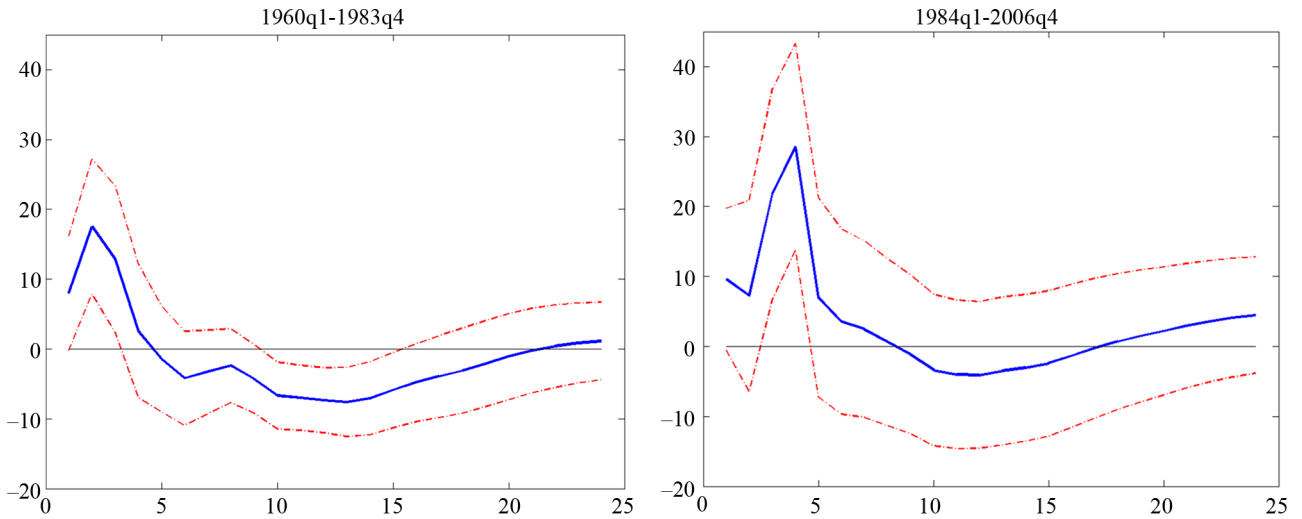


Figure 5. Effect on BNET of a monetary policy shock—CEE model.

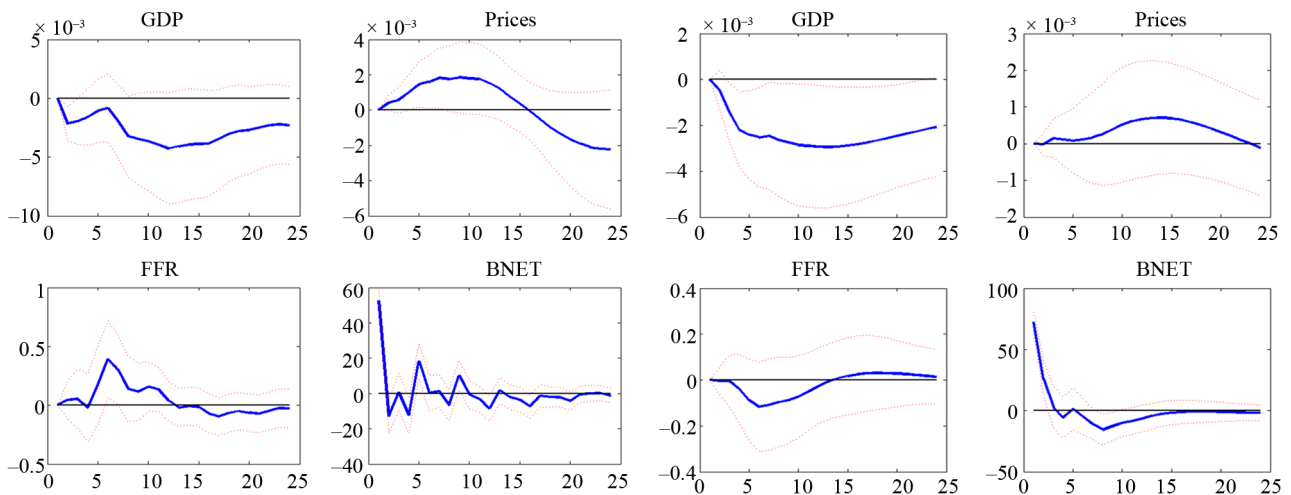


Figure 6. Responses to a financial shock—CEE model.

Table 2. Monetary policy shock contribution to volatility of GDP and prices.

	Early sample					
	4	8	12	16	20	24
GDP	11.67	19.43	20.21	19.68	19.38	19.39
GDPDEF	6.53	8.13	9.01	9.52	9.76	9.89
	4.88	5.23	10.18	14.77	17.24	17.97
	4.49	5.90	9.12	11.46	12.33	12.53
	Late sample					
	4	8	12	16	20	24
GDP	0.15	0.12	0.10	0.12	0.13	0.12
GDPDEF	20.9	3.73	4.63	5.16	5.64	6.02
	1.98	9.03	16.87	23.00	26.57	27.89
	3.21	7.71	10.87	12.32	12.73	12.57

the 29 percent after 24 quarters reported by CEE, and in line with the findings of the empirical literature (Jang and Ogaki [35]; Uhlig [36]; Canova and Gambetti [22]). When

the model is estimated from 1984 to 2006 (lower panel), the contribution of the Fed Funds shock however falls to zero at any horizon, thus confirming that monetary policy

has practically no effect on real GDP in the late sample. Even though stronger in the later sample, the contribution of the monetary policy shock to prices' volatility is instead comparable in the two periods.

The evidence is reversed when we look at the percentage of the forecast-error variance attributed to the financial shock (Table 3). The most important contribution is found in the later sample (lower panel), in which the share of the volatility attributable to the shock is 10 per cent after two years and grows to 19 per cent after 24 quarters. There is instead a limited impact on the volatility of prices in both samples.

In order to test the robustness of our results, we employ a model specification different from that of Christiano *et al.* [1] used in Sections 3 and 4. In particular, we rely on a VAR model which includes the monetary aggregate M2 but not non-borrowed and total reserves. We thus introduce explicitly a money supply and a money demand relation in the model⁷. The ordering of the variables in the VAR is the following: GDP, GDP_def, PCOM, FFR, M2.

The IRFs for the sample before the Great Moderation (1960Q1-1983Q4) and for the sample including the Great Moderation (1984Q1-2006Q4) show that an exogenous increase in the Fed Funds rate determines the expected reaction in all macroeconomic variables, including a decline in M2, only in the early sample. In the late period GDP seems again to be non affected by the monetary policy shock⁸. A persistent reduction in inflation is achieved, but not through a GDP decline.

As in the previous section we then focus on the effects of a financial shock: the differences in the two periods are again significant (Figure 7). A financial shock has no effect on GDP in the early sample (upper panel) whereas

it directly affects GDP in the most recent period (lower panel). Thus the possibility that financial innovation has contributed to a change in the transmission of both monetary and financial shocks is confirmed also when looking at a different specification of the US economy.

6. Conclusions

The paper has provided evidence of a change in the reaction of the US macroeconomic variables to monetary and financial shocks. Our findings are consistent with a broad literature suggesting that financial innovation is at least an important contributor to the smoothed business cycle fluctuations in the Eighties and Nineties, period labeled as the Great Moderation.

We started from an existing model by Christiano *et al.* [1] and we show that their model which was functioning relatively well over a period up to 1992, is not able to deliver the same good results over a longer time span which include all the Great Moderation period. We then analyse separately the responses to monetary and financial shocks into two sub-samples: one ending before the presumed start of the Great Moderation, and one including the whole Great Moderation era.

Our findings can be summarized as follows. First, monetary policy impulses have had in the later period a much weaker effect on GDP dynamics. In particular, a possible "business channel" of the monetary policy transmission mechanism that was working in the period before the Great Moderation has stopped working in the most recent period. The vigorous financial innovation of the last few decades has most likely induced a change in the business sector behaviour, allowing households and firms to insulate themselves from the impact of interest-rate fluctuations.

Table 3. Financial shock contribution to volatility of GDP and prices.

		Early sample					
		4	8	12	16	20	24
GDP		1.57	2.14	1.66	5.87	10.96	11.64
		2.91	3.71	3.36	5.27	6.78	7.03
GDPDEF		16.0	7.94	14.47	15.28	9.86	8.97
		2.77	7.55	11.30	11.85	10.06	9.28
		Late sample					
		4	8	12	16	20	24
GDP		5.39	10.59	13.45	15.98	17.89	18.95
		5.29	9.18	10.74	11.36	11.59	11.55
GDPDEF		0.13	0.17	0.89	1.60	1.74	1.61
		1.94	3.75	5.64	6.52	6.74	6.65

⁷There is a broad literature supporting the introduction of a monetary aggregate in the VAR identification; see for instance Kim [37], Leeper *et al.* [23], Sims and Zha [9], Boivin *et al.* [17].

⁸Results not shown but available upon request.

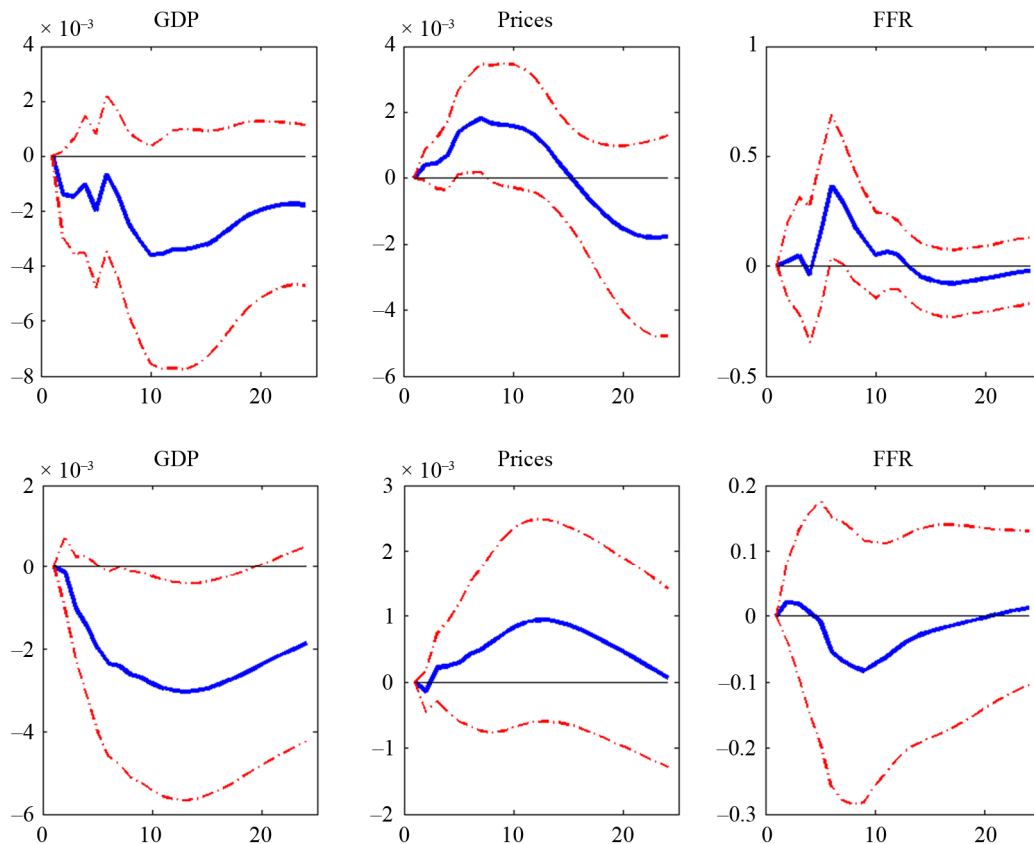


Figure 7. Financial shock (model 2): upper panel 1960-1983, lower panel 1984-2006.

Second, we documented a change also in the transmission of a financial shock. In the early period the financial shock was not transmitted to the real side of the economy, while it significantly affects GDP dynamics in the later sample. This evidence is even more relevant given that our sample ends in 2006 thus not including the financial turmoil started in the summer 2007 which had severe spillovers on the real economy.

7. Acknowledgements

The authors would like to thank an anonymous referee and M. Cecioni, G. Grande, S. Neri, R. Sabbatini and F. Zollino for comments and helpful suggestions. The views expressed in the paper do not necessarily reflect those of the Bank of Italy.

REFERENCES

- [1] L. J. Christiano, M. Eichenbaum and C. Evans, "The Effects of Monetary Policy Shocks: Evidence from the Flow of Funds," *Review of Economics and Statistics*, Vol. 78, No. 1, 1996, pp. 16-34.
- [2] J. Stock and M. W. Watson, "Has the Business Cycle Changed and Why?" NBER Macroeconomics Annual, MIT Press, Cambridge, 2002.
- [3] B. S. Bernanke and I. Mihov, "Measuring Monetary Policy," *Quarterly Journal of Economics*, Vol. 113, No. 3, 1998, pp. 869-902.
- [4] C. J. Kim and C. R. Nelson, "Has the US Economy Become More Stable? A Bayesian Approach Based on a Markov-Switching Model of the Business Cycle," *The Review of Economics and Statistics*, Vol. 81, No. 4, 1999, pp. 608-616.
- [5] M. M. McConell and G. Perez-Quiros, "Output Fluctuations in the United States: What Has Changed Since the Early 1980s?" *American Economic Review*, Vol. 90, No. 5, 2000, pp. 1464-1476. [doi:10.1257/aer.90.5.1464](https://doi.org/10.1257/aer.90.5.1464)
- [6] R. Clarida, J. Galí and M. Gertler, "Monetary Policy Rules and Macroeconomic Stability: Evidence and Some Theory," *Quarterly Journal of Economics*, Vol. 105, No. 1, 2000, pp. 147-180.
- [7] O. Blanchard and J. Simon, "The Long and Large Decline in Output Volatility," *Brookings Papers on Economic Activity*, Vol. 32, No. 1, 2001, pp. 135-164.
- [8] J. Stock and M. W. Watson, "Has the Business Cycle Changed? Evidence and Explanations," Monetary Policy and Uncertainty, Federal Reserve Bank of Kansas City, Kansas City, 2003, pp. 9-56.
- [9] C. Sims and T. Zha, "Were There Regime Switches in US Monetary Policy?" *American Economic Review*, Vol. 96, No. 1, 2006, pp. 54-81. [doi:10.1257/000282806776157678](https://doi.org/10.1257/000282806776157678)

- [10] T. Lubik and F. Schorfheide, "Testing for Indeterminacy: An Application to US Monetary Policy," *American Economic Review*, Vol. 94, No. 1, 2004, pp. 190-217. [doi:10.1257/000282804322970760](https://doi.org/10.1257/000282804322970760)
- [11] J. Boivin and M. Giannoni, "Has Monetary Policy Become More Effective?" *Review of Economics and Statistics*, Vol. 88, No. 3, 2006 pp. 445-462. [doi:10.1162/rest.88.3.445](https://doi.org/10.1162/rest.88.3.445)
- [12] D. Giannone, M. Lenza and L. Reichlin, "Explaining the Great Moderation: It Is Not the Shocks," *Journal of the European Economic Association*, Vol. 6, No. 2-3, 2008, pp. 621-633. [doi:10.1162/JEEA.2008.6.2-3.621](https://doi.org/10.1162/JEEA.2008.6.2-3.621)
- [13] J. Gali and L. Gambetti, "On the Sources of the Great Moderation," *American Economic Journal: Macroeconomics*, Vol. 1, 2009, pp. 26-57.
- [14] F. S. Mishkin, "Inflation Dynamics," *International Finance*, Vol. 10, No. 3, 2007, pp. 317-334. [doi:10.1111/j.1468-2362.2007.00205.x](https://doi.org/10.1111/j.1468-2362.2007.00205.x)
- [15] A. Calza and A. Zaghini, "Sectoral Money Demand and the Great Disinflation in the US," *Journal of Money, Credit and Banking*, Vol. 42, No. 8, 2010, pp. 1663-1678.
- [16] B. De Blas, "Can Financial Frictions Help Explain the Performance of the US Fed?" *The B.E. Journal of Macroeconomics*, Vol. 9, No. 1, 2009, 27 Pages.
- [17] J. Boivin, M. T. Kiley and F. S. Mishkin, "How Has the Monetary Transmission Mechanism Evolved over Time?" NBER Working Paper 15879, 2010.
- [18] F. Canova and L. Gambetti, "Structural Changes in the US Economy: Is There a Role for Monetary Policy?" *Journal of Economic Dynamics and Control*, Vol. 33, No. 2, 2009, pp. 477-490. [doi:10.1016/j.jedc.2008.05.010](https://doi.org/10.1016/j.jedc.2008.05.010)
- [19] S. Gilchrist, A. Ortiz and E. Zakrajšek, "Credit Risk and the Macroeconomy: Evidence from an Estimated DSGE Model," Unpublished Manuscript, May 2009.
- [20] A. Justiniano and G. Primiceri, "The Time Varying Volatility of Macroeconomic Fluctuations," *American Economic Review*, Vol. 98, No. 3, 2006, pp. 604-641.
- [21] S. G. Cecchetti, A. Flores-Lagunes and S. Krause, "Has Monetary Policy Become More Efficient? A Cross-Country Analysis," *Economic Journal*, Vol. 116, No. 511, 2006, pp. 408-433. [doi:10.1111/j.1468-0297.2006.01086.x](https://doi.org/10.1111/j.1468-0297.2006.01086.x)
- [22] F. Canova and L. Gambetti, "Do Expectations Matter? The Great Moderation Revisited," *American Economic Journal: Macroeconomics*, Vol. 2, No. 3, 2010, No. 3, pp. 183-205.
- [23] O. Korenok and S. Radchenko, "The Role of Permanent and Transitory Components in Business Cycle Volatility Moderation," *Empirical Economics*, Vol. 31, No. 1, 2006, pp. 217-241. [doi:10.1007/s00181-005-0042-5](https://doi.org/10.1007/s00181-005-0042-5)
- [24] C. J. Kim, C. R. Nelson and J. Piger, "The Less-Volatile US Economy: A Bayesian Investigation of Timing, Breadth, and Potential Explanations," *Journal of Business & Economic Statistics*, Vol. 22, No. 1, 2004, pp. 80-93.
- [25] A. B. Galvao and M. Marcellino, "Endogenous Monetary Policy Regimes and the Great Moderation," The Centre for Economic Policy Research 2010, Discussion Paper No. 7827.
- [26] M. Gertler and C. S. Lown, "The Information in the High-Yield Bond Spread for the Business Cycle: Evidence and Some Implications," *Oxford Review on Economic Policy*, Vol. 15, No. 3, 1999, pp. 132-150.
- [27] K. E. Dynan, D. W. Elmendorf and D. E. Sichel, "Can Financial Innovation Help to Explain the Reduced Volatility of Economic Activity," *Journal of Monetary Economics*, Vol. 53, No. 1, 2006.
- [28] U. Jermann and V. Quadrini, "Macroeconomic Effects of Financial Shocks," *American Economic Review*, Vol. 102, No.1, 2012, pp. 238-271.
- [29] C. Fuentes-Albero, "Financial Frictions, the Financial Immoderation, and the Great Moderation," Mimeo, University of Pennsylvania, 2009.
- [30] F. Smets and R. Wouters, "Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach," *American Economic Review*, Vol. 97, No. 3, 2007, pp. 586-606. [doi:10.1257/aer.97.3.586](https://doi.org/10.1257/aer.97.3.586)
- [31] M. Kiyotaki and J. Moore, "Credit Cycles," *Journal of Political Economy*, Vol. 105, No. 2, 1997, pp. 211-248.
- [32] B. S. Bernanke, M. Gertler and S. Gilchrist, "The Financial Accelerator in a Quantitative Business Cycle Model," In: J. B. Taylor and M. Woodford, Eds., *The Handbook of Macroeconomics*, Elsevier, Amsterdam, 1999, pp. 1341-1393.
- [33] W. Den Haan and V. Sterk, "The Myth of Financial Innovation and the Great Moderation," *Economic Journal*, Vol. 121, No. 553, 2011, pp. 707-739. [doi:10.1111/j.1468-0297.2010.02400.x](https://doi.org/10.1111/j.1468-0297.2010.02400.x)
- [34] L. Christiano, M. Eichenbaum and C. Evans, "Monetary Policy Shocks: What Have we Learned and to What End?" In: J. Taylor and M. Woodford, Eds., *Handbook of Macroeconomics*, North Holland, 1999, pp. 65-148.
- [35] K. Jang and M. Ogaki, "The Effects of Monetary Policy Shocks on Exchange Rates: A Structural Vector Error Correction Model Approach," *Journal of the Japanese and International Economies*, Vol. 18, No. 1, 2004, pp. 99-114. [doi:10.1016/S0889-1583\(03\)00042-X](https://doi.org/10.1016/S0889-1583(03)00042-X)
- [36] H. Uhlig, "What Are the Effects of Monetary Policy on Output? Results from an Agnostic Identification Procedure," *Journal of Monetary Economics*, Vol. 52, No. 2, 2005, pp. 381-419. [doi:10.1016/j.jmoneco.2004.05.007](https://doi.org/10.1016/j.jmoneco.2004.05.007)
- [37] S. Kim, "Do Monetary Policy Shocks Matter in the G-7 Countries? Using Common Identifying Assumptions about Monetary Policy across Countries," *Journal of International Economics*, Vol. 48, No. 2, 1999, pp. 387-412. [doi:10.1016/S0022-1996\(98\)00052-X](https://doi.org/10.1016/S0022-1996(98)00052-X)