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Monetary Policy, Output Composition and the Great Moderation

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Abstract

This paper shows how US monetary policy contributed to the drop in the volatility of US output fluctuations and to the decoupling of household investment from the business cycle. I estimate a model of household investment, an aggregate of non durable consumption and corporate sector investment, inflation and a short-term interest rate. Subsets of the models' parameters can vary along independent Markov Switching processes.

A specific form of switches in the monetary policy regimes, i.e. changes in the size of monetary policy shocks, affect both the correlation between output components and their volatility. A regime of high volatility in monetary policy shocks, that spanned from 1970 to 1975 and from 1979 to 1984 is characterized by large monetary policy shocks contributions to GDP components and by a high correlation of household investment to the business cycle. This contrasts with the 1960's, the 1976 to 1979 period and the post 1984 era where monetary policy shocks have little impact on the fluctuations of real output.

Keywords: business cycle volatility, monetary policy, Markov Switching VAR

JEL classification: E3 E5

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1. Introduction

This paper investigates the role of monetary policy in two related aspects of the great moderation: the mid 1980's decline of US output volatility and the decoupling of household investment expenditure from the business cycle. This decoupling, which was particularly obvious during the 2001 recession, sharply contrasts with the high degree of co-movement between GDP components that prevailed before the mid-1980's.

Why has household investment become less correlated to other GDP components and why does it matter for assessing the role of monetary policy in the reduction of US output volatility? Precisely, as this paper shows, because the monetary policy instability that characterizes the fifteen years prior to the great moderation amplified the fluctuations of GDP components as well as their co-movement. This co-movement of two GDP components implies, ceteris paribus, a higher variance of GDP.

These results resolve an ongoing controversy on the role of monetary policy in the great moderation of output fluctuations. A widely held view is that the reaction function of the Federal Reserve changed when Paul Volcker became Chairman of the FOMC (see for instance, Clarida, Galì and Gertler, 2000, Cogley and Sargent, 2005a, Lubik and Schorfheide, 2004, Boivin, 2006, and many others).[1] In essence, the response of the short-term real interest rates to inflation increased, became positive and therefore stabilizing for nominal as well as for real fluctuations. However, changes in the coefficients of the central bank reaction function have little impact on the magnitude of output fluctuations. Lubik and Schorfheide (2004) find that, in the indeterminacy regime that best characterizes the data of the 1970's, the sunspot shocks raise the variance of inflation and the nominal interest rate, but have hardly any impact on the variance of output. Stock and Watson (2003), who simulate post 1984 monetary policy rules in the 1970's, conclude that monetary policy "had the major impact of bringing inflation under control but happened not to have had a large effect on the cyclical volatility of output". Moreover, several econometric tests have failed to reject stability in the coefficients of the monetary policy rule or the transmission of monetary policy.[2][3]

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[1] See also the account of changes in the policy makers views on the controlability of inflation and the desirability of disinflation in Romer and Romer (2002), DeLong (1997, 2003) and Cogley and Sargent (2005b).

[2] Bernanke and Mihov (1998) is an early example. Among the more recent contributions, Canova and Gambeti (2005) showed that, although there is some evidence of coefficient instability in the 1979-1982 period, the response of interest rates to inflation in the 1990's is not clearly supperior to 1 nor to the esponse estimated in the 1970's. They also show that the monetary policy transmission has changed little over the last 40 years. See also Leeper and Zha (2003) and Canova (2005).

[3] Sims and Zha (2006) attempt to reconcile the conflicting econometric tests on changes in the "Taylor" coefficient. They come to the view that one can find evidence of changes in the coefficients of the Federal Reserve reaction function if one is looking for such changes. Correspondinly, they stress that specifications where time variation is limited to the magnitude of the shocks hitting the economy have a much better fit of the data.

Against this background, I revisit the role of monetary policy in the mid-1980's drop in output volatility using a two sector Markov Switching VAR of the US business cycle. The two sectors are household investment, i.e. the sum of durable consumption and residential investment, and the rest of domestic private sector demand (DPD, thereafter), i.e. the sum of non-durable consumption and corporate investment. This decomposition of output is warranted because the drop of GDP variance is essentially the drop of the variance of DPD, while net exports and government consumption play hardly any role, and the drop in the variance of DPD is owed largely to the decoupling of household investment from the business cycle. The Markov Switching VAR estimation procedure that Sims, Waggoner and Zha (2006) developed is then used to identify when the model's parameters changed and which of these changes influenced the covariance of the two DPD components included in the model.

I find that the change in the size of monetary policy shocks is the only pattern of time variation that has an impact on both the variance of DPD and the cross-correlation of its sub-components. DPD variance has been very high in regimes of high volatility of monetary policy shocks that have taken place from 1970 to 1975 and from 1979 to 1982, and lower in the 1960s and between 1976 and 1979 and from 1985 to 2006. The regime of highly volatile monetary policy shocks is one where these shocks have taken the business cycle in and out of the four recessions that took place between 1969 and 1982. This contrasts sharply with the 1991 and especially with the 2001 recession, during which the monetary policy shocks did not amplify the slowdown. Smaller monetary policy shocks reduce the relative importance of a source of business cycle fluctuations that has, over the last 50 years, moved household investment, household consumption and corporate sector investments together.

These results bring a new perspective on the role of monetary policy in the great moderation. They can be seen as an illustration of the impact of a particularly erratic monetary policy that largely conforms to the narrative analysis of monetary policy by Romer and Romer (2002). They stress that "in the 1970's ... monetary policy was used aggressively to support rapid economic growth... inflation became a problem and periodic severe recessions were necessary to keep inflation under check." The amplitude of unsystematic monetary policy during the early to mid-seventies and, as this paper shows, in the first years of Paul Volcker's FOMC Chairmanship, added considerable real volatility. The reduced scale of the unsystematic monetary policy under Greenspan, i.e. not deviating from a systematic "leaning against the wind" interest rate rule, implies much smaller contributions of monetary shocks to the volatility of GDP growth, in particular around the recessions of 1991 and 2001.

These conclusions differ from the view that monetary policy had little effects on the scale of output fluctuations for essentially three reasons. First, the model focuses on a decomposition of output that is highly relevant for the understanding of the great moderation. Most of the literature relies on one sector models (the above references and Boivin and Giannoni, 2006, Benati, 2006, Benati and Mumtaz, 2007, Blinder and Reis, 2005, Stock and Watson, 2002, 2003, Gordon, 2005, among others). A notable exception is Justiniano and Primiceri (2006), who analyze the great moderation using DGSE models that disentangle consumption from investment. In line with the state of the art estimated DSGE models, they use an investment measure that aggregates corporate and household investment. This paper focuses on another decomposition of demand because household investment have been much less correlated to either corporate investment or non durable consumption from 1985 to 2006 than between 1965 and 1984.[4]

This decoupling is likely to reflect structural changes in the financing of the household sector. The required downpayment to issue mortgages has fallen steadily since 1976 and an increasing number of households have used mortgage refinancing as a source of cash in the event of a decline in [long-term] interest rates (Canner et al., 2002). To the extent that long-term interest rates are correlated to the business cycle, more households have become able to shield their expenditure plans from business cycle induced reduction in income (Brender and Pisani, 2005).[5] Turning to automobiles, an important part of durable consumption, Ramey and Vine (2004) found that the volatility of inventories has dropped in line with in the persistence of car sales, which is itself driven by changes in the dynamics of interest rates.[6] Effectively, the last two US recessions, in 1991 and 2001,[7] are characterized by an increase in the household leverage, which contrasts sharply with the four US recessions previous to these two and may have helped dampen the business cycle. For all these reasons, I estimate a model that decomposes output to allow an explicit description of household investment and compare its dynamics to the dynamics of other expenditure components of GDP.

Second, the analysis presented in this paper estimates rather than imposes the dates of changes in monetary policy regimes. The Sims, Waggoner and Zha (2006) estimation procedure gives the possibility to test for regimes switches regarding either systematic or unsystematic monetary policy along Markov processes that are independent from the ones

[4]The correlation between the contribution of corporate investment and the contribution of durable consumption and residential investment to the growth rate of US GDP was 0.46 between 1965 Q1 and 1984 Q4. It was -0.14 between 1985 Q1 and 2006 Q3. Household investment has also become markedly less correlated to non-durable and services consumption while the correlation betwen corporate investment and non durable and services consumption has not changed significantly from the two decades before 1984 to the post 1984 period.

[5]Campbell and Hercowitz (2006), Cecchetti et al. (2005), Dynan et al. (2006), and Fisher and Gervais (2006) have also pointed to the broader availability of financial instruments as a cause of macroeconomic stability.

[6]Herrera and Pesavento (2004) confirm a link between the drop in the volatility of inventories and a reduction in the volatility of manufacturing sales.

[7]The 2001 recession was actually the first time since 1947 when residitial investment kept a positive contribution to GDP growth during a recession.

that govern potential changes in the variance of non policy shocks and the response of each variable of the model to these shocks. The estimation lumps together some of the 1970's with a large period of Volcker Chairmanship of the FOMC as one regime of highly volatile monetary policy shocks. The estimated sub-samples of monetary policy instability give the model a much more precise account of the impact of monetary instability on output fluctuations than the common practise of considering all the observations before or after 1979 or 1982 as one homogenous regime. In this respect, the results confirm the importance of abandoning the idea of once-and-for-all non stochastic regime switches (Sims and Zha, 2006).

Third, the impact of monetary policy on output fluctuations is not limited to changes in the coefficients of the policy rule and in particular to what has become refered to the "Taylor" coefficient, i.e. the response of the interest rate to inflation. While both changes in the coefficients in the policy rule and changes in the size of monetary policy shocks are explored, only the latter has a large effect on the variance and covariance of GDP components.

The paper goes as follows. Section 2 describes the changes in the covariance structure of the expenditure components that add up to GDP. Section 3 briefly presents the Markov Switching VAR model and the form of time variation that it can test. Section 4 presents the timing of switches in the models parameters and how they impact the covariance structure of GDP components. Section 5 summarizes the main results and concludes.

2. Covariances of GDP components and the great moderation

2.1. Changes in correlations of GDP components

There is already a dense literature on the great moderation of US nominal and real business cycle volatility (see the survey by Stock and Watson, 2002 and more recent references in Justiniano and Primiceri, 2006). Thanks to this literature, we know that the drop in real volatility is very much shared across the different expenditure components that add up to GDP and that it all starts in 1984.

Few papers also highlight that, beyond single components' volatility, the correlation and hence the covariance of some specific component has contributed to the fall of GDP growth variance. These changes in correlation are important for two reasons. First, they are suggestive of new endogenous adjustments of GDP components and thereby may lead us to the formulation of structural interpretation of the great moderation.[8] Second, they imply that one sector models could miss an essential characteristic of the greater stability of

[8] To some extent, because residuals reflect our "ignorance", many economists consider the Good Luck explanation of the Great Moderation as deeply unsatisfactory.

output fluctuations.

Early on, Kahn et al. (2003) reported the change in the covariance of inventories, investment and sales. This evolution can be due to the impact of IT on the supply side of inventories (McConnel and Perez-Quiros, 2000), to the impact of financial innovation on the demand of durable goods or again to better monetary policy (Ramey and Vine, 2006). More recently, Irvine and Schuh (2005), who use a supply side decomposition of output, stress that a large share of the output volatility decline is due to a reduction of the co-movement of sectorial business cycles. This result lead them to reject the Good Luck hypothesis. Galì and Gambetti (2007) stress the same intuition that, had good luck been prominent in the great moderation, we should not observe changes in the correlation of output components.

Finally, Dynan et al (2005) show that savings and income have become more correlated than they were, an evolution which should provide some form of automatic stabilization. This, again, could result from the improved completeness of the financial instruments available to US households.

In the following, I therefore propose to show whether and how the variance and the covariance of GDP main components have changed over time. Following the analysis reported in the first section of Stock and Watson (2002), I opt for the simplest form of time variation. I compare covariances across sub-samples and before and after 1984.[9]

2.2. The covariance matrix of DPD components contributions to the growth rate of GDP

My analysis of the (co)variance deviates slightly from Stock and Watson (2002) and others in a small and but nevertheless useful respect. Given that GDP growth is a weighted average of the growth rate of GDP components, I compute the full covariance matrix of the GDP growth contributions of GDP components. The contributions are directly taken from NIPA Table 1.1.2 published by the Bureau of Economic Analysis.

To start with, I focus on six components of GDP: consumption of durable goods, consumption of non-durable goods, consumption of services, fixed non-residential investment, residential investment and changes in inventories. These components, whose sum can be labelled DPD, are the most relevant because, as shown in Table 1, the variances and covariances involving net exports and government consumption had little impact on the post-1984 drop in the volatility of GDP growth. Actually, from 1965-1984 to 1985-2007, the variance of the DPD contribution to GDP growth has dropped more than the variance of GDP growth.

[9] Actually, McConnel and Perez-Quiros (2000) estimated 1984 as the date of the break in the volatility of US GDP growth. Stock and Watson (2002) confirmed that the fall in volatility is of a discrete nature and that its most likely date is indeed 1984.

The second panel of the table reports two summary statistics of the covariance matrix of these six components for the full post 1947 sample, and three sub-samples of about two decades each: 1976-1965, 1965-1984 and 1985-2006. Hence the post 1984 era can be compared to samples of similar length. The first summary statistic is the trace of the covariance matrix which summarizes the change in volatility of each GDP component taken in isolation. The second is the sum of the off-diagonal elements of the co-variance matrix, which allows us to assess the importance of co-movements in GDP components in the variance of GDP growth across samples.[10]

I do this decomposition both for contributions to quarter on quarter annualized GDP growth rates (in the top panel) and for their fluctuations of periodicity comprised between 6 and 32 quarters as extracted by a band pass filter (in the bottom panel).

First, Table 1 reveals that the great moderation is indeed remarkable. The variance of the GDP growth rate is divided by five, from about 20 % of annualized qoq GDP growth rate in the second sub-sample (Column c) to 4 % in the third sub-sample (column d). The volatility of the DPD contribution drops by an even larger magnitude, which is why the rest of this paper will abstract from net exports and government consumption.[11]

Second, the covariance terms in the variance of DPD fall from 11 %, i.e. nearly half of the variance DPD growth variance in the 1965-1984 sample to zero in the post 1985 sample. And the contribution of co-variances to the drop in variance after 1984 is even larger, in relative terms, at business cycle frequencies.

Taking a closer look at the data indicates that not all the 15 bilateral cross-correlations between the 6 contributions to the growth rate of GDP have dropped over time. The bulk of the drop in the covariances after 1984 comes from the fall in the correlation between "household investments", i.e. durable goods consumption plus residential investment (fh_t thereafter) and the rest of DPD ($ffch_t$, thereafter). The time series of these two sub-aggregate of GDP/DPD are reported in the top panels of Figure 1 and their variance and covariance are given in Table 2. Both series have had smaller fluctuations after the mid-1980's. In particular, fh_t has dropped much less in the two recessions of the post-1984 sample than in ones preceding it (see Figure 1). US households have increased their leverage through out the last two decades (Report on the Survey of Consumer Finance, Federal Reserve Monthly Bulletin 2006) including in 1991 and in 2001. This evolution may have dampened macroeconomic fluctuations in the sense that household investment becomes less dependent on their current income (Brender and Pisani, 2005, Campbell and Hercowitz,

[10] To fix ideas on the role of correlations and covariances in the variance of an aggregate, we have $Var(x+y) = Var(x) + Var(y) + 2Cov(x,y)$ and $Cov(x,y) = Cor(x,y) \times \sqrt{Var(x) \times Var(y)}$.

[11] The variance of the aggregate of net exports and government consumption also drops after 1984. However, its covariance with DPD becomes much less negative. This is why, altogether, net exports and government consumption explain little in the drop of GDP variance around 1984.

2004). Effectively, the correlation between $ffch_t$ and fh_t has become slightly negative and the covariance of household investment expenditure and the rest of DPD has stopped to contribute positively to the variance of GDP.

To sum up, the great moderation comes from a more stable DPD and the drop in the correlation of two specific sub-aggregates of DPD accounts for a sizeable fraction of the output stabilization.[12] This evolution may be related to transformations of the US financial system (Dynan et al, 2005, Fisher and Gervais, 2006, Campbell and Hercowitz, 2004 and references therein) and their effects on household's expenditure.

It is important to stress that this sectorial decomposition of output is not the one usually chosen to estimate DSGE models. Christiano, Eichenbaum and Evans (2005), Smets and Wouters (2007) and their numerous followers bundle together corporate and household investment as "investment" in the model. However, the correlation between the corporate and houshold investment has dropped dramatically during the last three decades (see footnote 4). Because this correlation is a constitutive feature of the great moderation, it could be desirable to estimate a time varying parameters DSGE model that singles out household investment to analyze the great moderation.[13] Rather than addressing this ample task, the following sections of the paper present the estimates of reduced-form models with time varying parameters in the spirit of Cogley and Sargent (2005a), Canova and Gambetti (2006), Primiceri (2005), Sims and Zha (2006) among many others. These reduced-form models have the advantage of being free of specific functional form assumptions necessary to estimate DSGE models.

3. A Markov Switching VAR evidence on the origin of the great moderation

3.1. The baseline model

The baseline VAR used for the analyzis models a vector of four endogenous variables:

$$y_t' = (ffch_t, fh_t, \pi_t, i_t) \tag{1}$$

[12] Stock and Watson (2005) showed that the drop of the variance of GDP growth is an international phenomenon. Unfortunately, we can't replicate Table 1 for other countries because the quarterly national accounts usually do not decompose investment into residential and non-residential. Moreover, quarterly national accounts data are usually not available before 1980. Partial evidence, based on shorter time series of consumption and investment show some decline in the 1990's of the correlation between the two main components of GDP in the UK, Australia, Italy, Japan, Spain and Belgium, but neither in France nor in the Netherlands. I leave the systematic study of international data for future research. See also Cecchetti et al. (2006) for a cross-country assessment of the effects of improvements in the conduct of monetary policy.

[13] Interestingly, two recent papers, Calza et al (2006) and Iacoviello and Neri (2007), single out residential investment within estimated constant parameters DSGE models. See also the discussion in Monacelli (2006).

1) $ffch_t$ is the sum of the contributions to the GDP growth rate of the consumption of non durable goods, consumption of services, non-residential fixed investment and change in inventories.

2) fh_t, household investment, is the sum of the contributions to the GDP growth rate of durable consumption and residential investment,

3) π_t is the inflation rate of the GDP deflator,

4) i_t is the interest rate on federal funds.

While the small number of variables may limit our ability to identify exogenous monetary policy shock, this model is preferred as a baseline in order to maximize the chances to detect regime switches in the data. I however checked that the main results hold in models that contain additional variables, including monetary aggregates, credit aggregates and commodity prices.

The model is estimated over the 1960-2006 sample with quarterly data.[14] The identification of monetary policy shocks is recursive as in Christiano, Eichenbaum and Evans (1999). In particular, the central bank information set comprises contemporaneous developments in the other variables of the model. The three other shocks, which are not given any structural interpretation, are also orthogonalized via a Cholesky decomposition of the VAR innovations.

One important shortcoming of analyzing the dynamics of y_t' with a standard, constant parameters, VAR model is that it would imply that the variables have a constant covariance matrix. It would therefore be totally at odd with the evidence of a decline in the variance of US output. This is why we turn to the recently developed estimation procedure of Sims, Waggoner and Zha (2006).[15]

3.2. The Sims, Waggoner and Zha (SWZ) methodology

SWZ have developed a Bayesian estimation of VAR models where subsets of parameters of the VAR evolve along independent Markov Switching processes. This section gives a brief overview of their approach. For a comprehensive presentation, the interested reader should report to SWZ and the seminal contributions by Hamilton (1989, 1994) and Kim and Nelson (1999).

Following SWZ, we assume that the time series of interest can be modelled as a VAR which parameters depend on unobserved Markov Switching processes. The model can be

[14] The time series where obtained from the BEA web site and, for the interest rate, monetary, credit and the index of commodity prices, from HAVER.

[15] Another possibility would be to fit a VAR with drifting coefficients and variance, as performed by Canova and Gambeti (2006), Cogley and Sargent (2005a) and Primiceri (2005). A systematic comparison of the Markov Switching VARs and the VAR with drifting parameters would, however, goes beyond the scope of this paper.

described as

$$y_t^{'}A_0(s_t) = \sum_{i=1}^{p} y_{t-i}^{'}A_i(s_t) + \varepsilon_t^{'}\Xi^{-1}(s_t)1 \text{ for } \leq t \leq T \tag{2}$$

where

p is the lag length,

y_t is an n dimensional vector of endogenous variables (e.g. (1)),

each observation belongs to one of k states s_t with some probability and for each of the k states of the model, $A(k)$ is invertible and $A_i(k)$ are $n \times n$ matrices and $\Xi^{-1}(k)$ is an $n \times n$ diagonal matrix.

Q is a Markov transition matrix of which the element $q_{i,j}$ gives the probability that s_t is in state i and s_{t-1}in state j.

All $q_{i,j} \geq 0$ and $\sum_j q_{i,j} = 1$.

3.2.1. Restrictions on the time variation and the transition probability matrix

The pattern of time variation as formulated in (2) is so general that it may be impossible to estimate for lack of degrees of freedom. Without restrictions on time variation, a VAR of n macroeconomic variables with p lags and k states would imply the estimation of $k \times (n \times (n \times p + 1) + (n \times (n-1)/2))$ parameters for the VAR plus $k \times (k-1)$ free elements in the matrix of cross-states transition probabilities Q.[16] This is why SWZ introduced restrictions on the time variation patterns allowed in the model.

First, the time variation of the parameters is constrained to the long run effects of variable j on variable i, though the lag structure of the impact is similar across states. This means that each additional state add only $n \times n$ more parameters on top of the $(n \times (n \times p + 1) + (n \times (n-1)/2))$ that are estimated in the constant parameter VAR.

Second, the transition probability matrix Q is the Kronecker product of κ sub-transition probability matrices Q^k that are associated to independent Markov processes. Each of these will, eventually, govern changes in a subset of VAR parameters. We have

$$Q = Q^1 \otimes ... \otimes Q^{\kappa}$$

where $\otimes$ is the Kronecker product.

Such a structure for Q greatly reduces the number of transition probabilities to be estimated. In the case of our benchmark model, a 4 equations VAR, we allow the variance of each of the four shocks of the model to take one of two values between 1960 and 2006. In

[16] To fix ideas, a 4 variables VAR with 4 lags and 12 regimes would imply that 1020 free parameters have to be estimated.

other words, we associate an independent two states Markov process to the variance of each shock. This amounts to allowing for $2^4 = 16$ different states. An unrestricted transition probability matrix Q would require the estimation of $16 \times (16 - 1) = 240$ free parameters. Instead, the composition of four 2×2 transition probability matrices involve the estimation of 8 free parameters.[17]

This formalization of the transition across regimes is very well suited for our purpose because subsets of the parameters of a time series model can change value along independent Markov processes. Hence changes in the coefficients or the error term variance of each of the model's equations can evolve depending on a specific Markov process. This is convenient because each subset of parameters may pertain to a specific economic hypothesis. The main advantage of this methodology over the one used by Sims and Zha (2006) is the ability to focus on particular parameters of the model and check whether the data point to regime switching for these parameters independently from regime switching that would signal changes of other parameters of the model.

For example, consider using a standard VAR of output growth, inflation and the short-term interest rate to assess the relative importance of "Good Luck, Good Practices and Good Policies". A first Markov Process would be used to model "Good Luck" as potential changes in the size of the shocks affecting output and inflation. A second Markov Process would be associated to "Good Practices", i.e. to changes in the propagation of shocks to the economy, i.e. the coefficients of the output growth and the inflation equations. A third Markov Process would pertain to "Good Policies", changes in the coefficients of the central bank interest rate rule.

Provided the estimation spots 2 regimes for each of the three Markov processes, we now would have characterized the sample period by $2\hat{}3 = 8$ regimes. However, we can more easily assess which one of the changes in the three subsets of parameters has indeed happened in the mid-1980's and whether this change of parameter translate into a sizeable impact on the volatility of either inflation or GDP growth. This approach can actually be taken a step further allowing for instance the dynamics of inflation to change at a different date than the dynamics of output growth. This would imply testing for altogether 16 states characterizing the VAR parameters for the sample under review, though identifying the dates of regime shifts separately for each subset of parameters. This procedure is clearly more tractable than the one consisting of allowing for 16 states where all parameters can change and then identifying ex post which states correspond to this or that subset of parameters.

[17] The set up of SWZ further allows one to introduce linear restrictions on the elements of the transition probability matrices Q^{κ}.A typical application would be a zero restrictions to impose absorbing states. See SWZ section 2.

3.2.2. Estimation

First, the prior on the parameters θ, which does not vary across states, is similar to the one introduced in Sims and Zha (1998), i.e. it is a generalization of Litterman's prior. The prior distribution of the VAR coefficients is normal while the prior distribution of the variances of the shocks is a gamma distribution.[18] The prior for the elements of the transition probability have a Dirilichet distribution (i.e. a convenient multidimensional Binomial distribution). The diagonal elements of the transition probability are much larger than the off diagonal elements to reflect the view that the economy tends to stay in one state once it is in that state.[19]

The formulation of the prior uses the independence of the parameters of the model θ, the transition probability Q and the an initial guess that at time 0 every states has an equal probability $1/h$. The posterior distribution of θ, conditional on the data, the sequence of states and the transition probability matrix across states is estimated by sampling sequentially from the conditional distribution of the parameters similar to a Gibbs sampler (see SWZ section 4).

Given that the posteriors have unknown shapes the estimation is very computationally intensive. However, SWZ have developed executables in C that can easily be implemented.[20] The estimation of the mode of the posterior distribution takes up to one hour on a standard PC and the estimation of the marginal data density up to a couple of days for most of the models reported in this paper.

4. Results

4.1. Model selection

I estimate several versions of the model which differ in terms of the set of parameters allowed to take different values across states of a Markov switching process and the number of states these processes can have. Given that the estimation allows for large combinations of time variation (actually twice the number of equations independent Markov Switching processes) it is important to set a criterion for accepting or rejecting the relevance of each of

[18] The models are estimated with the same hyper parameters of the priors as Sims, Waggoner and Zha (1998), i.e., in the notation of Sims and Zha (1998), $\lambda_0 = 1.0$, $\lambda_1 = 1.0$, $\lambda_2 = 1.0$, $\lambda_3 = 1.2$, $\lambda_4 = 0.1$, $\mu_5 = 1.0$ and $\mu_6 = 1.0$.

[19] Specifically, the prior distribution of the diagonal elements Q^k has its mode at 0.85. In the two states case, this implies that the prior value for the off diagonal elements of Q^k is 0.15. In the cases where three states are allowed for in the estimation, we rule out transitions from state 1 to state 3 and from state 3 to state 1 ($q_{13} = q_{31} = 0$). The prior mean for the transition probability from state 1 to state 2 and from state 3 to state 2 is 0.15 and from state 2 to either state 1 or state 3 is 0.075.

[20] Programs can be downloaded from Tao Zha's webpage:
http://home.earthlink.net/~tzha_center/

the time variation parts of the model. My criterion is to allow for time variation only when each of the states has probability 1 for at least some time in the sample.

This criterion has effectively restricted the variance of each shock to take up to three states and the coefficients up to two states. Additional states appear unlikely in the sense that they typically never have a high or even positive probability for the sample period. The fit of the different versions of the model is reported in Table 3.

The best fit is found for a variance only change model that allows for three different states for the variance of the monetary policy shocks, two states for the inflation shocks and 3 that govern jointly the two shocks of the first two equations of the model ($ffch_t$ and fh_t). The Ξ matrix therefore takes up to 18 different values as the state of the model changes through out the 1960-2006 sample.

Second, among models that admit changes in their coefficients, i.e. in A_0 and $A_1 ... A_4$, the only one that improves the fit markedly with respect to the constant parameters model allows for two states in the coefficients of the interest rate equation. Moreover, allowing for changes in coefficients in more than one equation dramatically worsens the fit of the model.

Third, models that combine two states for the coefficients of the interest rate equation and, in addition, allow for changes in the variance of the model's shocks do relatively well, even if not as well as the best fitting model.

The most surprising aspect of these results is that the only equation for which coefficients may have changed is the monetary policy rule.[21] The major transformations of the US economy (increased openness, improved completeness of financial markets, the rise of IT technologies and other forms of technical changes), as well as the great moderation itself would naturally lead one to expect more changes in the propagation of shocks since 1960. The results may be taken as an indication that these changes are gradual in nature and therefore hard to capture by models with "abrupt" Markov Switching processes.[22]

In principle, these results are also subject to the Benati and Surico (2006) critic, i.e. the risk that VARs estimate heteroscedasticity of shocks even in cases where the data generating process admits a break in the coefficients of the policy rule. However, we show that the Markov Switching VAR can indeed capture changes in the coefficients of the policy rule though not the ones related to the Taylor principle.[23]

[21] This is also true in versions of the VAR that have more variables including, credit, money or the price of commodities.

[22] Evidence of such changes were indeed obtained with VAR with drifting coefficients by Cogley and Sargent (2005) and Primiceri (2006) but not by Canova and Gambetti (2006).

[23] See also Leeper and Zha (2001) for a critical assessment of the impact of the Taylor principle on the stability of macroeconomic models.

4.2. The constant parameter VAR benchmark

In the constant VAR model, which actually sets the prior for the estimates of the time varying models (Sims, Waggoner and Zha, 2006), the impulse responses of the interest rate and the effects of the monetary policy shocks are standard. The interest rate increases following positive shocks to either of the two GDP components and following positive inflation shocks. The model's account of the transmission mechanism is also standard. A monetary policy tightening triggers a temporary decline in the two demand components and a somewhat delayed decline in inflation.[24]

However, the time series of the shocks estimated in this constant parameter model (Figure 2) show a sharp increase in their variance for the early 1970's and the early 1990's. There is also some milder evidence of heteroscedasticity of the three other shocks, which all tend to have a lower variance after 1990. This first evidence of time variation in the size of the shocks is then analyzed formally in the following sections.

4.3. The timing of regime switches

In this section, I describe the timing of regime switches for four cases of typical specification for the time variation that affect subsets of the VAR parameters.

4.3.1. Case 1: 2 states for the variance of each equation's shock

Let's first assume that the variance of each shock can take one of two values and that the timing of this change in values is independent across equations. I therefore have potentially four independent changes in regimes along the sample period, i.e. we can have up to sixteen different states, each having a specific Ξ. Although this model does not have the best fit, it provides a good support to illustrate the effects of time variation in this class of models.[25]

Figure 3 reports the time series of the probabilities of the high volatility regime for each of the equations' orthogonalized residuals.[26] Two observations are in order. First, these estimates confirm that the volatility of the shocks changes in the early to mid-1980s, i.e. when Kim and Nelson (1999), McConnel and Perez-Quiros (2000) and Stock and Watson (2002) date the great moderation. The shocks affecting our first domestic demand component, inflation and the federal funds rate drop around that time.

[24] The impulse responses are also standard in versions of the model where M1 and the prices of commodities are included. In particular, the shock to the interest rate, which triggers a decline in M1, can be interpreted as a money supply shock.

[25] Sims and Zha (2006) have showed that models that assign independent Markov processes to states of the variance of the structural shocks fit the US data very well. A result that this paper confirms.

[26] The time series of the 4 shocks are very similar to the ones reported in Figure 3.

Second, I notice that the change in the volatility of the shocks to the household investment is dropping only in the early 1990s, and that the shocks affecting the inflation equation and the monetary policy shocks have a higher volatility only between 1970 and 1985, with, for the latter shock, an intermediary period of moderate volatility between 1976 Q2[27] and 1979 Q2. This suggests that the great moderation may partly reflect the end of a specific high volatility episode, that took place in the 1970's and early 1980's and not strictly a secular evolution (as stressed by Blanchard and Simon, 2001). In particular, the high volatility of the monetary policy shock and the shock to the inflation equation covers the period of the four (NBER dated) recessions that took place between 1969 and 1982. It also shows that it is important that each shock can change variance independently from other shocks.

4.3.2. Case 2: Best fit model

Among specifications of changes in the states of the model's variance, the one with the best fit allows for three states for both equation 1 and 2, two states for the variance of the shock hitting the inflation equation and three states for the variance of the monetary policy shocks. The grouping of the time variation for equation 1 and 2 is an information efficient way to economize on parameters. Turning to the Monetary Policy shock variance, allowing for a three regimes greatly improves the fit of the model (Table 3).

The timing of the high volatility regimes is reported in Figure 4. The main change with respect to the previous model is that I now have a regime of moderate volatility of the monetary policy shocks, from 1969 Q2 to 1972, and a high volatility regime which spans from 1973 Q3 to 1976 Q1, from 1979 Q4 to 1982 Q3 and for the last quarter of 1984.

4.3.3. Case 3: Changes in coefficients

Among the specifications allowing for changes in the propagation of shocks, the models that admit two states for the coefficients of the interest rate equation are the only ones that imply a significant improvement in the fit of the model with respect to the constant parameter model or models with variance only changes. For all the other equations of the system, there is little support against the benchmark of no changes in the coefficients. This finding partially confirm the conclusions of several previous studies that failed to reject instability in the VAR coefficients.[28]

The first version of this model is one where I allow for 2 states for the coefficients in the interest rate equation with constant variances. This specification is interesting to report

[27] Dates of regime switching are given by the first observation when the probability of being in a regime is supperior to 0.5.

[28] See in particular, Bernanke and Mihov (1998), Canova (2005), Canova and Gambetti (2006) and Sims and Zha (2006)

even if it does not have the best fit because some, like Benati and Surico (2006) have argued that VAR estimates tend to confuse changes in variances for what are actually changes in coefficients of the reaction function.

Interestingly, the dates of the changes in coefficients of the interest rate equation coincide with the dates estimated for a change in the variance of the monetary policy shock in the case where these could change only for two states. The reaction function coefficient changed from 1969 Q3 to 1975 Q4 and from 1979 Q4 to1985 Q4. The main change in the coefficients is not so much related to the "Taylor principle" as to the reaction of the interest rate to the household investment and to the size of the monetary policy shocks.

These results point to a timing of change in the central bank's behavior that is very different from the conclusions stressed in the literature so far (Clarida et al., 2000, Cogley and Sargent, 2005a, Lubik and Schorfheide, 2004 and many others). First, it puts together in one regime the period when inflation took off and the Volker disinflation of the early 1980's. The model therefore lumps together some of the Burns and most of the Volker era as a distinctive regime that contrasts with the rest of the last half century. Perhaps more importantly the nature of the change in the systemic part of policy seems more related to changes in the mix of response to different components of demand and to the variance of the monetary policy shock around the policy rule than to the reaction of the interest rate to inflation.[29]

For the first part of the 1970's and the first half of the 1980's, the federal funds rate is estimated to react to household investment four times more than it responds to the rest of domestic demand (Table 4 upper panel). Outside this regime, the interest rate response to household investment becomes slightly negative, the response to the rest of domestic demand and to inflation increases slightly in the short run but hardly in the long run given that interest rates are estimated to be less autocorrelated in this other regime. The second sizable difference across regimes is that the standard deviation of monetary policy shocks are nearly five times as large in the former regime than in the latter. It therefore appears that, to some extent, the change in regime of the coefficients actually accounts for a change in the amplitude of non-systematic monetary policy shocks.[30] This result reinforces the case for the importance of changes in the size of monetary policy shocks during this sample period.

[29] This second change is actually consistent with the variance-only-change versions of the model and it drives most of the result that brings along the change in the share of the variance of demand that is due to interest rate shocks. This was clear in simulations (not reporte for the sake of space) where the impact of the shocks was rescaled to analyse the sole effects of the change in coefficients.

[30] In the model's specification, the strucutral shocks are normalized to a variance of one in the case where Ξ is constant accross regimes so that the coefficients measuring the impact of shocks on the variables belongs to the set of coefficients that evolve across states. Therefore, the relative size of the effects of these shocks can change change accross regimes together with all the coefficients of a given equation.

4.3.4. Case 4: The Full Monty

A natural last step is to estimate models where both the variance of the shocks and the coefficients of the model can change. One version of these models combines three states for the variance of the first two shocks, two states for the variance of the inflation equation shock, two states for the monetary policy shock and two states for the coefficients of the interest rate rule. The fit of this model slightly under-performs the fit of the variance only changes model presented as Case 2.

To a large extent, the timing of regime switches in this version of the model corresponds to a combination of case 2 and case 3 presented above. The coefficients of the monetary policy rule change consistently from 1969 Q3 to 1975 Q4 and from 1979 Q4 to1985 Q4 with respect to their value for the rest of the sample period (see the fourth panel of Figure 5 and the bottom panel of Table 4). Turning to the variance of the monetary policy shocks, the estimates put a high probability of a higher variance regime from 1960Q1 to 1960 Q4 and from 1978 Q4 to 1982 Q3 than for the rest of the sample period. The variance of the other shocks of the model change at identical dates to the ones estimated for case 3.

Altogether, as illustrated by these four typical specifications, there is ample evidence of time variation in the parameters of the VAR. More specifically, each shock has changed in scale at different times and the scale of the monetary policy shocks changes has been the largest. There is also some evidence of changes in the coefficients, though, only for the monetary policy rule. Moreover, an important aspect of this regime switch is the change in the impact of the monetary policy shock on the interest rate. It is therefore in part equivalent to versions of the model where only the variance of the shocks can change over time. Hence, a consistent result across all specifications of time variation that I have explored is that unsytematic monetary policy has been more erratic for the first part of the 1970's and for a few years after 1979 from what it was uniformly during the 1960's, the post 1985 period and from 1976 to 1979.

4.4. Regime switches and the variance of output

I can now use the models with time varying parameters to describe the evolution od output volatility. I compute the unconditional variance, the correlation of the variables and variance decompositions for each of the states and analyze their evolution as given by the probabilities of being in each state.[31]

[31] The results reported in this section and the next are based on the estimates obtained for the case 1 form of time variation, i.e. when each shocks can be in one of two states. Results for either case 2 or case 4, which is itself a generalization of case 3, are essentially similar. Some of these results are presented in appendix tables A1 and A2.

Figure 6 reports the standard deviation of $ffch_t + fh_t$, and the correlation of $ffch_t$ and fh_t, as implied by the changing states of the VARs parameters. These time series are weighted averages of these statistics across states where the weights are the probabilities of being in each state.

The time varying VAR captures the great moderation of output fluctuations quite well. The standard deviation of DPD declines from a peak of nearly 5.0 percent in the late 1970's to as low as 2.5 % in the early 1990's. The model also shows a sizeable decline in the correlation between household investment and the rest of DPD in the early 1980's.

Figure 6 reports the evolution of domestic demand volatility and cross components correlation, holding the volatility of the monetary policy component at the value it has in the high volatility regime. About half the drop in output volatility and all of the drop in cross-components correlation recovered by the model are associated to changes in the magnitude of the monetary policy shocks.

How did monetary policy contribute to the great moderation? The model's answer to this question is that monetary policy shocks have spurred the real fluctuations of the early 1970's and early 1980's. And, because monetary policy shocks are a source of fluctations that moves GDP components in the same direction, regimes where the variance of these shocks is high are periods when the correlation between DPD components is higher. In facts, as can be seen in Figure 1, the four recessions between 1969 and 1982 are characterized by the joint decline of $ffch_t$ and fh_t.

This interpretation is reinforced by the comparison of the forecast error decomposition across states (Table 5). In the regimes of high volatility of the monetary policy shocks, the latter explain up to 44 and 53 % of the variance of the $ffch_t$ and fh_t at horizon 8 to 16 quarters.[32] This is much more than what is estimated in the constant parameter VAR model (see upper panel of Table 4, that averages all regimes) and even more than in the pre-1970's post 1985 regime, where monetary policy shocks have a negligible impact on DPD components. Moreover, it is remarkable that in the low volatility regime, most of the variance of the monetary policy instrument can be traced back to developments in demand and in inflation. In other words, monetary policy shocks have not been a source of instability except in the regimes where the volatility of monetary policy shocks is high.

There results are robust to a number of changes in the speficication of time variation in the model or the set of variables included in the VAR. The Markov Switching VARs implies a large drop in the variance of DPD during the 1980's and that the changes in the scale of monetary policy shocks are the only ones that led to a drop in the variance and the

[32] These magnitude rise to 63 and 72 % (and to 50 and 59 %) for some of the regimes of high volatility in the policy shocks in case 2 (in case 4). See Table A1 and A2.

correlation of DPD components in the first half of the 1980's.[33]

4.5. Monetary policy and output fluctuations

The contribution of monetary policy shocks to output fluctuations can best be visualized by the historical contribution of these shocks to the two components of DPD included in the model. This is done in Figure 7 which reports the time series of monetary policy shocks and their historical contributions to the federal funds rate, to $ffch$ and to cf, [34] together with the dating of regime shifts as estimated with the SWZ methodology and NBER recessions. The top row of graph reports the timing of the high volatility when two regimes are allowed for. The bottom two graphs show how, between 1969 and 1982, the monetary shocks explain the evolution of both GDP components in and out of the recessions. This contrast sharply with 1991 and 2001, when monetary policy shocks revamp the economy out of the recession but did not contribute much to getting it there in the first place.[35]

I also use the historical decomposition of the VAR to simulate a counterfactual experiment whereby, for the full sample, the Monetary Policy shocks are re-scaled to a "Greenspanian" amplitude. As can be seen in Figure 8, this reduction of monetary policy shocks volatility greatly reduces the volatility of DPD between 1970 and the mid-1980's. Monetary policy shocks had been essentially stimulative between 1970 and 1975. As the result, output appear to have been stimulated twice in 1972 and in 1976 by nearly 2 percent in excess of what it would have been if the policy shocks had the same scale as in the 1960's or under the Chairmanship of Greenspan. The reverse situation occurs from 1978 to 1984. An important aspect of this experiment though, is that the first subsample of monetary policy volatility comprises some observations of "excessive tightening" and the second one, under the Chairmanship of Volker, contains episodes of "excessive loosening" of the monetary policy instrument. These occurences explain why the model outlines these two periods as one regime of excess volatility of unsystematic monetary policy rather than two different regimes with different sets of coefficients.

[33] In the case of the best fit model (case 2), the regime that spans from 1973 to 1975 and from 1979 to 1982, where the variance of monetary policy shocks is the highest, implies a correlation of 0.54 between the two DPD components, while this correlation is only 0.28 in the low volatility regime.

[34] These are actually based on standard fixed parameter VARs, estimated by OLS. The times series of the two GDP components are 4 quarters averages of the contributions in order to improve the readibility of the graph. This transformation of the data does not change the timing of the regimes shifts estimated in the SWZ Markov Switching VARs.

[35] Extending the sample period to include the second half of the 1950s indicates that the monetary policy shock was stimulative during the 1957 recession and did contribute little to the 1960 recession. This reinforces the view that monetary policy had a special role in either triggering or reinforcing the recessions in the 1970's and early 1980's. See also the discussion in Romer and Romer (2002).

4.6. Robustness

The finding that monetary policy shocks have had such a large impact on the business cycle volatility could in principle reflect the influence of other variables omitted in the model. First, inflation of commodity prices shocks are the number one suspect for the turbulences the US economy went through in the 1970's. Second, Sims and Zha (2006) insist on the role of money in the decisions of the Federal Reserve in the 1970's. The omission of money from the model could lead one to confuse monetary policy shocks for what have actually been changes in the federal funds rate driven by money demand shocks.

The model (1) was therefore augmented in turn with the yoy inflation rate of commodities, the yoy growth rate of M1 and with both of these variables. In these estimates, not reported for the sake of space, I allow for changes in the volatility of the shocks affecting the equation of either variables and find indeed two regimes for each of these volatilities.[36] However, this does not affect the timing of the changes in the variance of monetary policy shocks, nor the impact of these changes in the covariance matrix of domestic demand components.

5. Summary and conclusions

An important characteristic of the sharp decline in the US business cycle volatility is the drop in the correlation between household investments, i.e. the sum of residential investment and durable consumption, and the aggregate of corporate investment and non-durable goods and services consumption. I therefore investigate the joint dynamics of these two sub-aggregates of GDP in a time varying Markov Switching VAR model that also includes inflation and the short-term interest rate.

I find strong evidence of higher volatility of all shocks during a period starting with the 1969 recession and ending in the aftermath of the 1982 recession. In particular, the change in variance has been the largest for monetary policy shocks between 1970 and 1975, and from 1979 Q4 to 1984. During these episodes, the variance and the correlation of the two GDP components are much higher than for the rest of the last five decades.

These results point to an important role of monetary policy instability in raising the volatility of GDP in the 1970's and early 1980's. Interestingly these effects of monetary policy are not associated to changes in the coefficients of the monetary policy rule, nor do they square with the usual timing of monetary policy regimes into the terms of the Presidents of the FOMC. In particular, the regime of high monetary policy includes periods of Arthur Burns' Chairmanship and several years of the one of Paul Volcker.

[36] Models with changes in coefficients for these equations were also estimated, but the specifications with changes in the volatility of shocks had a much better fit.

One the one hand, the results are consistent with the view that Alan Greenspan has created little GDP volatility. On the other hand, they also also stress that the 1984 sudden drop in the US business cycle volatility largely reflects the end of a very particular regime of monetary policy. One where monetary policy had such a large influence on the fluctuations of demand components that they were highly correlated to one another, thereby further spurring the variance of GDP. After 1984, the Federal Reserve could be praised for having managed to avoid the return to this type of interest rate instability as the short-term interest rate remained much closer to a "neutral" monetary policy stance. This may be seen as an important achievement of Alan Greenspan.

Three other aspects of the results should be highlighted. First, although the great moderation comes largely from the variance of the VAR shocks, it does not imply that "Good Luck" has been the driving factor of output stabilization. This paper has stressed the role of unsystematic monetary policy which reflects the distance of the interest rate from the estimated monetary policy rule. The paper showed how the drop in scale of non-systematic monetary policy contributed to the mid-1980s drop of the variance and correlation of output components. Second, the results are consistent with the view that it is easier for the central bank to avoid recessions or not having to trigger recessions when inflation expectations are anchored than when they are not. They provide a quantitative assessment of the changes in the conduct of monetary policy described in the narrative analyzis of Romer and Romer (2002).

Finally, I do not find changes in the propagation of shocks. The effects of monetary policy on the two GDP components that I analyze in the model have not changed. This is somewhat surprising given the evolution of financial markets and, for instance, the increasing recourse of households to mortgage refinancing at times of declining interest rates. The Markov Switching VAR simply did not capture changes in the coefficients of demand components equations that would improve the fit of the model to the data. One potential explanation is that Markov Switching regimes are not able to spot gradual changes in the coefficients of the model. It would be useful that future research find out whether time variation models with parameters' drift capture an evolution of GDP components' responses to monetary policy.

References

Ahmed S., An. Levin, and B.-A. Wilson (2004), "Recent U.S. Macroeconomic Stability: Good Policies, Good Practices, or Good Luck?" *Review of Economics and Statistics 86*(3): 824-832.

Baxter, M. and R. King (1999), "Measuring Business Cycles: Approximate Band-Pass Filters For Economic Time Series", *Review of Economics and Statistics 81(4)*, 575-593.

Benati L. and P. Surico (2006): "VAR Analyses of the Great Moderation", mimeo, Bank of England.

Benati L. and H. Mumtaz (2007), "US Evolving Macroeconomic Dynamics: A Structural Investigation", ECB Working Paper 746.

Bernanke, B., and I. Mihov (1998): "Measuring Monetary Policy", *Quarterly Journal of Economics, 113*(3), 869–902.

Blanchard, O., and J. Simon (2001): "The Long and Large Decline in U.S. Output Volatility", *Brookings Papers on Economic Activity*, 135-164.

Blinder A. And R. Reis (2005), "Understanding the Greenspan Standard", Princeton University, CEPS Working Paper No. 114.

Boivin, J. (2006): "Has U.S. Monetary Policy Changed? Evidence from Drifting Coefficients and Real-Time Data," *Journal of Money, Credit and Banking, 38 (5)*, 1149-1174.

Boivin J. and M.P. Giannoni (2006), "Has Monetary Policy Become More Effective?", *The Review of Economics and Statistics, 88 (3)*: 445-462.

Brender A. and F. Pisani (2005): The New American Economy, Economica, Paris.

Calza A., T. Monacelli and L. Stracca (2007), "Mortgage Markets, Collateral Constraints and Monetary Authority: Do Institutions Matter?", CEPR Discussion Paper 6231.

Campbell J. and Z. Hercowitz (2004), "The Role of Households' Collateralized Debts in Macroeconomic Stabilization", Federal Reserve Bank of Chicago WP 2004-24.

Canner G., K. Dynan and W. Passmore (2002): "Mortgage Refinancing in 2001 and Early 2002", *Federal Reserve Bulletin*, December, 469-481.

Canova F. (2005), "Monetary Policy and the Evolution of the US Economy: 1948-2002", Pompeu Fabra Universtity, mimeo.

Canova F. and L. Gambetti (2005): "Structural Changes in the US Economy: Bad Luck of Bad Policy?", mimeo, University Pompeu Fabra.

Cecchetti SG, A Flores-Lagunes and S Krause (2005), "Assessing the Sources of Changes in the Volatility of Real Growth", *Proceedings of the Reserve Bank of Australia Annual Conference*, 2005.

Cecchetti SG, A Flores-Lagunes and S Krause (2006),"Has Monetary Policy Become More Efficient? A Cross-Country Analysis", The Economic *Journal 116 (2),* 408-433.

Christiano L., M. Eichenbaum and C. Evans (2005), "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy", *Journal of Political Economy 113 (1)*, 1-45.

Christiano, L. J., M. Eichenbaum and C. Evans, (1999), "Monetary policy shocks: what have we learned and to what end?", in J. B. Taylor and M. Woodford (eds.), *Handbook of Macroeconomics*, Volume 1A, 65-148.

Clarida R., J. Galì and M. Gertler (2000), "Monetary policy rules and macroeconomic stability: evidence and some theory", *Quarterly Journal of Economics 115 (1),* 147-180.

Cogley, T., and T. J. Sargent (2005a): "Drifts and Volatilities: Monetary Policies and Outcomes in Post WWII U.S.", *Review of Economics Dynamics 8 (2)*, 262-302.

Cogley, T., and T. J. Sargent (2005b): "The Conquest of US Inflation: Learning and Robustness to Model Uncertainty," *Review of Economics Dynamics 8 (2)*, 528-563.

DeLong B. (1997), "America's Only Peacetime Inflation: the 1970's", in C. Romer and D. Romer (Editors), Reducing inflation, *NBER Studies in Business Cycles 30.* University of Chicago Press.

DeLong B. (2003), "Comment on James Stock and Mark Watson, 'Has the Business Cycle Changed?'", in *Monetary Policy and Uncertainty, Federal Reserve Bank of Kansas City*, 9-56.

Dynan K., D. Elmendorf and D. Sichel (2006). "Can Financial Innovation Explain the Reduced Volatility of Economic Activity?", *Journal of Monetary Economics 53 (1)*, 123-150.

Fisher, J. and M. Gervais (2006), "First-Time Home Buyers", 2006 Meeting Papers 432, Society for Economic Dynamics.

Galì J; and L; Gambetti (2007), "On the Sources of the Great Moderation", Pompeu Fabra Universtity, mimeo.

Giannone D., L. Reichlin and L. Sala (2002), "Tracking Greenspan: Systematic and Unsystematic Monetary Policy Revisited", IGiER mimeo.

Gordon R. (2005), "What Has Caused the Decline in US business Cycle Volatility?", NBER working paper 11777.

Hamilton J. (1989), "A New Approach to the Economic Analysis of Nonstationary Time Series and the Business Cycle", *Econometrica 57(2)*, 357-384.

Hamilton J. (1994), "Time Series Analysis", Princeton University Press.

Herrera A.-M. and E. Pesavento (2004), "The Decline in U.S. Output Volatility: Structural Changes and Inventory Investment", mimeo, Michigan University.

Iacoviello M; and S. Neri (2007), "The Role of Housing Collateral in an Estimated Two-Sector Model of the US Economy", Boston College mimeo.

Irvine F. and S. Schuh (2005), "The Roles of Co-Movement and Inventory Investment in the Reduction of Output Volatility", Federal Reserve Bank of Boston Working Paper No 05-9.

Justiniano A. and G. Primiceri (2006), "The Time Varying Volatility of Macroeconomic Fluctuations", mimeo, Northwestern University.

Kahn, J., M. McConnell, and G. Perez-Quiros (2002), "On the Causes of the Increased Stability of the U.S. Economy", *Federal Reserve Bank of New York, Economic Policy Review 8*(1): 183-202.

Kim, C. and C. Nelson (1999): "State Space Models with Regime Switching", MIT Press, London and Cambridge, Mass.

Leeper E; and T. Zha (2003), "Modest Policy Interventions", *Journal of Monetary Economics 50* (8), 1673-1700.

Monacelli T. (2006), "New Keynesian Models , Durable Goods and Borrowing Constraints", CEPR Discussion Paper 5916.

McConnell, M., and G. Perez-Quiros (2000), "Output Fluctuations in the United States: What Has Changed Since the Early 1980s?" *American Economic Review 90*, 1464-1476.

McConnell M., R. Peach and A. Al-Haschim (2003), "After the Refinancing Boom: Will Consumers Scale Back Their Spending?", *Current Issues in Economics and Finance 9*, No. 12.

Leeper E. and T. Zha (2001), "Assessing Simple Policy Rules: A View from a Complete Macroeconomic Model", *Federal Reserve Bank of Saint-Louis Review*, 83-110.

Lubik T. and F. Schorfheide (2004), "Testing for Indeterminacy: An application to U.S. Monetary Policy", *American Economic Review 94* (1), 190:217.

Primiceri G. (2005): “Time Varying Structural Vector Autoregressions and Monetary Policy”, *Review of Economic Studies 72*, pp821-852.

Primiceri G. (forthcoming): “Why Inflation Rose and Fell: Policymakers’ Beliefs and US Postwar Stabilization Policy,” *Quarterly Journal of Economics*.

Ramey, V. and D. Vine (2004) “Tracking the Source of the Decline in GDP Volatility: An Analysis of the Automobile Industry”,” NBER working paper 10384.

Ramey V. and D. Vine (2005), “Declining Volatility in the US Automobile Industry”, NBER Working Paper 11596.

Romer C. and D. Romer, “The Evolution of Econmic Understanding and Postwar Stabilization Policy”, T*he Federal Reserve Bank of Kansas City - Economic Review*.

Sellon G., (2002), “Changing U.S. financial system: Some Implications for the Monetary Transmission”, The Federal Reserve Bank of Kansas City - Economic Review, First Quarter 2002.

Sims C., D. Waggoner and T. Zha (2006), “Methods for Inference in Large Multiple-Equation Markov-Switching Models”, Federal Reserve Bank of Atlanta, mimeo.

Sims C. and T. Zha (1998), “Bayesian Methods for Dynamic Multivariate Models”, International Economic Review 39(4), 949-968.

Sims C. and T. Zha (2006), “Were There Regime Switches in U.S. Monetary Policy?”, Forthcoming, *American Economic Review*.

Smets, F. and R. Wouters, (2007), “Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach,” ECB Working Paper 722, forthcoming in the *American Economic Review*.

Stock J., and M. Watson (2002), “Has the Business Cycle Changed and Why?" *NBER Macroeconomics Annual 2002*: 159-218.

Stock J., and M. Watson (2003), “Has the Business Cycle Changed? Evidence and Explanations,” in *Monetary Policy and Uncertainty, Federal Reserve Bank of Kansas City*: 9-56.

Stock J., and M. Watson (2005), “Understanding Changes in International Business Cycle Dynamics”, *Journal of the European Economic Association 3* (5), 968-1006.

Table 1: Decomposition of the variance of the US Private Sector Domestic Demand into the variances and co-variances of its main components

	a	b	c	d	c - b	d - c
	1947-2006	1947-1965	1965-1984	1985-2006		
Quarterly growth rates and contributions						
GDP growth rate variance	17	28	21	4	-6	-17
Domestic private demand contribution variance	20	33	25	5	-9	-20
Net exports+Government consumption variance	4	8	3	1	-5	-2
2 Covariance of the above 2 sub-aggregates of GDP	-7	-14	-6	-2	8	5
Decomposition of DPD contribution variance						
Trace of the covariance matrix of its 6 components	13	23	**13**	**5**	-10	-8
Sum of off diagonal terms among the 6 components	7	10	**11**	**0.0**	1	**-11**
Band pass filtered (6,32,8) quarterly growth rates and contributions						
GDP growth rate variance	8	18	8	2	-10	-7
Domestic private demand growth rate variance	12	27	10	2	-17	-8
Trace of the covariance matrix of its 6 components	4	8	**3**	**1**	-5	-2
Sum of off diagonal terms among the 6 components	8	19	**7**	**1**	-12	**-6**

Notes: Domestic private demand (DPD) contribution to GDP growth is the sum of 6 sub-aggregates: residential investment, durable consumption, consumption of non-durable goods, consumption of services, fixed non-residential investment and inventory investment. The table decomposes the covariance matrix of these 6 sub-aggregates. All data come from "Table 1.1.2. Contributions to Percent Change in Real Gross Domestic Product". The Band Pass Filter methodology is presented in Baxter and King (1999).

Table 2: Decomposition of the variance of the US Private Sector Domestic Demand into the variances and co-variances of Households Investments and the aggregate of other components

	a	b	c	d	c - b	d - c
	1947-2006	1947-1965	1965-1984	1985-2006		
Quarterly growth rates and contributions						
Domestic private demand growth rate variance	20	33	25	5	-9	-20
Trace of the covariance matrix of its 2 components	3	27	**17.6**	**5.5**	-10	-12
Sum of off diagonal terms among the 2 components	17	6	**7.1**	**-0.5**	1	**-8**
correlation of the 2 components	0.27	0.26	**0.46**	**-0.14**		
Band pass filtered (6,32,8) quarterly growth rates and contributions						
Domestic private demand growth rate variance	12	27	10	2	-17	-8.3
Trace of the covariance matrix of its 2 components	8	17	**6.6**	**1.8**	-10	-4.8
Sum of off diagonal terms among the 2 components	4	11	**3.7**	**0.2**	-7	**-3.5**
correlation of the 2 components	0.65	0.71	**0.63**	**0.20**		

Notes: Domestic private demand (DPD) contribution to GDP growth is the sum of 2 sub-aggregates: household investments defined as the sum of residential investment and durable consumption and the aggregate of non-durable goods consumption, services consumption, fixed non-residential investment and inventory investment. The table decomposes the covariance matrix of these 2 sub-aggregates. All data come from "Table 1.1.2. Contributions to Percent Change in Real Gross Domestic Product".

Table 3: Marginal likelihood of 4 variables model depending on its form of time variation

					Marginal likelihood
	Constant parameters VAR				-1139.9

Specifications with changes only in the variances

	ffch	fh	dpgdp	ffr	Marginal likelihood
	constant	constant	constant	2 S	-1085.5
	2 S	constant	constant	constant	-1131.1
	constant	2 S	constant	constant	-1136.4
	constant	constant	2 S	constant	-1126.5
	constant	constant	constant	2 S	-1085.5
	constant	constant	constant	3 S	-1053.4
	constant	constant	2 S	2 S	-1072.1
	constant	constant	2 S	3 S	-1040.1
	constant	constant	3 S	2 S	-1068.7
	constant	2 S	2 S	2 S	-1068.6
	constant	2 S	2 S	3 S	-1036.5
Case 1	**2 S**	**2 S**	**2 S**	**2 S**	**-1059.9**
	2 S	2 S	2 S	3 S	-1027.8
	3 S		2 S	2 S	-1054.5
Case 2	**3 S**		**2 S**	**3 S**	**-1022.5**
	3 S		3 S	3 S	-1019.2

Specifications with changes only in the coefficients

	ffch	fh	dpgdp	ffr	Marginal likelihood
Case 3	constant	constant	constant	2 S	-1069.6
	2 S	constant	constant	constant	-1132.4
	constant	2 S	constant	constant	-1135.2
	constant	constant	2 S	constant	-1131.7
	constant	constant	constant	3 S	-1070.7
	constant	constant	2 S	2 S	-1353.4
	constant	constant	2 S	3 S	-1609.8
	constant	constant	3S	3 S	-1085.5

Specification with changes both in the variance and in the coefficients

	Variances				Coefficients				
	2 S	2 S	2 S	2 S	constant	constant	constant	2 S	-1032.2
	2 S	2 S	2 S	3 S	constant	constant	constant	2 S	-1029.1
Case 4	**3 S**		**2 S**	**2 S**	**constant**	**constant**	**constant**	**2 S**	**-1027.7**
	3 S		2 S	3 S	constant	constant	constant	2 S	-1024.6

Note: The variance of the shocks and the coefficients can be either constant; take one of 2 values (2S) or one of three values (3S).

indicates models for which the results are discussed in the text.

Table 4: Coefficients of the interest rate equation accross regimes

VAR model (Case 3)

	ff+ch	cf	dpgdp	ffr
Regime 1: 1969 Q3 to 1975 Q4 and 1979 Q4 to1985 Q4				
	0.04	0.18	0.02	0.98
Regime 2: 1960's, 1976:Q1 to 1979:Q3 and post 1986Q1				
	0.05	0.00	0.05	0.95

VAR model (Case 4)

	ff+ch	cf	dpgdp	ffr
Regime 1: 1969 Q3 to 1975 Q4 and 1979 Q4 to1985 Q4				
	0.05	0.20	0.03	0.97
Regime 2: 1960's, 1976:Q1 to 1979:Q3 and post 1986Q1				
	0.06	-0.01	0.04	0.95

Note: the table reports the sum of A0(j,4) and sum/lags of A(j,4)lags. Confidence intervals based on draws from the posterior distribution of the models parameters are avalaible upon request.

Table 5: Forecast error variance decomposition across states of different volatility of Monetary Policy Shocks

VAR model with constant parameters

	contrib of MP shock to				contrib to FFR of shocks to the equation of			
	ff+ch	cf	dpgdp	ffr	ff+ch	cf	dpgdp	ffr
4 quarters	14	21	3	64	19	4	14	64
8 quarters	16	21	2	47	25	8	20	47
12 quarters	16	21	2	38	28	11	23	38
16 quarters	16	21	2	33	28	12	27	33

VAR with time variation specification sv12 (ML=-1059.9)

Regime 1: High MP shock volatility, 1969Q2 to 1975 Q4 and 1979Q4 to 1984Q4

	contrib of MP shock to				contrib to FFR of shocks to the equation of			
	ff+ch	cf	dpgdp	ffr	ff+ch	cf	dpgdp	ffr
4 quarters	30	48	9	90	5	1	4	90
8 quarters	43	53	8	80	8	5	7	80
12 quarters	44	53	7	73	11	8	9	73
16 quarters	44	53	10	68	12	9	12	68

Regime 2: Low MP shock volatility of the 1960's, the mid-1970's and the "Greenspan era"

	contrib of MP shock to				contrib to FFR of shocks to the equation of			
	ff+ch	cf	dpgdp	ffr	ff+ch	cf	dpgdp	ffr
4 quarters	3	6	1	40	31	7	22	40
8 quarters	5	7	1	22	32	19	27	22
12 quarters	5	7	1	16	33	24	27	16
16 quarters	5	7	1	13	32	25	30	13

Note: report the percent of the variance of the variables explained by the monetary policy shocks (left panel) and the contribution of the shocks of each equation to the variance of the federal funds rate (right panel), all numbers are percentages. Confidence intervals based on draws from the posterior distribution of the models parameters are avalaible upon request.

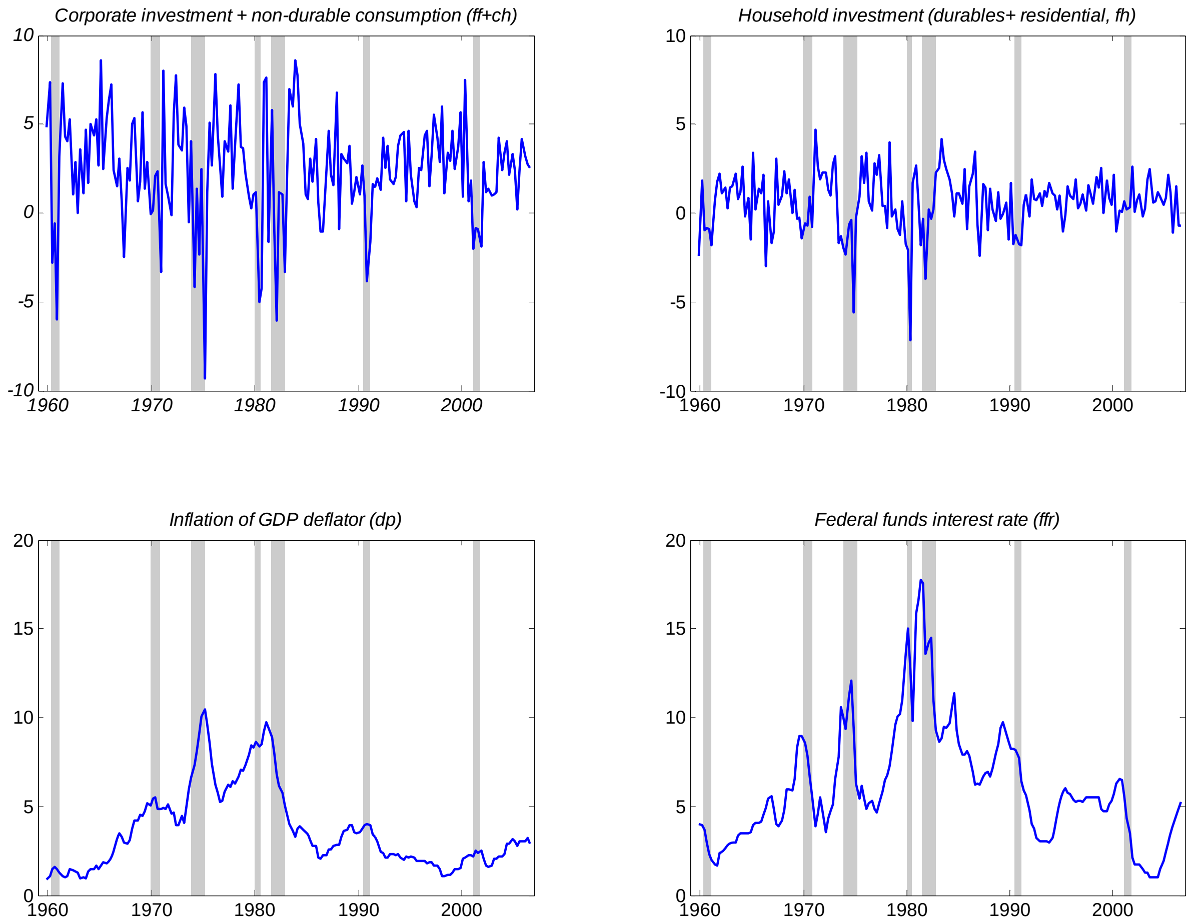

Figure 1: Time series of contributions to GDP growth, GDP deflator inflation and the federal funds rate
Grey areas indicates the periods designated by the NBER as recessions

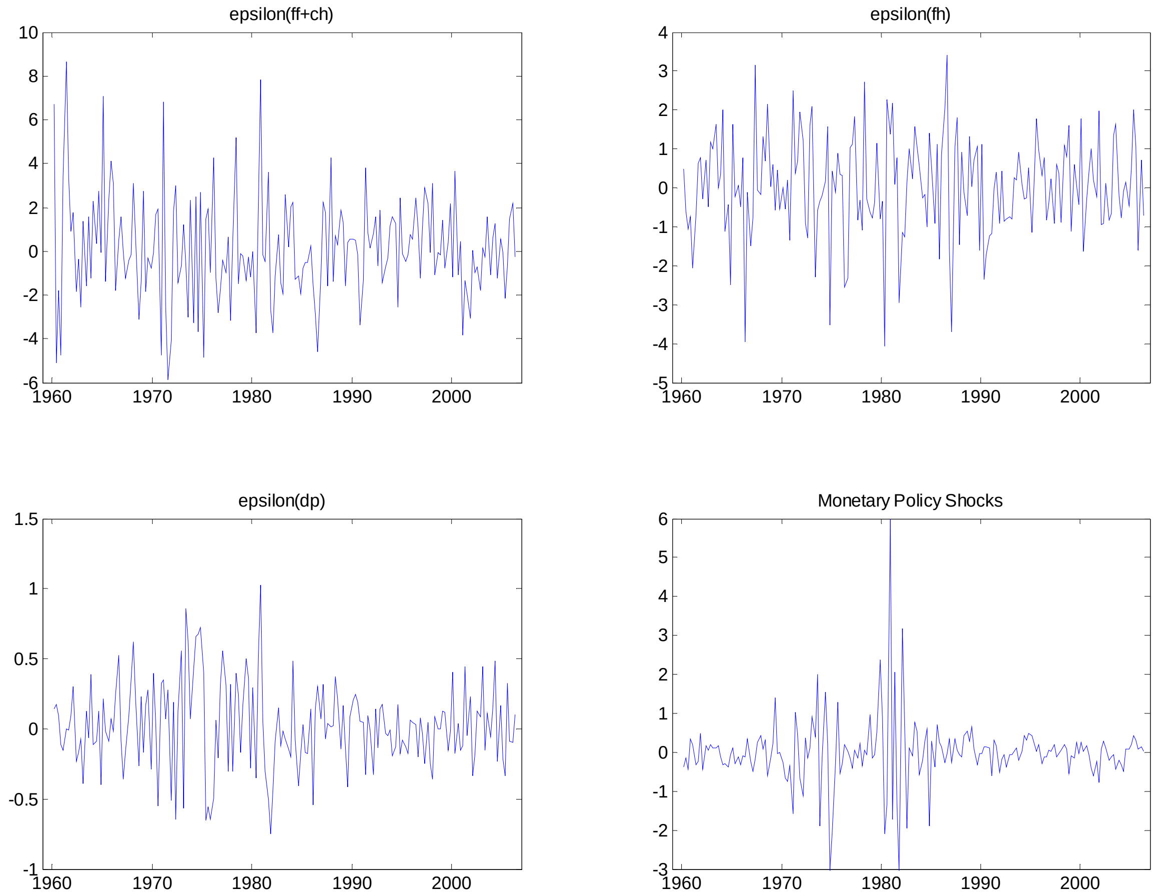

Figure 2: Identified shocks as estimated in the constant parameters VAR model

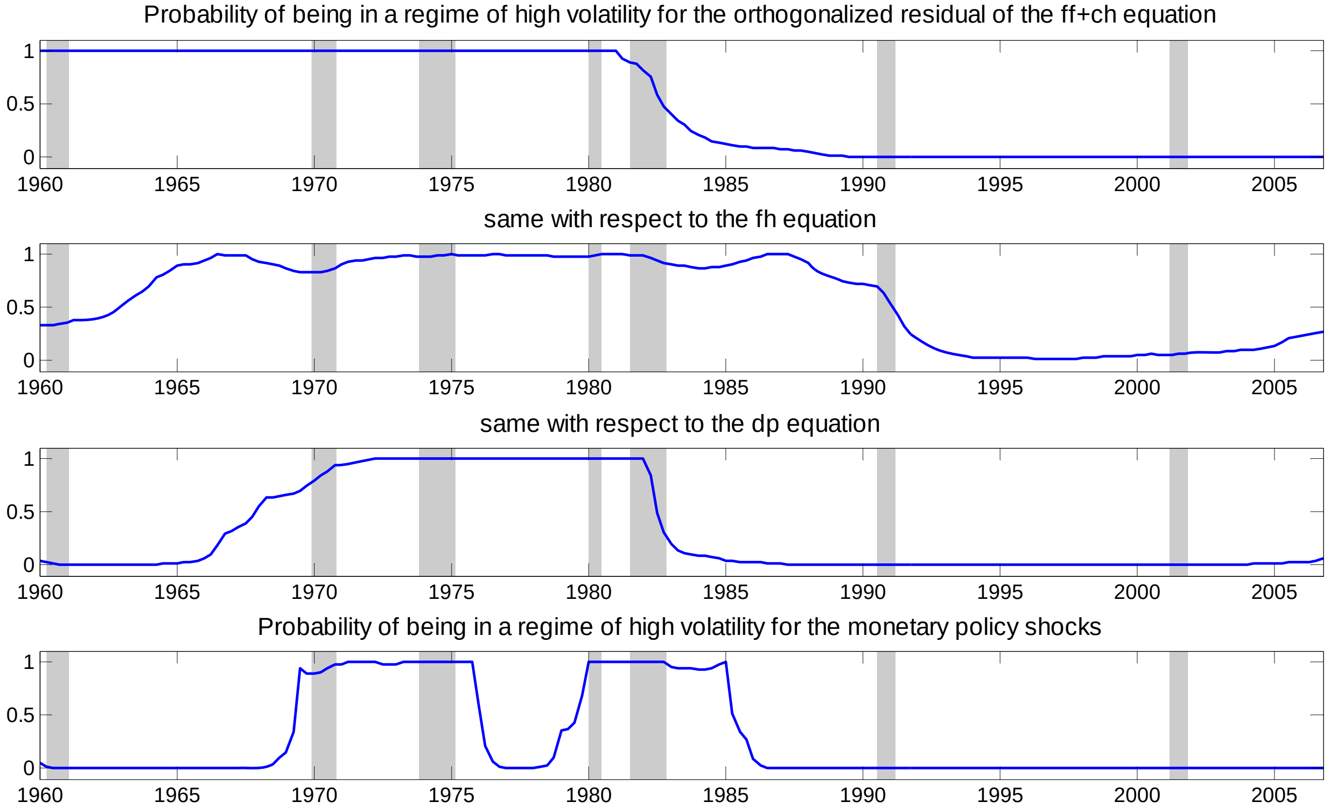

Figure 3: Case 1 model, Probabilities of being in high volatility states for the identified shocks
Grey areas indicates periods designated by the NBER as recessions

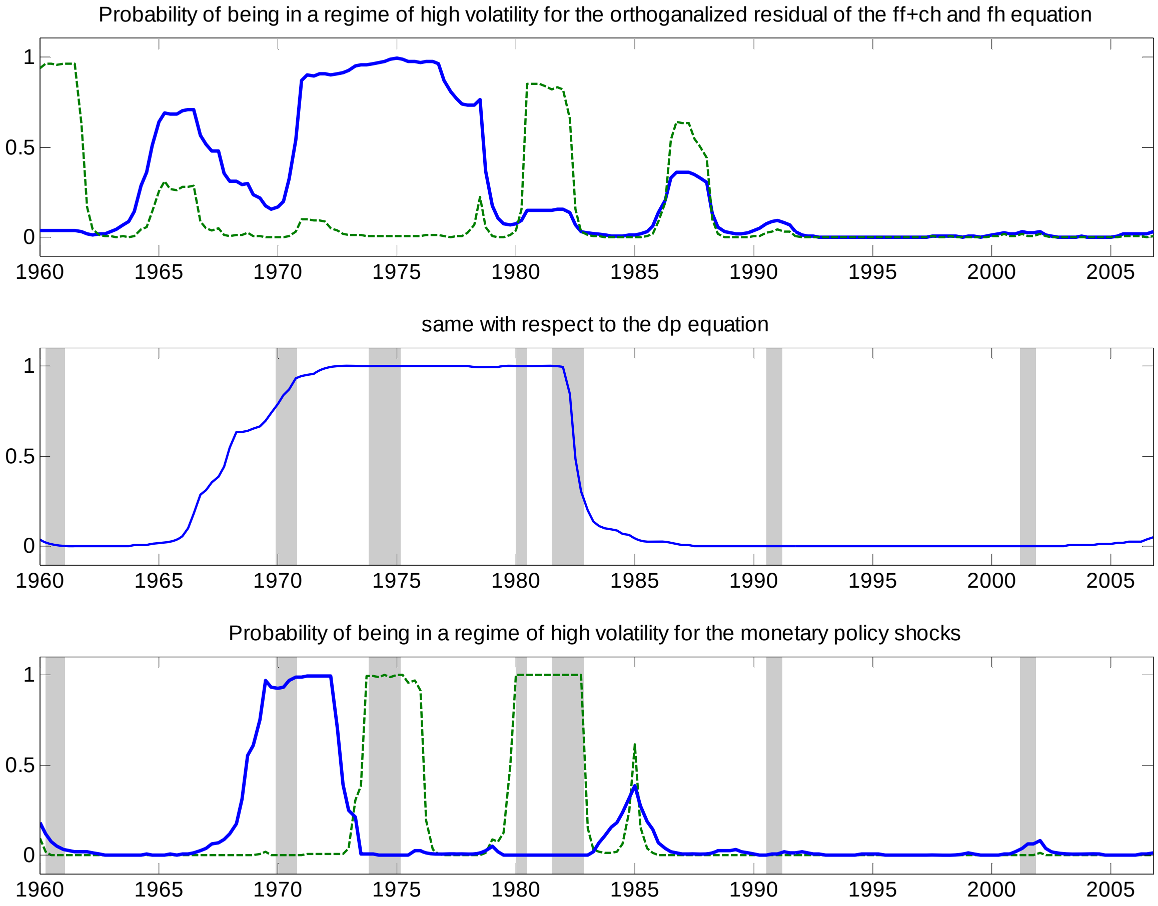

Figure 4: Case 2 model, Probabilities of being in high volatility states for the identified shocks

(green-dotted for high blue full line for either high or intermediate volatility regimes)

Grey areas indicates periods designated by the NBER as recessions

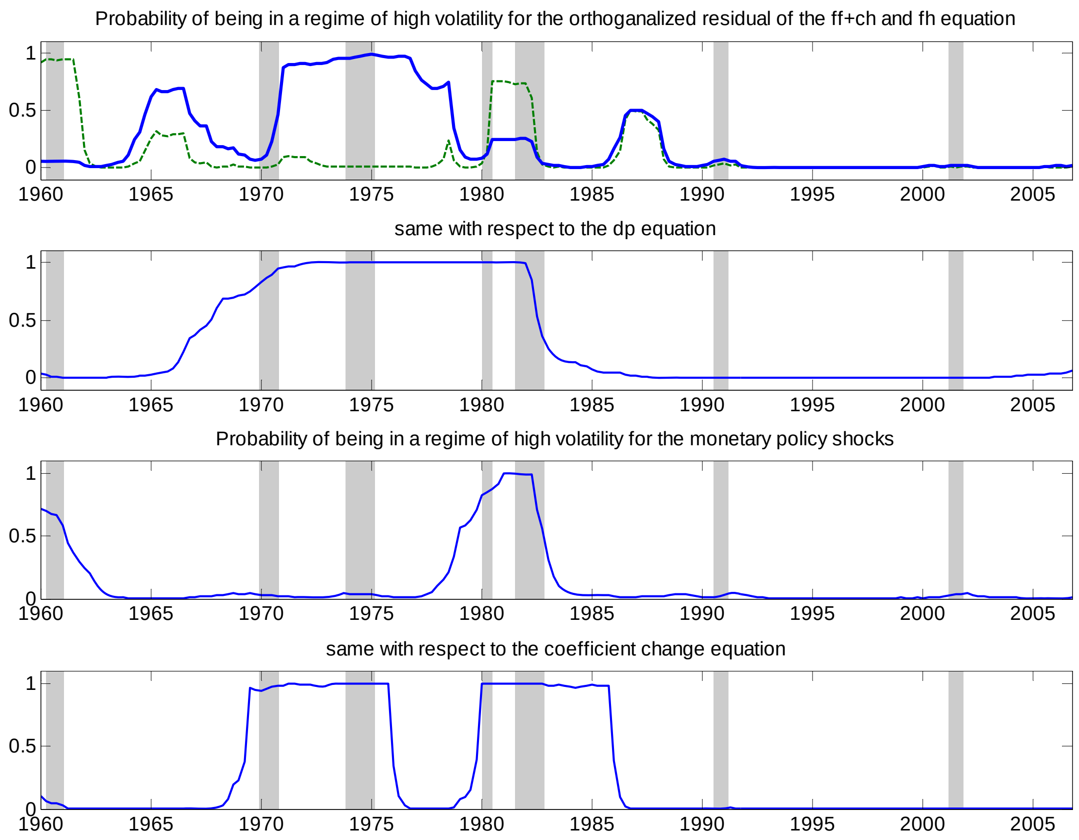

Figure 5: Case 4 model, Probabilities of being in high volatility states and regime 2 coefficients of the monetary policy rule

(green-dotted for high blue full line for either high or intermediate volatility regimes)

Grey areas indicates the periods designated by the NBER as recessions

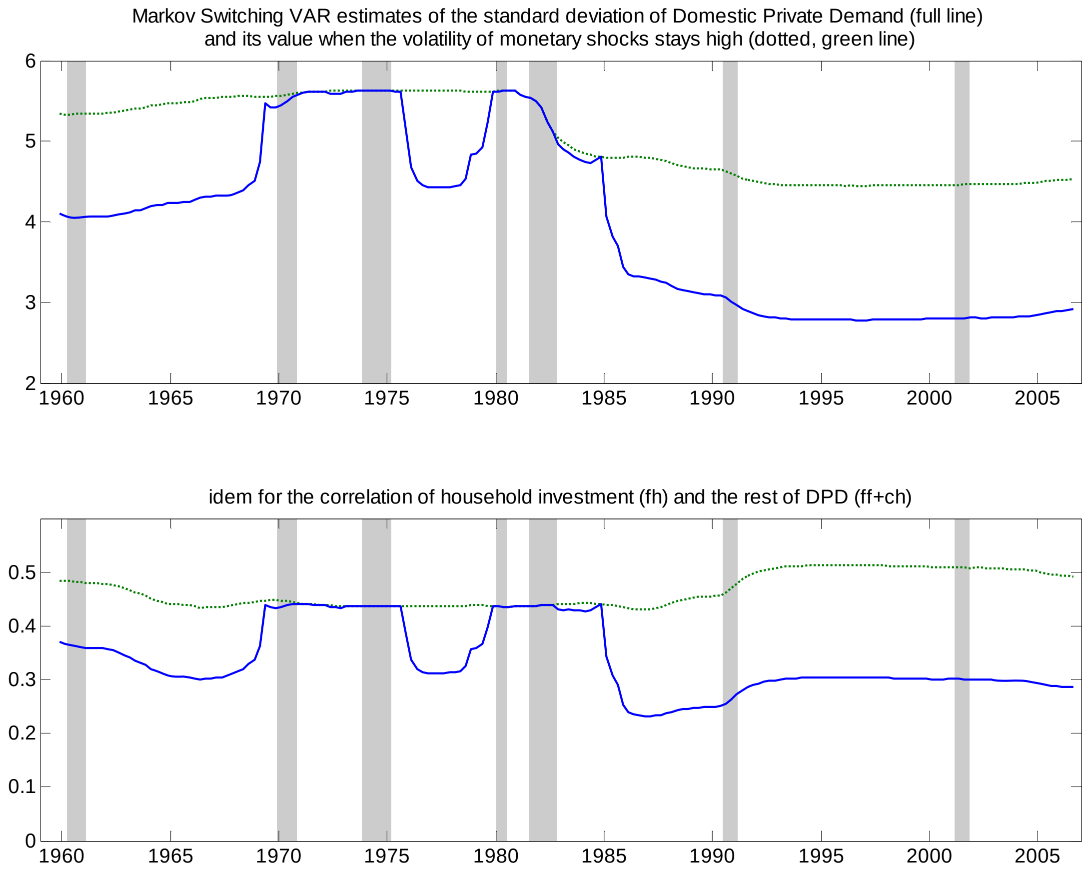

Figure 6: Time variation in the standard deviation of Domestic Private Demand (upper panel) and the correlation of its two components (lower panel) and holding the variance of monetary policy shock at its highest level (green-dotted)

Grey areas indicates the periods designated by the NBER as recessions

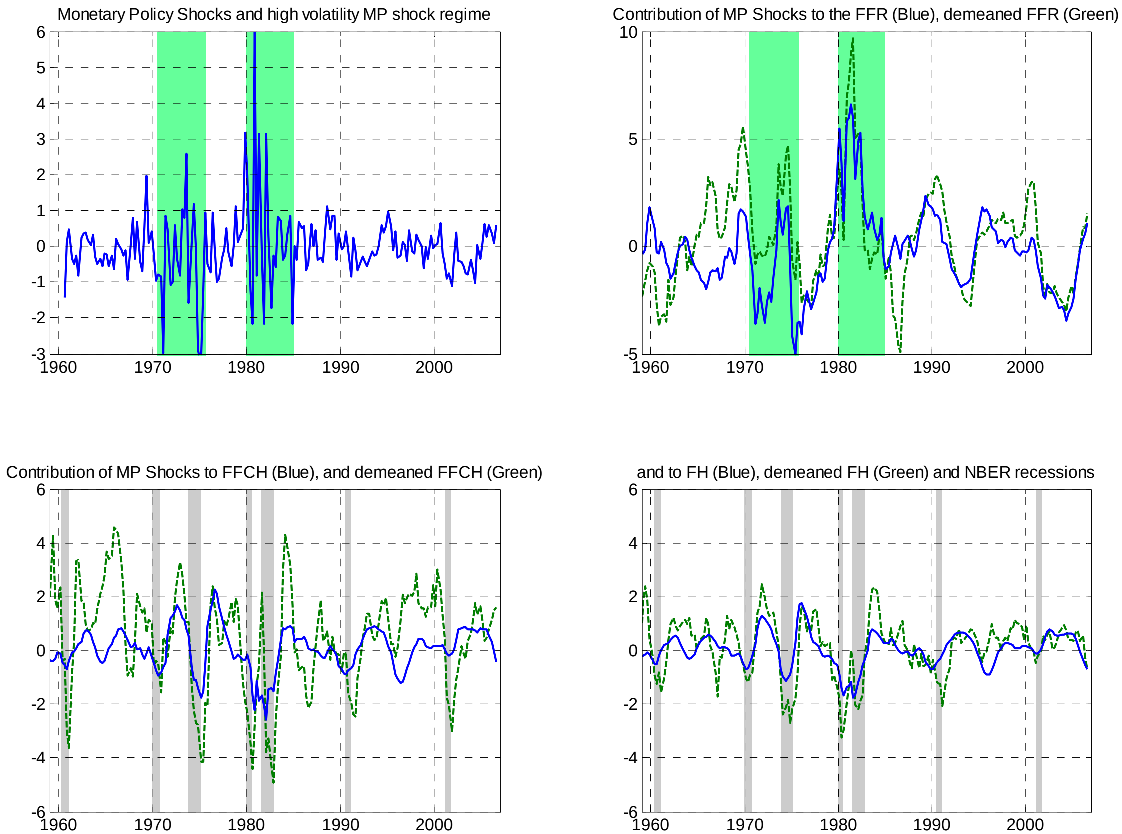

Figure 7: Monetary policy shocks, and their historical contribution to the federal funds rate and GDP components

Top panel: dark areas designate the period when the model estimates a higher volatility of monetary policy shocks.

Bottom panel: grey areas indicates the periods designated by the NBER as recessions

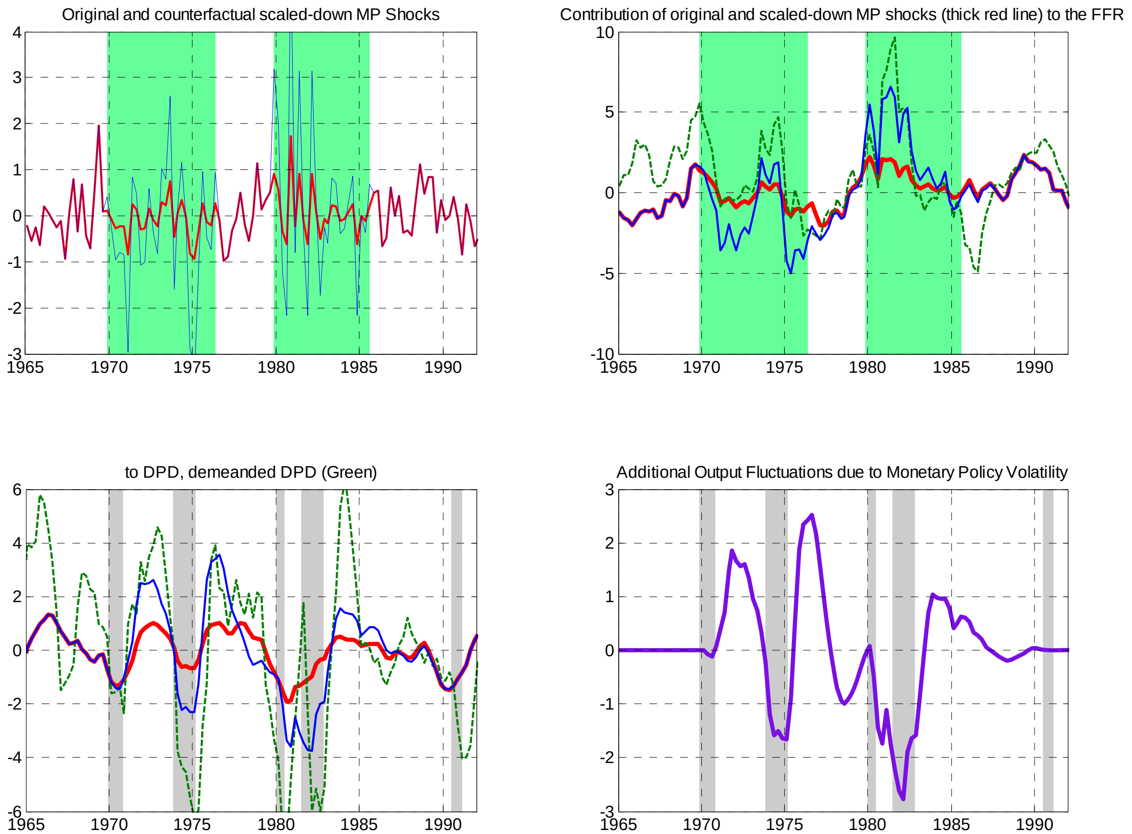

Figure 8: Effects of scaling down monetary policy shocks on the federal funds rate and the historical contribution of monetary policy shocks to Domestic Private Demand

Top panel: dark areas designate the period when the model estimates a higher volatility of monetary policy shocks.
Bottom panel: grey areas indicates the periods designated by the NBER as recessions

Appendix: Additional Tables

Table A1: Forecast error variance decomposition across states of different volatility of Monetary Policy Shocks

Best fit VAR model, 3 regimes for the shocks f equation 1 and 2, 2 regimes for equation 3, 3 regimes for the MP Shocks (ML=-1022.9)

Regime 1: High MP shock volatility, 1973 Q3 to 1976 Q1, from 1979 Q4 to 1982 Q3 and 1984 Q4

	contrib of MP shock to				contrib to FFR of shocks to the equation of			
	ff+ch	cf	dpgdp	ffr	ff+ch	cf	dpgdp	ffr
4 quarters	46	68	25	97	2	1	1	97
8 quarters	62	72	21	92	3	3	2	92
12 quarters	63	72	20	89	5	4	2	89
16 quarters	63	73	26	86	5	5	3	86

Regime 2: Moderately high MP shock volatility, 1969 Q1 to 1971 Q4

	contrib of MP shock to				contrib to FFR of shocks to the equation of			
	ff+ch	cf	dpgdp	ffr	ff+ch	cf	dpgdp	ffr
4 quarters	9	19	3	74	14	5	7	74
8 quarters	17	23	3	56	18	15	11	56
12 quarters	18	23	2	47	21	20	12	47
16 quarters	18	23	4	41	22	22	14	41

Regime 3: Low MP shock volatility of the 1960's, the mid-1970's and the "Greenspan era"

	contrib of MP shock to				contrib to FFR of shocks to the equation of			
	ff+ch	cf	dpgdp	ffr	ff+ch	cf	dpgdp	ffr
4 quarters	2	5	1	39	33	11	18	39
8 quarters	4	6	1	22	31	27	20	22
12 quarters	4	6	0	16	32	32	20	16
16 quarters	4	6	1	13	32	33	22	13

Note: report the percent of the variance of the variables explained by the monetary policy shocks (left panel) and the contribution of the shocks of each equation to the variance of the federal funds rate (right panel), all numbers are percentages.Confidence intervals based on draws from the posterior distribution of the models parameters are avalaible upon request.

Table A2: Forecast error variance decomposition across states of different volatility of Monetary Policy Shocks

Regime 1: High Variance of Monetary Policy shocks and Coeffients combination 1 : Period 1979Q4 to 1982Q4								
	contrib of MP shock to				contrib to FFR of shocks to the equation of			
	ff+ch	cf	dpgdp	ffr	ff+ch	cf	dpgdp	ffr
4 quarters	41	56	18	85	5	7	2	85
8 quarters	49	59	13	78	9	11	2	78
12 quarters	50	59	12	74	11	13	3	74
16 quarters	49	59	14	70	12	15	3	70
Regime 2: Low Variance of Monetary Policy shocks and Coeffients combination 1 : 1969 Q2 to 1975 Q4 and 1982 Q4 to1985 Q4								
	contrib of MP shock to				contrib to FFR of shocks to the equation of			
	ff+ch	cf	dpgdp	ffr	ff+ch	cf	dpgdp	ffr
4 quarters	18	28	6	63	13	18	5	63
8 quarters	24	30	4	52	19	24	5	52
12 quarters	24	30	4	46	21	27	6	46
16 quarters	24	30	5	42	22	28	7	42
Regime 3: High Variance of Monetary Policy shocks and Coeffients combination 2 : Period 1960 Q1 to 1960 Q4 and 1978 Q3 to 1979 Q3								
	contrib of MP shock to				contrib to FFR of shocks to the equation of			
	ff+ch	cf	dpgdp	ffr	ff+ch	cf	dpgdp	ffr
4 quarters	6	13	2	62	25	2	11	62
8 quarters	13	18	2	48	27	10	15	48
12 quarters	14	18	2	40	28	15	17	40
16 quarters	14	19	3	36	28	18	18	36
Regime 4: Low Variance of Monetary Policy shocks and Coeffients combination 1 : Period 1960's, 1976-1979 and post 1986								
	contrib of MP shock to				contrib to FFR of shocks to the equation of			
	ff+ch	cf	dpgdp	ffr	ff+ch	cf	dpgdp	ffr
4 quarters	2	4	1	33	42	4	20	33
8 quarters	4	6	1	22	40	15	23	22
12 quarters	5	6	1	17	38	21	24	17
16 quarters	5	6	1	14	37	24	25	14

Note: report the percent of the variance of the variables explained by the monetary policy shocks (left panel) and the contribution of the shocks of each equation to the variance of the federal funds rate (right panel), all numbers are percentages. Confidence intervals based on draws from the posterior distribution of the models parameters are avalaible upon request.

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