Monetary Analysis and the Financial Crisis: Can We Learn Anything from It?

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Abstract

Many observers have argued that monetary policy strategies that attach a role to money and credit are more robust than other policy frameworks. In particular, such strategies can detect developments in the financial sphere of the economy that may impact on inflation at longer time horizon than that normally considered or that may trigger risks to financial stability. We assess these claims by looking at a number of such indicators linking banks' funding decisions to money demand and relate these to financial sector instabilities and inflation pressures before the crisis in the US, the euro area, the UK, and Switzerland.

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1. Introduction

The financial crisis has led economists and policy makers to challenge the foundations of much of modern central banking and financial regulation. A number of observers have argued that monetary policy strategies that attach an important role to developments in money and credit are more robust than traditional inflation targeting and closely related frameworks. In particular, such strategies may be better able to detect the developments in financial imbalances that may trigger risks to financial stability. They may also impact on inflation at longer time horizon than those typically considered by leading to a long boom with rising prices of non-traded goods and therefore overall inflation, or to a sharp decline in inflation pressures if the boom would turn to a bust.

The period before the onset of the financial crisis that erupted after the collapse of Lehman on September 15, 2008 is a case in point. John Taylor has emphasised in a series of papers that the Federal Reserve set interest rates in the early 2000s below the level suggested by the celebrated Taylor rule.[2] Similarly, Hofmann and Bogdanova (2012) present evidence that this was also the case for other advanced and emerging economies. From these observations it is natural to conclude, rightly or wrongly, that monetary policy was too expansionary before the crisis, that this amplified the boom and accentuated inflation pressures, particularly in countries with housing bubbles, and that the bursting of the bubble led to strong downward pressure on inflation.

An obvious way to avoid a repetition of such an error, if an error indeed was made, would be to adhere more rigorously to the Taylor rule. But presumably the reason central banks deviated from the rule was that they did thought it necessary to do so. For this reason it would be desirable to have independent indicators that can be used to assess whether adhering to the Taylor rule is appropriate. Monetary and credit aggregates would seem natural candidates for at least three reasons.

First, they are available with very short lags and statistical revisions tend to be insignificant. By contrast, the output gap that enters as a central component in the Taylor rule relies on data on real GDP, which are published with long lags, and is subject to many and potentially large revisions. Furthermore, it is notoriously difficult to estimate since it is subject to model uncertainty.

[2] See for instance Taylor (2007).

Second, changes in the stance of monetary policy seem likely to affect money and credit stocks more rapidly than they impact on inflation and output gaps. Attaching significance to money and credit may therefore make it easier to assess the stance of policy in real time.

Third, money and credit aggregates are more likely than inflation and output gaps to contain information about the state of the financial system and macro prudential risks.

In this paper we study the question whether monetary policy in the US, the euro area, the UK, and Switzerland was too expansionary before the crisis. Our approach follows Dokko et al. (2009) and is straightforward. We start by estimating Vector Auto-Regressions (VARs), using data for the period up to 2002. We use these to compute forecasts of one or a subset of the included variables, conditional on the other variables for the period 2003-2008 period, without imposing a specific model structure. In particular, we can assess whether the actual path of short-term interest rates was unusually high or low, given the state of the macro economy as captured by the actual evolution of the other variables. Clarida and Friedman (1984) use a similar approach to investigate whether interest rates in the US were too high in the post-1979 period.

The paper is organised as follows. We first discuss the data and the specification of the VAR models. Then we compute unconditional forecasts for the 2003-2008 period, which serve as a benchmark for the following conditional forecasting exercises. For the US, the unconditional forecasts match the actual behaviour of key macroeconomic variables like the price level and real GDP quite well. Moreover, the unconditional forecasts as well as the forecasts conditioned on the price level and real GDP imply that the short-term interest rate would rise earlier but by less than it actually did. For the other countries, results differ in some aspects, but generally show a similar pattern. When we condition on financial stability variables, a higher interest rate is seen as appropriate from the VAR models' perspective.

2. Empirical methodology and data

As noted above, we start by estimating VARs for countries included in our study on data prior to 2002. The start of our sample period is dictated by data availability, in particular for credit aggregates and property prices, and varies between the countries. For the UK, data starts in 1972, for the US in 1975 and for Switzerland in 1976. For the euro area consistent data could be obtained only from 1980 on. We estimate the models up to 2002 after the burst of the dotcom bubble. This allows us to investigate the stance of monetary policy in the 2003-2008

period, that is, in the run-up to the financial crisis, and whether monetary policy was adjusted in response to the imbalances that built up in asset and financial markets.

For this approach to be sensible, it is essential that the VAR include sufficient variables capture macroeconomic and financial conditions. We therefore include a range of variables in our analysis. Details on the definition of the data and their sources are given in the Appendix.

1. To capture the stance of monetary policy, we include the fed funds rate for the US and a three-month interest rate for the other countries.
2. To capture broad macroeconomic conditions, we include real GDP growth and the inflation rate since empirical reaction functions indicate that these variables are the main determinants of central banks' monetary policy actions. We use CPI inflation for the euro area, the UK and Switzerland, and PCE inflation for the US since the Fed tends to consider it as its preferred measure of the price level. Moreover, we consider the unemployment rate as a measure of slack in the economy.
3. We include the growth rate of nominal broad money and total bank loans. Much of our interest below concerns whether these aggregates behaved in an unusual way in the run-up to the crisis.
4. Property prices, equity prices [to be added] and the long-term interest rate are used to capture financial market developments.
5. For Switzerland we also include the effective exchange rate since it has an important influence on monetary conditions.

Figures 1 to 4 plot the data in levels and in first differences. There are number of similarities for the countries in the sample. Short and long-term interest rates were relatively high in the early 1980s, then decreased as global efforts to reduce inflation pressures proved successful. The short interest rates reached a new peak around 1990 which, except for Switzerland, is almost not present in the long-term rate. The CPI, real GDP, money and credit series show clear trending behaviour. The slope of the trend, however, varies greatly among countries. In general, growth rates were higher in the first part of the sample, but for the US credit growth and property-price growth have picked up since the mid-1990s. For the other countries, however, this feature of the data is not prominent. Unemployment shows clear cyclical peaks for the US and the euro area, and, to a smaller extent, for the UK. All countries experience an increase in the unemployment rate in the early 1980s and a second, smaller one in the early 2000s. In addition, in the US a peak around 1993 occurs that it not present in the euro area and the UK. Over the full sample period the unemployment rate shows a downward trend.

First, we use all data for the full sample, that is, from the earliest available observation to 2008, to check the specification of our VAR models. Following Dokko et al. (2011), we estimate the VAR in levels. We first compute information criteria to determine the lag length for the VAR models, considering a maximum lag length of four. For all countries, the Akaike information criterion points to four lags, whereas the Schwarz criterion and the Hannan Quinn criterion prefer a single lag. With a single lag, however, residuals showed significant autocorrelation. We therefore estimate the VARs for all countries with two lags. Table xx shows some residual statistics that indicate that the model is well specified [to be added].

In order to draw valid conclusions from our analysis we need to show that the models are stable over the period that we analyse. We therefore perform Chow tests for the system as a whole and for single equations. As Candelon and Lütkepohl (2001) show that the asymptotic distribution of the test statistic in multivariate systems can deviate substantially from the asymptotic critical values, we simulate bootstrapped critical values [to be added]. Table 1 shows the results. In general, the stability of the models is satisfactory. Problems with stability occur in the inflation equations for the euro area and for Switzerland. When looking at the data, a changing seasonal pattern seems to be responsible for the break. For the euro area, stability is rejected as well for the money equation. Moreover, the property-price equation in the US shows signs of instability, which is not surprising given the strong decline in the growth rate that started around 2005. The tests for the system as a whole show that the chosen specification can be considered as stable.

Additional evidence on the stability of the relation can be obtained by CUSUM tests. Figures 5 to 8 show the results. For the UK, several tests statistics indicate instability of the model, which might be due to the long sample period. Results for the UK thus should regarded with some caution. For the other countries, the CUSUM tests in general do not show evidence of misspecification. One exception is the CUSUM test for the money equation of the euro area, which confirms the result from the Chow test. For Switzerland, the CUSUM test for the short term interest rate is at the lower significance bound.

Results

We next compute unconditional forecasts for the variables for the period 2003Q1 to 2008Q3. We stop in the third quarter of 2008 because we want to exclude the effects caused by the collapse of Lehman Brothers on September 15. The unconditional forecasts will serve as a benchmark to compare the conditional forecasts with and show how the model predicts the variables solely based on the information in past data.

Tables 2 to 5 summarise the results in terms of the root mean squared error and the mean error for the four countries we consider. Figures 9 to 12 plot the corresponding forecasts. As the VAR is estimated in levels, persistence in the forecasts is high. Despite the long forecasting horizon, some variables are tracked quite well by the unconditional forecasts. For the US, forecasts for the price level and real GDP show a low RMSE. Money growth is slightly over-predicted during 2004 to 2008, whereas actual mortgage growth was somewhat stronger than implied by the VAR forecasts starting in 2005. By contrast, house prices increased much more than implied by the unconditional forecasts, which indicates that this growth cannot be explained by the usual correlations between the time series over the estimation period of the model. The VAR expects the short-term interest rate to increase more quickly in 2003/04 but then to remain on a lower level than actually observed.

The predictions for the euro area show a similar pattern. The price level, real GDP and bank loans are tracked well over the 2003-2008 period. By contrast, money and house prices actually increased much more than what the predictions would imply. The short-term interest rate is predicted higher during 2003-2005 but the actual rise in 2006 is not captured by the forecast.

The results for the UK and Switzerland differ with respect to the predicted paths for prices and GDP. For both countries GDP grew more strongly than implied by the VAR forecasts, whereas inflation was lower than predicted. While the model for the UK broadly captures the actual trend development of money and bank loans, house prices increased much more strongly. For Switzerland, money increased more than implied by the VAR forecasts, whereas bank loans increased less than the unconditional forecasts. The most obvious difference emerges for house prices, which increased much less than predicted. The unconditional VAR forecasts expect the short-term interest rate to be higher until 2006 for the UK, whereas interest rates in Switzerland are too low compared to the forecasts for the whole forecast horizon. As the models for the UK and Switzerland showed some signs of instability, results should be treated with caution.

Next we condition our forecasts on the traditional target variables for monetary policy, that is, the price level and real GDP, using the methodology of Doan et al. (1984). We would expect that conditioning on these variables should add information to the forecasts of the remaining variables. The results are shown in the second columns of Tables 2 to 5. This is indeed that case for the euro area and the UK, where, except for the UK unemployment rate, RMSEs decrease if we condition on these two variables. Figure 10 shows that for the euro area the

actual increase in the short-term interest rate is now accurately captured by the conditional forecast. Consequently, the RMSE for the short-term interest rate falls from 7.70 for the unconditional to 3.02 for the conditional forecast.

For the US, however, conditioning on these two macro variables leads to an even stronger deviation of the Fed funds rate from its actual path. The fit for bank loans and property prices increases, but, as Figure 9 shows, also the conditional predictions miss the strong increases in these variables. We thus conclude that the behaviour of prices and output are not sufficient to explain the path of the policy rate in the US whereas they do improve predictions for the short-term interest rate in the euro area.

We next condition our projections on financial stability variables in addition to the price level and real GDP. We consider two groups of variables: first, quantity variables, that is, the money stock and bank lending, second, price variables, that is, property prices [and equity prices; to be added]. Results are summarised in columns three to five of Tables 2-4. When we condition on money, the mean error for the short-term interest rate becomes negative, implying that policy rates are predicted to be higher once the information from money is taken into account. When we condition on bank lending or house prices, the same conclusion is obtained for all countries except for the UK.

We finally consider the question whether property prices were unusually high, given the prevailing macroeconomic conditions, or, to put it the other way, whether interest rates were too low, given the evolution of the macroeconomy and the financial sector. Figures 13 to 16 show the results from this exercise. For the US, we replicate the finding of Dokko et al. (2011), despite having different variables in our model. Actual house prices increased by more than would could be expected on the basis of the historical relationships. If we condition on house prices, it turns out that the Fed funds rate is predicted to increase earlier and more than actually was the case.

For the other countries, however, the results are less striking. For the UK and Switzerland, house prices also increased more strongly than what would have been predicted by the model. For the UK, however, the short-term interest rate is seen as too high by the model, pointing to some problem in the model specification. For Switzerland, the short-term rate turns out to be higher, but also more volatile than actually was the case. The reason for this is possibly that the model predictions expect a decline in house prices until 2005 before they increase quickly and reach their actual level in 2008. For the euro area, house prices increase more rapidly than predicted until 2006, but then they fall below the forecasted path. Consequently, the short-

term interest rate is seen as too low in the first part of the forecasting period, but then falls quickly to even negative values. In total, we find some evidence that a faster increase in interest rates after the burst of the dot-com bubble in 2002 would have been warranted.

3. Robustness checks

We tried different specifications of the VAR. First, we use the output gap instead of real GDP growth as typical monetary policy rules are generally specified in terms of the output gap. [..]

We augmented the model by additional variables like commodity prices [..]

4. Conclusions

In this paper, we computed unconditional and conditional forecasts for the 2003-2008 period from VAR models for the US, the euro area, the UK and Switzerland to evaluate monetary policy strategies that focus on quantity variables like money versus strategies that rely on GDP and the price level. We find that for the US, the unconditional forecasts match the actual behaviour of key macroeconomic variables like the price level and real GDP quite well. Both, the unconditional forecasts and the forecasts conditioned on the price level and real GDP imply that the short-term interest rate would have risen earlier but by less than it actually did. For the other countries, results differ in some aspects, but generally show a similar pattern. When we condition on financial stability variables, a higher interest rate is seen as appropriate from the VAR models' perspective. We interpret this finding as suggesting that monetary policy strategies that take into account the evolution of money and credit aggregates help preserving financial stability in the sense that they help contain possibly unsustainable developments in property prices.

Data Appendix

US

sri	short-run interest rates (fed funds rate)	IFS,
pce	PCE	FED St. Louis
gdp	real GDP, seasonally adjusted	IFS,
lri	long-run interest rates (10y govt bond yield)	IFS,
exch	exchange rates (reer based on cp)	IFS,
m	MZM stock, transformed from monthly to quarterly frequency by taking end-of period values	FED St. Louis
bl	bank loans (total mortgages outstanding)	BIS,
ppr	property prices (residential existing 1-family houses)	BIS,

Euro Area

sri	short-run interest rates	AWM database, ECB
cpi	CPI, all items city average	AWM database, ECB
gdp	real GDP, seasonally adjusted	AWM database, ECB
lri	long-run interest rates	AWM database, ECB
exch	exchange rates (reer based on cp)	AWM database, ECB
m	M3 money stock mu11-mu17, m-end data	EasyR, BIS
bl	Total loans	ECB, OECD
ppr	property prices, all dwellings (MU17)	AWM database, ECB

UK

sri	short-run interest rates (3M Libor GBP)	IFS,
cpi	CPI, all items	OECD,
gdp	real GDP, seasonally adjusted	IFS,
lri	long-run interest rates (long-run govt yield)	IFS,
exch	exchange rates (reer based on cp)	IFS,
m	money stock M4, NSA	BIS,
bl	bank loans (total lending of banks and building societies)	BIS,
ppr	property prices (all dwellings)	BIS,

Switzerland

name	*description*	*source*
sri	short-run interest rates (3M Libor CHF)	IFS,
cpi	CPI, all items	IFS,
gdp	real GDP, seasonally adjusted	IFS,
lri	long-run interest rates (long-run govt yield)	IFS,

exch	exchange rates (reer based on cp)	IFS,
m	M3 money aggregate, transformed from monthly to quarterly frequency by taking end-of period values	SNB1,
bl	bank loans, calculation Romain	Romain
ppr	property prices (owner-occup. 1-family houses)	BIS,

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Figures and Tables

Table 1. Chow test

	US	Euro Area	UK	Switzerland
Interest rate	0.61 (0.88)	1.56 (0.10)	0.19 (0.99)	0.40 (0.98)
Price level	0.98 (0.59)	4.12 (0.00)	0.30 (0.99)	3.01 (0.00)
Real GDP	0.67 (0.82)	0.75 (0.74)	0.96 (0.50)	0.78 (0.70)
Bond yield	0.36 (0.99)	1.66 (0.07)	0.39 (0.98)	1.14 (0.32)
Unemployment	0.83 (0.65)	1.69 (0.06)	0.53 (0.93)	
Exchange rate				0.64 (0.85)
Broad money	0.69 (0.80)	2.12 (0.01)	1.28 (0.22)	1.10 (0.36)
Bank loans	2.10 (0.01)	1.73 (0.05)	1.52 (0.10)	1.15 (0.32)
Property prices	6.97 (0.00)	0.66 (0.84)	0.74 (0.75)	0.63 (0.85)
System	1.28 (0.32)	1.06 (0.43)	0.59 (0.77)	0.88 (0.55)

Chow breakpoint tests for a break in 2003Q1 in a VAR model with two lags. The sample period starts in 1975Q1 for the US, 1980Q1 for the euro area, 1972Q1 for the UK and 1976Q1 for Switzerland. It ends in 2008Q3 for all countries. The entries in the table show the test statistic, which is distributed as F(17,91) for the US, F(17,79) for the euro area, F(17,111) for the UK and F(17,95) for Switzerland, and its significance level in parentheses. The last line shows the Chow forecast test for the full VAR (see Candelon and Lütkepohl, 2001), which is distributed as F(184,665) for the US, F(184,514) for the euro area, F(184,756) for the UK and F(184,635) for Switzerland.

Table 2. Alternative forecasts for the US

RMSE	Unconditional	Conditioned on			
		CPI, GDP	CPI, GDP, M	CPI, GDP, C	CPI GDP PP
Fed funds rate	9.76	10.69	3.44	8.29	12.96
PCE price index	0.07	0.00	0.00	0.00	0.00
Real GDP	0.06	0.00	0.00	0.00	0.00
Bond yield	2.34	3.73	1.47	4.36	7.90
Unemployment rate	2.34	1.89	2.07	3.51	4.06
MZM Money	0.24	0.41	0.00	0.53	0.53
Bank lending	0.28	0.26	0.35	0.00	0.14
House prices	0.49	0.41	0.44	0.27	0.00
Mean error	Unconditional	Conditioned on			
		CPI, GDP	CPI, GDP, M	CPI, GDP, C	CPI GDP PP
Fed funds rate	18.59	23.76	-9.17	-16.73	-38.62
PCE price index	0.11	0.00	0.00	0.00	0.00
Real GDP	-0.01	-0.00	0.00	0.00	-0.00
Bond yield	2.32	8.71	-1.99	-14.62	-35.52
Unemployment rate	4.53	5.91	6.38	14.96	6.61
MZM Money	-0.81	-1.50	0.00	-2.07	-2.12
Bank lending	1.00	0.86	1.32	0.00	-0.34
House prices	1.99	1.62	1.79	0.89	0.00

VAR model with two lags. The estimation runs from 1975Q1 to 2002Q4, forecasts are computed from 2003Q1 to 2008Q3.

Table 3. Alternative forecasts for the euro area

RMSE	Unconditional	Conditioned on			
		CPI, GDP	CPI, GDP, M	CPI, GDP, C	CPI GDP PP
Short-term rate	7.70	3.02	20.20	2.68	9.05
HICP price index	0.03	0.00	0.00	0.00	0.00
Real GDP	0.07	0.00	0.00	0.00	0.00
Bond yield	3.65	3.60	11.35	2.87	6.06
Unemployment rate	0.05	0.02	0.08	0.03	0.03
Money M3	0.58	0.52	0.00	0.51	0.45
Bank lending	0.16	0.10	1.07	0.00	0.26
House prices	0.39	0.25	0.82	0.27	0.00
Mean error	Unconditional	Conditioned on			
		CPI, GDP	CPI, GDP, M	CPI, GDP, C	CPI GDP PP
Short-term rate	6.36	-10.48	-89.88	-3.09	-37.72
HICP price index	0.01	-0.00	-0.00	-0.00	-0.00
Real GDP	0.14	0.00	-0.00	0.00	0.00
Bond yield	-5.75	-15.35	-48.85	-11.34	-27.27
Unemployment rate	-0.16	-0.10	-0.18	-0.12	-0.12
Money M3	2.27	2.16	0.00	2.12	1.82
Bank lending	0.23	0.34	4.81	0.00	1.24
House prices	1.61	1.09	-3.22	1.17	0.00

VAR model with two lags. The estimation runs from 1980Q1 to 2002Q4, forecasts are computed from 2003Q1 to 2008Q3.

Table 4. Alternative forecasts for the UK

RMSE	Unconditional	Conditioned on			
		CPI, GDP	CPI, GDP, M	CPI, GDP, C	CPI GDP PP
Interest rate	8.15	7.20	4.15	6.49	6.69
CPI	0.40	0.00	0.00	0.00	0.00
Real GDP	0.31	0.00	0.00	0.00	0.00
Bond yield	7.68	2.71	2.77	3.17	3.03
Unemployment rate	0.17	0.29	0.32	0.30	0.31
Money	0.47	0.25	0.00	0.26	0.18
Lending	0.38	0.15	0.44	0.00	0.28
Property prices	0.66	0.26	0.34	0.31	0.00
Mean error	Unconditional	Conditioned on			
		CPI, GDP	CPI, GDP, M	CPI, GDP, C	CPI GDP PP
Interest rate	-21.02	20.12	-4.56	11.58	14.40
CPI	-1.72	-0.00	-0.00	-0.00	-0.00
Real GDP	1.28	0.00	0.00	0.00	0.00
Bond yield	-34.29	-4.78	-7.76	-4.56	-7.47
Unemployment rate	-0.20	-0.95	-1.24	-1.10	-1.19
Money	1.46	0.51	-0.00	0.89	0.08
Lending	0.99	-0.38	-1.78	0.00	-1.23
Property prices	2.55	1.07	-48.66	0.64	-0.00

VAR model with two lags. The estimation runs from 1972Q1 to 2002Q4, forecasts are computed from 2003Q1 to 2008Q3.

Table 5. Alternative forecasts for Switzerland

RMSE	Unconditional	Conditioned on			
		CPI, GDP	CPI, GDP, M	CPI, GDP, C	CPI GDP PP
Interest rate	16.49	13.88	14.23	9.80	6.92
CPI	0.12	0.00	0.00	0.00	0.00
Real GDP	0.25	0.00	0.00	0.00	0.00
Bond yield	8.58	5.80	6.11	3.70	3.11
Exchange rate	0.52	0.39	0.24	0.38	0.35
Money M3	0.24	0.12	0.00	0.42	0.19
Bank lending	0.57	0.84	0.78	0.00	0.33
Property prices	1.39	1.65	1.41	0.26	0.00
Mean error	Unconditional	Conditioned on			
		CPI, GDP	CPI, GDP, M	CPI, GDP, C	CPI GDP PP
Interest rate	-72.25	-57.61	-58.49	-42.57	-30.29
CPI	-0.27	0.00	0.00	-0.00	0.00
Real GDP	0.81	0.00	0.00	0.00	0.00
Bond yield	-34.29	-21.09	-21.25	-14.77	-11.67
Exchange rate	-2.36	-1.76	-1.07	1.62	1.30
Money M3	1.09	0.10	0.00	1.91	0.84
Bank lending	-2.47	-3.35	-3.23	0.00	-1.48
Property price	-5.99	-6.61	-5.73	0.95	0.00

VAR model with two lags. The estimation runs from 1976Q1 to 2002Q4, forecasts are computed from 2003Q1 to 2008Q3.

Figure 1. US Data

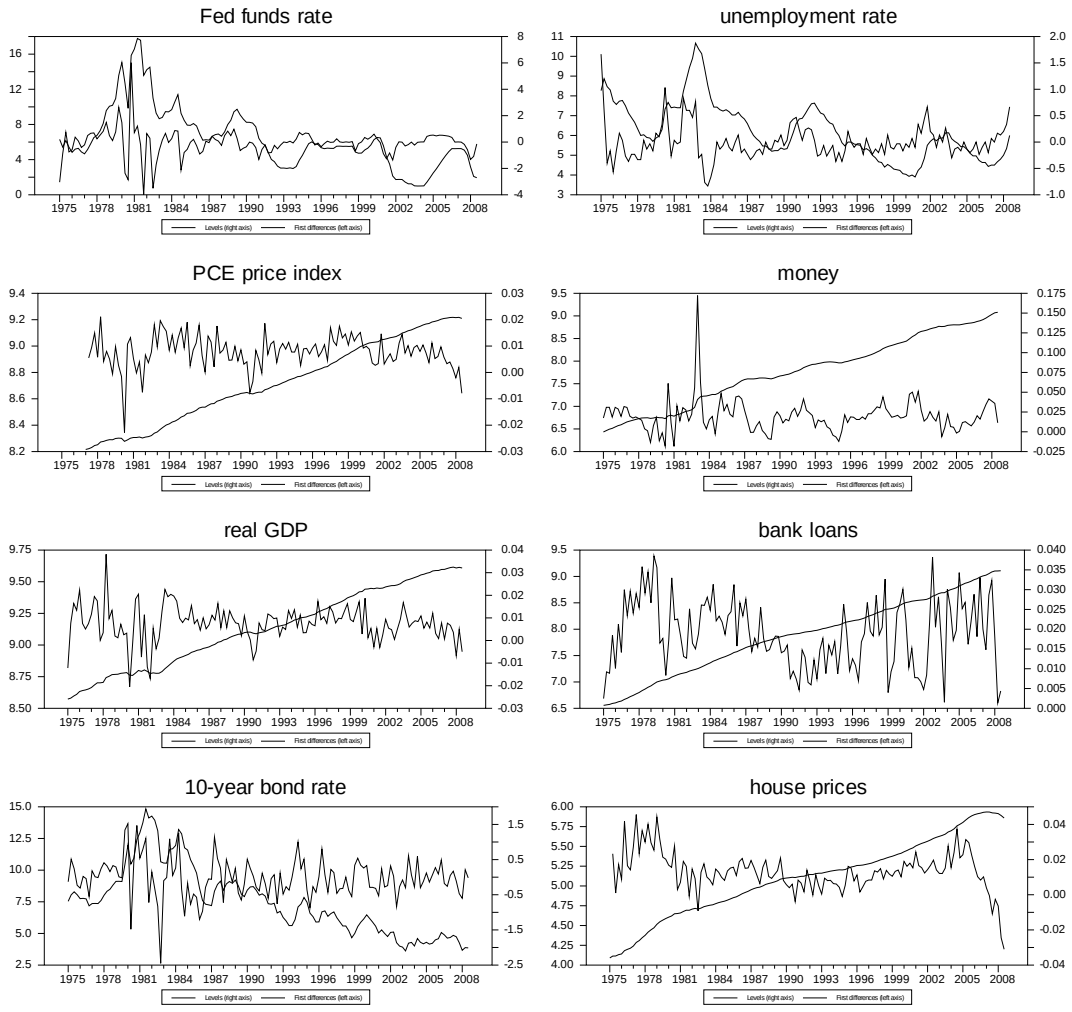

Figure 2 Euro area data

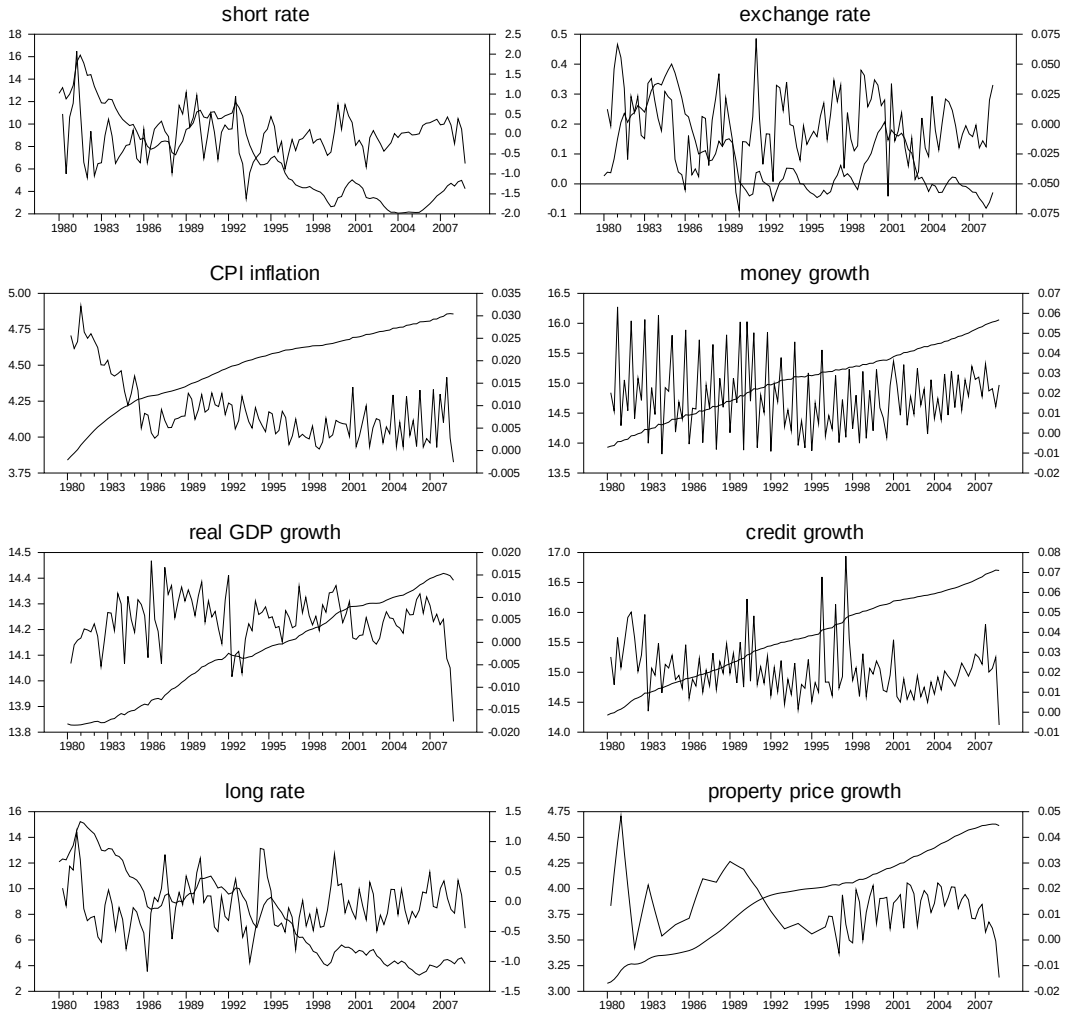

Figure 3. UK data

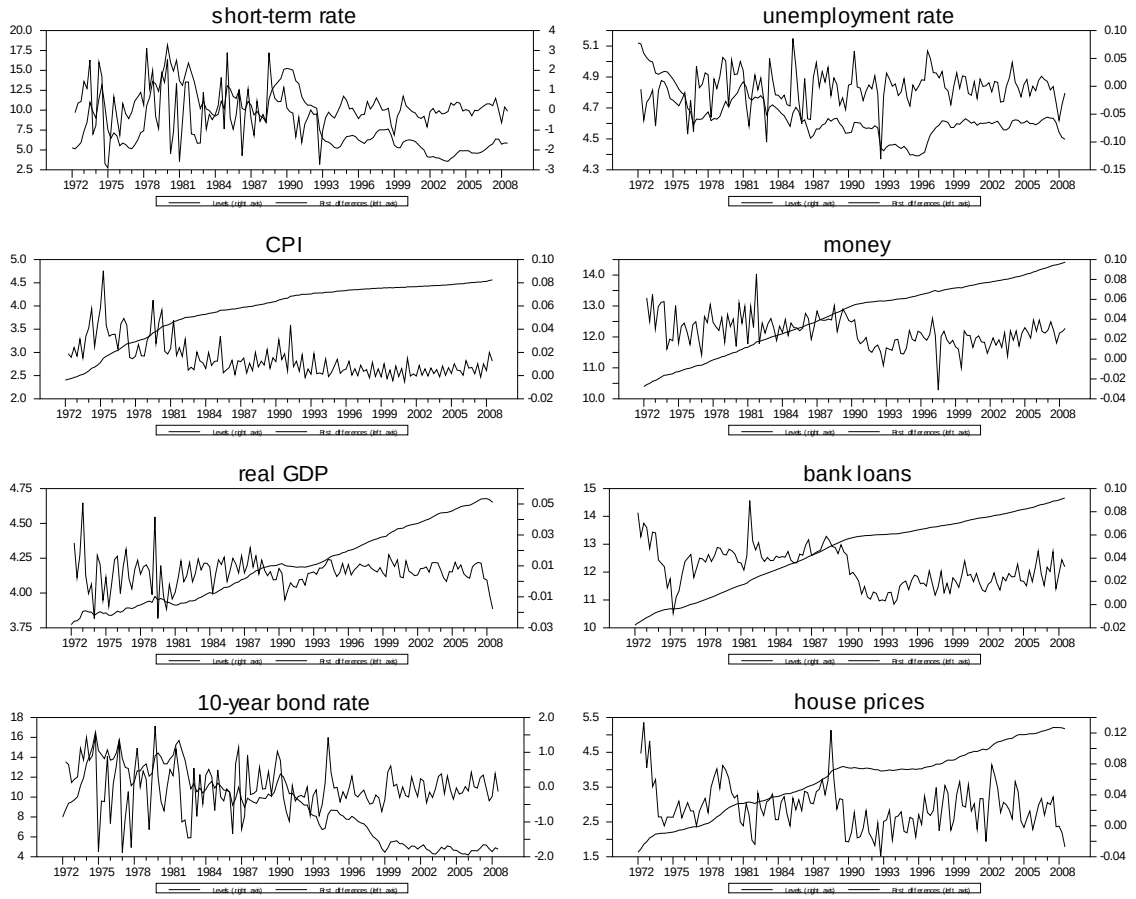

Figure 4. Swiss data

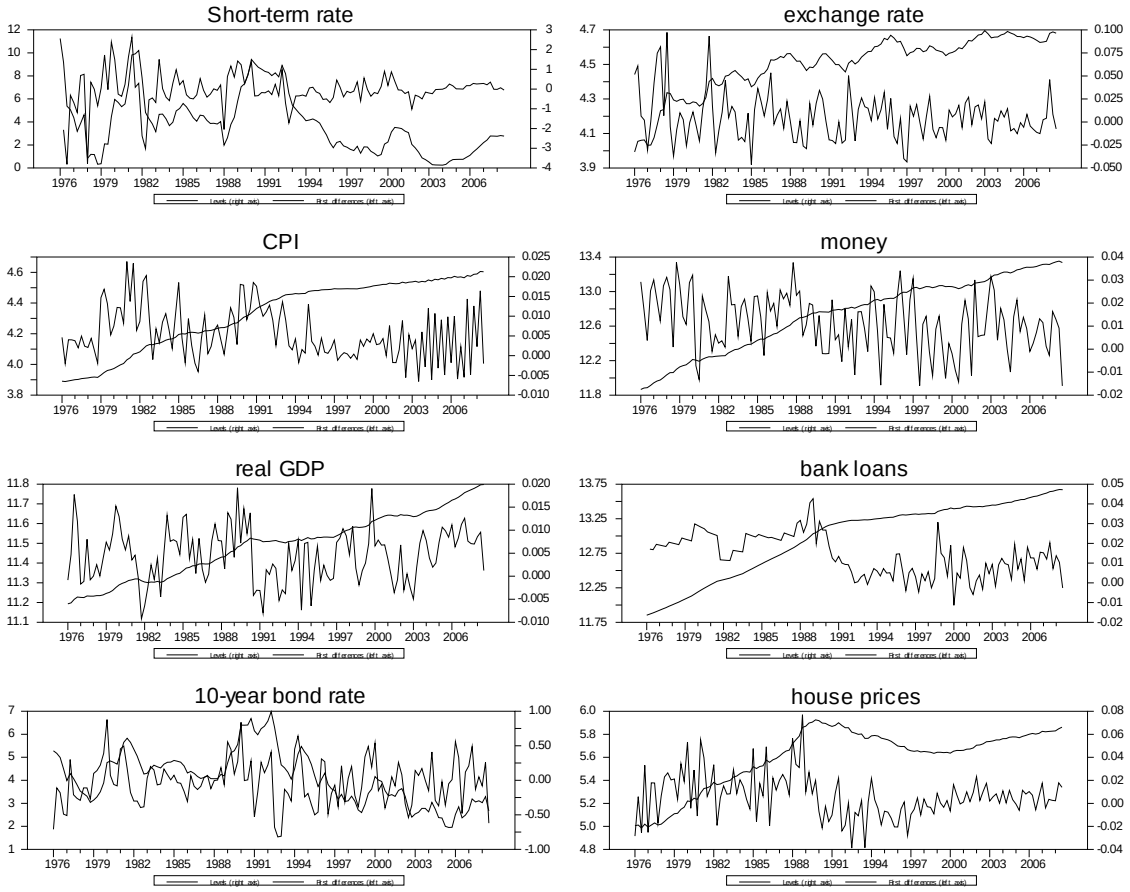

Figure 5 Cusum tests US

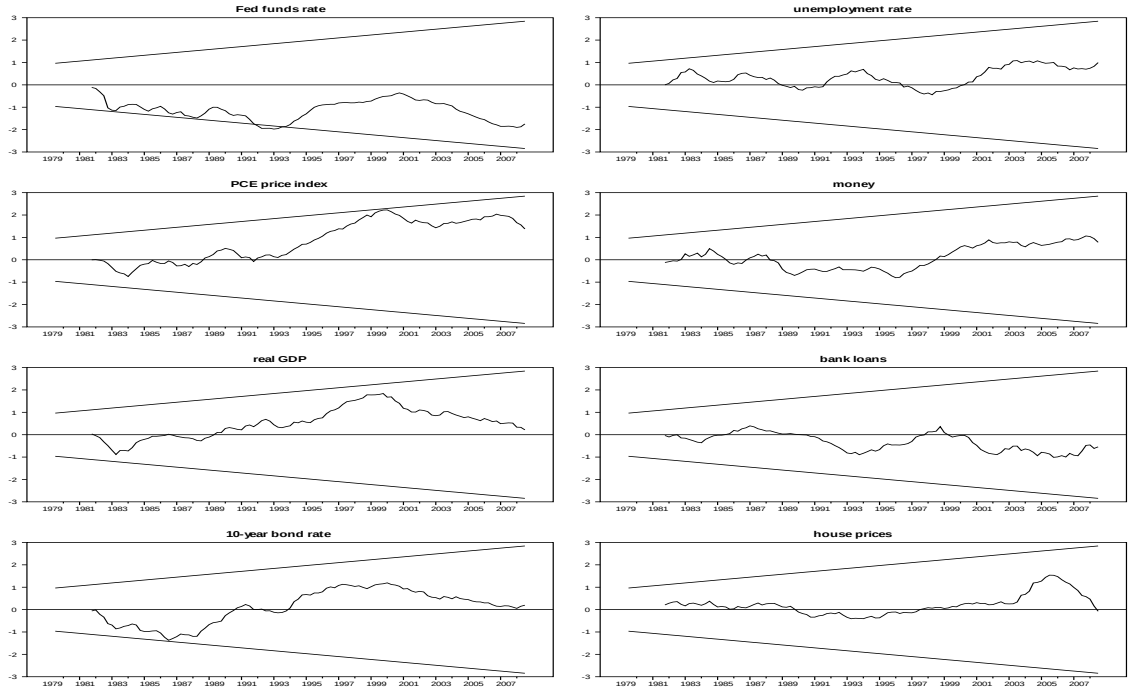

Figure 6. Cusum tests euro area

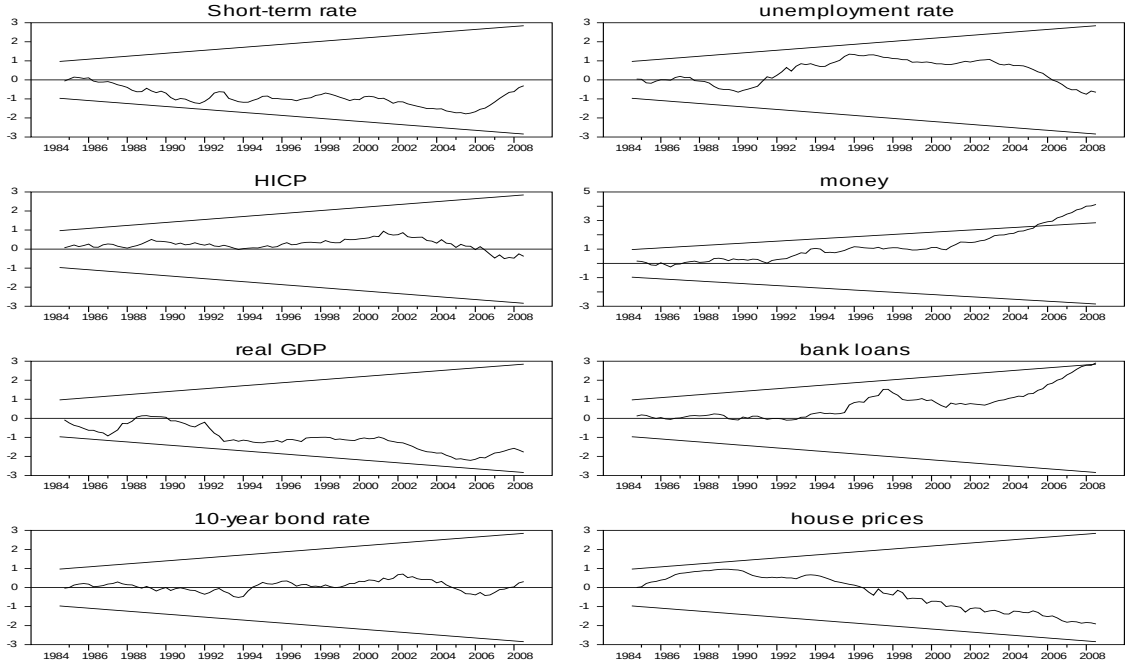

Figure 7 Cusum tests UK

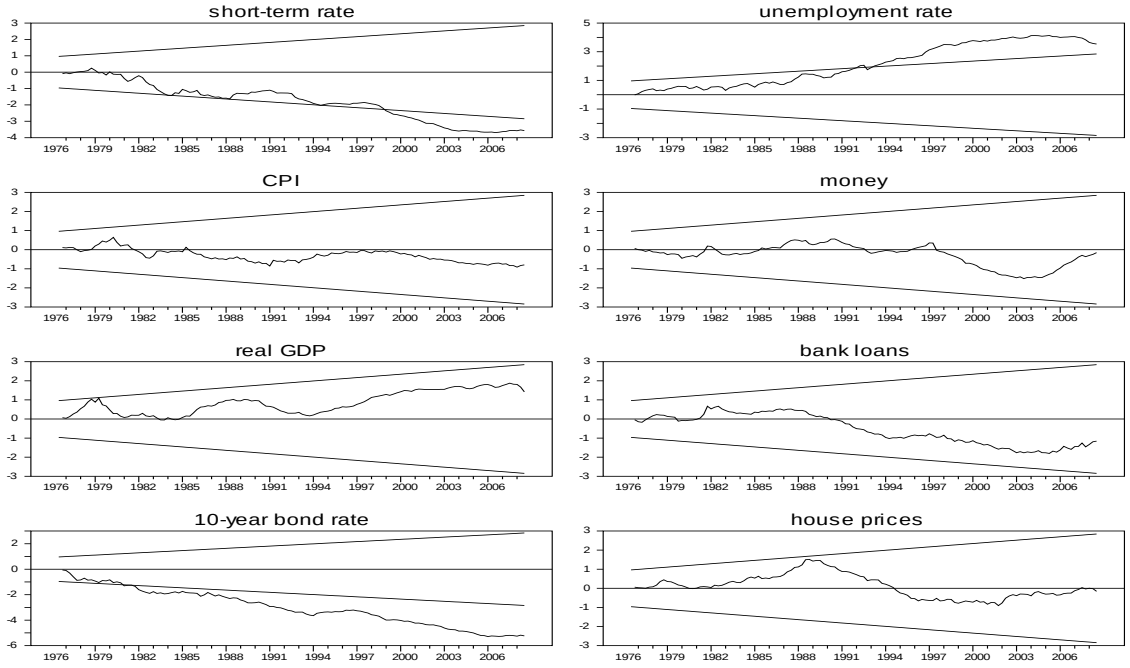

Figure 8. Cusum tests Switzerland

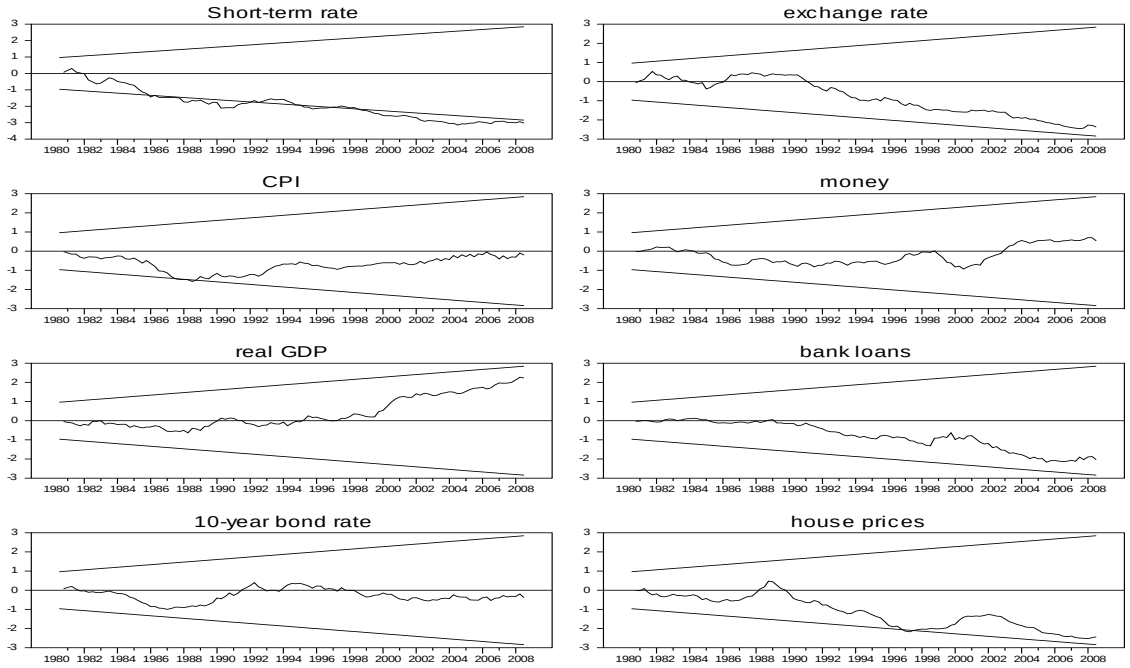

Figure 9. Unconditional and conditional forecasts for the US

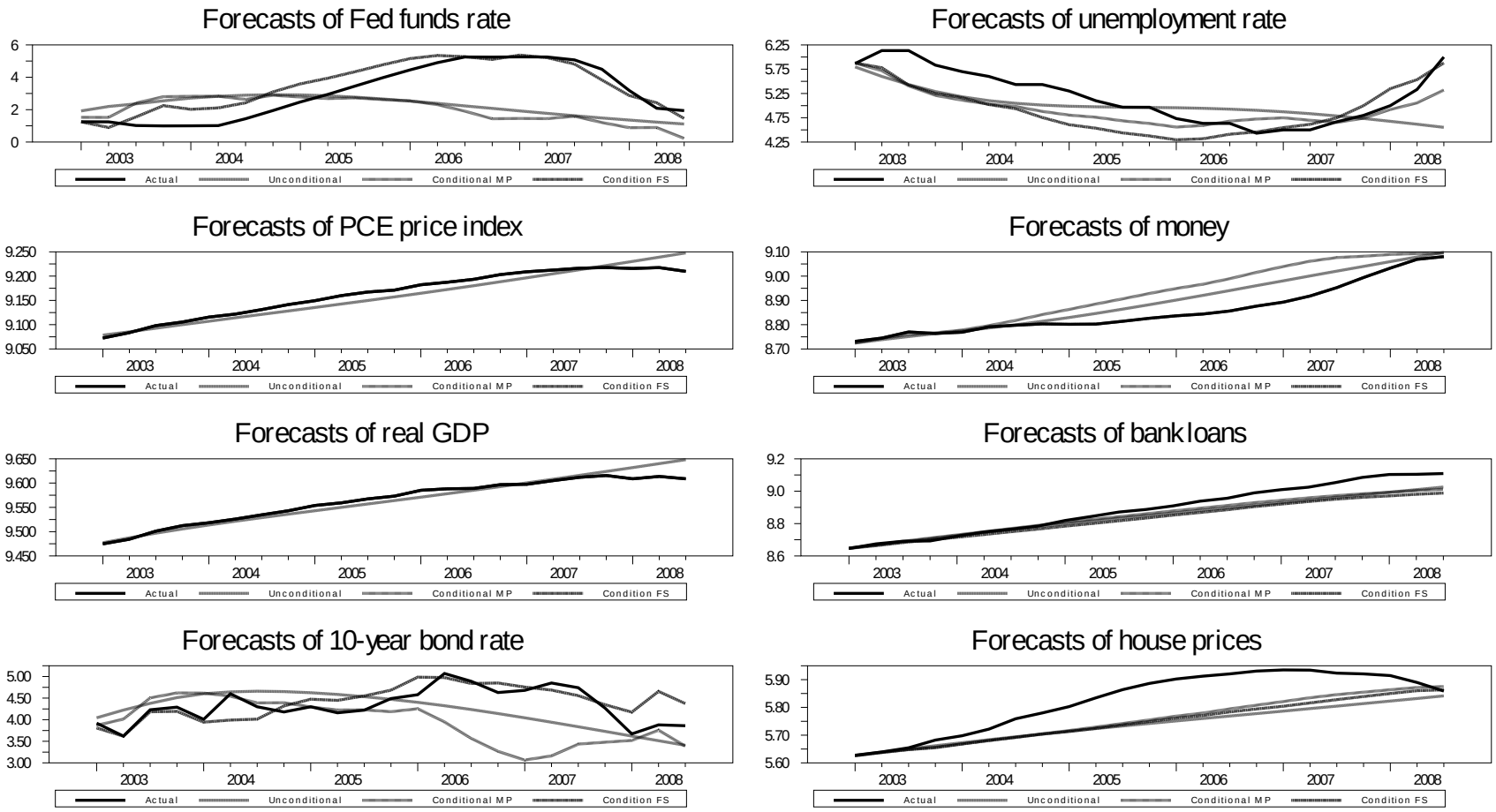

Figure 10. Unconditional and conditional forecasts for the euro area

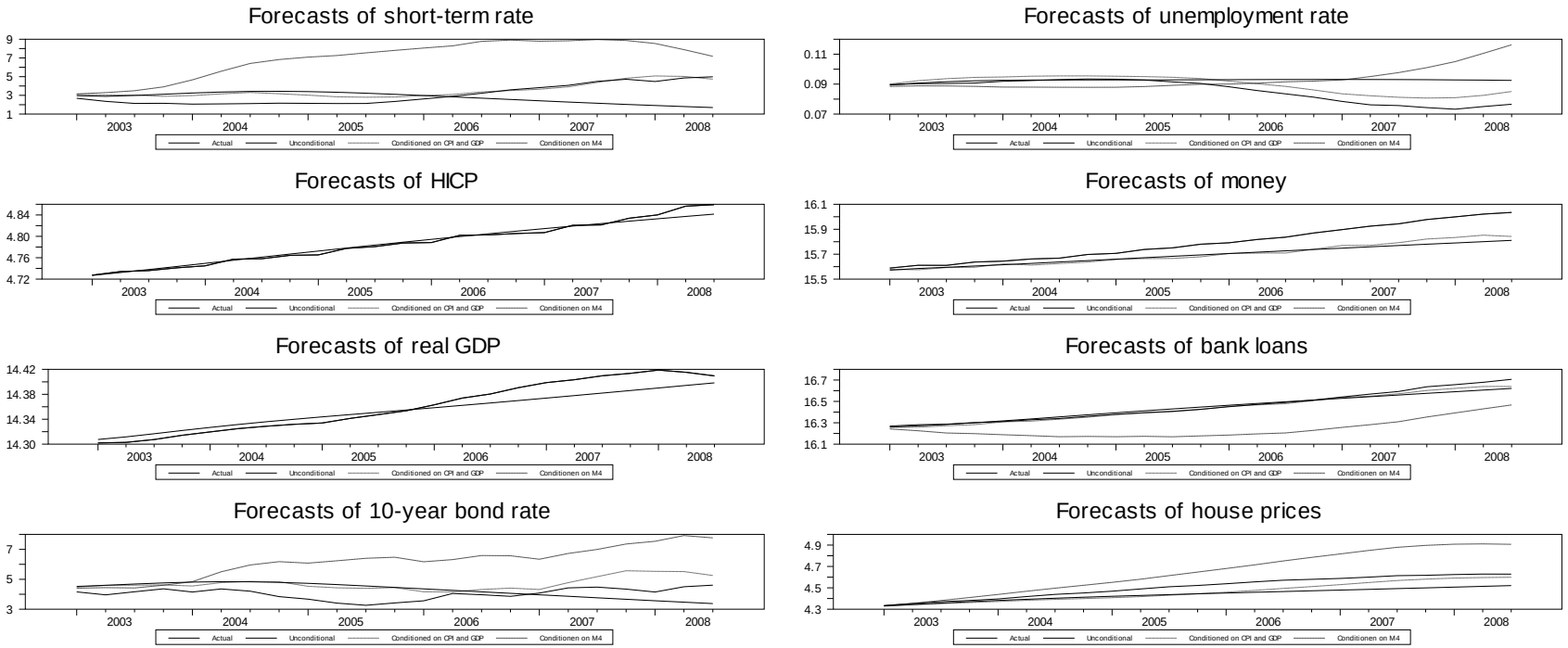

Figure 11. Unconditional and conditional forecasts for the UK

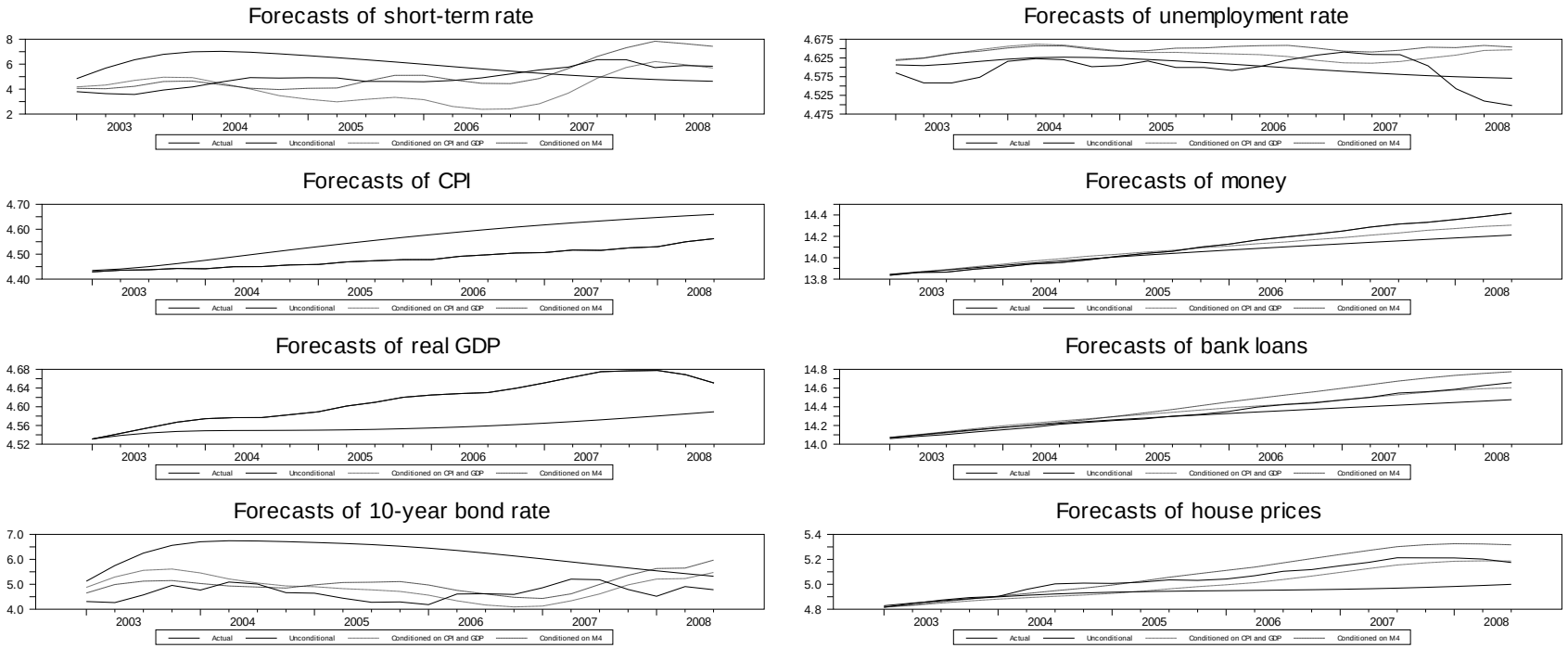

Figure 12. Unconditional and conditional forecasts for Switzerland

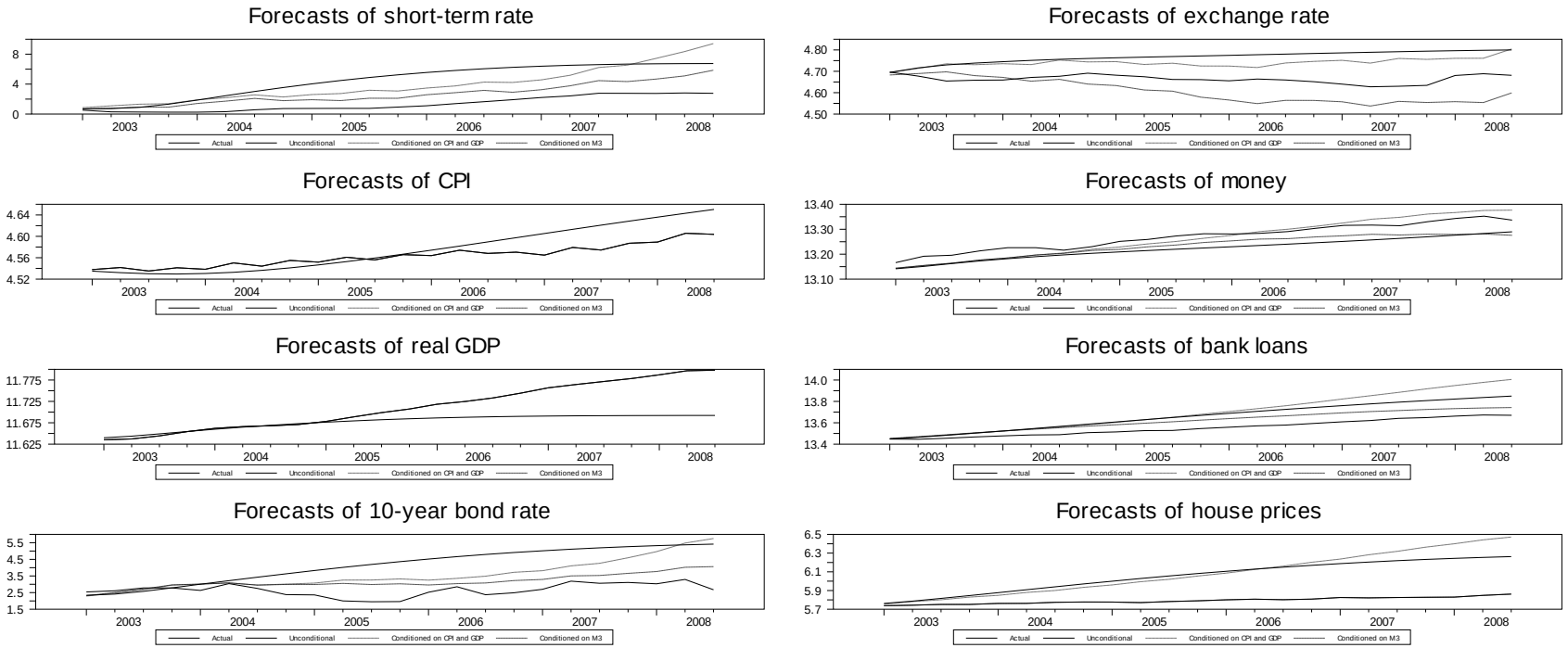

Figure 13. US

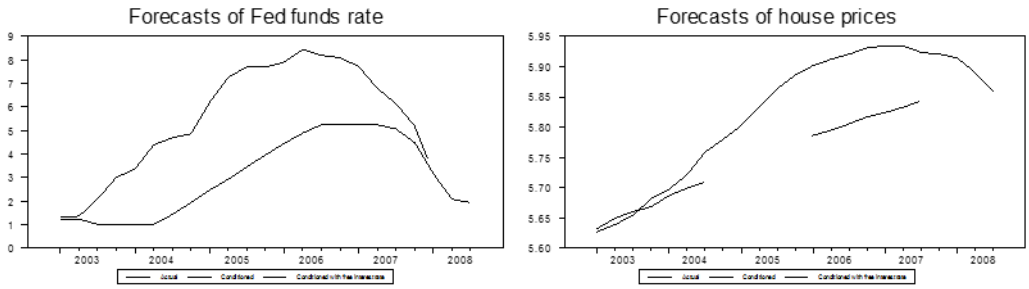

Figure 14. Euro area

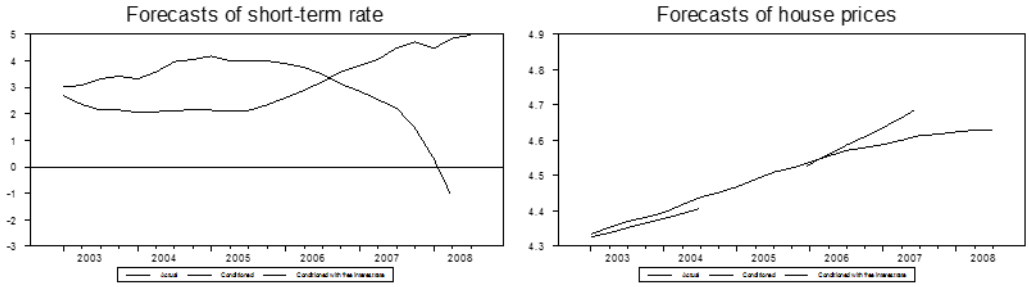

Figure 15. UK

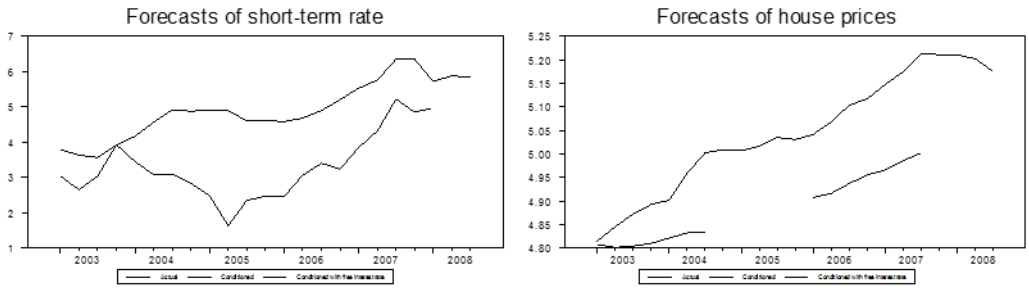

Figure 16. Switzerland