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ASSESSING THE LINK BETWEEN PRICE AND FINANCIAL STABILITY

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Abstract

This paper aims at investigating first the (possibly time-varying) empirical relationship between the level and conditional variances of price and financial stability, and second, the effects of macro and policy variables on this relationship in the United States and the Eurozone. Three empirical methods are used to examine the relevance of A.J. Schwartz's "conventional wisdom" that price stability would yield financial stability. Using simple correlations, VAR and Dynamic Conditional Correlations, we reject the hypothesis that price stability is positively correlated to financial stability. We then discuss the empirical appropriateness of the "leaning against the wind" monetary policy approach.

Keywords: Price stability, Financial stability, DCC-GARCH, VAR

JEL classification: C32, E31, E44, E52

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1. Introduction

Is financial stability correlated to price stability? This topical question matters for policy implementation, since most of the central banks have become responsible for financial stability supervision in the aftermath of the global financial crisis. In spite of its relevance, the literature on the subject is surprisingly limited, and mostly dominated by a "conventional wisdom" on the links between monetary and financial stability summarised by Borio & Lowe (2002, p. 27): "A monetary regime that produces aggregate price stability will, as a by-product, tend to promote stability of the financial system". The conventional wisdom originates in Schwartz (1988, 1995), who emphasizes both a micro and a macro channel in the link between inflation and asset prices. On the micro side, she relates price instability to inflation distortion, growing uncertainty, shortened investment horizons, and governments' nominal gains. All these dimensions produce financial instability. On the macro side, she discusses the impact of price instability on the value of collateral and on financial risk. Then, inflation would encourage speculative investment leading to financial instability.

Besides, the link between financial and price stability is also relevant for the ongoing theoretical debate on the conduct of monetary policy, and in particular on monetary policy instruments and objectives (Woodford, 2012). Assuming that the conventional wisdom is true, a central bank focusing on price stability would then also contribute to financial stability (Bordo & Wheelock, 1998). The recent financial turmoil has cast some doubts on these issues. The dotcom bubble and the subprime crises have indeed erupted in a context of low and stable inflation: the so-called "Great Moderation", where the role of central banks has also been emphasized (Stock & Watson, 2003, or more recently Mumtaz and Surico, 2012). There is consequently a need for an in-depth analysis on the link between price stability and financial stability. To our knowledge, there is no empirical assessment of this link in the literature.

The objective of this paper is to fill this gap and to investigate evidence on the link between the level and conditional variances of price and financial stability from 1993 for the United States (US) and 1999 for the Eurozone (EZ) to 2012, which covers stable and volatile periods and allows us to assess the effect of changing economic conditions on the empirical relevance of the conventional wisdom. It must be stressed that we do not address the issue of the causality as the conventional wisdom is compatible with several approaches.

Based on three statistical and econometrics techniques, we test the hypothesis that price stability is positively correlated to financial stability. This task is made difficult because there is no precise definition of financial instability. Borio (2012) or Drehman, Borio and Tsatsaronis (2012) seek to characterize financial cycles by using ad-hoc frequency-based filters. The identification of financial cycles may be useful to characterize periods of booms and busts but such an approach goes further than what may be financial instability. Hence, we use the indices of financial stability constructed by the ECB and the St Louis Fed, plus asset price variables for robustness purposes.

We assess the link with price stability through three different methods. We start with simple correlation analysis that, while unsophisticated, has the merit of simplicity and clarity while using no statistical or theoretical manipulation of the data. We then test our hypothesis using a simple VAR model using as endogenous variables industrial production, inflation, asset prices and various financial stability indicators. Finally, we estimate a time-varying measure of correlations based on dynamic conditional correlation (DCC). The three methods give converging results. We reject the hypothesis that price stability is positively correlated to financial stability and do not find evidence in support of the conventional wisdom. None of the three empirical methodologies shows a continuous positive link between financial and price stability. Moreover, a negative link sometimes appears.

The rest of this paper is structured as follows. Section 2 presents the related literature. Section 3 describes the data and section 4 the empirical methodologies and the results. Section 5 concludes.

2. Related Literature

2.1. Conventional wisdom, from theory to empirics

The "conventional wisdom" (also known as the Schwartz hypothesis), is based on relatively few contributions. Besides the work of Schwartz (1995), the idea that price and financial stability exhibit a positive correlation is supported by Bordo et al. (2001), Borio & Lowe (2002), and Issing (2003). Schwartz's mainly focuses on the banking sector: "the fact remains that price instability undermines sound banking. It contributes to financial risk" (p. 39). The paper by A.J. Schwartz goes beyond the debt-deflation à la Fisher (1933) as she relates the end of price (hence financial) instability to sound monetary policy. Woodford (2012) also argues that monetary stability eliminate numerous sources of financial stability such as a wage-price spirals. Nevertheless, to our knowledge, only a few empirical papers are specifically dedicated to an empirical assessment of the conventional wisdom. Bordo & Wheelock (1998) or Bordo et al. (2001) conclude that "unanticipated movements in the price level and inflation rate have contributed historically to financial instability in the US', ever more so between 1870 & 1933, or in the 1980s and 1990s".

Before the global financial crisis, the conventional wisdom had already come to be criticized e.g. by Borio & Lowe (2002), White (2006) and Leijonhufvud (2007). These authors claimed that monetary stability could lead to financial instability in the way that it sometimes allows low interest rates (« cheap money ») favoring projects with a high level of risk. The argument is also raised by Taylor (2009) who presents a counterfactual dynamics of housing market prices from 2001 to 2006. He argues that if monetary policy rates had not been excessively low, regarding what is implied by a Taylor rule, the housing boom would have been avoided and no bust would have occurred. These different views also point out that major economic and financial crises were not preceded by inflationary pressures. This is the "paradox of credibility" according to which central bank have gained credibility in curbing inflation leading to an increase in the vulnerability of the financial system and then to financial instability. Thus, it seems that inflation is not a good indicator to predict a banking or financial crisis.

The (assumed positive) correlation between price and financial stability has then become a crucial issue for monetary policy. Some critics urged discussing about the introduction of "financial stability" as an objective of the central bank. These discussions are related to the Tinbergen principle that postulates that N instruments are needed to achieve N objectives. This branch of the literature is abundant (see Disyatat, 2010) but it does not seriously challenge the "conventional wisdom". Indeed, Blanchard et al. (2010) explain that no change is required in the policy reaction function, except a better cooperation with supervisory body. Woodford (2012) proposes only a marginal change in the way that the central bank should embrace a flexible inflation targeting strategy. Some, following White (2009), go a step further and ask for a "leaning against the wind policy".

2.2. Potential theoretical linkages between price and financial stability

According to Bordo & Wheelock (1998), there is no specific theory explaining the conventional wisdom. On the one hand, financial instability may result from monetary disturbances. According to a monetarist view, the unexpected inflation resulting from monetary contractions or expansions may lead to banking panics. On the other hand, the correlation between financial and price stability may also be the consequence of a financial fragility view where in periods of economic booms, confidence improves and leverage increases leading to over indebtedness. Asset prices also increase but not necessarily the price of goods and services. When it increases, it may even inflate the bubble as rising inflation leads to a decrease in the real cost of borrowing. The process ends when agents are unable to repay their debt. The initial shock triggering the bust may either be an exogenous business cycle downturn or a tightening of monetary policy. The economy may then enter a debt-deflation process where price and financial instability fuel each other.

A recent view on the relation between price and financial stability is proposed by Woodford (2012) who builds a simple New Keynesian model in which financial frictions, identified with the spread between safe and risky borrowers reduce the average marginal utility of income, for a given level of real activity. Thus, larger credit frictions impact both the IS (reducing aggregate demand for given inflation), and the Phillips curve (increasing inflationary pressures for given levels of the output gap). Financial frictions may increase with an endogenous probability increasing on the level of leverage of the economy that in turn is positively related, via the level of intermediation, to the output gap. This simple modification of an otherwise standard allows the emergence of a number of results. First, with completely exogenous credit frictions, it is possible to show that inflation targeting remains the optimal strategy for central banks, and that credit frictions play the same role as cost push shocks: increasing financial instability yields inflationary pressure, and requires the central bank to increase interest rates to stabilize prices.

Woodford then shows that when the probability of crises is endogenous, and related to the level of leverage in the economy, flexible inflation targeting remains the optimal monetary policy strategy. Nevertheless, if the risk of financial crises increases beyond a certain threshold, then it may be optimal for the central bank to "lean against the credit boom", increasing rates beyond the level that would be required by the macroeconomic variables. As a consequence, the central bank could be led to undershoot both the inflation rate and the output gap objectives.

While Woodford himself acknowledges that the step between his model and practical guidelines for central bank action remains wide, his paper highlights the theoretical channel between financial stability and price stability that mostly goes through an augmented version of the Phillips curve. To summarize, Woodford concludes from his analysis that (a) monetary policy impacts financial and price stability in the same direction, thus lending support to the Conventional Wisdom; this is especially true in normal times, when the impact of financial crisis probabilities on the conduct of monetary policy is negligible; (b) that when financial crises risk increases substantially, it may become optimal to undershoot the inflation objective (i.e. that whenever facing the risk of financial instability, it is better to err on the restrictive side).

Woodford's argument is nevertheless nuanced by the possible conflict of objectives in situations of high risk:

> "Nor does the analysis offered here imply in any way that the conventional monetary policy should be assigned *the* primary responsibility for containing risks to financial stability, so that other regulatory and supervisory safeguards are unnecessary. To the contrary, because the analysis identifies reasons for a tension to exist between the conventional stabilization goals and the goal of reducing the distortions resulting from financial crises (over and above their consequences for the stability of inflation and the output gap), it implies that the existence of additional policy instruments — that could ensure that significant variations in marginal crisis risk never occur, even when conventional interest- rate policy is used purely to minimize the variability of inflation and the output gap — should allow better outcomes on both dimensions. Hence the development of such tools, possibly including new instruments of "macroprudential policy is highly desirable to extent that it proves to be practical. (Woodford, 2012, p. 22)

Woodford's model, therefore, reaches the conclusion that standard inflation targeting strategies are only exceptionally altered by the possibility of financial instability, and that the latter problem is best dealt with by appropriate regulation. His conclusion is that monetary policy as we came to know it before the crisis needs not to be substantially reshaped.

Gali (2013) reaches a different conclusion. In a rational-expectations setting, he argues that a bubble has two different components which react differently to a change in short-term interest rates: the fundamental component and the bubble (or self-fulfilling) component. The fundamental component clearly confirms the usefulness of the "leaning against the wind" monetary policy: a higher nominal short-term interest rate will dampen aggregate demand. The bubble component requires dampening *future* aggregate demand; hence it requires a lower short-term nominal interest rate. The optimal monetary policy depends on the relative size of the bubble component *vis-à-vis* the fundamental one. Though his model does not incorporate credit or financial frictions, Gali (2013) warns against a "leaning against the wind" policy, and advocates further research on macroprudential policies.

3. Data

Our data set focuses on price and financial stability variables from the United States and the Eurozone. We deal with monthly samples: 1993M12-2012M12 for the US and 1999M01-2012M12 for the EZ. Samples' lengths are limited by the availability of financial stability indices.

As a measure of price stability, we both use the consumer price index and the GDP deflator in the US and in the EZ. The measure of financial stability is far more controversial (Allen & Wood, 2006)[1]. It is a polymorphous concept as it may either be related to the volatility of some asset prices, to the financial conditions of financial institutions or to the ability of the financial system

[1] See also Creel, Hubert and Labondance (2013).

to deal with shocks. No consensus has clearly emerged so far to provide a definition. In this paper, the empirical analysis is realised with the financial stability indicators constructed by the Federal reserve of St Louis for the US and by the ECB for the EZ. The St Louis financial stress index (STLFSI) measures the degree of financial stress in the markets and is constructed from 18 weekly data series: seven interest rate series, six yield spreads and five other indicators. Each of these variables captures some aspect of financial stress. Accordingly, as the level of financial stress in the economy changes, the data series are likely to move together[2]. The ECB has also constructed a composite indicator of systemic stress (CISS). The CISS includes 15 raw, mainly market-based financial stress measures that are split equally into five categories, namely the financial intermediaries sector, money markets, equity markets, bond markets and foreign exchange markets. The CISS thus places relatively more weight on situations in which stress prevails simultaneously in several market segments. It is unit-free and constrained to lie within the interval (0, 1). For further details, see Hollo, Kremer and Lo Duca (2012).

Beyond STLFSI and CISS, we also use other macroeconomic variables in our VAR and DCC specifications. All variables, except FSI, are in Y-o-Y growth rates. Table 1 presents their definition and sources. Figure 1 plots price and financial stability data and Table 2 presents descriptive statistics.

4. Identifying the Link between Price and Financial Stability

We assess the link between price and financial stability through three methods: simple correlation, VAR and DCC. As the conventional wisdom does not provide any clear guidance on any structural relation between financial and price stability, these methods appear consistently appropriate as they focus on different statistical representations of the link between the two variables of interest and do not rely on specific theoretical foundations. The first method looks at the simple static correlation between levels of the 2 variables of interest. The second assesses how exogenous shocks to one of the variable of interest affect the level of the other. It adds information, relative to the simple correlation analysis, as the VAR enables to take into account the past dynamics of price stability and financial stability and to identify shocks, orthogonal to macro variables (industrial production, inflation and the central bank interest rate) and variables possibly affecting price and financial stability (loans, monetary aggregate, housing prices and stock market prices), in order to assess the response of financial stability (respectively price stability) to a shock on price stability (respectively price stability). The third investigates the dynamic conditional correlation (DCC) between conditional variances of the two variables. This method presents two additional advantages relative to the static correlation and VAR analyses. First, the approach is time-varying, which improves the information relative to a static correlation approach. Second, it is based on an estimate of the conditional volatility resulting from GARCH model within a multivariate framework. Most recent papers drawing on DCC have investigated the linkages between bond prices (Antonakakis, 2012), stock prices (Cai, Chou and Li, 2009), stock and bond prices (Yang, Zhou and Wang, 2009) with an extension to commodity futures (Silvennoinen and Thorp, 2013) or to commodity prices (Creti, Joets and Mignon, 2013). Though Cai et al. and Yang et al. take care of the inflation environment, they do not study the linkages between financial and consumer prices *per se*.

[2] The latest STLFSI press release, with commentary, can be found at http://www.stlouisfed.org/newsroom/financial-stress-index.

4.1. Simple correlation

We first address our research question in computing correlation coefficients between inflation and financial stability indicators. Correlations are measured here for the whole sample and are presented in Table 3. Figure 2 shows scatterplots of price and financial stability variables together with linear fit and Epanechnikov-Kernel smoothing lines. Whereas the conventional wisdom assumes a positive correlation between price and financial stability, we do not find such a result with our data. Results for the Eurozone show a negative correlation coefficient which is not significant with CPI, suggesting the absence of a relationship between price and financial stability in Europe since 1999. The correlation is found negative and statistically significant for the GDP deflator. Results for the United States are also inconclusive in terms of the conventional wisdom. They suggest that prices, measured either by CPI or GDP deflator, and financial stability are not or negatively correlated.

4.2. VAR

We second estimate a VAR model for the US and the EZ composed of a vector of 8 endogenous variables ordered in the following way: house prices, industrial production, consumer price index, loans to the non financial sector, money supply, main central banks' interest rate, stock markets and the financial stability index [HOUS, INDPRO, CPI, LOAN, M, CBRATE, STOCK, FSI]. The identification of shocks is based on Cholesky decomposition. Variables' ordering is supposed to mimic the speed of reaction of each series. Financial market variables are supposed to react the fastest and macro variables data the slowest. Estimations are performed with 3 lags. The case of house prices may yet be specific as it can be considered as a financial variable which adjusts slowly, notably because the price is not set daily on an organized market. The VAR model enables to take into account the past dynamics of each variable when assessing the correlation between price and financial stability. Hence, the shock on financial stability is interpreted as the unexpected component of FSI once the past dynamics of all the variables from the VAR and the current unexpected shock on the other 7 variables of the VAR have been taken into account.

As the focus of the paper is on the effect of financial stability on price stability and vice versa, Figure 3 provides the corresponding impulse response functions (IRF) both in the US and the EZ. Results in the US are significantly asymmetric. Indeed, an inflationary shock in the US increases financial instability. We isolate a positive link in this direction. The impact is significant for more than 12 months when the shock is measured by CPI inflation and only for a few months when it is measured by GDP deflator. On the contrary, a financial instability shock reduces inflation. Here the shock on the financial stability index might reflect an increase in financial fragility or a financial crisis leading to a reduction of inflation and, in the worst case, to a debt-deflation process. Results thus show evidence of a positive and a negative link between financial instability and price stability in the US. Results in the Eurozone indicate the same asymmetry with the response of the financial stability variable to a shock to the GDP deflator being insignificant.

4.3. Dynamic Conditional Correlations

The two previous methods failed to lend support to the conventional wisdom, in that no clear positive relationship emerges between indicators of price stability and indicators of financial stability. This outcome could be due to the length of the time span that we considered (almost two decades for the United States, and slightly less for the Eurozone). Indeed, the existence of structural breaks could affect the results. Therefore, it is certainly worth resorting to a time-varying analysis of correlation to assess whether there have been sub-periods over which the conventional wisdom can be supported by data. To identify the possibly time-varying relationship between price and financial stability, we estimate a time-varying measure of correlations based on the dynamic conditional correlation (DCC) model of Engle (2002), in which the conditional correlation follows a GARCH(1,1) process.

The GARCH model is a specification of both the conditional mean and the conditional variance, where the variance is a function of prior unanticipated innovations ε_t^2 and prior conditional variances σ_t^2.

$$y_t = \beta X_t + \varepsilon_t, \text{ with } \varepsilon_t \sim (0, \sigma_t^2)$$
$$\sigma_t^2 = \gamma_0 + \gamma_1 \sigma_{t-1}^2 + \gamma_2 \varepsilon_{t-1}^2$$

A DCC-GARCH model (see Engle, 2002) can be viewed as a multivariate representation of a univariate GARCH process from which dynamic covariance is computed from conditional variance. The procedure involves 2 steps: first, estimating the conditional volatility of each individual series and, second, capturing dynamics in the covariance of the standardized residuals from the first stage procedure and using them as inputs to estimate a time-varying correlation matrix.

We estimate four different DCC-GARCH models for inflation and financial stability:

1. a specification with a constant only. Here financial stability and inflation are therefore determined by a constant term. It is the most parsimonious model. For the equation explaining inflation, it boils down to the case where inflation is equal to a target plus an error term. There is no link between price and financial stability except in the variance—covariance matrix,
2. a specification including potential components of financial instability: housing prices, stock market prices, loans to private sector's volumes, and a monetary aggregate (see Bordo et al., 2001),
3. a specification including policy variables: the central bank interest rate and the monetary aggregate,
4. a specification including all variables of models 2 and 3.

When interpreting the results, one has to keep in mind that the DCC matrix is a weighted average of the unconditional covariance matrix of the standardized residuals, and of parameters that govern the dynamics of conditional quasi-correlations. The DCC matrix is not the unconditional correlation matrix and for this reason, it is generally labeled "quasi-correlations"; see Aielli (2009) and Engle (2009).

Quasi-correlation coefficients are shown in Table 4. Results are broadly in line with simple correlation coefficients. In the US, quasi-correlation coefficients are negative, except between CPI and FSI in model 4, but this coefficient is not statistically significant. In the case of the Euro zone, results are less clear-cut. On the one hand, results with CPI are never statistically significant. On the other hand, three models give a significant coefficient between PGDP and FSI (models 1, 3 and 4), but model 1 gives a positive coefficient, whereas models 3 and 4 give negative ones.

The dynamic correlations for each specification and for the two indicators of inflation are plotted in Figure 4. The solid blue constant line is the average of the dynamic correlation. These results indicate that the co-evolution of financial and price stability conditional variances is highly volatile on the sample. Stated differently, the correlation between price and financial stability conditional variances does not present any empirical regularity. It can be either positive or negative for several months and then it can rapidly switch sign. The DCC approach shows that the conventional wisdom, according to which price and financial stability go hand in hand, is clearly not confirmed by the empirical analysis. As a consequence, it is hard to conclude that ensuring price stability can be a necessary or sufficient condition to achieve financial stability. Yet, there are even some periods, when one uses models which include the US GDP deflator, over which the dynamic correlation is clearly negative. This is notably the case between the early 2000s and mid-2007. It is ever more striking after 2003 when the DCC exhibits a clear and long-lasting negative relationship. This empirical feature is illustrated in the 4 specifications. During this sub-period of great moderation, inflation was contained and financial imbalances, notably in the housing market were growing. It gives force to the argument of the paradox of credibility illustrated by Borio and White (2004) or White (2006). Section 5 will provide further insights on that issue.

4.3. Robustness with stock prices

For robustness purposes, we carry on the same three methodologies replacing FSI by stock market prices. Table 5 presents the results for the simple correlation coefficients. For the US, results remain the same but, in the Eurozone, they are now clearly negative and significant. Scatterplots are shown in Figure 5. IRFs from the VAR methodology are represented in Figure 6. Inflation shocks affect negatively the stock markets in the US and in the Eurozone. Finally, DCC results are presented in Figure 7: in accordance with former DCC outcomes, they are from time to time either positive or negative, showing that the stock prices-price stability nexus evolves over time.

Results provided by the IRFs are very interesting in the sense that they show that a negative inflation shock has a positive effect on stock prices. This result can be related with the argument suggested by Leijonhufvud (2007). During periods of low inflation and low interest rates, investors are eager to find high returns. In absence of strong regulations, this has led to the development of financial innovations that have proven riskier and able to generate financial instability.

5. Determinants of the Link between Price and Financial Stability

Finally, we seek to investigate whether there are macroeconomic, monetary or financial determinants to the correlation between price and financial stability. Finding determinants to this correlation might possibly shed light on the overall instability of DCC estimates. To this end, we compute different OLS estimations, drawing on DCC estimates from our four models as the dependent variable. Results are reported in Table 6. There is a clear distinction between the results drawn from the US or from the Eurozone case.

In the US, several results can be identified. A higher financial instability (superior to its mean) is positively correlated with a higher (superior to its mean) correlation between price and financial stability. It confirms that financial instability can trigger economic turmoil, increasing then price instability. The same result holds between, on the one hand, higher inflation, higher money supply and higher industrial production and, on the other hand, a higher DCC. Turning to the Fed's decisions, a high Fed interest is positively correlated with a high DCC between price and financial stability whereas long-term government interest rates are not significant. This may explain why, in the early years of 2000, we have observed a stable negative correlation between price and financial stability in the US. On the contrary, a tighter monetary policy would be positively correlated with the link between price and financial stability, hence giving some empirical weight to the "leaning against the wind" position. Finally, estimations show that the occurrence of the crisis is positively correlated with the link between price and financial stability.

In the Eurozone, results are far less conclusive. A higher financial instability (superior to its mean) is positively correlated with a higher (superior to its mean) link between price and financial stability. This result is in line with what has been highlighted for the US. Yet, contrary to the US, the reverse is not true: inflation is not a statistically significant determinant of DCC estimates, except when the PGDP-FSI link in model 3 is investigated. In this latter case, GDP inflation is positively correlated with the DCC. Monetary supply has a weak positive correlation with the DCC. The same is true for industrial production and long term government bond yields in model 1. This might be attributed to the European sovereign debt crisis. Regarding the correlation between ECB interest rate policy and the DCC, results are at odds with what was found in the US case. The ECB MRO (main refinancing operation) rate has no significant explanatory power on the dynamic correlation between price and financial stability, except in model 1 for the PDGP-FSI link, but the coefficient is negative. In the general case, a tight monetary policy in the Eurozone cannot be expected to have an impact on financial stability. This outcome disputes a crucial assumption of the "leaning against the wind" position. Finally, the crisis is only positively correlated in model 3 for the FSI-PGDP link.

6. Conclusion

This paper describes empirically the relationship between the level and conditional variances of price and financial stability in the US and the Eurozone. Results are based on three methodologies: simple correlation coefficient, VAR and DCC-GARCH. Finally, we examine the determinants that are correlated with the DCC. The main result is that no evidence supports the conventional wisdom in the US (resp. Eurozone) economies since the early (resp. late) 1990s. None of the three empirical methodologies shows a continuous positive link between financial and price stability. Moreover, a negative link sometimes appears in the data.

This result suggests that the conventional wisdom is not empirically well grounded and it therefore questions the relevance of policy prescriptions drawing from this "wisdom". Evidence showed that financial instability can develop itself even in a low inflation environment. Financial stability should certainly be addressed independently from the objective of price stability. Some other results of this paper discuss the "leaning against the wind" monetary policy: a contradiction arises between the US, where this policy might be appropriate, and the Eurozone, where it might not be. Drawing on the absence of a shared conclusion between these two countries, financial stability should be addressed with other instruments than the sole interest rate fixed by central banks. Macro and micro regulations may prove useful to foster financial stability.

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Table 1: Data Description

Variable	Definition	Source
us_cpi	Consumer Price Index for All Urban Consumers: All Items	FRED
us_pgdp	Gross Domestic Product: Implicit Price Deflator monthly interpolated (linear match)	FRED
us_fsi	St. Louis Fed Financial Stress Index	FRED
us_hous	Median Sales Price for New Houses Sold in the United States	FRED
us_stock	S&P 500 Stock Price Index	FRED
us_loan	Loans and Leases in Bank Credit, All Commercial Banks	FRED
us_m	Money Zero Maturity - Money Stock	FRED
us_indpro	Industrial Production Index	FRED
us_cbrate	Effective Federal Funds Rate	FRED
us_bonds	10-Year Treasury Constant Maturity Interest Rate	FRED
us_rbonds	Real 10-Year Treasury Constant Maturity Interest Rate	Authors' computation
ez_cpi	Euro area HICP - Overall index	ECB
ez_pgdp	Gross Domestic Product Deflator for the Euro Area, monthly interpolated (linear match)	ECB
ez_fsi	Euro area CISS, Systemic Stress Composite Indicator.	ECB
ez_hous	Euro area , Residential property prices, New and existing dwellings; Residential property in good & poor condition; Whole country	ECB
ez_stock	Dow Jones Euro Stoxx 50 Price Index - Historical close, average of observations through period	ECB
ez_loan	Euro area, Monetary and Financial Institutions (MFIs) reporting sector-Loans, Total maturity, Non-Financial corporations (S.11) sector	ECB
ez_m	M3 for the Euro Area	ECB
ez_indpro	Euro area Industrial Production Index, Total Industry (excluding construction)	ECB
ez_cbrate	Main refinancing operations interest rate	ECB
ez_bonds	Long-Term Government Bond Yields: 10-year: interest rate Main (Including Benchmark) for the Euro Area	ECB
ez_rbonds	Real Long-Term Government Bond Yields: 10-year interest rate	Authors' computation
oil	Spot Oil Price: West Texas Intermediate	FRED

Table 2: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
us_cpi	229	2,48	1,13	-1,99	5,53
us_pgdp	229	1,99	0,66	0,22	3,38
us_fsi	229	0,03	1,00	-1,32	5,49
us_hous	229	3,63	6,11	-14,51	18,08
us_stock	229	5,15	17,76	-42,27	48,75
us_loan	229	4,08	4,13	-10,89	10,55
us_m	229	4,92	5,06	-5,96	19,28
us_indpro	229	2,25	4,58	-15,15	8,73
us_cbrate	229	3,21	2,23	0,07	6,54
us_bonds	229	4,73	1,44	1,53	7,96
us_rbonds	229	2,25	1,64	-1,92	5,55
ez_cpi	168	2,07	0,77	-0,60	4,00
ez_pgdp	168	1,74	0,57	0,57	2,82
ez_fsi	168	0,22	0,18	0,04	0,78
ez_hous	168	3,86	3,33	-4,36	7,52
ez_stock	168	1,19	23,38	-45,12	50,87
ez_loan	168	5,64	5,22	-3,92	15,11
ez_m	168	5,95	3,53	-2,07	12,62
ez_indpro	168	0,70	5,60	-21,44	9,05
ez_cbrate	168	2,52	1,19	0,75	4,75
ez_bonds	168	4,25	0,68	2,10	5,70
ez_rbonds	168	2,18	1,00	-0,19	4,69
oil	229	11,34	34,05	-58,97	136,76

Table 3: Correlation pairs

	us_fsi	us_cpi	us_pgdp		ez_fsi	ez_cpi	ez_pgdp
us_fsi	1			ez_fsi	1		
us_cpi	-0,32	1		ez_cpi	-0,05	1	
	(0,00)				(0,52)		
us_pgdp	-0,34	0,93	1	ez_pgdp	-0,28	0,39	1
	(0,00)	(0,00)			(0,00)	(0,00)	
N		229		N		168	

Note: Significance level of each correlation coefficient in parenthesis.

Table 4: DCC Quasi-Correlation Coefficients

Variable	Obs	Coef	Robust SE	*p-value*
US				
CPI - FSI (model 1)	229	-0,30	0,13	0,02
PGDP - FSI (model 1)	229	-0,49	0,17	0,00
CPI - FSI (model 2)	229	-0,25	0,17	0,13
PGDP - FSI (model 2)	229	-0,53	0,18	0,00
CPI - FSI (model 3)	229	-0,20	0,15	0,20
PGDP - FSI (model 3)	229	-0,58	0,24	0,01
CPI - FSI (model 4)	229	0,03	0,23	0,91
PGDP - FSI (model 4)	229	-0,39	0,25	0,11
EZ				
CPI - FSI (model 1)	168	0,17	0,15	0,23
PGDP - FSI (model 1)	168	0,61	0,13	0,00
CPI - FSI (model 2)	168	0,02	1,16	0,99
PGDP - FSI (model 2)	168	0,04	0,22	0,88
CPI - FSI (model 3)	168	0,04	0,15	0,78
PGDP - FSI (model 3)	168	-0,58	0,11	0,00
CPI - FSI (model 4)	168	-0,13	0,15	0,39
PGDP - FSI (model 4)	168	-0,32	0,16	0,04

Table 5: Correlation pairs

	us_stock	us_cpi	us_pgdp		**ez_stock**	ez_cpi	ez_pgdp
us_stock	1			**ez_stock**	1		
us_cpi	-0,31	1		ez_cpi	-0,17	1	
	(0,00)				(0,01)		
us_pgdp	-0,31	0,93	1	ez_pgdp	-0,44	0,39	1
	(0,00)	(0,00)			(0,00)	(0,00)	
N		229		N		168	

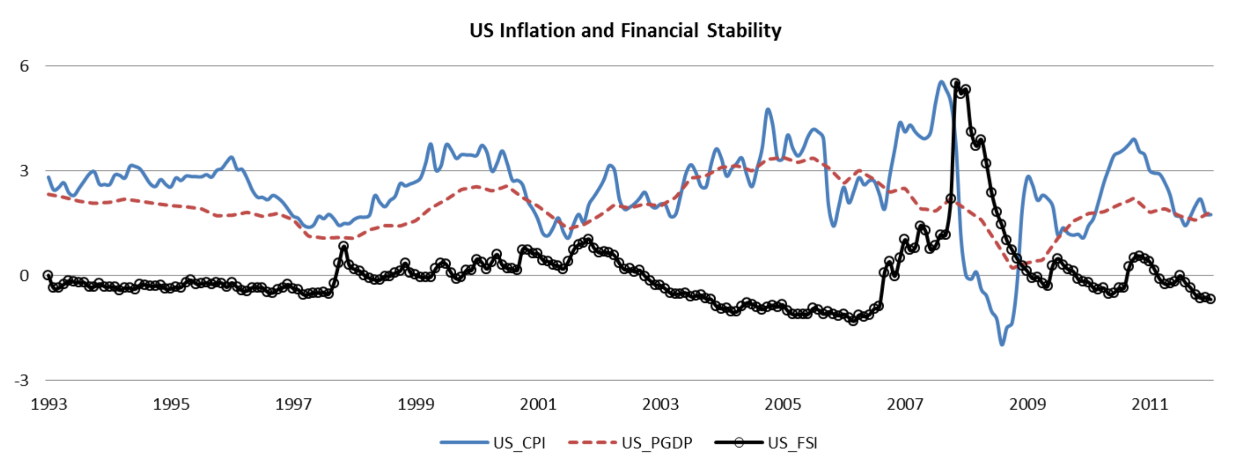
Note: Significance level of each correlation coefficient in parenthesis.

Table 6: Determinants of DCC

	US				EZ			
	Model 1		Model 3		Model 1		Model 3	
	dcc_fsi_cpi	dcc_fsi_pgdp	dcc_fsi_cpi	dcc_fsi_pgdp	dcc_fsi_cpi	dcc_fsi_pgdp	dcc_fsi_cpi	dcc_fsi_pgdp
fsi	0.19***	0.20***	0.17***	0.25***	1.18**	0,28	1.11**	-1.60***
	[0.05]	[0.05]	[0.05]	[0.05]	[0.46]	[0.58]	[0.43]	[0.60]
cpi	0.15***		0.09**		0,11		-0,04	
	[0.05]		[0.04]		[0.07]		[0.07]	
pgdp		0.18*		0,1		0,02		0.44**
		[0.09]		[0.09]		[0.14]		[0.20]
cbrate	0.12***	0.09**	0.07*	0.08**	0,01	-0.37***	0,03	0,04
	[0.03]	[0.03]	[0.03]	[0.04]	[0.08]	[0.08]	[0.08]	[0.10]
m	0,02	0.04***	0.03***	0.09***	0,02	0.05*	0,04	0,05
	[0.01]	[0.01]	[0.01]	[0.01]	[0.03]	[0.03]	[0.03]	[0.03]
indpro	0.03**	0.06***	0.03**	0.08***	0.02*	0.03***	0.04***	0.02**
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
bonds	-0,06	0,05	-0,03	0,11	0,04	0.30***	0	0,17
	[0.05]	[0.06]	[0.05]	[0.07]	[0.09]	[0.08]	[0.08]	[0.12]
oil	0	-0.00***	0.00***	0	0.00*	0	0.00**	0
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
crisis	0,17	0.83***	-0,09	0.59**	-0,27	-0,29	-0,13	0.92**
	[0.17]	[0.18]	[0.18]	[0.25]	[0.25]	[0.28]	[0.25]	[0.41]
_cons	-0.81**	-1.63***	-0.53*	-1.74***	-0.66*	-0,21	-0,59	-1.95***
	[0.32]	[0.46]	[0.32]	[0.51]	[0.40]	[0.39]	[0.36]	[0.60]
N	229	229	229	229	168	168	168	168
R^2	0,22	0,24	0,23	0,39	0,23	0,17	0,28	0,23

Note: Robust standard errors in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Figure 1 – Data



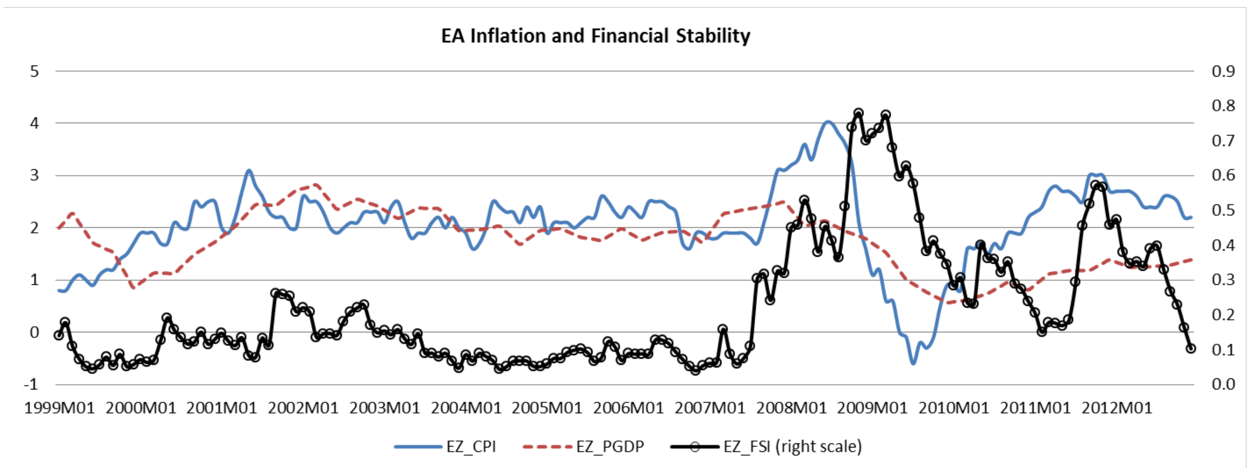


Figure 2 – Linear Fit and Epanechnikov-Kernel smoothing lines (with 95% confidence bands) of the link between Price and Financial Stability variables

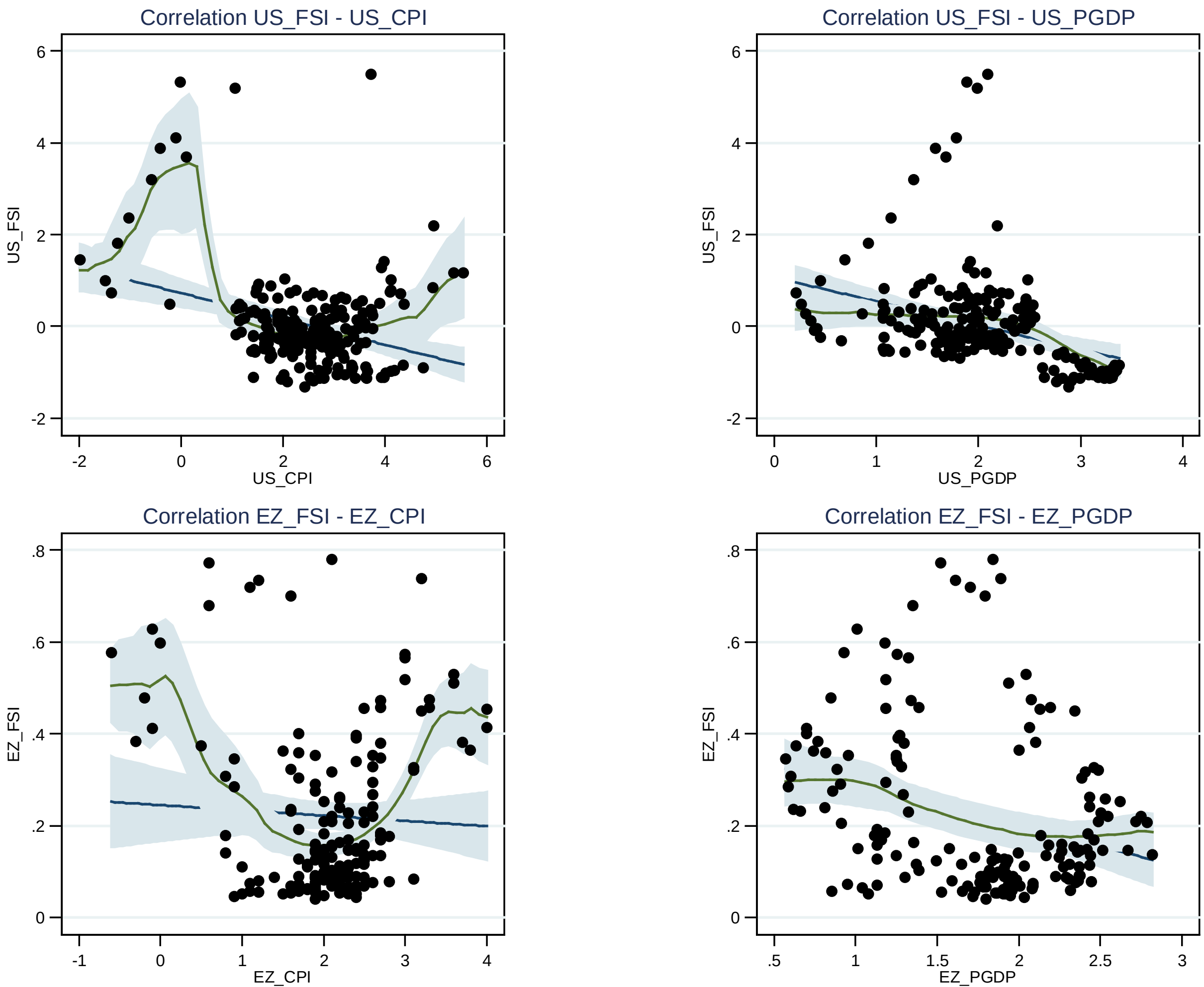
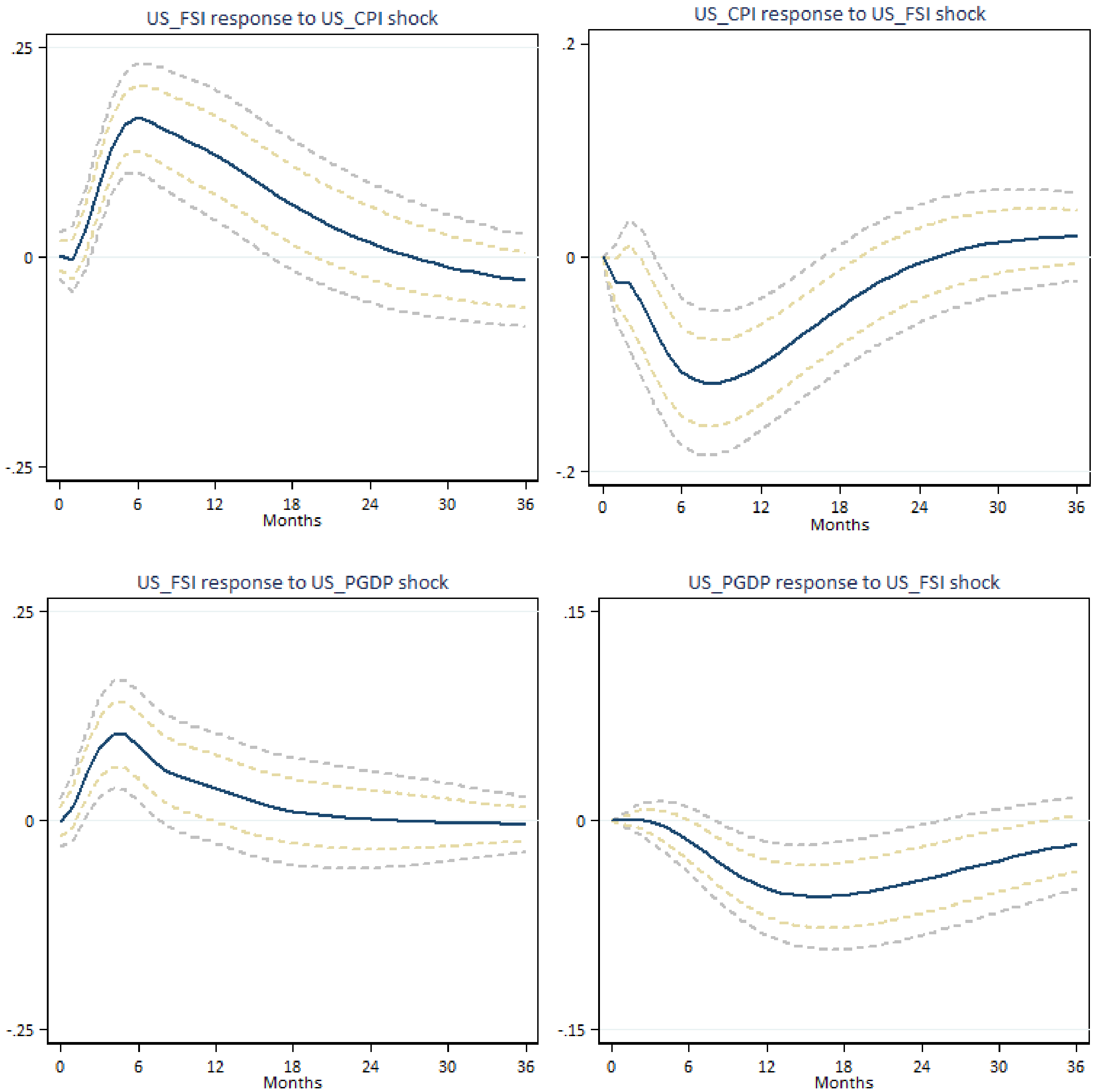
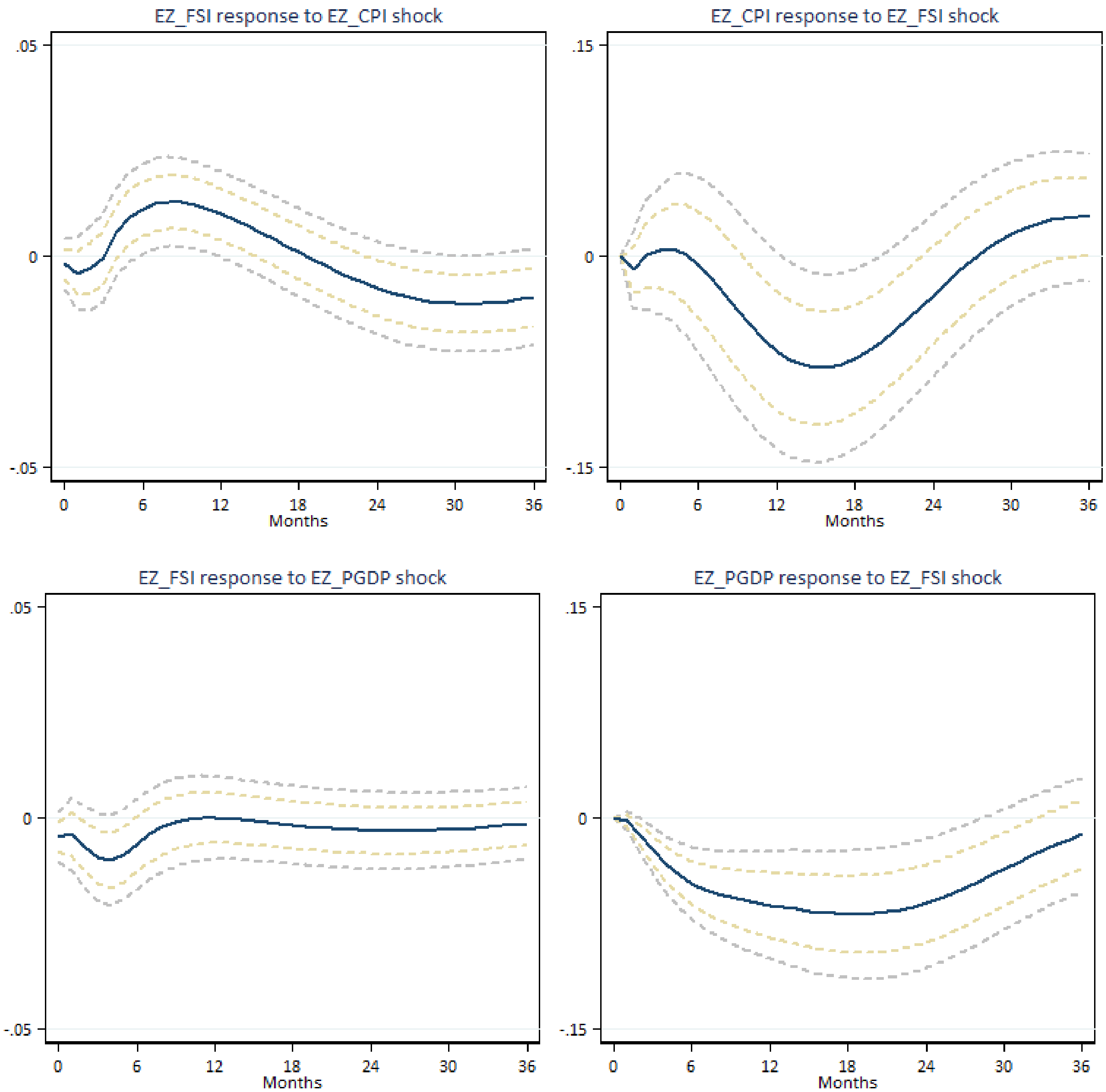


Figure 3 – IRFs



Note: Dotted lines represent 1 and 2 SE confidence bands.

Figure 3 – IRFs (continued)

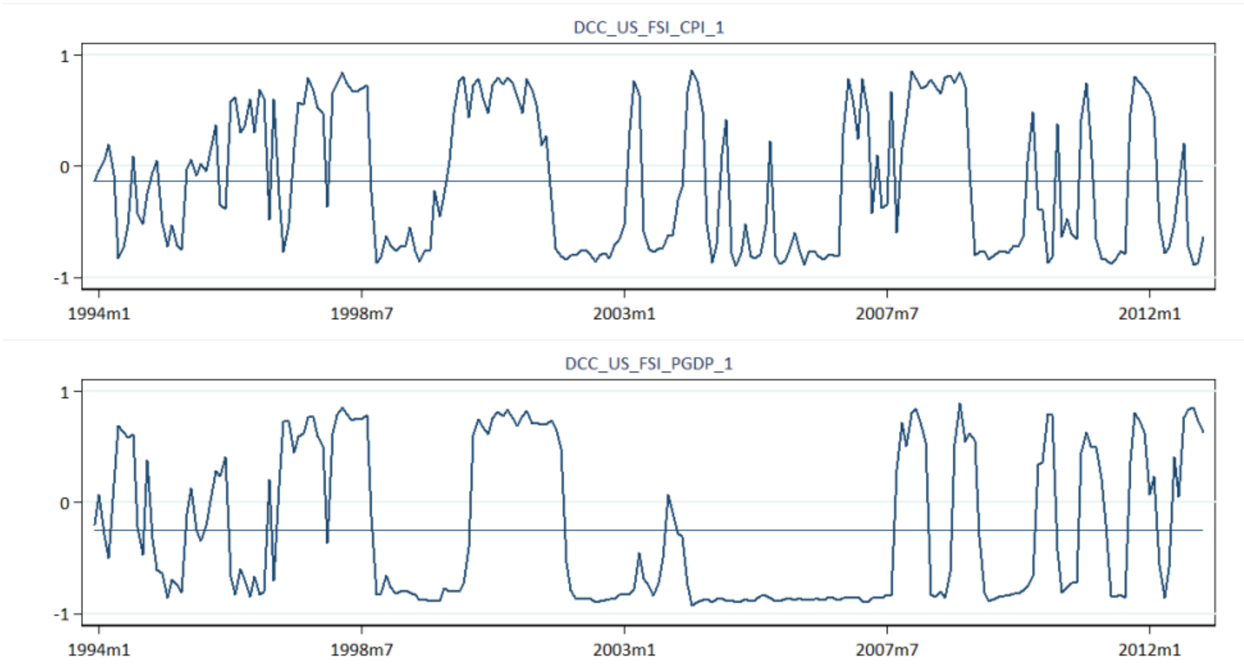


Note: Dotted lines represent 1 and 2 SE confidence bands.

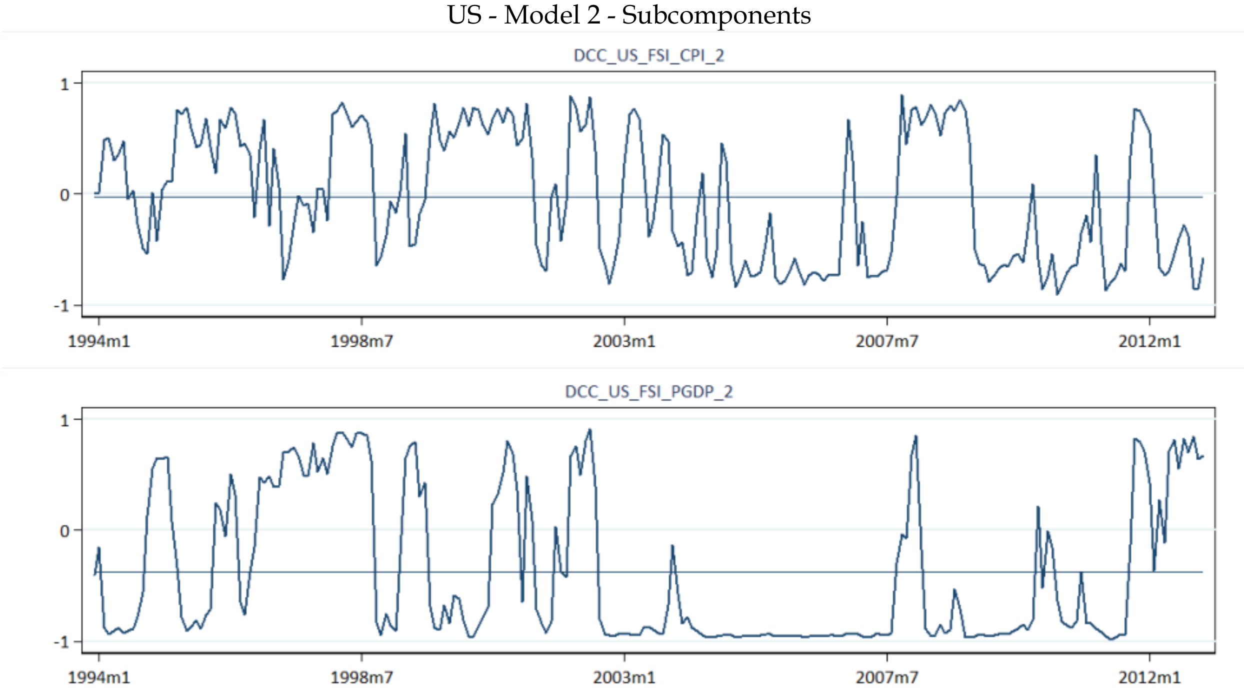
Figure 4 – Dynamic Conditional Correlations

Note: Constant lines represent the average of the dynamic correlations.

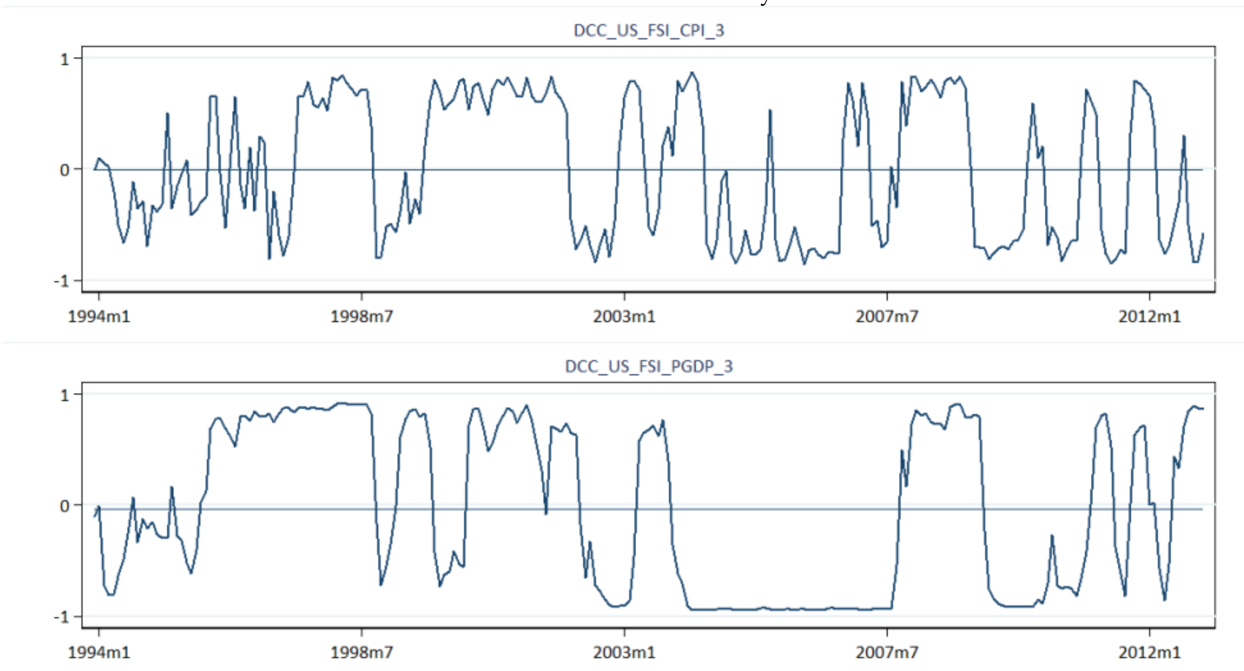
US - Model 1 - constant



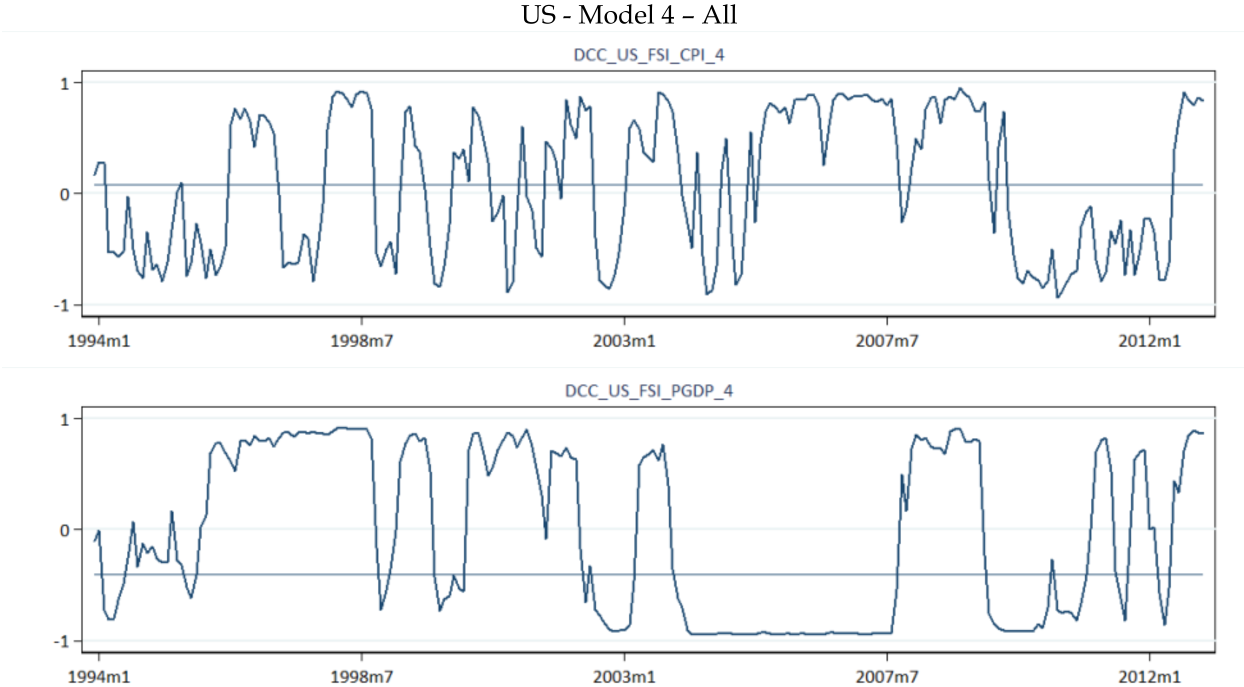
US - Model 2 - Subcomponents



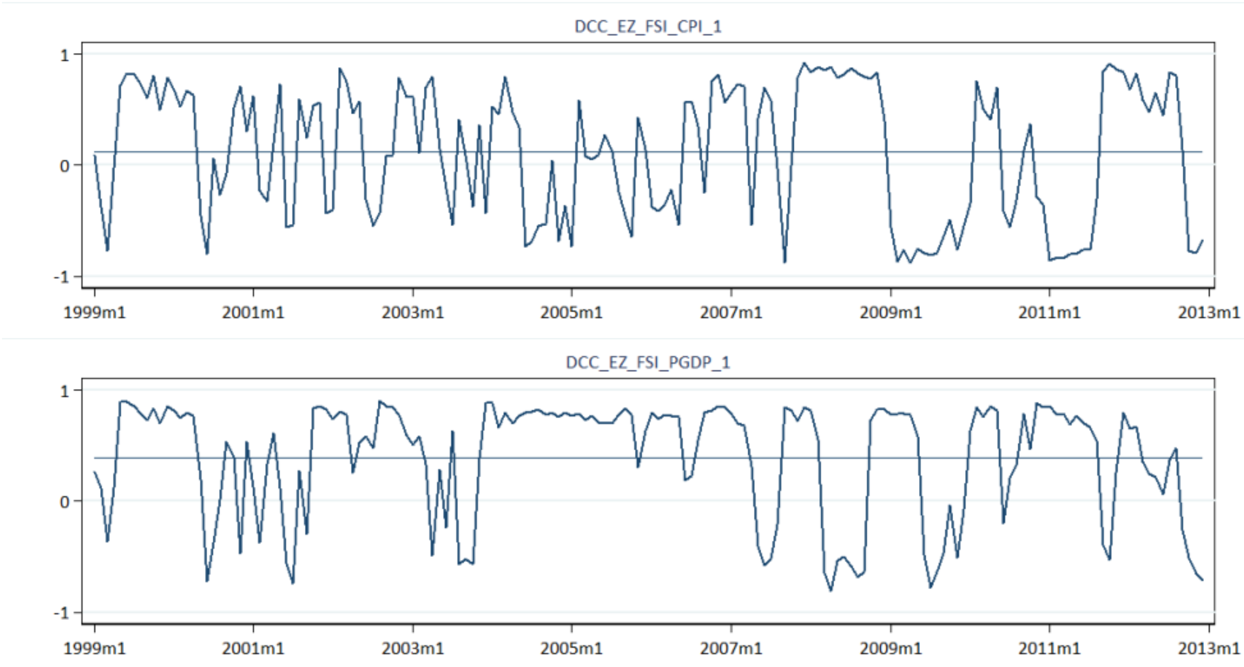
US - Model 3 - Monetary



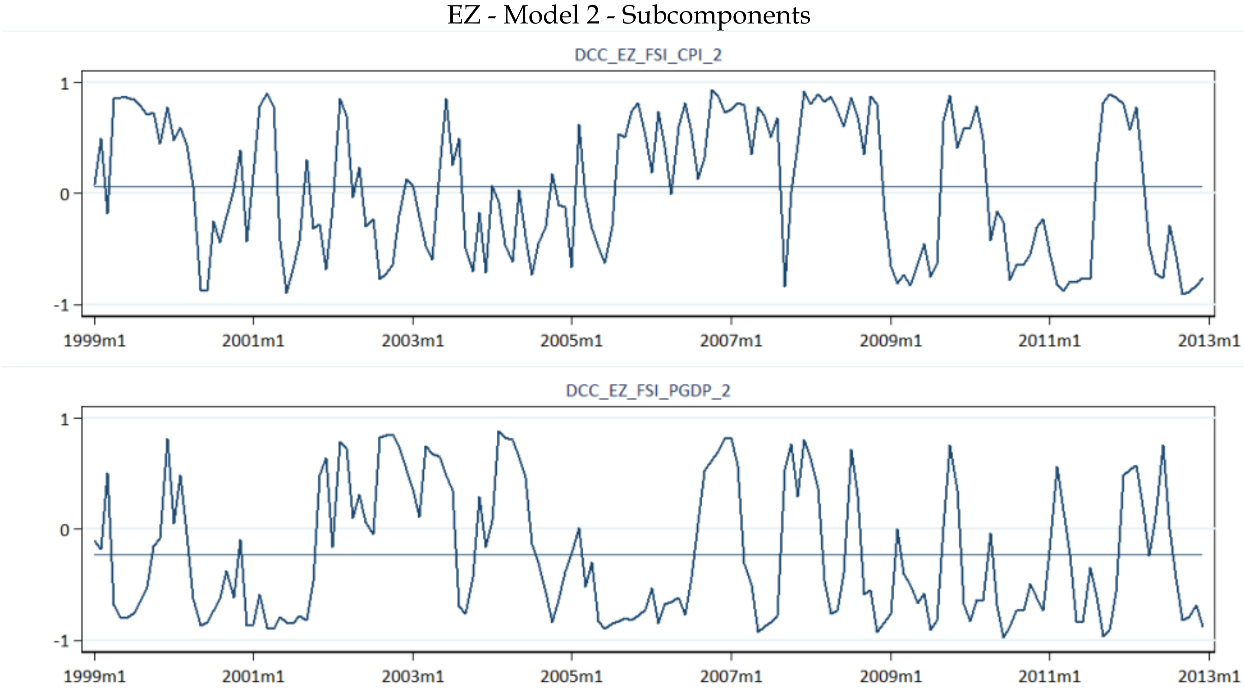
US - Model 4 – All



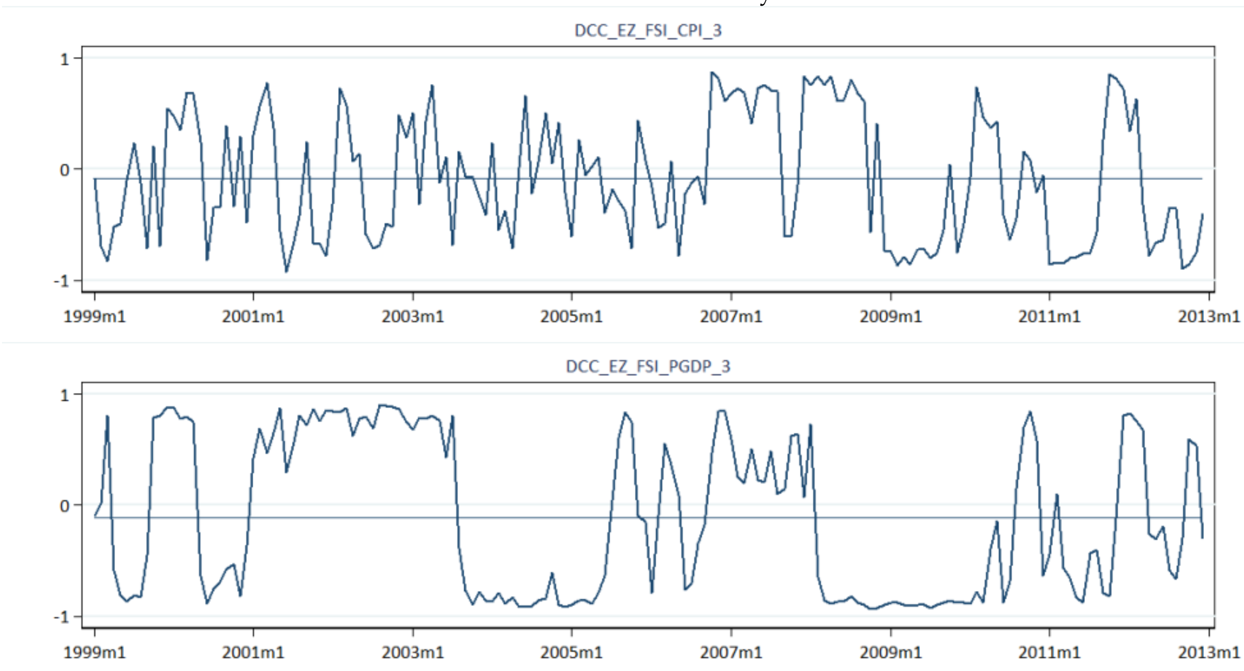
EZ - Model 1 - constant



EZ - Model 2 - Subcomponents



EZ - Model 3 - Monetary



EZ - Model 4 – All

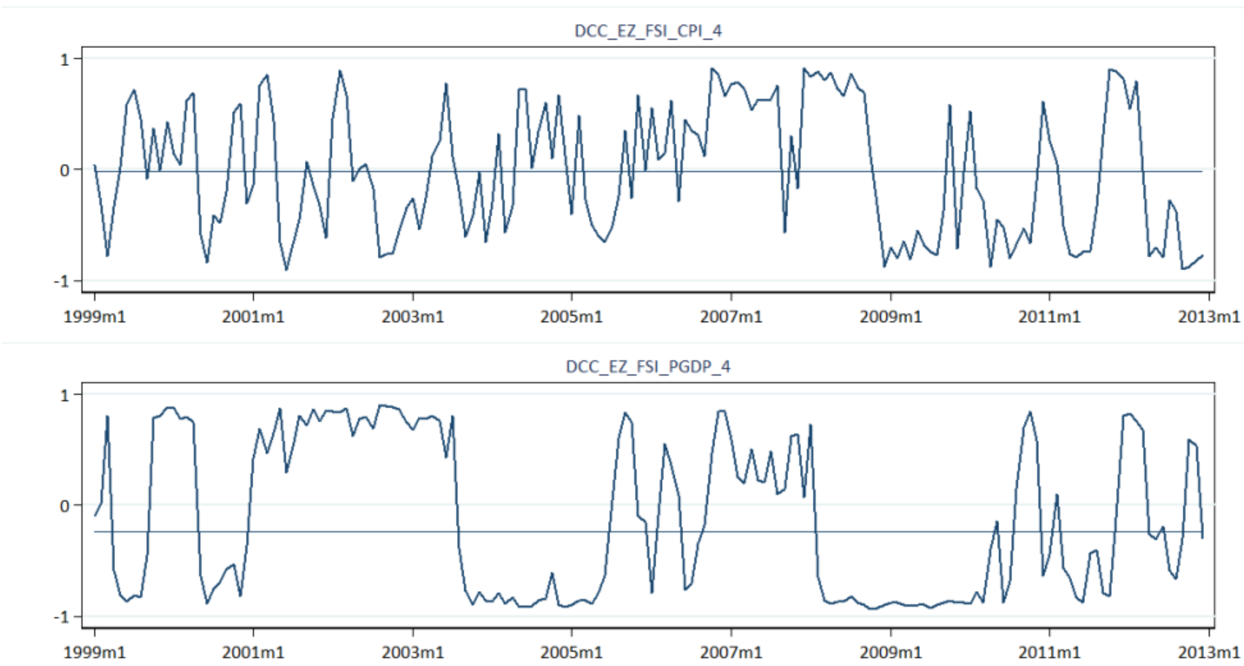


Figure 5 – Robustness – Linear Fit and Epanechnikov-Kernel smoothing lines (with 95% confidence bands)

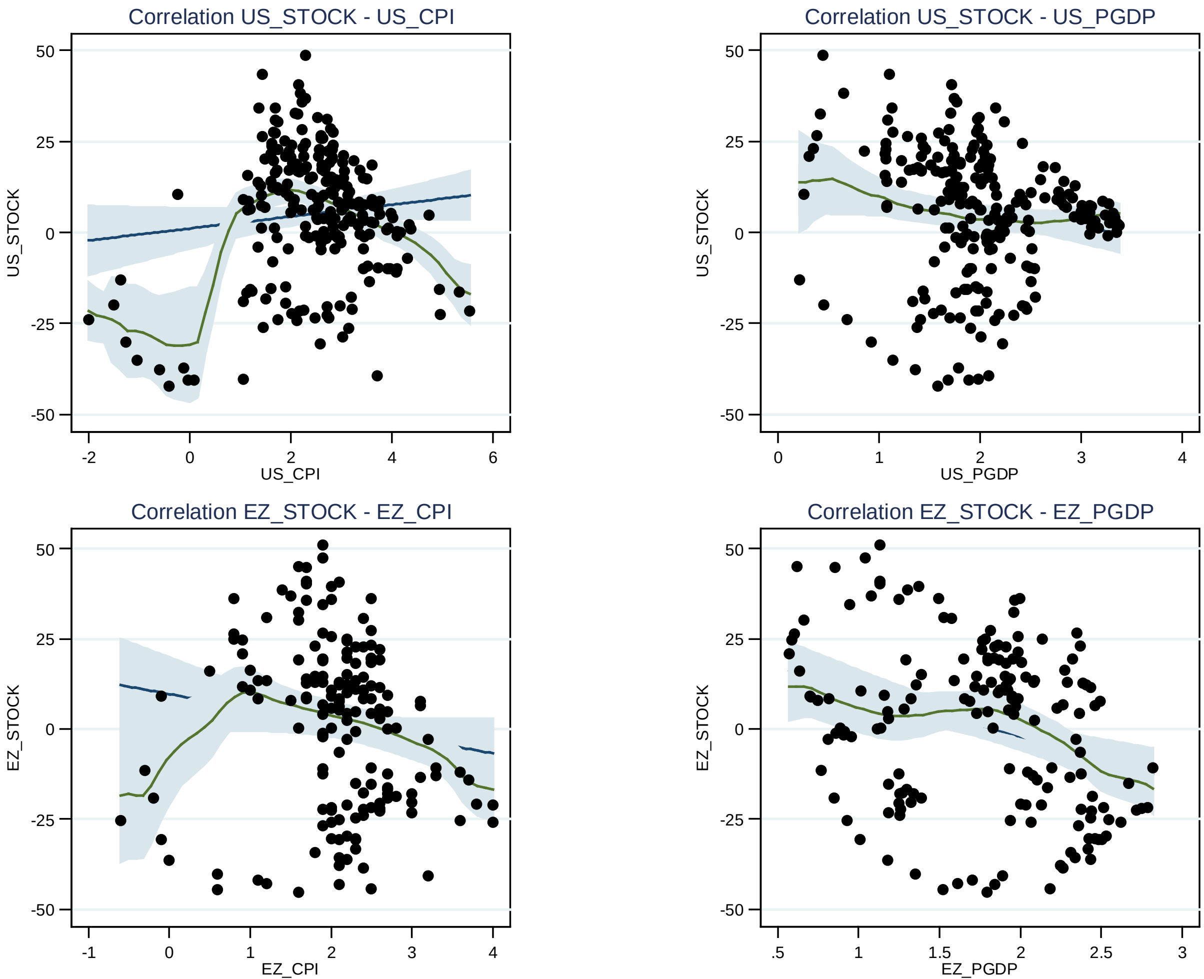
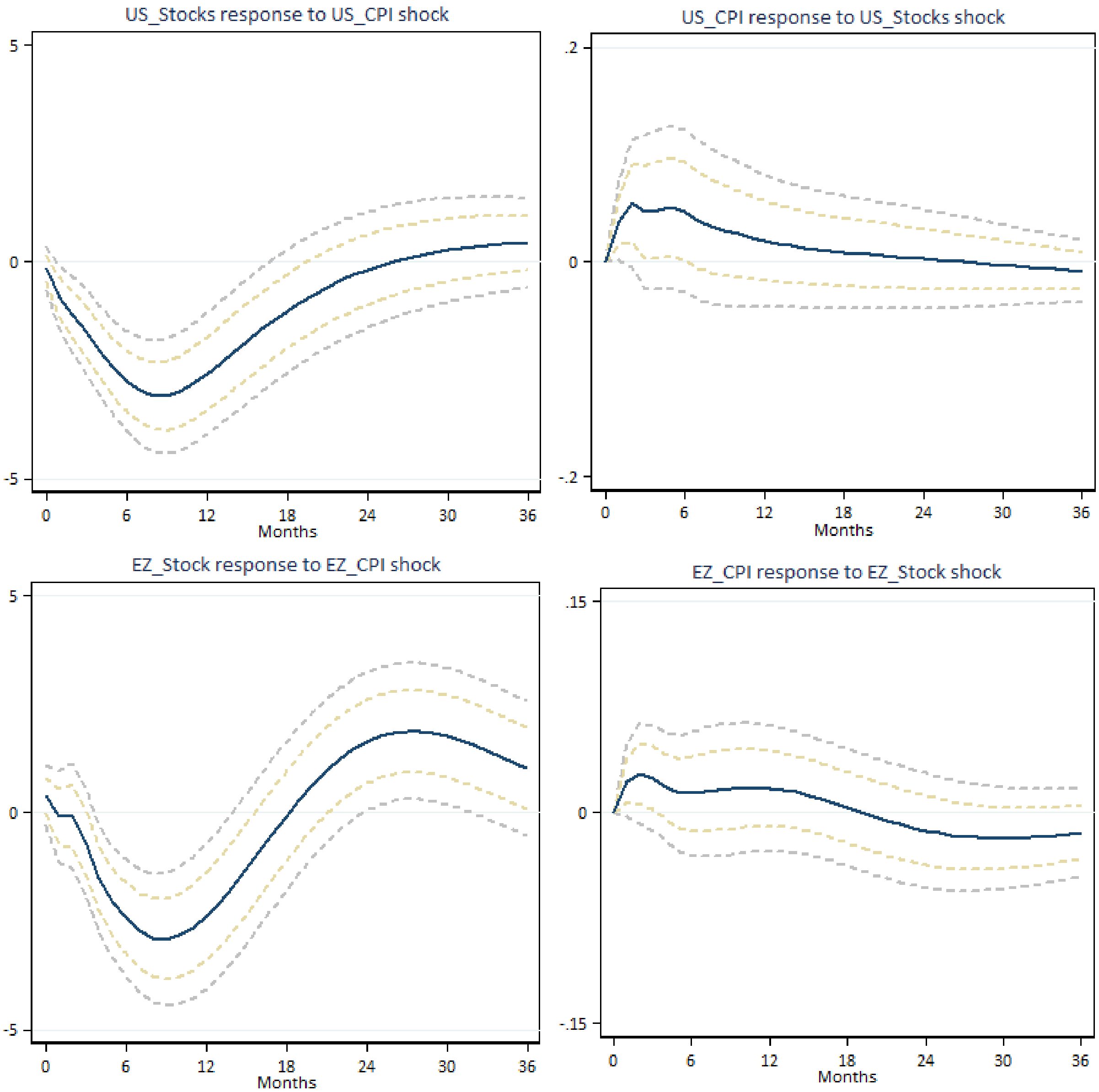


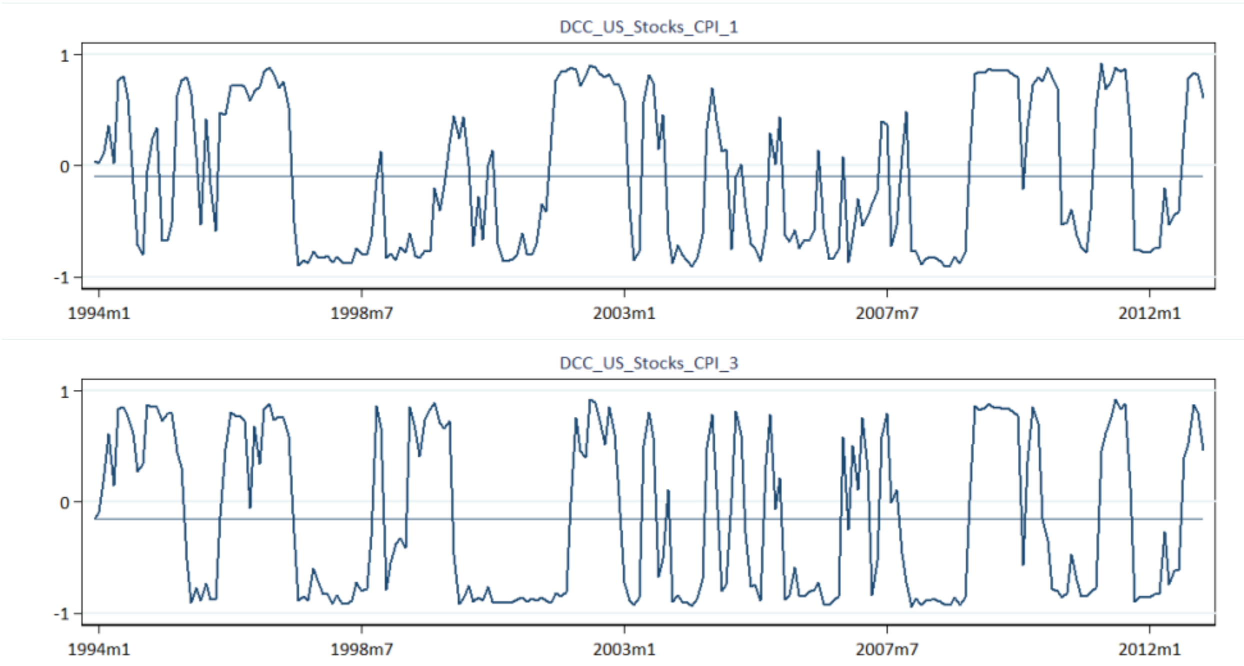
Figure 6 – Robustness – IRFs



Note: Dotted lines represent 1 and 2 SE confidence bands.

Figure 7 – Robustness – DCC

US



Euro Zone