Uncertainty and Financial Stability: a VAR Analysis*

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Abstract

PRELIMINARY - DO NOT CIRCULATE
In this paper, we study the relative importance of three shocks for macroeconomic and financial conditions: real, financial and uncertainty shocks. We find that shocks to financial uncertainty play a supplementary role in addition to real and financial shocks, and lead to a deterioration of the macroeconomic and financial outlook. Asset valuations in equities, corporate markets, and real estate decline. Businesses and households increase their savings and start a long-lasting process of deleveraging. The supply of credit to the economy retrenches, with underwriting standards tightening especially for commercial real estate and commercial and industrial loans. The financial sector experiences a deleveraging in banks, and a buildup of leverage in other nonfinancial institutions.

*The views expressed in this paper are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or of any other person associated with the Federal Reserve System. We thank participants of the XIII Conference on Real-Time Data Analysis, Methods and Applications for their helpful comments, and Young Soo Jang and Karen Kim for valuable research assistance. All errors are our sole responsibility.

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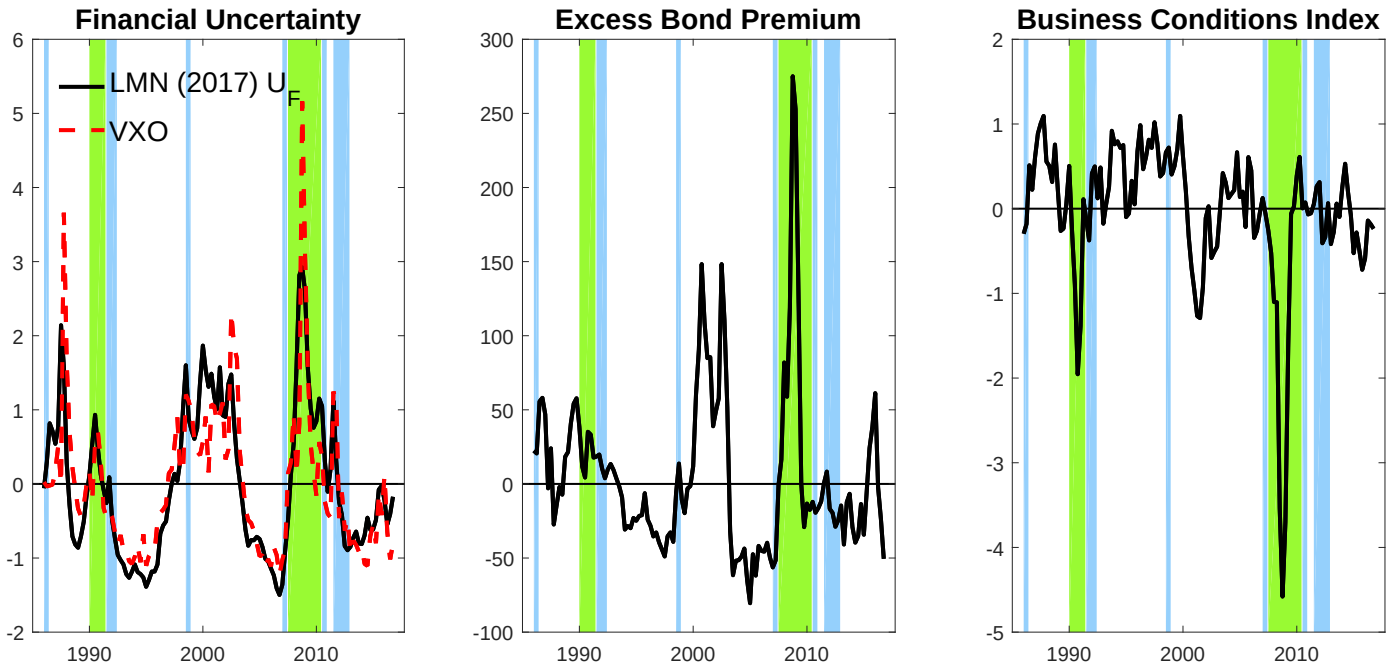
1 Introduction

Do movements in financial uncertainty contain signals about financial distress? This question is motivated by the observation that financial uncertainty indicators tend to rise sharply at the onset of financial crises. An illustration of this empirical regularity for the United States is presented in the left panel of Figure 1, which plots two indexes of financial volatility—the Ludvigson et al. (2015) financial uncertainty index and the CBOE S&P 100 Volatility Index (VXO). The shaded areas depict periods of financial crises (green areas) and credit disruptions (blue area) identified according to Romer and Romer (2017): both indicators of financial uncertainty tend to spike before these episode.

As shown in the remaining panels of Figure 1, variables that are routinely used to track real and financial conditions exhibit a similar behavior. A prominent example is the excess bond premium (EBP) developed by Gilchrist and Zakrajšek (2012), which measures the variation in corporate spreads associated with the price of bearing exposure to U.S. corporate risk beyond the compensation for expected default. Corporate spreads are a good thermometer of financial conditions, rising before and during financial crises. Similarly, the Aruoba et al. (2009) ADS index—a timely indicator of business and labor market conditions—falls sharply when financial conditions are tight. The EBP and the ADS index also display a high degree of correlation with the uncertainty indicators plotted in Figure 1, 0.65 and -0.7, respectively. Given the similarities and the high correlation, it is unclear whether financial uncertainty contains *additional* information about financial distress compared to widely-employed indicators of the business and financial cycles.

In this paper, we show that surprise changes in financial uncertainty—identified controlling for movements in corporate spreads and in business conditions—predict periods of persistent financial distress. We reach this conclusion estimating a structural vector autoregressive (SVAR) model, which we use to identify recursively three shocks to the indicators presented in Figure 1. In particular, we first identify a shock to the Aruoba et al. (2009) index, which we interpret as a shock to real activity. A sharp decrease in U.S. employment or a productivity shock in a foreign country with which the United States has significant trading relations are example of real shocks that might manifest in a decrease in the ADS index. We then identify a shock to the excess bond premium that, following Gilchrist

Figure 1: Financial Uncertainty, Credit Conditions, and Real Activity.



Note: The left panel plots the standardized index of financial uncertainty constructed by Ludvigson et al. (2015) and the CBOE S&P 100 Volatility Index. The middle panel plots the excess bond premium developed by Gilchrist and Zakrajšek (2012), while the right panel plots the Aruoba et al. (2009) business condition index. The shaded areas represent periods of financial crises (green areas) and credit disruptions (blue areas) as identified by Romer and Romer (2017).

and Zakrajšek (2012), we interpret as a financial shock. A sharp rise in term premia, disruptions in clearing and settlement of U.S. Treasury securities, or U.S. dollar funding strains are some example of financial shocks that could be picked up by an increase in EBP. Finally, we identify a financial uncertainty shock. Under the baseline specification of the model, we use the Ludvigson et al. (2015) financial uncertainty indicator, LMN henceforth, while under the alternative specification, we use the VXO. Uncertainty about the health of the financial sector and about monetary policy are example of what could be considered financial uncertainty shocks. In this paper, we study the relative importance of these three shocks for macroeconomic and financial conditions. Importantly, despite the use of a SVAR model, our goal is not to identify fundamental shocks with a structural interpretation. Instead, we view this model as providing a parsimonious approach to extract movements in uncertainty that (i) are unanticipated based on past realizations of real and financial variables and (ii) are uncorrelated to contemporaneous movements in corporate spreads and indicators of real activity. Thus, the use of a

recursive identification is appropriate to answer the question posed in the paper.

Our VAR models consist of two blocks. The core of the model—beyond the ADS index, the EBP, and an uncertainty proxy—contains the consumer price index, the S&P 500 index, and an indicator of monetary policy stance, namely the yield on two-year Treasury bonds. These variables are typically included in VAR models used to identify the macroeconomic effects of uncertainty and financial shocks. The second block rotates financial indicators measuring conditions in asset markets, in the financial sector (covering both banks and other financial institutions), and balance-sheet conditions in the non-financial sector. In particular, we select those variables that have been recognized in the literature as important for financial stability (Adrian et al., 2015; Aikman et al., 2017) and are available at least starting from 1990.

We find that, under our baseline specification, shocks to financial uncertainty—proxied by the LMN index— play a supplementary role in addition to real and financial shocks, and lead to a deterioration of the macroeconomic and financial outlook. Asset valuations in equities, corporate markets, and real estate decline. Businesses and households increase their savings and start a long-lasting process of deleveraging. The supply of credit to the economy retrenches, with underwriting standards tightening especially for commercial real estate and commercial and industrial loans. The financial sector experiences a deleveraging in banks, and a buildup of leverage in other nonfinancial institutions. The improvement in capital positions at banks can be due to an actual increase in capital, but it is also consistent with a decrease in assets (or their riskiness) and hence a decrease in bank lending, which is compensated by an increase in nonbank lending to the rest of the economy. The effects of financial uncertainty shocks are qualitatively similar under the alternative specification—which proxies financial uncertainty using the VXO—but are quantitatively smaller. The importance of the LMN financial uncertainty indicator relative to the VXO is surprising, given the striking similarities between the two series. Our results suggest that a possible explanation could be that VXO and EBP share similar information and—once we control for movements in the EBP—there is a reduced role left for surprise changes in the VXO.

We also find that real and financial shocks lead to a deterioration of financial variables in all sectors, a finding consistent with the literature. Yet, a comparison between these two shocks and the uncertainty

shock identified in the baseline model reveals a different shape of the responses, with uncertainty shocks exhibiting delayed but substantially more persistent effects. Thus, all shocks identified by our model have a quantitatively relevant impact on financial stability, with the key difference among shocks being the timing of their effects.

To provide an encompassing description of the relationship between uncertainty and financial stability, we extend our analysis to additional uncertainty measures. First, we follow Bekaert et al. (2013) and decompose the VIX into a risk aversion and an uncertainty component. Second, we include non-financial proxies of uncertainty in the VAR model. We focus on three indicators: the real uncertainty index constructed by Ludvigson et al. (2015); the economic policy uncertainty index developed by Baker et al. (2016); and the Scotti (2016) macro uncertainty index. Preliminary findings suggest that the risk aversion and uncertainty components of the VIX have similar effects on financial conditions, except for the impact on leverage in the financial sector. Shocks to macroeconomic uncertainty have a distinct secondary role for financial conditions, especially when conditioning of financial uncertainty.

Our analysis is complementary to the literature that studies and monitors systemic risk, defined by Adrian et al. (2015) as the collection of factors that could amplify the impact of financial shocks and lead to widespread financial externalities. Aikman et al. (2017) propose a program to monitor systemic risk constructing a summary measure of system-wide vulnerabilities based on a large number of financial indicators. The goal of this line of research is to offer monitoring tools to policy-makers in order to setup macroprudential policies aimed at preventing the build-up of financial imbalances. By contrast, in our paper we make use of the same variables used to track financial vulnerabilities, but document the financial implications of various shocks, focusing on the role of uncertainty shocks. Thus, our analysis can provide additional insights to policy-makers, for instance in designing policies tailored to counteract the adverse impact of the shocks that hit the economy.

This paper is also connected to the growing literature that documents the important effects that uncertainty has on the macroeconomy. No matter whether it is measured as implied volatility, the Baker et al. (2016) economic policy uncertainty, the Jurado et al. (2015) financial and macro uncertainty, the Scotti (2016) real-activity uncertainty or the Caldara and Iacoviello (2017) geopolitical risk, uncertainty tends to depress output and employment. However, little or no studies have considered the effects of

uncertainty on financial stability. Nonetheless, our results are consistent with the evidence presented in Ludvigson et al. (2015) and Caldara et al. (2016). The former shows that financial uncertainty—and not macroeconomic uncertainty—is an important driver of the economy. The latter shows that, controlling for financial conditions, increases in most uncertainty proxies do not generate meaningful economic effects. The only exception is the Jurado et al. (2015) uncertainty proxy, a variable that combines the financial and macroeconomic uncertainty indexes used in our paper.

The remainder of the paper is organized as follows. Section 2 presents the econometric methodology, describing the data and the VAR setup. Section 3 describes the effects of financial uncertainty on standard macro variables and on financial vulnerabilities. Section 4 presents the analysis for additional uncertainty measures. Section 5 concludes.

2 Econometric Methodology

In this section, we describe the data used in the analysis, as well as the VAR details and the Bayesian estimation framework.

2.1 Data

Our analysis makes use of a variety of indicators spanning real, financial, balance-sheet and uncertainty data.

Financial Stability Indicators

We consider a subset of the financial vulnerabilities analyzed in Adrian et al. (2015) and Aikman et al. (2017), among others. The data series are chosen so that their history goes back to January 1990 and so that they cover the following areas: risk appetite and asset valuation, household and business debt and savings, real estate, bank and nonbank sectors. We use the variables at the monthly frequency when available (risk appetite and asset valuation variables), and at quarterly frequency otherwise. Table 1 summarizes and groups the variables used in the analysis.

Our subset of monthly financial variables consist of indicators that are associated with risk appetite and asset valuations in the housing and assets markets. In the housing sector, we use the house price-

Table 1: Financial Vulnerabilities Data

Monthly Financial Variables – Risk Appetite and Asset Valuation
Housing
House prices/rents
Case-Shiller house price index
Equity Markets
Equity premium ratio
Fixed-income
High yield bond spread
BAA-10yr spread
Ten-year Treasury yields
Non Financial Imbalances 1 (Q,NF1) – Households and Business Debt and Savings
Debt Indicators
Non-financial businesses real debt growth
Home-mortgage debt income ratio
Households and Business Net Saving Indicators (Net of capital formation)
Business savings
Household net savings
Consumer Debt Indicators
Consumer credit to GDP
Consumer credit debt service ratio
Non Financial Imbalances 2 (Q,NF2) – Real Estate
Housing Indicators
Total mortgage debt/GDP
Home mortgage debt service ratio
Commercial Real Estate Indicators
CRE Prices
Lending Standards
SLOOS residential lending standards
SLOOS commercial real estate lending standards
SLOOS C&I lending standards
Financial Imbalances (Q,FIN) – Bank and Non-Bank Sectors
Bank Leverage & Capital
Tangible common equity to tangible assets at BHC
Total risk-based capital ratio at commercial banks
Non-Bank Leverage
Non-bank leverage ratio (broker-dealers' leverage ratio)
Short-Term Funding
Gross Short Term Wholesale Debt of Financial Sector to GDP
Total runnables (at banks and nonbanks)
Size
Total liabilities of U.S. financial sector to GDP Ratio

to-rent ratio and the Case-Shiller house price index as measures of valuation pressures. House prices are important because borrowers (and lenders) may be exposed to financial distress should price fall. Likewise, the price-to-rent ratio is a well-established economic indicator used for real estate valuation that, while comparing the economics of buying versus renting, it also gives information about possible imbalances in the housing market and the potential build-up of bubbles (Cecchetti (2008)). Asset market indicators encompass equity and fixed income markets. We use the equity risk premium, computed as the ratio of forward earnings to 10-year Treasury yields, as a measure of valuation pressure in the equity markets. In addition to the narrowing of equity premia, corporate bond spreads, specifically the high-yield and the Baa-10year spreads, are important indicators for asset valuations, in that very compressed risk spreads could mis-price the required compensation for expected losses. Finally, we also include 10-year Treasury yields among this group of indicators, with the idea that sudden reversal in those yields might cause instability issues for levered investors and institutions that have high interest rate exposure.

We divide the quarterly variables available from 1990 into three groups: two groups cover non-financial indicators –households and business debt and savings indicators, as well as real estate– and the third comprises a number of quarterly financial variables. The non-financial sector is closely linked to the real economy via the wealth effect of household and non financial business sectors. It is also linked to the financial sectors because losses among households and businesses can lead to losses at financial institutions (see Bernanke and Gertler (1989). These losses might impair financial institutions' capital adequacy leading to decreases in credit availability, and then spurring and averse feedback loop.

Non-financial indicators include measures of debt service, like non-financial businesses real debt growth and aggregate home-mortgage debt-to-income ratio, household and business net saving indicators, and consumer debt indicator, like consumer credit to GDP (a basic indicator of consumer leverage) and consumer credit service ratio (ratio of debt service payments on consumer debt to disposable personal income). Non-financial indicators also cover additional real estate indicators that are available at the quarterly frequency and changes in lending standards. Additional housing indicators include total non-financial mortgage debt to GDP and home-mortgage-debt service ratio, which are basic aggregate indicators of leverage in the non-financial sector. Commercial real estate (CRE) indicators include CRE

prices, which are a measure of pressure and vulnerability in the commercial real estate sector and, similar to house prices, are important because borrowers (and lenders) may be exposed to financial distress should price fall. Finally, the change in lending standards from the Senior Loan Officer Opinion Survey (SLOOS) is meant to capture the underlying riskiness of loans and the overall stance of credit availability (as in Sufi (2014)).

The set of quarterly financial variables includes indicators from the bank and non-bank sectors. Bank leverage and capital are measured with the ratio of tangible common equity to tangible assets at bank holding companies (BHC) and the total risk-based capital ratio at commercial banks. Non-bank leverage is measured by stripping out banking leverage from total financial system leverage. Adrian and Shin (2010) and Berger and Bouwman (2013) are, among others, example of papers that document the importance of these variables. Based on the idea that financial stability vulnerabilities go beyond leverage and also include maturity and liquidity transformation (as in Brunnermeier and Oehmke (2013) and Brunnermeier et al. (2014)), we also include data on the gross short-term wholesale funding of financial institutions as well as a measure of "runnables" liabilities in the financial system (see Bao et al. (2015)), which includes fed funds and repurchase agreements, commercial paper, uninsured deposits, variable rate demand obligations, securities lending, and money market funds. Finally, we also use the ratio of total liabilities of the U.S. financial sector to GDP, which is a measure of the size of the financial system (see Greenwood and Scharfstein (2013)).

Uncertainty Measures

Traditionally, implied stock market volatility has been used to measure uncertainty. The VIX, which is defined as the option-based expectation of the volatility of the S&P 500 index over the next 30 days, or the VXO, the CBOE S&P 100 Volatility Index, are in fact useful predictors of future realized volatility, but they are not necessarily a clean measure of uncertainty as they contain information about both expectations and preferences. Many new proxies have been proposed in the literature over the past few years. These new measures explore different dimensions, like the underlying kind of uncertainty that they are trying to measure (macro, financial, monetary policy, geopolitical, economic policy, etc.) or the methodology and data they use (news-based versus google-search approaches).

In this paper, in addition to the VIX/VXO measure, we focus on three new uncertainty proxies: the

financial uncertainty index constructed by Ludvigson et al. (2015); the economic policy uncertainty index developed by Baker et al. (2016); and the Scotti (2016) real-activity uncertainty index. Ludvigson et al. (2015) construct indices of macroeconomic uncertainty focusing on the uncertainty around objective statistical forecasts for hundreds of economic series, with the idea that macroeconomic and financial uncertainty can be constructed as an appropriately weighted average of the forecast error variance of all these macroeconomic indicators. They compute h-period ahead uncertainty based on the forecast horizon that they use, and they distinguish between macro, financial and real-activity uncertainty by selecting the appropriate variables in their estimation. Baker et al. (2016) develop an index of economic policy uncertainty (EPU) based on news coverage, tax policy horizons, and economic forecasts. For the United States, the EPU index is constructed from three types of underlying components: the newspaper coverage of policy-related economic uncertainty, the number of federal tax code provisions set to expire, and the disagreement among economic forecasters. Finally, Scotti (2016) uses macroeconomic news and survey forecasts to construct an ex-post, realized measure of uncertainty about the state of the real economy.

Core Variables

In addition to financial stability indicators and uncertainty measures, our core model utilizes a number of additional variables, like the excess bond premium (EBP) developed by Gilchrist and Zakrajšek (2012), which measures the variation in corporate spreads associated with the price of bearing exposure to U.S. corporate risk beyond the compensation for expected default, and the Aruoba et al. (2009) ADS index, which is a timely indicator of business and labor market conditions. The consumer price index, the S&P 500 index, and an indicator of monetary policy stance, namely the yield on two-year Treasury bonds, are also included in VAR models used to identify the macroeconomic effects of uncertainty, real and financial shocks.

2.2 VAR Setup and Estimation Framework

TBD

3 The Effects of Financial Uncertainty

Our results show that, under our baseline specification, shocks to financial uncertainty—proxied by the LMN index— play a supplementary role in addition to real and financial shocks, and lead to a deterioration of the macroeconomic and financial outlook. Asset valuations in equities, corporate markets, and real estate decline. Businesses and households increase their savings and start a long-lasting process of deleveraging. The supply of credit to the economy retrenches, with underwriting standards tightening especially for commercial real estate and commercial and industrial loans. The financial sector experiences a deleveraging in banks, and a buildup of leverage in other nonfinancial institutions. The effects of financial uncertainty shocks are qualitatively similar under the alternative specification—which proxies financial uncertainty using the VXO—but are quantitatively smaller. The importance of the LMN financial uncertainty indicator relative to the VXO is surprising, given the striking similarities between the two series. Our results suggest that a possible explanation could be that VXO and EBP share similar information and—once we control for movements in the EBP—there is a reduced role left for surprise changes in the VXO.

We also find that real and financial shocks lead to a deterioration of financial variables in all sectors, a finding consistent with the literature. Yet, a comparison between these two shocks and the uncertainty shock identified in the baseline model reveals a different shape of the responses, with uncertainty shocks exhibiting delayed but substantially more persistent effects. Thus, all shocks identified by our model have a quantitatively relevant impact on financial stability, with the key difference among shocks being the timing of their effects.

COMMENTS: (1)for now, given that we are pressed with time, I would not do many changes. But there are a few easy changes to the pictures that we might try to do (see text). (2) We might want to leave results for the core variables at the end if we want to focus immediately on the new variables

3.1 Standard Macro Variables

Before digging into reviewing the impulse responses for our financial stability variables, we review the impulse responses of the six core variables for the monthly model, which include: ADS, EBP, uncertainty, prices, two-year Treasury rates and the S&P500 index. Results for the quarterly core model can be found in the Appendix.

Figure 2 presents the impulse responses of a one-standard deviation shock in the ADS index, EBP, and uncertainty on each others.(**replace the label of the third column. I think it should be uncertainty rather than VIX**) Red solid lines are responses of a model in which the financial uncertainty shock is identified with the Ludvigson et al. (2015) financial uncertainty measure, while the black broken (**change to broken, so that it works in b&w**) lines are the responses of a model in which the financial uncertainty shock is identified with the VIX. (**instead of having 68 and 90 sets, I would probably do 68 only but have both sets for VIX and LMN**) ADS and EBP shocks (first and second columns) depress real activity and increase spreads, consistently with the literature. Their impact on uncertainty is different according to how it is measured. Both real and financial shocks cause and increase in the VIX, while the impact on the LMN measure is muted. Interestingly, as shown in the third column of the figure, uncertainty plays a role in addition to real and financial shocks. However, results look different when the uncertainty shock is identified with the VIX or the LMN measure. A VIX shock marginally and briefly depresses economic activity and increases spreads, while a LMN shock has a delayed and more pronounced effect than the VIX, as shown by the red lines.

do we want to comment a little the economic magnitude?

Figure 3 presents impulse response functions for the other core variables –prices, Treasury yields and stock prices. Results are still in line with traditional findings in that real and financial shocks depress prices, yields and stock prices. However, these effects are reduced when uncertainty is proxied with the LMN measure and the effect on prices is even flipped (**do we want to talk about this and comment why?**) Once more, there is a role for the effects of an uncertainty shock on these variables, though the effect is more pronounced and more persistent with the LMN measure.

The bigger role for the financial uncertainty shock as measured by the LMN financial uncertainty

measure will continue in the rest of the analysis. One possible explanation could be that VIX and EBP share similar information (**check correlations**) and once we control for EBP, there is little role left for the VIX. In fact, as can be seen in Figures 2 and 3, an EBP shock moves on impact the VIX but has no effect on the LMN financial uncertainty measure. Conversely, while the EBP is barely moved by a VIX shock, a one-standard deviation shock in the LMN measure has a significant positive impact on the EBP. These results therefore suggest that when financial uncertainty is measured with the LMN proxy, it has a bigger and separate role to real and financial shocks.

Figures A.1 and A.2 in the Appendix confirm these findings for the quarterly model. (**ho messo queste figure in appendix. ci sono un sacco di figure gia', non aggiungono niente a quando detto per le monthly, e alzi l'impatto del vix su ebp e ads e' flipped...forse non le mettiamo del tutto?**

3.2 Financial Stability Variables

As mention in the data section, we estimate four different VAR models where the core variables are the same but we add six different additional financial stability variables in each of the four models.

Model 1. Risk Appetite and Asset Valuations

Real, financial, and uncertainty shocks seem to have a similar effect on house prices and the equity premium in terms of shape of the impulse responses: as shown in Figure 4, they depress house prices and increase the equity premium. However, as shown in the rightmost column, the corrections in house prices that follow the LMN uncertainty shock are more severe that those that follow real and financial shocks. This sharp corrections in asset valuations could have the potential to turn into a threat to financial stability, especially in the presence of stretched investor leverage, maturity mistmatch, and liquidity mistmatch. While the effect of the LMN shock on impact tends not to be striking, its persistence is severe. That is, when uncertainty is present, the corrections following a shock tend to last longer.

Figure 5 presents the results for corporate spreads and Treasury yields. (**i would reorganize the rows and move TR2 to the last row, so that we have first both spreads**) As mentioned before,

the VIX might carry very similar information to EBP and spreads. This can be seen by the fact that the shape of the IRFs to a VIX shock is similar to that of an EBP shock. Instead, once more, the LMN shock is delayed but more persistent.

Model 2. Household & Business Debt and Savings

The analysis of the impact of uncertainty shocks on non-financial variables related to the household and business sectors is shown in Figures 6 and 7. Real and financial shocks display a similar effect on the non-financial variables in terms of pattern, though the magnitudes are different: they generally depress debt measures both in the household and in the business sectors (**should we number the panels 1-9, so that we can refer to them more easily?**). In contrast, while real shocks increase business and household savings, financial shocks have a muted impact on savings. Uncertainty shocks, as measured by the LMN measure, once more have the same sign as real and financial shocks. As in the previous cases, their effects build up more slowly but are more persistent. In contrast, shocks to the VIX are hardly significant once we control for real and financial shocks.

Model 3. Real Estate

The impact of real and financial shocks on lending standards shows that in most cases an initial tightening in standards is then followed by a prolonged loosening period (see Figure 8. The impact of uncertainty shocks is different according to how me measure it: while there is a muted reaction in lending standards following a VIX shock, there is a more severe initial tightening of standards followed by a stronger and more prolonged loosening of standards in the CRE and C&I sectors following LMN shocks. CRE price generally decline following any of the three shocks, as shown in Figure 9. Total non-financial mortgage debt to GDP and home-mortgage-debt service ratio, which are basic aggregate indicators of leverage in the non-financial sector, increase modestly after a real shock, but are generally not affected much by financial and uncertainty shocks.

Model 4. Bank and NonBank Sectors

Figures A.1 and 11 present the results for the bank and nonbank sectors. After any shocks, banks'

capital positions tend to improve, with some short-lived exceptions. This effect can be due to an actual increase in capital, but it is also consistent with a decrease in assets (or their riskiness) and hence a decrease in bank lending. In contrast, non bank leverage increases, suggesting an increase in broker-dealer financing to the rest of the financial system. **move fin B?Y to the end so that we have st b/y and tot runnables together.** Gross short-term wholesale funding of financial institutions and "runnables" liabilities in the financial system decrease after any of the three shocks considered. Interestingly, after controlling for real and financial shocks, uncertainty still has an impact on those variables and the effect is quite prolonged in the case of the LMN shock. The size of the financial system, as measured by the ratio of total liabilities of the U.S. financial sector to GDP, shrinks abruptly on impact with any of the shocks and the effect is long lasting following real and LMN shocks.

4 Decomposing the VIX

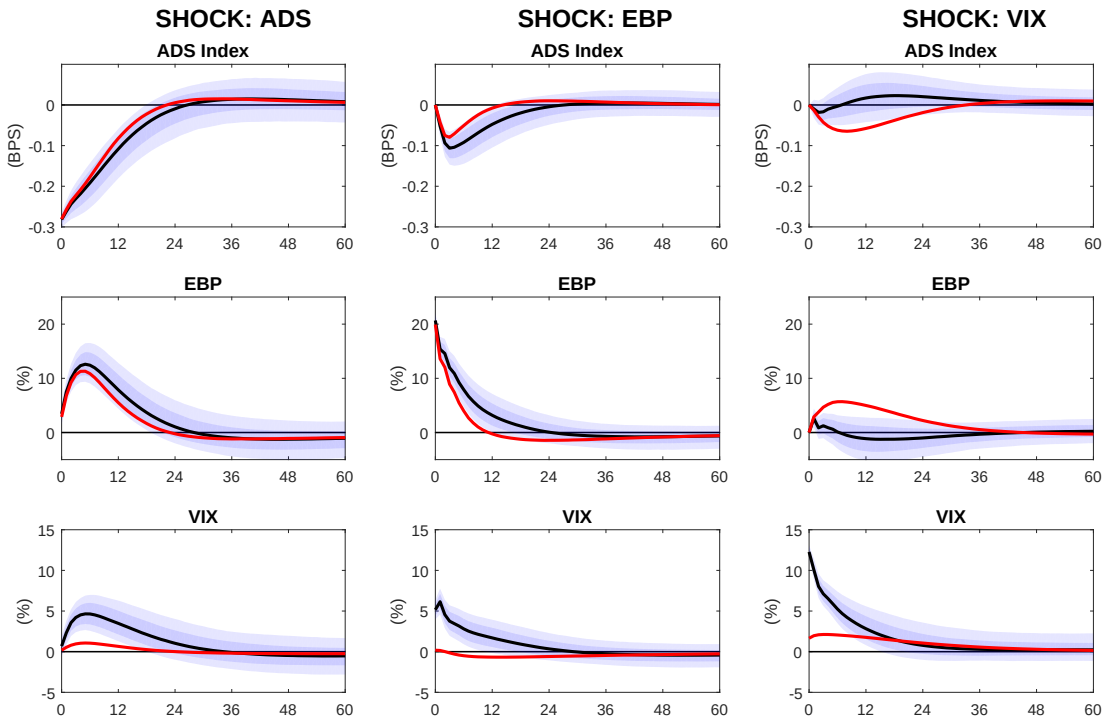
follow Bekaert et al. (2013) to decompose the VIX

5 The Effects of Non-Financial Uncertainty

show results for BBD and Scotti

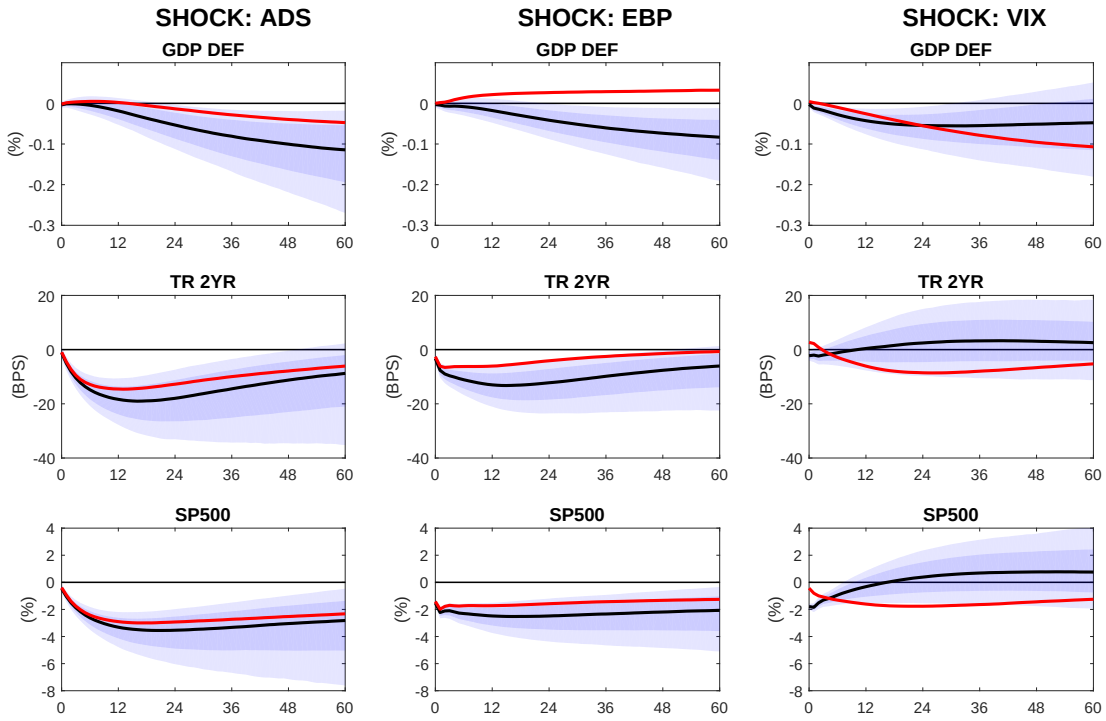
6 Conclusion

Figure 2: Standard Macro Effects, Monthly Baseline 1.



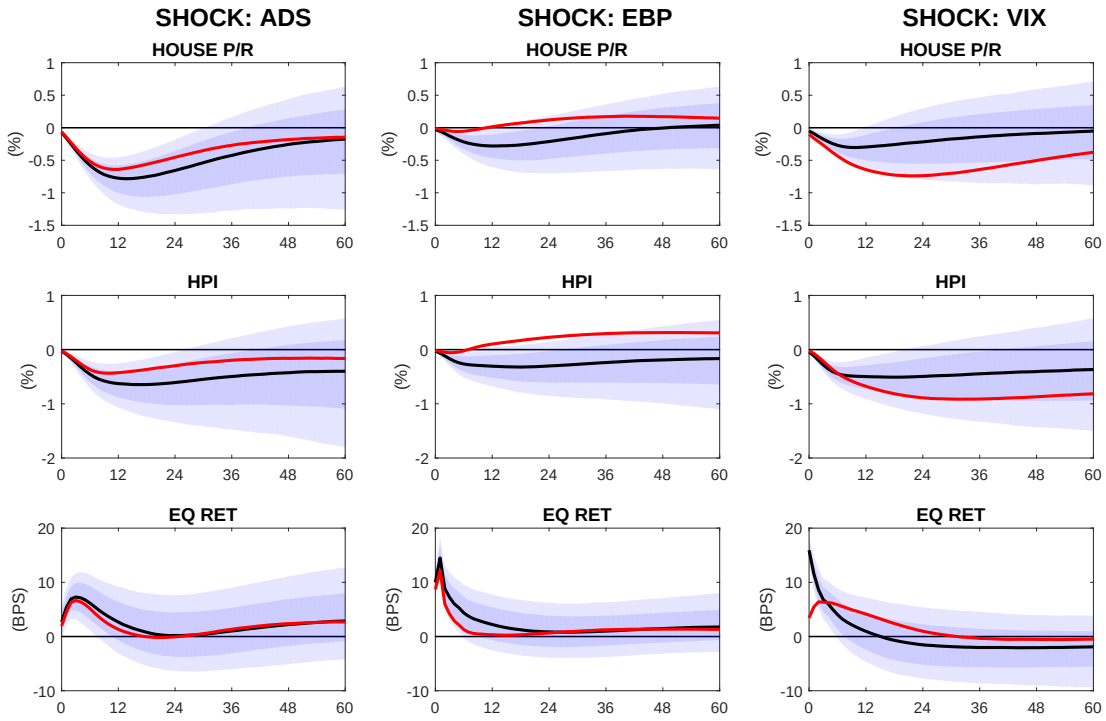
Note: Each panel depicts the median impulse response of the specified variable to a one-standard deviation real, financial and uncertainty shock, shown respectively in the three columns. Red solid lines are responses of a model in which the financial uncertainty shock is identified with the Ludvigson et al. (2015) financial uncertainty measure, while the black broken lines are the responses of a model in which the financial uncertainty shock is identified with the VIX. Shaded bands denotes the 68 (darker) and 90 percent pointwise credible sets for the model where VIX is used as uncertainty measure.**should change credible set. see text**

Figure 3: Standard Macro Effects, Monthly Baseline 2.



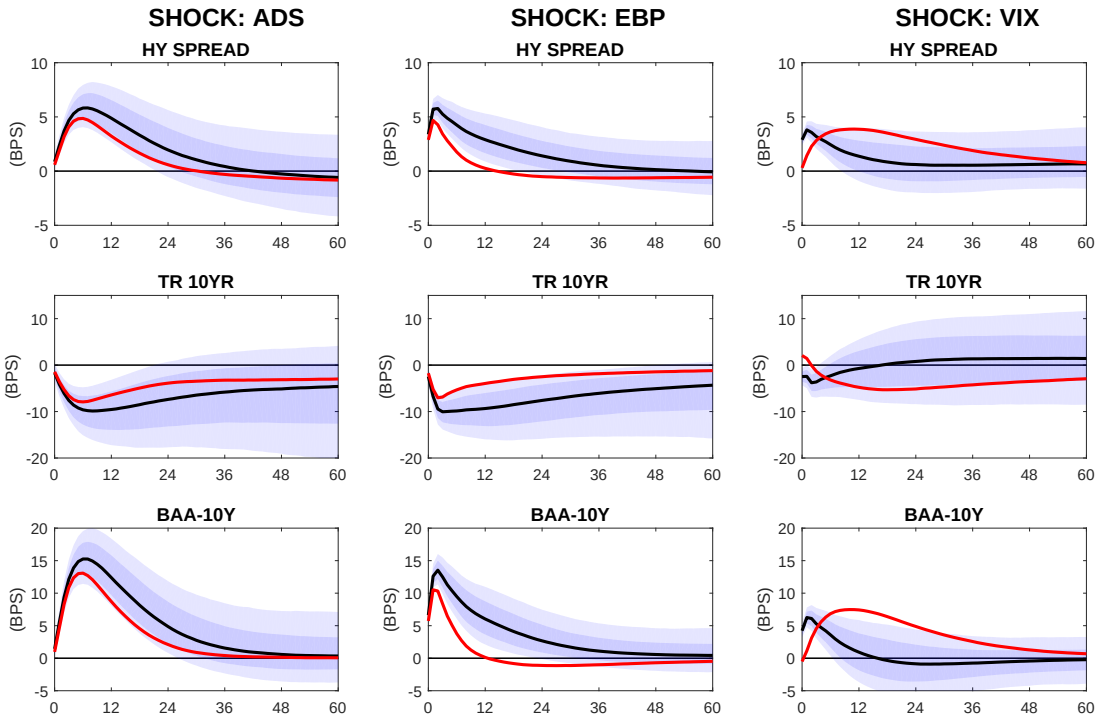
Note: Each panel depicts the median impulse response of the specified variable to a one-standard deviation real, financial and uncertainty shock, shown respectively in the three columns. Black solid lines are responses of a model in which the financial uncertainty shock is identified with the VIX, while the red broken lines are the responses of a model in which the financial uncertainty shock is identified with Jurado et al. (2015) financial uncertainty measure. Shaded bands denotes the 68 (darker) and 90 percent pointwise credible sets for the model where VIX is used as uncertainty measure.

Figure 4: Financial Variables, Monthly 1.



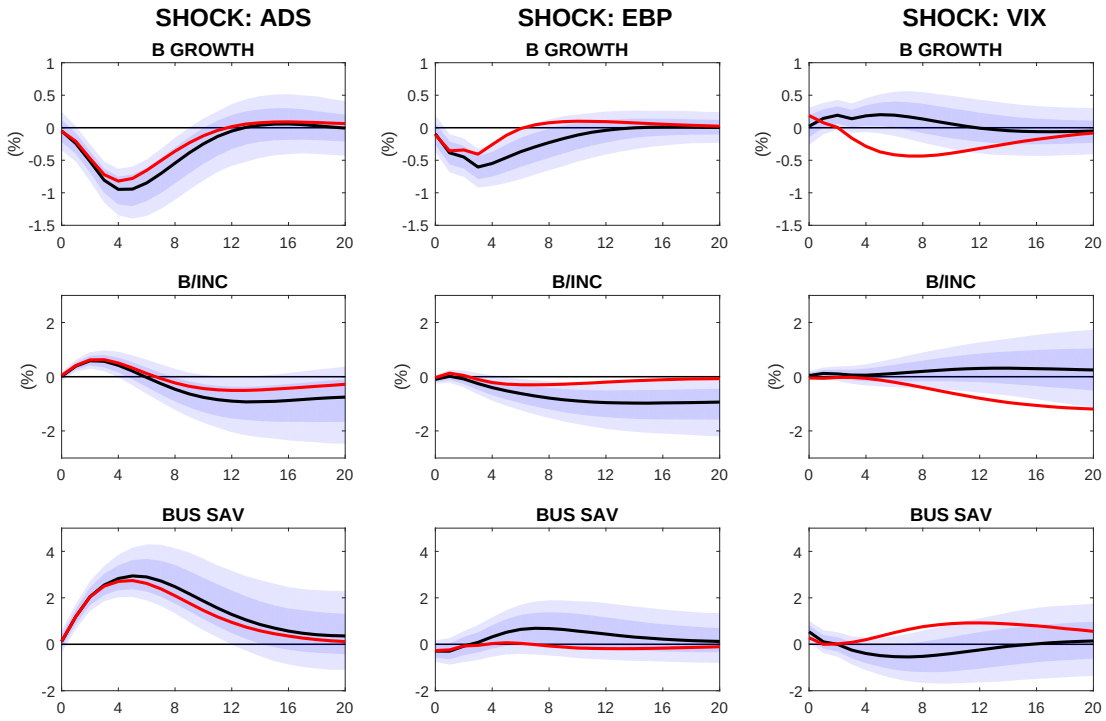
Note: Each panel depicts the median impulse response of the specified variable to a one-standard deviation real, financial and uncertainty shock, shown respectively in the three columns. Black solid lines are responses of a model in which the financial uncertainty shock is identified with the VIX, while the red broken lines are the responses of a model in which the financial uncertainty shock is identified with Jurado et al. (2015) financial uncertainty measure. Shaded bands denotes the 68 (darker) and 90 percent pointwise credible sets for the model where VIX is used as uncertainty measure.

Figure 5: Financial Variables, Monthly 2.



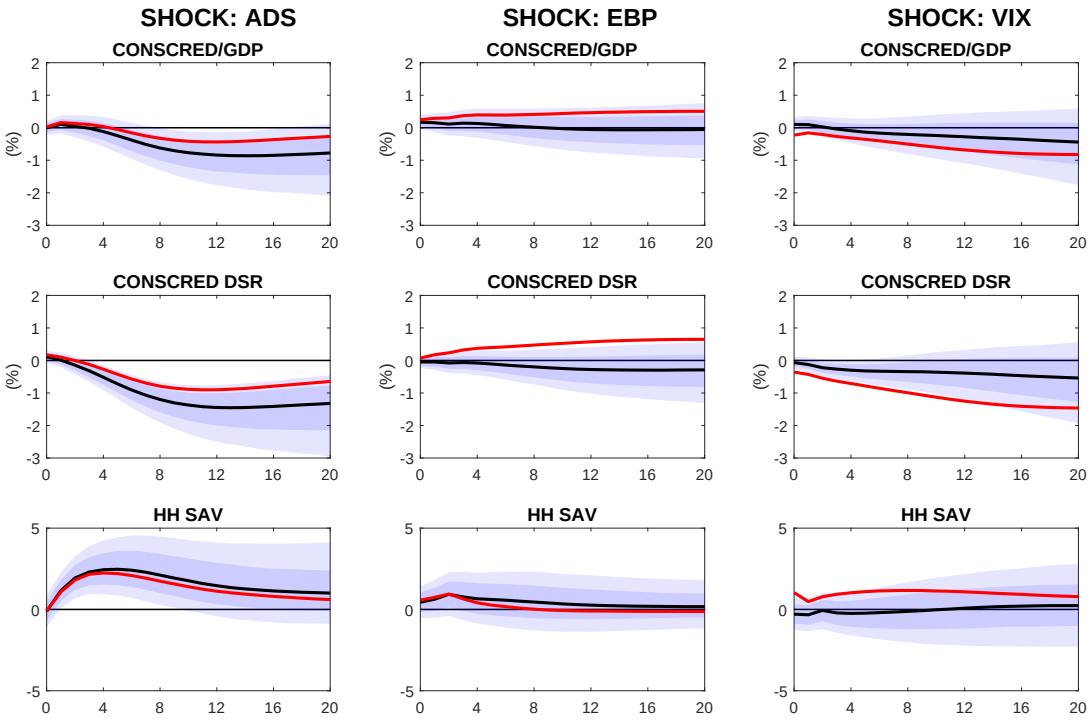
Note: Each panel depicts the median impulse response of the specified variable to a one-standard deviation real, financial and uncertainty shock, shown respectively in the three columns. Black solid lines are responses of a model in which the financial uncertainty shock is identified with the VIX, while the red broken lines are the responses of a model in which the financial uncertainty shock is identified with Jurado et al. (2015) financial uncertainty measure. Shaded bands denotes the 68 (darker) and 90 percent pointwise credible sets for the model where VIX is used as uncertainty measure.

Figure 6: Non-Financial Variables, Quarterly 1.



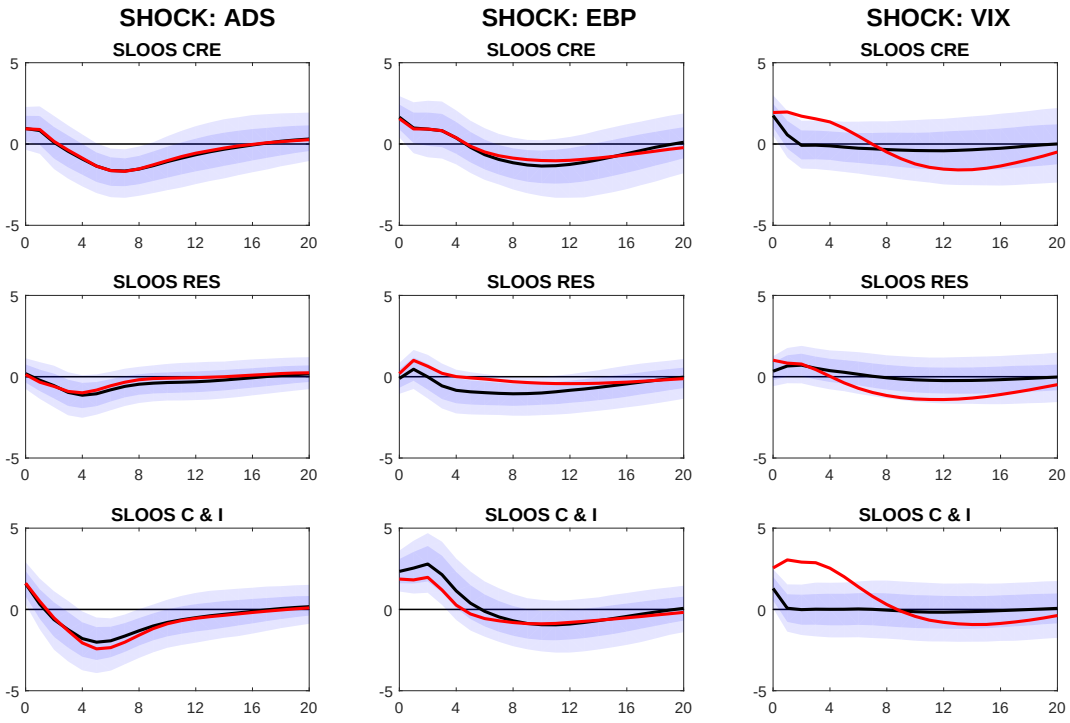
Note: Each panel depicts the median impulse response of the specified variable to a one-standard deviation real, financial and uncertainty shock, shown respectively in the three columns. Black solid lines are responses of a model in which the financial uncertainty shock is identified with the VIX, while the red broken lines are the responses of a model in which the financial uncertainty shock is identified with Jurado et al. (2015) financial uncertainty measure. Shaded bands denotes the 68 (darker) and 90 percent pointwise credible sets for the model where VIX is used as uncertainty measure.

Figure 7: Non-Financial Variables, Quarterly 2.



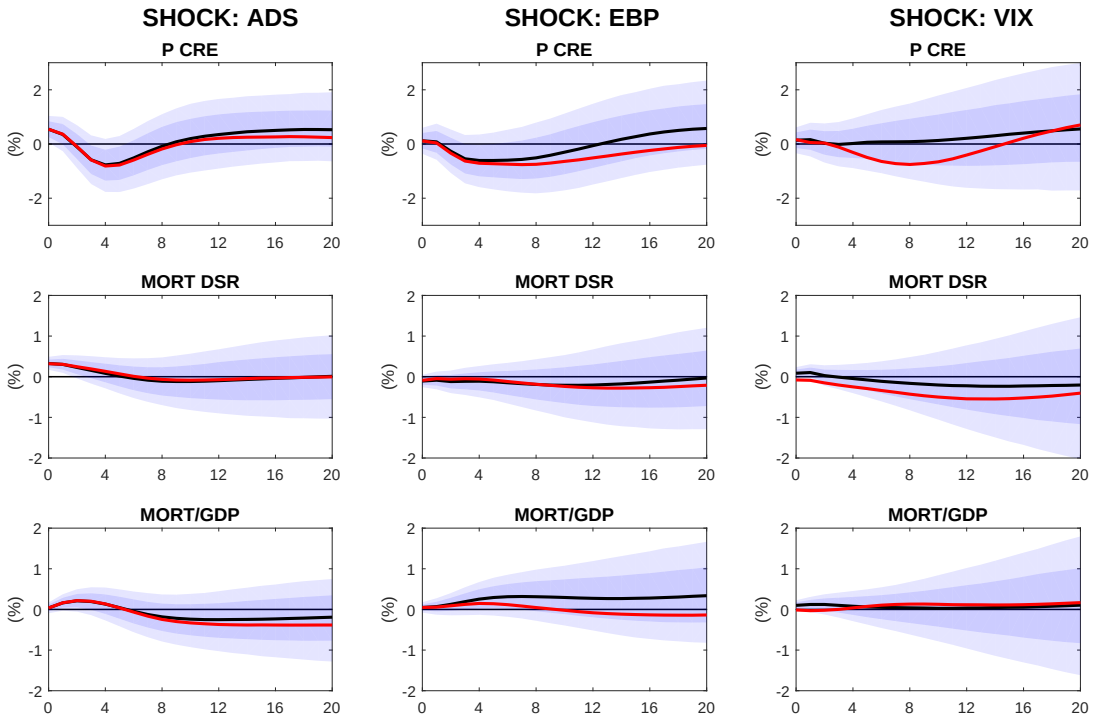
Note: Each panel depicts the median impulse response of the specified variable to a one-standard deviation real, financial and uncertainty shock, shown respectively in the three columns. Black solid lines are responses of a model in which the financial uncertainty shock is identified with the VIX, while the red broken lines are the responses of a model in which the financial uncertainty shock is identified with Jurado et al. (2015) financial uncertainty measure. Shaded bands denotes the 68 (darker) and 90 percent pointwise credible sets for the model where VIX is used as uncertainty measure.

Figure 8: Non-Financial Variables 2, Quarterly 1.



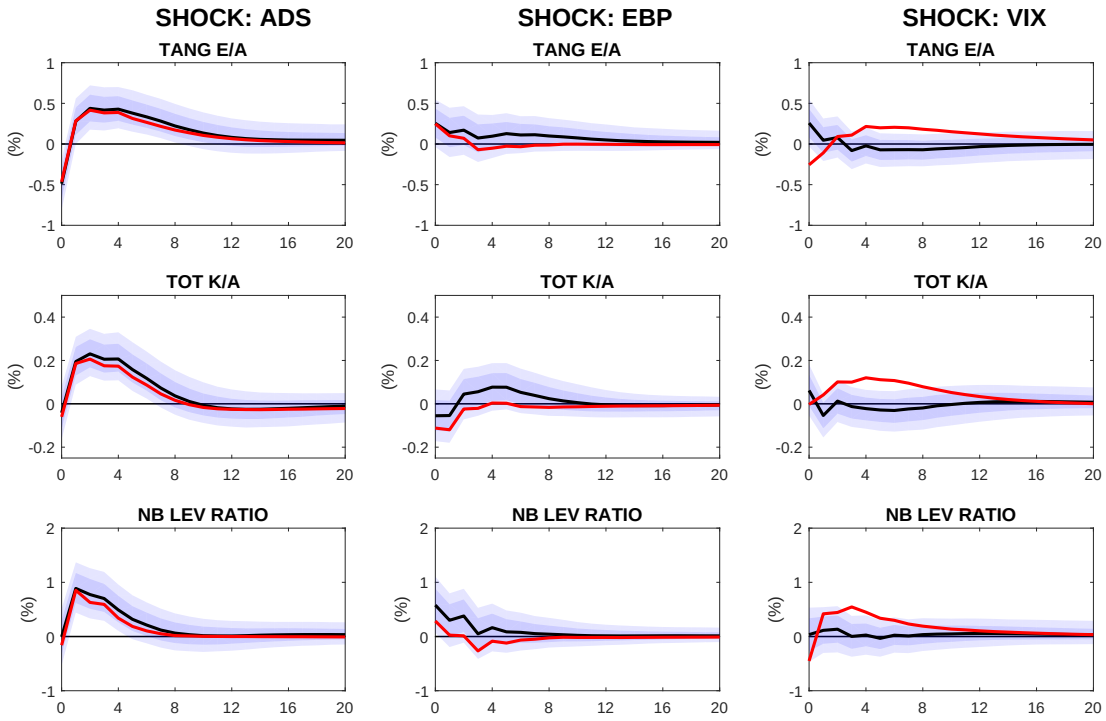
Note: Each panel depicts the median impulse response of the specified variable to a one-standard deviation real, financial and uncertainty shock, shown respectively in the three columns. Black solid lines are responses of a model in which the financial uncertainty shock is identified with the VIX, while the red broken lines are the responses of a model in which the financial uncertainty shock is identified with Jurado et al. (2015) financial uncertainty measure. Shaded bands denotes the 68 (darker) and 90 percent pointwise credible sets for the model where VIX is used as uncertainty measure.

Figure 9: Non-Financial Variables 2, Quarterly 2.



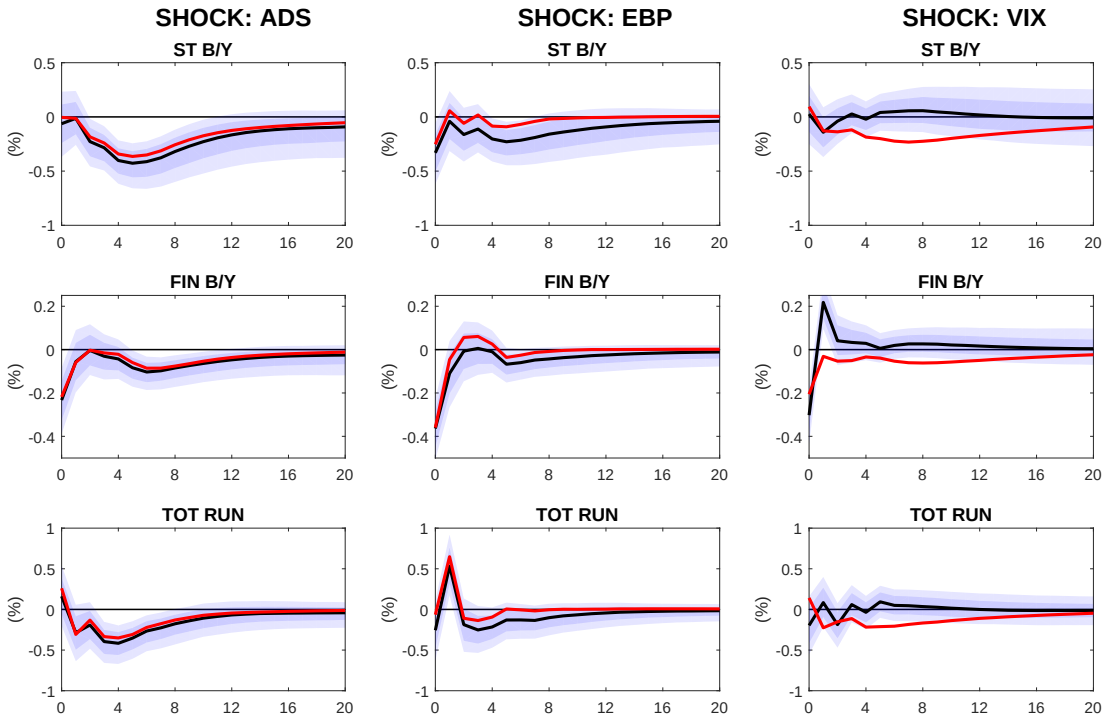
Note: Each panel depicts the median impulse response of the specified variable to a one-standard deviation real, financial and uncertainty shock, shown respectively in the three columns. Black solid lines are responses of a model in which the financial uncertainty shock is identified with the VIX, while the red broken lines are the responses of a model in which the financial uncertainty shock is identified with Jurado et al. (2015) financial uncertainty measure. Shaded bands denotes the 68 (darker) and 90 percent pointwise credible sets for the model where VIX is used as uncertainty measure.

Figure 10: Financial Variables, Quarterly 1



Note: Each panel depicts the median impulse response of the specified variable to a one-standard deviation real, financial and uncertainty shock, shown respectively in the three columns. Black solid lines are responses of a model in which the financial uncertainty shock is identified with the VIX, while the red broken lines are the responses of a model in which the financial uncertainty shock is identified with Jurado et al. (2015) financial uncertainty measure. Shaded bands denotes the 68 (darker) and 90 percent pointwise credible sets for the model where VIX is used as uncertainty measure.

Figure 11: Financial Variables, Quarterly 2.



Note: Each panel depicts the median impulse response of the specified variable to a one-standard deviation real, financial and uncertainty shock, shown respectively in the three columns. Black solid lines are responses of a model in which the financial uncertainty shock is identified with the VIX, while the red broken lines are the responses of a model in which the financial uncertainty shock is identified with Jurado et al. (2015) financial uncertainty measure. Shaded bands denotes the 68 (darker) and 90 percent pointwise credible sets for the model where VIX is used as uncertainty measure.

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7 Appendix

Figure A.1: Standard Macro Effects, Quarterly Baseline 2.

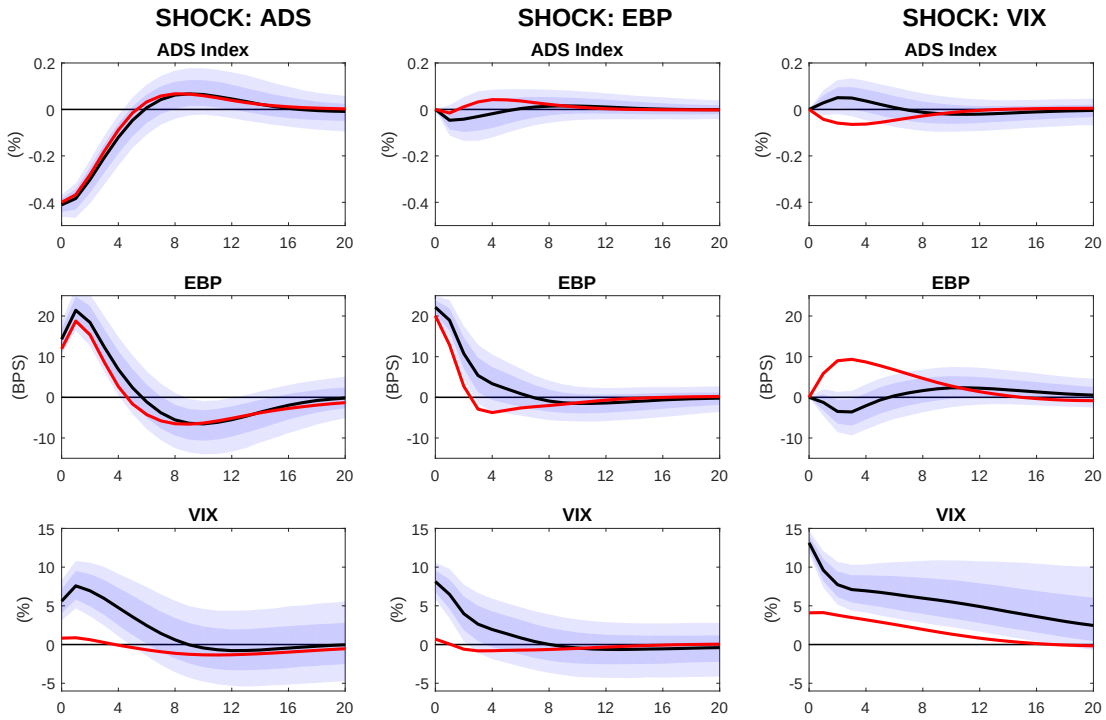

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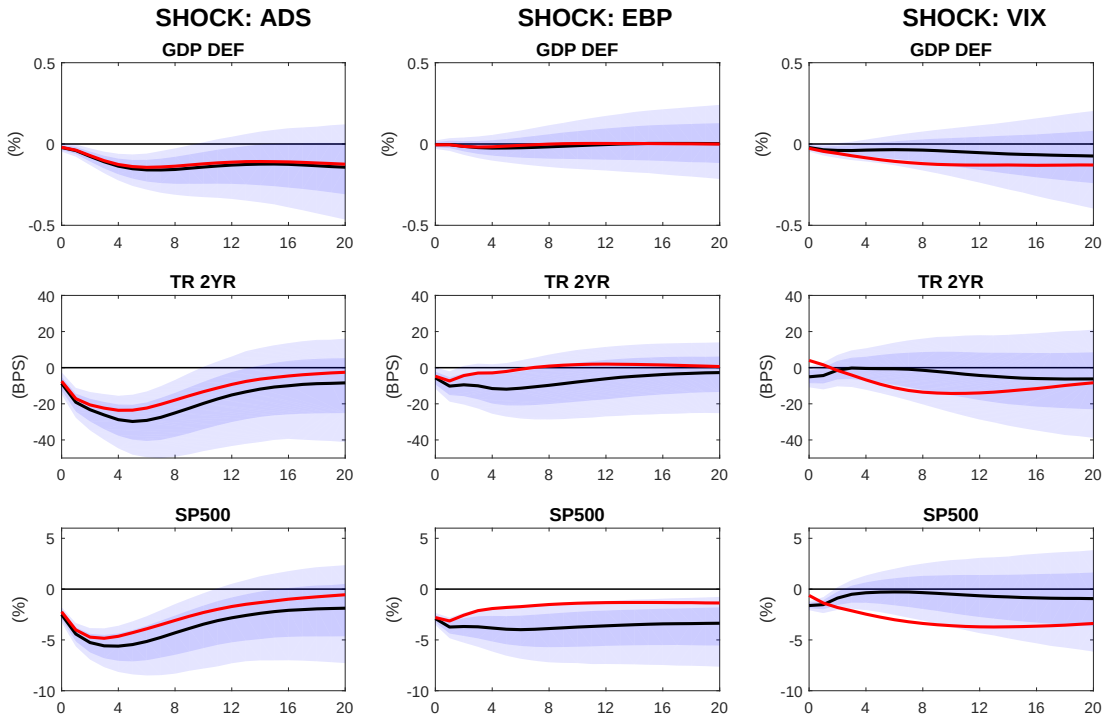
Figure A.2: Standard Macro Effects, Quarterly Baseline 2.



Note: Each panel depicts the median impulse response of the specified variable to a one-standard deviation real, financial and uncertainty shock, shown respectively in the three columns. Black solid lines are responses of a model in which the financial uncertainty shock is identified with the VIX, while the red broken lines are the responses of a model in which the financial uncertainty shock is identified with Jurado et al. (2015) financial uncertainty measure. Shaded bands denotes the 68 (darker) and 90 percent pointwise credible sets for the model where VIX is used as uncertainty measure.