MACROECONOMIC EFFECTS OF UNCERTAINTY SHOCKS: EVIDENCE FROM SURVEY DATA

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ABSTRACT. We examine the effects of uncertainty on macroeconomic fluctuations. We measure uncertainty based on surveys of consumers and firms in the U.S. and the UK. In particular, we measure uncertainty as the fraction of respondents who report "future uncertainty" as a factor that limits consumers' durable goods purchases or firms' capital expenditures. We use the timing of the survey relative to macro data releases to identify the effects of uncertainty shocks in our vector autoregression (VAR) framework. We find that an increase in the level of uncertainty raises unemployment and credit spreads, and lowers investment, inflation, and short-term interest rates, suggesting that uncertainty shocks act like aggregate demand shocks. Consistent with the option-value theory, elevated uncertainty leads to greater declines in full-time than in part-time employment and greater reductions in spending on durable goods than on nondurables and services. Further, the responses of macroeconomic variables following a shock to the survey-based uncertainty measures are broadly similar to other measures of uncertainty used in the literature. We discuss a few alternative transmission mechanisms in DSGE models that may help explain these findings.

> With many businesses and consumers uncertain about future taxes, regulations, and the financial ramifications of the European sovereign debt situation, it is no wonder that sentiment is flagging. This high degree of uncertainty dampens current growth and poses added risk to the forecast. [Charles Plosser, October 2011]

> Coherent financial, fiscal and monetary measures are all needed. ...[T]hey will help reduce uncertainty, lower risk spreads, and get consumers and firms spending again. If policymakers act decisively, private demand will recover sooner rather than later. [Olivier Blanchard, January 2009]

I. Introduction

The theoretical literature suggests that elevated uncertainty can deepen recessions and slow down recoveries (Bernanke, 1983). Existing studies suggest that measures of uncertainty jumps up in periods with financial crisis such as the Great Depression and the Great Recession (Romer, 1990; Bloom, 2009). Uncertainty also rises when major policy shifts are expected in the near future (Baker, Bloom, and Davis, 2011). The recent literature suggests that uncertainty shocks can be an important driving force for business cycles in dynamic stochastic general equilibrium (DSGE) models (Bloom, Floetotto, and Jaimovich, 2010; Gilchrist, Sim, and Zakrajsek, 2010; Basu and Bundick, 2011; Fernandez-Villaverde, Guerron-Quintana, Kuester, and Rubio-Ramirez, 2011).

Despite the importance attached to uncertainty shocks, formal empirical evidence on how uncertainty shocks impact upon macroeconomic fluctuations is scarce. The goal of this paper is to examine the macroeconomic effects of uncertainty in a vector-autoregression (VAR) model, using direct measures of perceived uncertainty by consumers and firms from survey data. We focus on the Michigan Survey of Consumers in the United States and the CBI Industrial Trends Survey of firms in the United kingdom. Both surveys tally responses that make explicit references to "uncertainty." We exploit the timing of the surveys' construction to help identify structural shocks to uncertainty. In our benchmark model, we examine the effects of uncertainty shocks on the unemployment rate, the CPI inflation rate, and the three-month T-bill rate. Since these data series are not subject to frequent revisions, the focus on these time series data helps us mitigate the difficulties related to the use of ex post revised data.

A robust result that emerges from our study is that an increase in uncertainty raises unemployment and lowers inflation and short-term nominal interest rates. This result suggests that uncertainty shocks act like a negative aggregate demand shock, which policymakers accommodate with an easier policy stance. Thus, our results are in line with Blanchard (2009)'s view that high levels of uncertainty depress economic activity mainly through a fall in private demand, as consumers and firms postpone spending and wait for uncertainty to be resolved over time.

Using our framework, we examine the empirical plausibility of the option-value theory of investment, which suggests that elevated uncertainty should discourage irreversible investment (Bernanke, 1983; Pindyck, 1988). For this purpose, we expand our benchmark VAR model to include additional macro variables such as full-time vs part-time employment and durable vs non-durable consumption expenditures. We find that, consistent with the option-value theory, an increase in uncertainty leads to a greater decline in spending on durable goods than on non-durable goods and services and a greater decline in full-time employment than part-time employment.

Recent work suggests that uncertainty shocks can be transmitted through financial frictions in a DSGE framework (Gilchrist, Sim, and Zakrajsek, 2010; Arellano, Bai, and Kehoe, 2011). Consistent with this literature, we find that elevated uncertainty leads to a sharp rise in credit spread and a decline in equity prices. These findings suggest that incorporating financial frictions in DSGE models is promising for understanding the transmission of uncertainty shocks.

Our direct measures of perceived uncertainty come from very different sources than more standard measures such as the VIX index studied extensively by Bloom (2009) and others or the measure of policy uncertainty constructed by Baker, Bloom, and Davis (2011). To examine the robustness of our results that uncertainty shocks act like a negative demand shock, we replace our uncertainty measure in the VAR models by the VIX index or policy uncertainty. We find, somewhat surprisingly, that the impulse responses of the macro variables following a VIX shock or a policy uncertainty shock are broadly similar to those obtained using our survey-based uncertainty measures. They all reveal that elevated uncertainty leads to a rise in unemployment and a decline in inflation and nominal interest rates. This similarity carries over in our expanded VAR system with additional macro and financial variables. Thus, our result that uncertainty shocks act as a negative demand shock is a robust finding.

Our emphasis on the "demand shock" aspect of uncertainty shocks is new to the literature. Existing studies focus on the effects of uncertainty shocks on real activity such as aggregate output, investment, and employment (Alexopoulos and Cohen, 2009; Bloom, 2009). Our finding suggests that examining the joint effects on real activity and inflation can help better understand the transmission mechanism of uncertainty shocks.

Other studies also use survey data to measure uncertainty, although with different methodologies. For example, Bachmann, Elstner, and Sims (2011) measure uncertainty using dispersions of firms' expectations of business conditions using data from a business survey. Baker, Bloom, and Davis (2011) use forecast disagreement on the future paths of inflation and government spending from the Survey of Professional Forecasters as a component of their policy uncertainty measure. We use direct measures of uncertainty as reported by consumers and firms in the surveys. Our measure is desirable because it can be difficult to interpret the link between forecast disagreement and uncertainty about future outcomes (Rich and Tracy, 2010).

To conclude the paper, we discuss a few key ingredients that might be essential for a DSGE model to explain the observed macroeconomic effects of uncertainty shocks. We do this by introducing a few sources of volatility shocks in a stylized real business cycle model with financial frictions (Liu and Wang, 2009). Based on closed-form (non-linear) solutions, we show that a standard real business cycle (RBC) model without financial frictions is incapable of explaining the recessionary effects of uncertainty shocks, especially on labor market variables. In the standard RBC model, aggregate output is convex in the level of technology. Thus, an increase in uncertainty can leads to a short-run expansion in output, similar to the finding in Gilchrist and Williams (2005).

Incorporating financial frictions in the RBC model helps generate the recessionary effects of uncertainty shocks. This result obtains because a rise in uncertainty lowers asset prices and, because productive firms are credit constrained, the decline in asset prices tightens the borrowing constraints for productive firms and reallocates resources to less productive firms. This reallocation reduces aggregate productivity and depresses asset prices and output further. The financial transmission mechanism is promising for understanding the macroeconomic effects of uncertainty shocks, especially because our VAR evidence shows that an increase in uncertainty leads to a sharp decline in asset prices.

Of course, to understand the broader impact of uncertainty shocks requires a richer DSGE model that takes into account financial frictions and nominal rigidities. Basu and Bundick (2011) show that incorporating nominal rigidities is important not just because the model has implications for inflation dynamics but because nominal rigidities help generate the observed macroeconomic comovement following uncertainty shocks. Our empirical finding that uncertainty shocks act like an aggregate demand shock suggests that nominal rigidities along with financial frictions and labor-market search frictions should be important ingredients to explain the observed macroeconomic effects of uncertainty shocks.

II. Measures of Uncertainty and Uncertainty Shocks

We consider direct measures of perceived uncertainty by consumers and firms. We focus on two sets of survey data: the Michigan Survey of Consumers in the United States. and the CBI Industrial Trends Survey of firms in the United Kingdom. Each month since 1978 the Michigan Survey conducts interviews of about 500 households throughout the United States asking question ranging from their perception of business conditions to expectations of future movements in prices. More important for our analysis, the survey also tallies the fraction of respondents who report that "future uncertainty" is a factor that will likely limit their expenditures on durable goods (such as cars) over the next 12 months.[1] Figure 1 shows the time-series plots of consumers' perceived uncertainty along with the VIX index, a standard gauge of uncertainty that measures the implied volatility of the S&P 500 and that is often used in the literature Bloom (2009). Similar to the VIX index, consumer perceived uncertainty is countercyclical. It rises in recession and falls in expansions. A notable difference between the consumers' perceived uncertainty and financial uncertainty measured by the VIX is that the 1997 East-Asian financial crisis and the 1998 Russian debt crisis led to large spikes in the VIX, but did not seem to have much impact on consumer perceptions of uncertainty.

Similarly, since 1978, the CBI surveys a large sample of roughly 1,100 firms in the United Kingdom each quarter. From this survey, we use the fraction of firms that report "uncertainty

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[1]More specifically, the question is "Speaking now of the automobile market–do you think the next 12 months or sowill be a good time or a bad time to buy a vehicle, such as a car, pickup,van or sport utility vehicle? Why do you say so?" Reasons related to uncertainty are then compiled. Note that the series is weigthed by age, income, region, and sex to be nationally representative.

about demand" as a factor limiting their capital expenditures over the next 12 months.[2] As Figure 2 shows, firms' perceived uncertainty also tends to rise in recessions. However, these movements are roughly similar to those occuring during good times. Overall, U.K. firms' perception of uncertainty is relatively more stable than what is reported by the Michigan survey of consumers, possibly reflecting the fact that U.K. firms are asked about a specific form of uncertainty (i.e., about the demand for their products), whereas no such specificity is attached to the measure of uncertainty in the Michigan survey.

Consider now the implications of a baseline VAR model comprising one of our two measures of uncertainty, and other variables such as the unemployment rate, the CPI inflation rate, and the nominal 3-month Treasury bill rate. The key specification issue for investigating the consequences of shifts in uncertainty is how to identify uncertainty shocks. To do so, we use the the timing of the surveys and the way we have aligned the other data in the VAR (see also Leduc, Sill, and Stark (2007) and Leduc and Sill (2010)), which allows us to place the measure of uncertainty first in a recursive ordering.

More specifically, the Michigan Survey, for instance, conducts phone interviews throughout the month, with most interviews being conducted by the middle of each month when preliminary results are then released.[3] When answering questions about why the next 12 months will be a good or a bad time to buy a vehicle, survey participants therefore know the previous month's unemployment and inflation rates, for instance, but do not know the current realizations of those indicators since that information has yet to be made public. Hence, our identification strategy uses the fact that when answering questions at time t about their expectations of the future, the information set on which survey participants condition their answers will not include, by construction, the time t realizations of the unemployment rate and the other variables in our VAR (since survey participants did not have that information at the time to fill in the survey questionnaires).

Similarly, the questionnaires for the CBI survey must be returned by the middle of the first month of each quarter. Again, the design of the survey implies that participants had information about the values of the variables in the VAR for the previous quarter when they filled in the survey, but did not know those values for the current quarter.

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[2]The questions asked by the CBI is "What factors are likely to limit (wholly or partly) your capital expenditure authorisations over the next twelve months?" Participants can choose "uncertainty about demand" as one of six options. Firms can also provide other reasons. Finally, multiple reasons can be chosen.

[3]The final results are typically released by the end of the month.

III. The Macroeconomic Effects of Uncertainty Shocks

We now assess the effects of uncertainty shocks in the United States and in the United Kingdom using baseline VARs with variables subject to little data revisions. We do this to minimize the possible misspecification issues arising from the fact that survey participants had a particular vintage of data when they answered the survey questionnaires. Including final releases of heavily revised series in the VARs would assume that participants had more information than they really possessed at the time the surveys were taken. Our baseline VARs thus include the unemployment rate as an indicator of economic activity as it experiences little revisions through time compared, for instance, to a broader measure like real GDP and its components. We also include the CPI inflation rate and a three-month interest rate.

For the U.S. VARs, we first use data from January 1978, the start of uncertainty measure, through 2008. By ending the sample in 2008 we avoid issues related to the zero lower bound on nominal interest rates. Below, we also examine the robustness of our results to extending the sample to 2011. We estimate the U.K. VARs using data from 1979Q4, since this is when the CBI survey was first conducted. To facilitate comparison with other papers in the literature (see, for instance, Baker, Bloom, and Davis (2011), we report one-standard-error bands in the figures below, though the responses are typically significant at the 90 percent confidence level as well.

Figure 3 shows that an unanticipated increase in uncertainty leads to a persistent increase in the unemployment rate and to a fall in inflation, which starts declining roughly 6 months after the initial increase in uncertainty. The figure also shows that monetary policymakers react to the decline in activity and the fall in the inflation rate by easing the stance of policy.

The results are similar for the UK data, as shown in Figure 4. As in the case for the U.S., an unanticipated increase in perceived demand uncertainty (here, by firms instead of consumers) leads to an increase in the unemployment rate and a fall in inflation. The UK monetary policy also accommodates the shock by lowering interest rates. The similarity in the effects of uncertainty shocks in the United States and the United Kingdom is surprising and indeed, revealing; because the measures of uncertainty are taken from different sources (consumers in the US and firms in the UK) and these measures display very different cyclical patterns.

Overall, the results from our baseline model suggest that uncertainty shocks behave like negative demand shocks: they depress economic activity and lower inflation at the same

time. In this sense, our finding provides evidence supporting Blanchard's (2009) argument that elevated uncertainty deepens recessions because it depresses demand by consumers and firms.

IV. Irreversible Investments and Financial Markets

The option-value theory predicts that uncertainty leads to decline in irreversible investment. Thus, if the theory is correct, then one should expect an increase in uncertainty to be associated with a decline in firms' investment and consumers' durable-good spending. Similarly, labor search models emphasize that employment can also be thought of as a form of (human capital) investment. One would thus expect an increase in uncertainty to be associated with a decline in full-time employment relative to part-time. Moreover, recent work emphasize the role of finance in the transmission of uncertainty shocks. In this section, we examine whether the uncertainty shock we identify has implications consistent with the predictions of the option-value theory and what it implies for the movements of financial variables. Because the data is more limited for the United Kingdom, we first focus our analysis on the United States.

We first augment our baseline VAR by adding real durable and non durable consumption, for which we have data at a monthly frequency. Figure 5 reports the results where we only report the responses of durable and non-durable consumptions for ease of exposition. The figure shows that following an unanticipated rise in uncertainty both the consumption of durable and non-durable goods decline. However, the fall in durable goods consumption is about an order of magnitude larger than that of non-durable consumption. We thus find these responses to be broadly in line with the option-value theory. Our findings are also in line with those of Romer (1990) who finds a similar pattern during the early part of the Great Depression, proxying uncertainty with the stock market crash of 1929.

To complement these findings, we also examine a quarterly version of our benchmark VAR augmented with real investment in equipment and software. Figure 6 indicates that as predicted by the option-value theory, a rise in our uncertainty measure brings about a decline in investment. Comparing Figures 5 and 6, we note that the fall in investment is of a similar magnitude as that of durable consumption.

Firms' investment in full-time employment relationships also falls markedly with a rise in uncertainty, as shown in Figure 7. However, while firms cut full-time workers, they also tend

to rely more on part-time employment. Because the economic environment is uncertain, firms prefer the flexibility of part-time employment relationships, which allow them to more easily adjust to unforeseen changes in the economy.

Overall, we interpret these results as suggesting that our measure of uncertainty do indeed capture features associated with consumers and firms behavior under uncertainty. This is also true for our U.K. measure of uncertainty. For instance, when we augment the benchmark VAR for the United Kingdom with investment, we also find that a rise in uncertainty leads to a drop in that variable,as shown in Figure 8.

Finally, in line with the recent research emphasizing the importance of financial variables in the transmission of uncertainty shocks, we report in Figure 9 that a rise in uncertainty triggers an increase in corporate bond spreads and a decline in equity prices.

V. Conclusion

We have examined the macroeconomic effects of uncertainty shocks using direct measures of uncertainty taken from consumer and firm survey data. One robust finding is that uncertainty shocks act like a demand shock. An increase in the level of uncertainty leads to a rise in unemployment and a fall in inflation. This pattern is robust when we consider different measures of uncertainty, including the standard VIX index and policy uncertainty, in addition to our direct measures of uncertainty based on the Michigan Consumer Survey in the United States and the CBI Industrial Trends Survey of firms in the United Kingdom. The result is also robust when we include additional macroeconomic variables and financial variables in the VAR and when we move to a quarterly time-series data (so we can include investment in the VAR).

The stylized facts that emerge from our study help shed lights on the transmission mechanisms of uncertainty shocks. Our simple analytical example suggests that several ingredients in a DSGE model can be essential to understand the observed macroeconomic effects of uncertainty shocks. These ingredients include nominal rigidities, financial frictions, and to have something interesting to say about unemployment, also labor market search frictions. In our view, future research that incorporates these frictions to understand the transmission channels of uncertainty shocks should be both promising and fruitful.

Figure 1. Consumers' Perceived Uncertainty & VIX Index

Percent of Respondents   Index
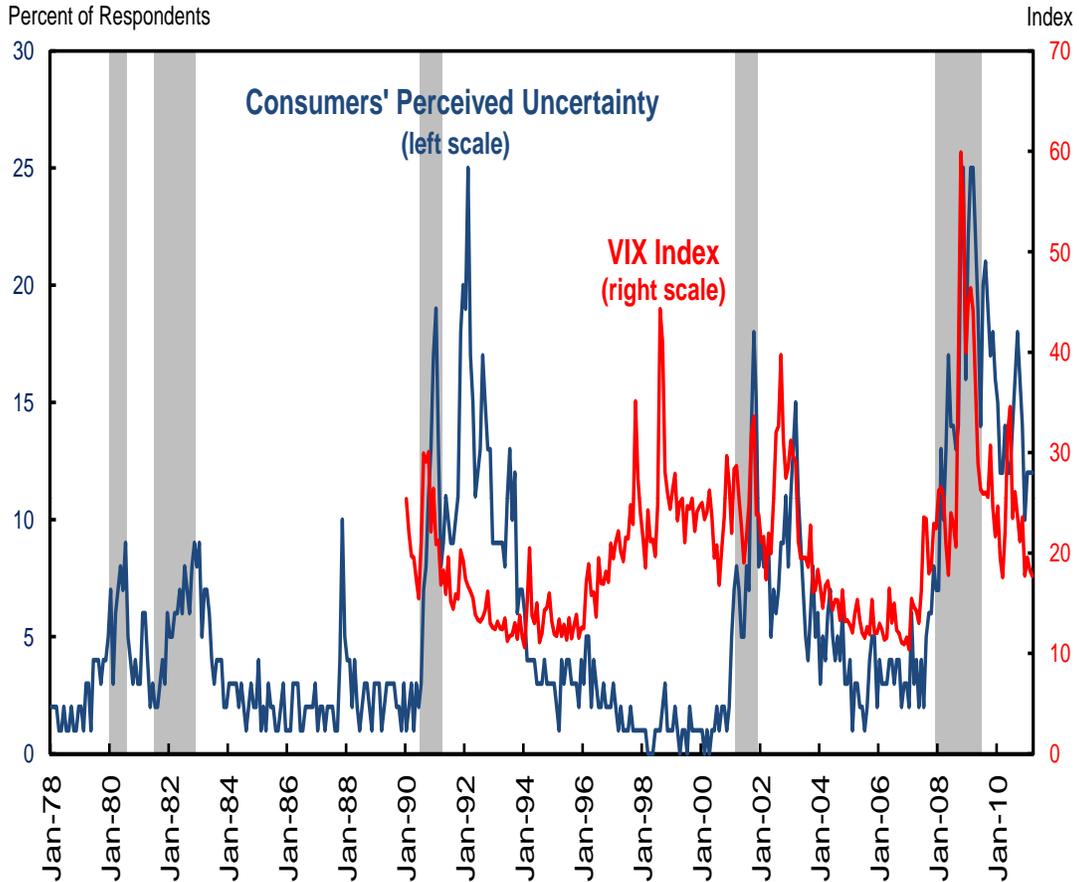
Source: Michigan Survey and Bloomberg.

FIGURE 1. Time-series plot of uncertainty measures: consumers' perceived uncertainty vs the VIX index. Consumers' perceived uncertainty is the fraction of respondents in the Michigan Survey of Consumers, who report that "future uncertainty" is a factor limiting their purchases of durable goods.

Figure 2. Firms' Perceived Uncertainty
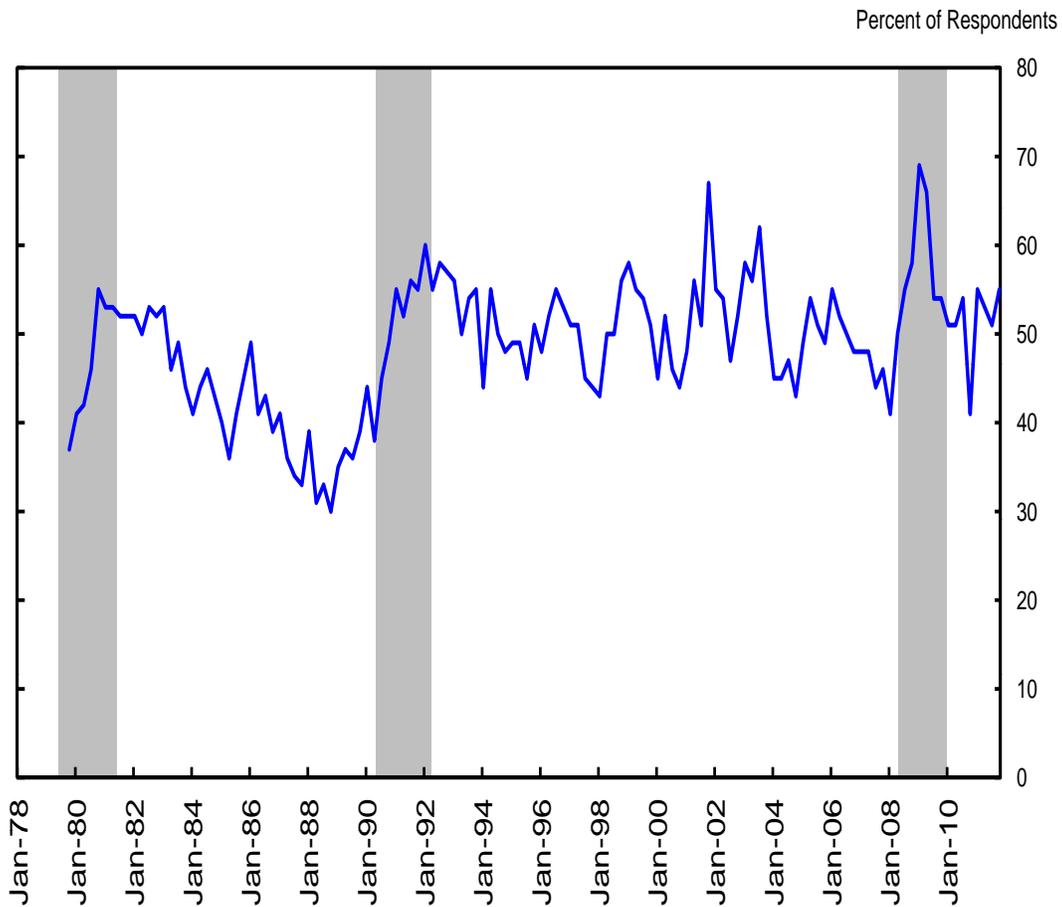
Source: CBI Industrial Trends Survey

FIGURE 2. Time-series plot of firms' perceived uncertainty, which is the fraction of firms in the CBI Industrial Trends Survey for firms in the United Kingdom, who report that "demand uncertainty" is a factor limiting their capital expenditures.

Figure 3. Uncertainty Shock: U.S. Benchmark VAR
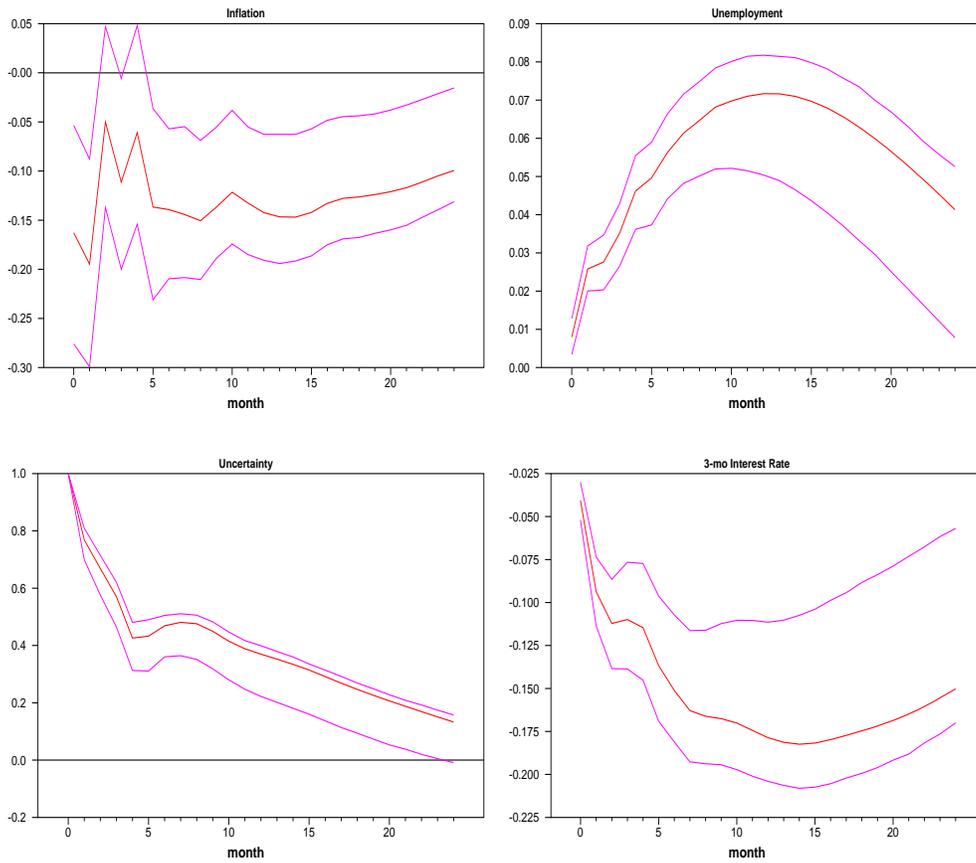
FIGURE 3. The effects of a one-standard deviation shock to perceived uncertainty in the Michigan Survey of Consumers: Benchmark VAR model.

Figure 4. Uncertainty Shock: U.K. Benchmark VAR
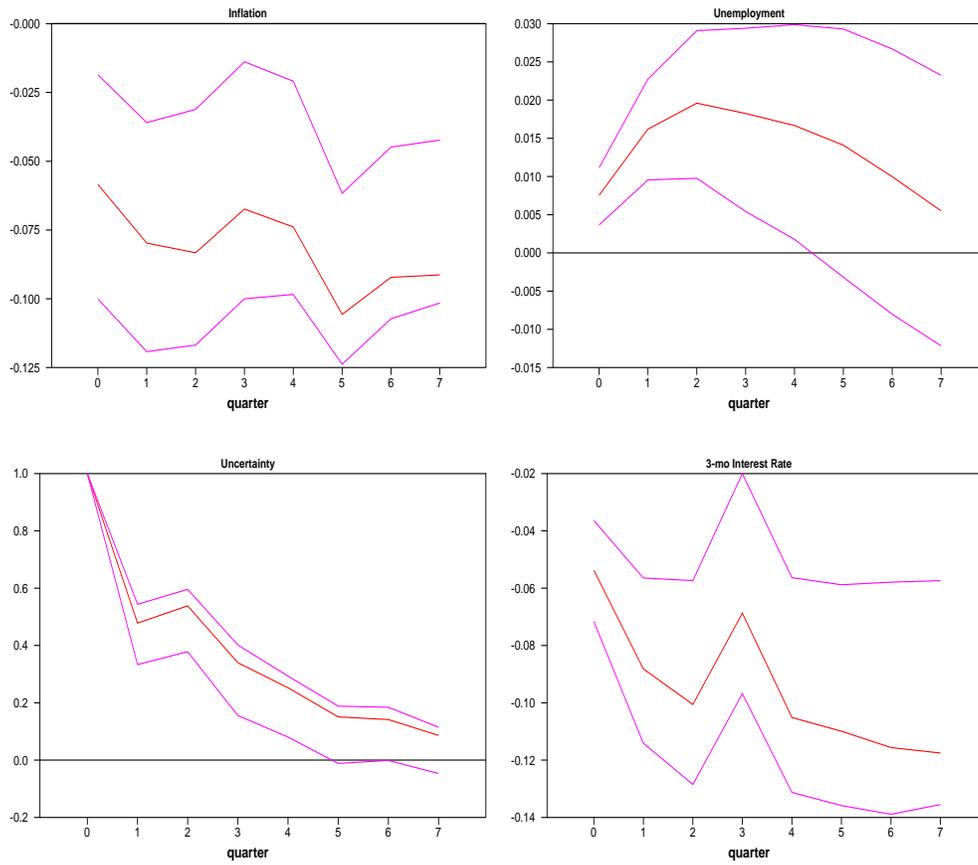
FIGURE 4. The effects of a one-standard deviation shock to perceived uncertainty in the CBI Industrial Trends Survey in the United Kingdom: Benchmark VAR model
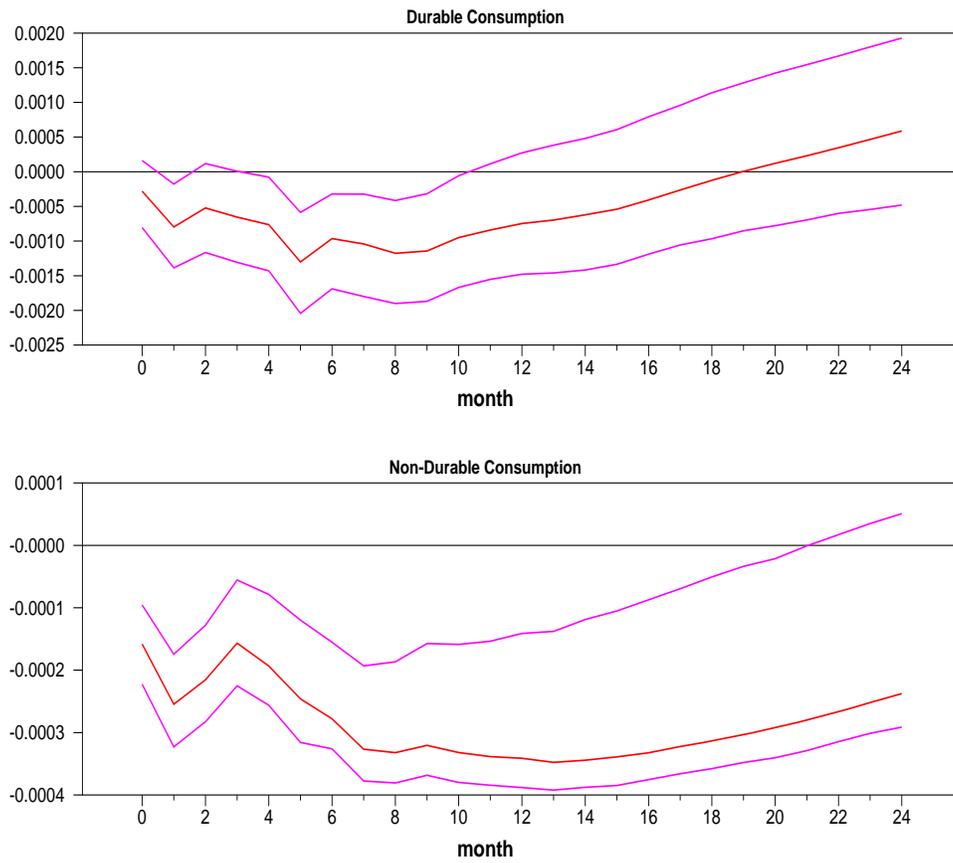
Figure 5. Uncertainty Shock and Option-Value Theory (U.S. VAR)

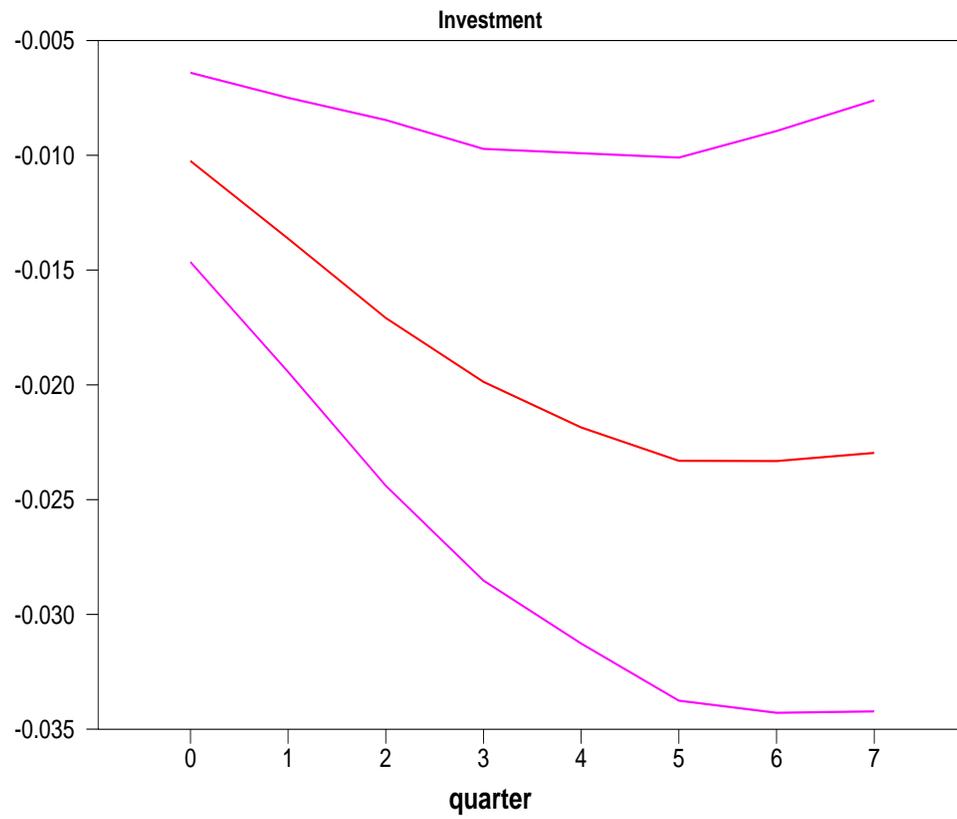FIGURE 5. Uncertainty shock and consumption: VAR with monthly U.S. data

Figure 6. Uncertainty Shock and Investment: US Quarterly VAR

FIGURE 6. Uncertainty shock and investment: VAR with quarterly U.S. data

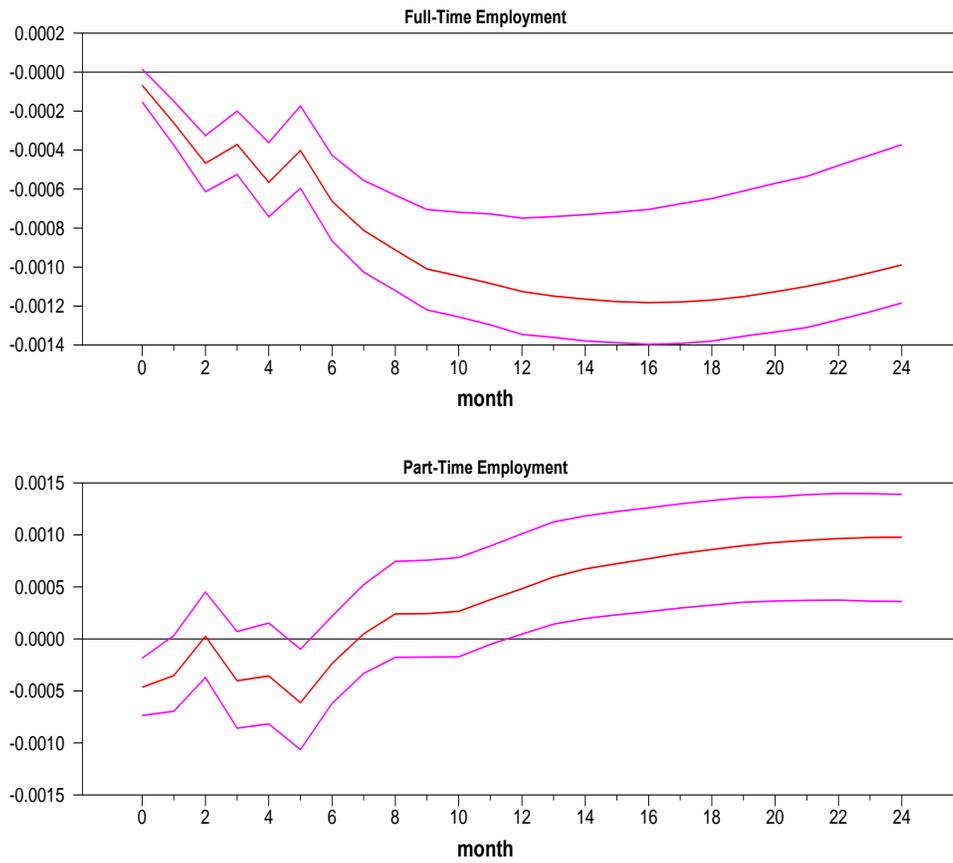**Figure 7. Uncertainty Shock and Labor Markets (U.S. VAR)**

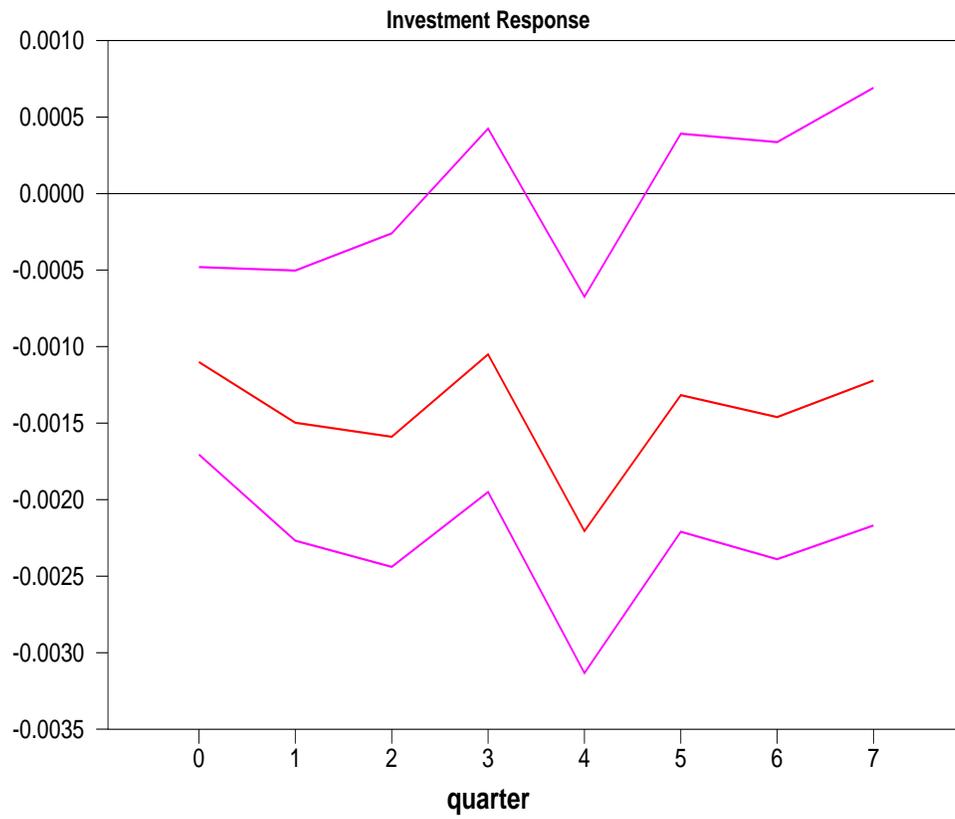FIGURE 7. Uncertainty shock and the labor markets: VAR with monthly U.S. data

Figure 8. Uncertainty Shock and Investment: UK VAR

FIGURE 8. Uncertainty shock and investment: VAR with quarterly U.K. data

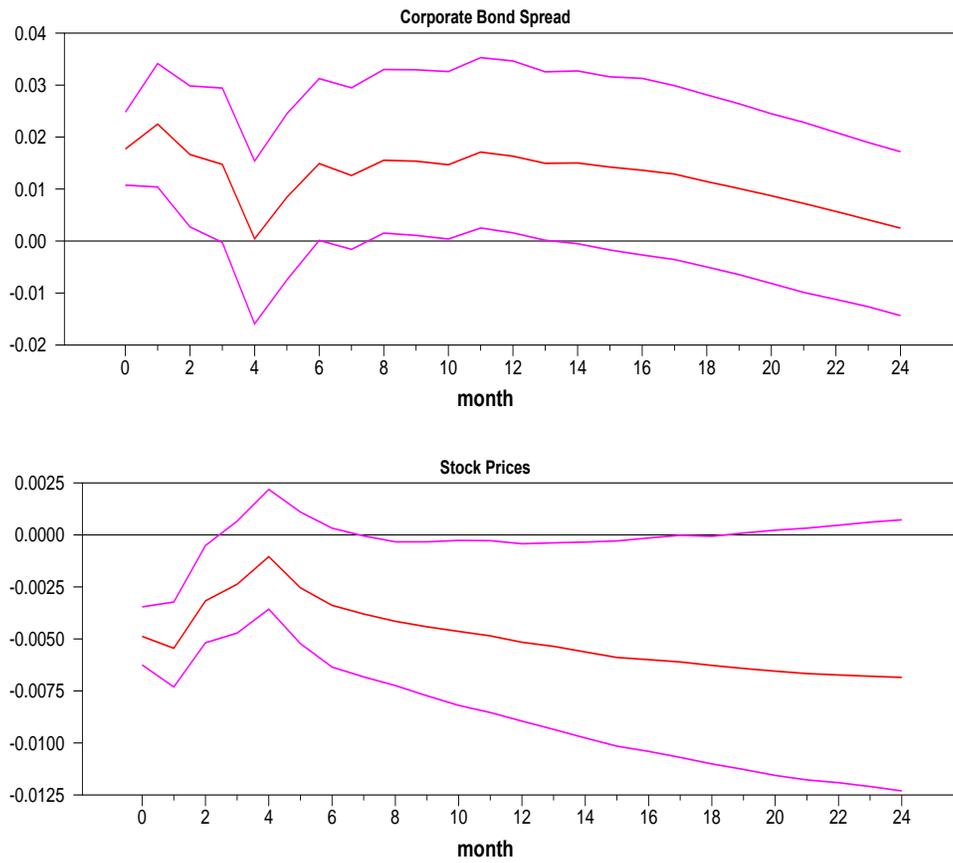**Figure 9. Uncertainty Shock and Financial Markets (U.S. VAR)**

FIGURE 9. Uncertainty shock and the financial markets: VAR with monthly U.S. data

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