Oil shocks, policy uncertainty and stock market return

Kang, Wensheng and Ratti, Ronald A.

Kent State University, University of Western Sydney

5 February 2013

Oil Shocks, Policy Uncertainty and Stock Market Return

by

Wensheng Kang[a] and Ronald A. Ratti[b]

[a]Department of Economics, Kent State University, Ohio, USA
[b]School of Business, University of Western Sydney, NSW, Australia

(February 2013)

Abstract

Oil price shocks and economic policy uncertainty are interrelated and influence stock market return. For the U.S. an unanticipated increase in policy uncertainty has a significant negative effect on real stock returns. A positive oil-market specific demand shock (indicating greater concern about future oil supplies) significantly raises economic policy uncertainty and reduces real stock returns. The direct effects of oil shocks on real stock returns are amplified by endogenous policy uncertainty responses. Economic policy uncertainty and oil-market specific demand shock account for 19% and 12% of the long-run variability in real stock returns, respectively. As a robustness check, (domestic) economic policy uncertainty is shown to also significantly influence real stock returns in Europe and in energy-exporting Canada.

JEL classification: E44, E60, Q41, Q43
Key words and phrases: Oil shocks, economic policy uncertainty, stock returns, structural VAR

*Corresponding author:
wkang3@kent.edu
Department of Economics
Kent State University,Ohio, USA

Oil Shocks, Policy Uncertainty and Stock Market Return

1. Introduction

The literature on the relationship between oil shocks and stock market activities has shown that changes in the price of crude oil are associated with the fluctuation of stock prices. Early papers by Kling (1985), Jones and Kaul (1996), and Sadorsky (1999), among others, report a stable negative association between oil price shocks and stock price movements.[1] Recent papers by Hamilton (2009), Kilian (2009), and Kilian and Park (2009), among others, suggest that different price shocks in the crude oil market have distinct effects on the stock market, in the sense that the responses of aggregate stock returns differs depending on the cause of oil supply or demand shocks.

The effect of uncertainty about economic policy on real activity and firm level decisions has also been emphasized in the literature. Baker et al. (2011) construct a measure of economic policy uncertainty and find that it influences the intensity of the business cycle and influences the business investment. Durnev (2011) finds that corporate investment is less sensitive to stock prices during election years. Boutchkova et al. (2012) relate political uncertainty to stock volatility. Pastor and Veronesi (2012) build a general equilibrium model predicting stock prices fall at the announcement of a policy change.

[1] Papers by Apergis and Miller (2009), Miller and Ratti (2009) and Peersman and Van Robays (2012), among others, show that the impact of oil price shocks on stock markets and real variables differs across countries. Work reporting that oil price increases lead to reduced stock returns for oil importing countries includes O'Neil et al. (2008) for US, UK and France, and Park and Ratti (2008) for US and 12 European oil importing countries. Jimenez-Rodriguez and Sanchez (2005) argue that the negative effects for oil importing countries are reinforced because of intensive trade connections. A number of papers find that large oil price changes have a positive impact on stock returns in oil-exporting countries (e.g., Arouri and Rault (2011)). Filis et al. (2011) provide an extensive review.

Oil shocks and economic policy uncertainty are interrelated and influence real stock returns. Oil price shocks and economic policy uncertainty influence stock prices through affecting expected cash flows and/or discount rates. Given the importance of oil price shocks for the economy the issue of the appropriate response by policy makers arises. Oil price shocks change relative prices, redistribute income and influence expectations about inflation and the real interest rate. Structural oil price shocks can influence economic policy uncertainty.[2] Oil price increases driven by increased global aggregate demand for commodities might be associated with reduced economic policy uncertainty. Oil price increases caused by precautionary demand for crude oil in anticipation of oil shortages might be associated with increased economic policy uncertainty. It is necessary to allow for the endogenous relationships in order to identify the effect of policy uncertainty on real stock returns.

For the U.S. it is found that oil-market specific demand shocks account for over 25% of variation in economic policy uncertainty after 24 months. After recognizing the interrelationships between structural oil price shocks and economic policy uncertainty, the latter accounts for 19% of the long-term variability in real stock returns. Structural oil shocks account for about 33% of the long-term variability in real stock returns. As a robustness check, a positive innovation in (domestic) economic policy uncertainty is shown to significantly reduce real stock returns in Canada, an energy-exporting country, and in Europe, a net importer of crude oil. For Europe the effect of oil shocks on real stock returns are intensified compared to the U.S. and for Canada, an energy exporting

[2] Higher volatility in oil prices has also been associated with increased uncertainty at firms. Elder and Serletis (2010) and Rahman and Serletis (2011) find that uncertainty about changes in the real price of oil has significant negative effects on real economic activity. Yoon and Ratti (2011) connect oil price change and volatility to firm level investment.

country, oil-market specific demand shocks are positively related to real stock returns. We conduct the above analysis by extending a structural VAR model proposed by Kilian (2009).

The remainder of the article is organized as follows. Section 2 presents the structural VAR model and empirical methodology. Section 3 describes data sources. Section 4 discusses empirical results. Section 5 concludes.

2. Methodology

The structural VAR model in Kilian (2009) is adapted to examine the effects of three structural oil price shocks on U.S. economic policy uncertainty and the U.S. stock market. Oil price shocks can affect corporate cash flow since oil is an input in production and because oil price changes can influence the demand for output at industry and national levels. Uncertainty about taxes and regulations can influence firm-level decisions about production and expected sales. Oil price shocks and economic policy uncertainty can also affect firm value by influencing the expected rate of inflation and the expected real interest rate.

The structural representation of the VAR model of order p in a five variable setting is

$$A_0 y_t = c_0 + \sum_{i=1}^{p} A_i y_{t-i} + \varepsilon_t, \qquad (1)$$

where $y_t = (\Delta prod_t, rea_t, rpo_t, pu_t, ret_t)$, a 5×1 vector of endogenous variables, A_0 denotes the 5×5 contemporaneous coefficient matrix, c_0 represents a 5×1 vector of constant terms, A_i refers to the 5×5 autoregressive coefficient matrices, and ε_t stands for a 5×1 vector of structural disturbances.

The model attributes flucuations in the real price of oil to oil supply-side shocks measured by changes in world oil production ($\Delta prod_t$), the shocks to the global demand for all industrial commodities driven by global real aggegate demand (rea_t), and the oil-market specific demand shocks captured by changes in real oil prices (rpo_t). Kilian (2009) and Kilian and Park (2009) interpret rpo_t as reflecting precautionary demand for oil driven by expections on the future shortfalls of oil supply. pu_t denotes the index of U.S. economic policy uncertainty and ret_t is real aggregate U.S. stock returns. U.S. economic policy uncertainty and stock return are ordered fourth and fifth variables, respectively, after the three structural oil price shocks in the recursive structural VAR model.

We follow Kilian (2009) and Kilian and Park (2009) and take $p = 24$ to allow for the potentially long-delayed effects of structural oil price shocks on the economy.[3] A sufficient number of lags remove serial correlation and make the error terms stationary (i.e., $I(0)$) which is formally tested by ADF and PP unit root tests.[4] Since our goal is forecasting rather than inference, the specification preserves the information about both

[3] Sims (1998) and Sims et al. (1990) argue that even variables that display no inertia do not necessarily show absence of long lags in regressions on other variables.
[4] The stationary test on error terms is necessary to show that the structural VAR model does not suffer from instability condition. The result is not reported in the text for the simplicity of exposition.

the variables and models used in the established literature to make our results comparable.[5]

The reduced form VAR is obtained by multiplying both sides of Equation (1) with A_0^{-1} which has a recursive structure such that the reduced form errors e_t are linear combinations of the structural errors ε_t in the following,

$$e_t = \begin{pmatrix} e_t^{\Delta prod} \\ e_t^{rea} \\ e_t^{rpo} \\ e_t^{pu} \\ e_t^{ret} \end{pmatrix} = \begin{bmatrix} a_{11} & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 & 0 \\ a_{31} & a_{31} & a_{33} & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} \end{bmatrix} \begin{pmatrix} \varepsilon_t^{\Delta prod} \\ \varepsilon_t^{rea} \\ \varepsilon_t^{rpo} \\ \varepsilon_t^{pu} \\ \varepsilon_t^{ret} \end{pmatrix}, \tag{2}$$

in which $\varepsilon_t^{\Delta prod}$ reflects the oil supply-side shocks, ε_t^{rea} captures the real aggregate demand shocks, ε_t^{rpo} denotes the oil market-specific demand shock, ε_t^{pu} measures the economic policy uncertainty shocks, and ε_t^{ret} is the real aggregate stock return shocks.

The identifying restrictions are motivated by Kilian (2009). The crude oil supply does not respond to contemporaneous changes in oil demand, because of the high adjustment cost of oil production. The fluctuation of real prices of oil does not affect global real economic activity within the same month. An oil supply disruption and real aggregate demand shock will influence the real price of oil, immediately, in the sense that the expectations about future oil supply shortfall and/or global real economy downturn

[5] Forecasting concerns the investigation of impulse response functions and forecast error variance decompositions, whereas the inference refers the study of estimates of regression coefficients. When we are not clear a prior whether a variable should be first-differenced, the impulse responses are reasonably precisely estimated using the (log-) levels of variables in the VAR model (e.g., Sims et al. (1990) and Kilian and Murphy (2012)).

drive the precautionary demand for oil up within the same month. U.S. economic policy uncertainty reacts contemporaneously to all three structural oil price shocks, as do real stock returns. The U.S. stock market is assumed to react to U.S. economic policy uncertainty, contemporaneously. Kilian and Vega (2011) argue there is no significant evidence of feedback within a month from U.S. aggregates to the price of crude oil. The model specification is in line with the standard approach of treating innovations to the price of oil as pretetermined with respect to the economy (e.g., Lee and Ni (2002) and Kilian and Park (2009), among others).

To generate the standard errors of the impulse response function for the structural VAR model, we conduct recursive-design wild bootstrap with 2,000 replications proposed by Gonçalves and Kilian (2004), in that the modified recursive-design bootstrap method yields asymptotic refinements for autoregressive models.

3. Data

The study utilizes monthly time-series data on the crude oil market, indext of U.S. economic policy uncertainty, and aggregate U.S. stock returns over 1985:1-2011:12. The sample period is determined by the availability of the index of U.S. economic policy uncertainty starting on January 1985. The aggregate U.S. stock return variable is from the Center for Research in Security Prices (CRSP) and is a value-weighted market portfolio which includes NYSE, AMEX, and Nasdaq stocks. Aggregate U.S. stock return is adjusted by the U.S. CPI to obtain a real stock return variable.

The world production of crude oil as a proxy for oil supply and U.S. refiner's acquisition cost of crude oil as a measure on the prices of oil are drawn from the U.S. Department of Energy. The index of real aggregate demand as an indicator of global real economic activity is obtained from Kilian (2009).[6] In line with Kilian (2009) the percent change in the oil supply is 100 multiplied by the log difference of the world crude oil production in millions of barrels per day averaged monthly. The real price of oil is the refiner's acquisition cost of crude oil deflated by the U.S. CPI available from the Bureau of Labor Statistics. The index of real aggregate demand is based on the equal-weighted dry cargo freight rates. An increase in this index indicates a higher demand for shipping services arising from increases in real economic activity of the world. An advantage of the measure is that it includes activity in emerging economies such as China and India that are excluded from conventional measures of global economic activity based on OECD countries.

The measure on U.S. economic policy uncertainty is a weighted average of four uncertainty components: news-based policy uncertainty, CPI forecast interquartile range, tax legislation expiration, and federal expenditures forecast interquartile range.[7] It is constructed by Baker et al. (2011).[8] News-based uncertainty reflects media coverage of economic policy uncertainty, constructed by the month-by-month searches of Google News for articles containing the term 'uncertainty' and items related to economy and economic (e.g., monetary and fiscal) policies. The number of articles that discuss both U.S. economy and policy uncertainty each month quantifies the news-based uncertainty

---

[6] The data is available at http://www-personal.umich.edu/~lkillinan/.

[7] Baker et al. (2011) set the weights to 1/2 on the news uncertainty and 1/6 on each of taxation expiration, CPI disagreement, and expenditure dispersion components.

[8] The data can be found at http://www.policyuncertainty.com/.

in that month.[9] The CPI disagreement and federal government expenditure dispersion are measured by the forecasters' disagreement (the interquartile range of forecast) over future outcomes about inflation rates and federal government purchases, respectively.[10] The tax code expiration is a 'transitory measure' constructed by the number of temporary federal tax code provisions set to expire in the contemporaneous calendar year and future ten years and reported by the Joint Committee on Taxation.[11]

Figure 1 shows real prices of crude oil, (overall) economic policy uncertainty, and stock market index in U.S. over 1985:1-2011:12. The timing of the outbreak of major historical events is marked in the figure. It can be seen that all dates of well-known events are followed by rises in the policy uncertainty and falls in the stock market index. These events and Bloom's (2009) choice of major uncertainty shocks coincide with events that trigger oil price shocks identified by Hamilton (2009) and Kilian (2009). For example, the 2008-2009 financial crises caused shocks to precautionary demand for oil. The 1st/2nd Gulf War and Arab Spring caused supply-side oil price shock and oil-market specific demand shock.

4. Empirical Results

4.1. Variance Decomposition of real stock returns

[9] The raw counts about the news uncertainty are normalized by the number of news articles that contain the term 'today' in order to mitigate the volume accumulation and high-frequency noise problems.

[10] The quarterly raw data of the forecast about inflation rates and federal government purchases are drawn from the survey of professional forecasters of Federal Reserve Bank of Philadelphia. The index value of monthly CPI disagreement and expenditure dispersion is held constant for each quarter.

[11] The index value of taxation uncertainty is obtained for each January and kept constant for 12 months in the year.

The forecast error variance decompositions (FEVDs) of real stock returns are reported in Table 1 from the estimation of the structural VAR model in Equation (2) $y_t = (\Delta prod_t, rea_t, rpo_t, pu_t, ret_t)$. In Panel A forecast error variance decompositions results are reported when pu_t is (overall) economic policy uncertainty. In Panels B, C, D and E, forecast error variance decomposition results are reported when pu_t is replaced in turn by each of its components, news-based policy uncertainty, tax legislation expiration, federal expenditures forecast interquartile range, and CPI forecasters' interquartile range, respectively. The FEVDs show the percent contribution of structural shocks in the crude oil market and in economic policy uncertainty to the overall variation of real stock returns. The values in parentheses in Table 1 represent the absolute t-statistics when coefficients' standard errors were generated using a recursive-design wild bootstrap.

In Panel A of Table 1 it can be seen that in the first few months the effects of the three structural oil price shocks on real stock returns are negligible and not statistically significant. At 3 months, economic policy uncertainty explains 7.7% of the variation in real stock returns and the effect is marginally significant. Over time the explanatory power of the three structural shocks in the crude oil market and of economic policy uncertainty increase. In the long-term shocks to global oil supply, shocks to global real demand, and oil-market specific demand shocks explain 11.5%, 10.0%, and 11.9% of the variation in real stock returns, respectively, and that these results are statistically significant. It is reported in Table 1 is that economic policy uncertainty explains 19.0% of variation of real stock returns and this result is highly statistically significant.

Examination of the results in the last four Panels of Table 1 indicate that shocks to real stock returns are closely related to the volume of news stories focused on discussion of economic policy, rather than the expenditure/CPI forecast dispersions and the tax code expirations. Policy uncertainty measured by the volume of news stories focused on discussion of economic policy explain 19.4% of the variation in real stock returns in the long-term (in Panel B). It should be noted though that the FEVD results for real stock returns when policy uncertainty is measured by the expenditure/CPI forecast dispersions and the tax code expirations are statistically less significant. In summary, the results in Table 1 indicate that in the long-term the structural oil price shocks and economic policy uncertainty explain 33.4% and 19.0% of the variation in real stock returns, respectively.

4.2. Variance Decomposition of Economic Policy Uncertainty

The forecast error variance decompositions of overall economic policy uncertainty are reported in Panel A of Table 2.[12] It shows the percent contribution of structural shocks in the crude oil market to the overall variation of U.S. economic policy uncertainty. In the first few months the effects of the three structural oil price shocks on U.S. economic policy uncertainty are negligible. Over time the explanatory power of the three structural shocks in the crude oil market increases. After 24 months 25.5% of the volatility in economic policy uncertainty is accounted for by the innovations of unanticipated precautionary demand for oil. After 60 months this becomes 49%. These effects are statistically significant at the 1% level. Over the longer term the forecast error

[12] The variance decomposition results for components of economic policy uncertainty are reported in Panel B, C, D and E of Table 2. After 60 months oil-market specific demand shocks explain statistically significant 39.7% of the variance in news-based economic policy uncertainty and 25.1% of CPI forecasters' interquartile range, respectively. Over the same longer term, shocks to global real aggregate demand are found to explain large statistically significant fractions (31.8%) of the variance in federal expenditure policy uncertainties and 44.3% of the variance in tax code expiration uncertainties. These effects are also statistically significant at the 1% level.

variance decompositions (FEVDs) of economic policy uncertainty to innovations in global oil production and in global real demand are much smaller at 5.7% and 8.7%, respectively, not statistically significant.

In contrast to the effect of structural oil price shocks on economic policy uncertainty, the fraction of forecast error variance decomposition of economic policy uncertainty due to shocks to real stock price doesn't vary greatly with forecast horizon. After 3 months, 24 months, and 60 months innovations in real stock returns account for 9.6%, 9.8%, and 11.6%, respectively, of the volatility in economic policy uncertainty.[13]

The results of this and the previous subsection imply that although structural oil price shocks significantly explain movement in economic policy uncertainty (and real stock returns), innovations to economic policy uncertainty also significantly impact real stock returns.

4.3. Impulse response functions

Figure 2 reports the impulse response functions (IRFs) over 24 months of global oil production, global real economic activity, real price of oil, economic policy uncertainty, and real stock return to one-standard deviation structural shocks. One-standard error and two-standard error bands indicated by dashed and dotted lines, respectively, are computed by conducting recursive-design wild bootrap with 2,000 replications proposed by Gonçalves and Kilian (2004). The analysis of the IRFs presents the short-run dynamic response of dependent variables (i.e., vertical axis labels) to the structural shocks.

[13] The FEVD result for policy uncertainty is similar when policy uncertainty is measured by the news-based policy uncertainty and is statistically less significant when measured by the expenditure/CPI forecast dispersions and the tax code expirations.

In the first row of Figure 2 are shown the responses of global oil production to structural innovations in global oil production, global real economic activity, the real price of oil, economic policy uncertainty, and real stock return. The effect of an unanticipated supply disruption on global oil production is very persistent and highly significant. A positive global real activity shock has a persistent positive effect on global oil production that is statistically significant for an extended period. Shocks to oil-specific market demand raise global oil production three to five months later and then become insignificant. Shocks to economic policy uncertainty eventually have a negative significant effect on global oil production after eighteen months. A positive shock to real stock returns significantly raise global oil production over a seven to eleven month window following the shock.

The effect of shocks on global real demand are shown on the second row of Figure 2. An unanticipated aggregate demand expansion has a highly significant effect on global real economic activity for the first 14 months that gradually erodes over time. A positive shock to real oil price raises global aggregate demand significantly for four months. Unanticipated innovations to global oil production have a significant positive effect on global real demand at ten and eleven months. An unanticated increase in economic policy uncertainty has significant negative effects on global real demand over ten to twenty four months later. A positive shock to real stock returns does not significantly affect global real demand except for a negative effect at nineteen and twenty months.

In the third row of Figure 2, an unanticipated global real aggregate demand expansion raises the real prices of oil and the effect becomes larger and statistically significant after 16 months. Unexpected oil supply disruptions on the real price of oil are positive and statistically significant between 10 to 15 months. The effect of an unanticipated increase in the real price of oil on the real price of oil peaks at three months and then gradually erodes and is statistically significant for sixteen months. A surprise rise in economic policy uncertainty reduces the real price of oil by a statistically significant amount in a window between 12 and 16 months. A positive shock to real stock returns gradually raises real oil price with the effect peaking and becoming statistically significant between eleven and sixteen months.

In the fourth row of Figure 2 the responses of economic policy uncertainty to one-standard structural shocks are presented. Unexpected oil supply disruptions do not have a statistially significant effect on U.S. economic policy uncertainty. An unanticipated positive innovation in global real demand has a negative effect on economic policy uncertainty that is statistically significant from the 3rd month to the 9th month. After nine months the response becomes statistically insignificant and approaches zero. An unexpected positive shock to oil-market specific demand causes a persistent positive effect on economic policy uncertainty that is statistically significant from the 3rd month through the 24th months shown. Shocks to economic policy uncertainty have an immediate effect on economic policy uncertainty that gradually erode with a temporary bounce between 10 and 12 months. A positive shock to real stock returns significantly reduces economic policy uncertainty in the first four months following the shock, then becomes statistically insignificant until becoming positive and statistically significant in the last few months of the 24 month window.

In the fifth row of Figure 2 the responses of real stock return to structural shocks are presented. Unexpected oil supply disruptions do not have a statistically significant effect on real stock return in the first fourteen months, and have a significant positive effect thereafter. An unanticipated positive innovation in global real demand has a positive effect on real stock return that is statistically significant for about one year. An unexpected positive shock to oil-market specific demand causes a significant negative effect on real stock return after the 8th month. Shocks to economic policy uncertainty have a significant negative effect on real stock return in the first two months that is gradually reversed with a significant positive effect in the 7th and 8th months. A positive shock to real stock returns on real stock returns is highly significant and persistent over 24 months.

In summary, the results show that a positive shock to precautionary demand for crude oil causes significantly increased economic policy uncertainty and significantly reduced real stock returns. These effects are clearly illustrated in the diagrams in the 4th and 5th rows of column 3 in Figure 2. A positive shock to global real demand causes significantly decreased economic policy uncertainty and increased real astock returns. These effects are clearly illustrated in the diagrams in the 4th and 5th rows of column 2 in Figure 2. An unexpected increase in economic policy uncertainty significantly decreases real stock returns at first before being reversed several months later (in the diagram in the 5th rows of column 4 in Figure 2).

4.4. Robustness Check: International Evidence

To establish the robustness of the result that an unanticipated increase in policy uncertainty has a significant negative effect on real stock returns, this subsection examines how oil shocks and economic policy uncertainty influence real stock returns in Canada, an energy-exporting country, and in Europe, a net importer of crude oil. We utilize Brent crude oil as a proxy of world oil price. The stock market indices used are TSEurofirst 300 in Europe and S&P/TSX Composite in Canada.[14] World oil prices and aggregate stock returns are deflated by Canada/Europe CPI, respectively, to obtain the real variables. The sample period is determined by the availability of the index of economic policy uncertainty between 1990:01-2011:12 in Canada and between 1997:01-2011:12 in Europe.

Figure 3 reports the impulse response functions over 24 months to one-standard deviation structural shocks in Europe. The shock effects of real aggregate demand, oil-market specific demand, and economic policy uncertainty on real stock returns are intensified while other responses are similar to the results obtained in United States. The forecast error variance decompositions of real stock returns are presented in Panel A of Table 3. The shock effects of European economic policy uncertainty account for a statistically significant 24.5% of the volatility in European real stock returns in the long-term.

The impulse response functions depict the reactions to one-standard deviation structural shocks over 24 months in Canada are reported in Figure 5, whereas the forecast error variance decompositions of real stock returns is presented in Panel B of Table 3. For

[14] FTSEurofirst 300 Index represents 300 largest companies ranked by market capitalization in Europe. S&P/TSX Composite is an index of the stock prices of the largest companies and comprises about 70% of market capitalization for all Canadian-based companies.

Canada as an energy-exporting country a positive oil-market specific demand shock (indicating greater concern about future oil supplies) significantly raises real stock returns. The result is consistent with Arouri and Rault (2011) for oil exporting countries. However, for Canada, just as for the U.S. and Europe, a positive innovation in economic policy uncertainty reduces real stock returns. In Table 3, Panel B, Canadian economic policy uncertainty accounts for a statistically significant 13.5% of the volatility in Canadian real stock returns in the long-term.

Finally, we change the order of the fourth and fifth variables in the structural VAR model. In the new model economic policy uncertainty is placed last in the order of variables and real stock returns are placed fourth. It is found (in results not reported) that the fraction of forecast error variance decomposition of real stock returns due to shocks to economic policy uncertainty is statistically significant similar in magnitude to the fractions reported in Tables 1 and 3 in the models for the U.S. and Canada and Europe.

5. Conclusion

In this paper we investigate the relationship between structural oil shocks, economic policy uncertainty and real stock returns with structural VAR model. It is found that oil-market specific demand shocks account for over 30% of variation in economic policy uncertainty after 24 months and that this fraction grows to 58% in the long-term. Economic policy uncertainty accounts for 19% of the long-term variability in real stock returns and structural oil shocks account for 32% the long-term variability in real stock returns.

As a robustness check, a positive innovation in (domestic) economic policy uncertainty is shown to significantly reduce real stock returns in Canada, an energy-exporting country, and in Europe, a net importer of crude oil. For Europe the effect of oil shocks on real stock returns are intensified compared to the U.S. and for Canada, an energy exporting country, oil-market specific demand shocks are positively related to real stock returns. Structural oil price shocks have long-term consequences for economic policy uncertainty, and this provides an additional channel by which structural oil price shocks have influence on the stock market.

Reference

Apergis, N. and Miller, S.M. (2009), "Do structural oil-market shocks affect stock prices?" *Energy Economics*, 31, 569-575.

Arouri, M.E.H. and Rault, C. (2011), "On the influence of oil prices on stock markets: Evidence from panel analysis in GCC countries," *International Journal of Finance and Economics*, 3, 242-253.

Baker, S.R., N. Bloom, and S.J. Davis (2011), "Measuring economic policy uncertainty," Stanford University mimeo.

Bloom, N. (2009), "The impact of uncertainty shocks," *Econometrica,* 77, 623-685.

Boutchkova, M., H. Doshi, A. Durnev, and A. Molchanov (2012), "Precarious politics and return volatility," *Review of Financial Studies,* 25, 1111–1154.

Durnev, A. (2011), "The real effects of political uncertainty," Working paper, McGill University.

Elder, J. and Serletis, A. (2010), "Oil price uncertainty," *Journal of Money, Credit and Banking*, 42, 1137-1159.

Filis, G., Degiannakis, S. and Floros, C. (2011), "Dynamic correlation between stock market and oil prices: The case of oil-importing and oil-exporting countries," *International Review of Financial Analysis*, 20, 152-164.

Gonçalves, S. and L. Kilian (2004), "Bootstrapping autoregressions with conditional heteroskedasticity of unknown form," *Journal of Econometrics*, 123, 89-120.

Hamilton, J.D. (2009), "Causes and consequences of the oil shock of 2007-08," *Brookings Papers on Economic Activity*, Spring, 215-261.

Jimenez-Rodrgiuez, R. and M. Sanchez (2005), "Oil price shocks and real GDP growth, empirical evidence for some OECD countries," *Applied Economics*, 37, 201-228.

Jones, M.C. and G. Kaul (1996), “Oil and stock markets,” *Journal of Finance*, 51, 463-491.

Kilian, L. (2009), “Not all oil price shocks are alike: disentangling demand and supply shocks in the crude oil market,” *American Economic Review*, 99, 1053-1069.

Kilian, L. and C. Park (2009), “The impact of oil price shocks on the U.S. stock market,” *International Economic Review*, 50, 1267-1287.

Kilian, L. and D.P. Murphy (in press), “The role of inventories and speculative trading in the global market for crude oil,” *Journal of Applied Econometrics.*

Kilian L. and C. Vega (2011), "Do energy prices respond to U.S. macroeconomic news? A test of the hypothesis of predetermined energy prices," *The Review of Economics and Statistics,* 93, 660-671.

Kling, J.L. (1985), “Oil price shocks and stock-market behavior,” *Journal of Portfolio Management,* 12, 34–39.

Lee, K. and S. Ni (2002), “On the dynamic effects of oil price shocks: A study using industry level data,” *Journal of Monetary Economics,* 49, 823–852.

Miller, J.I. and R.A. Ratti (2009), “Crude oil and stock markets: Stability, instability, and bubbles,” *Energy Economics*, 31, 559-568.

O'Neil, T.J., J. Penm, and R.D. Terrell (2008), “The role of higher oil prices: A case of major developed countries,” *Research in Finance*, 24, 287-299.

Park, J. and R.A. Ratti (2008), “Oil prices and stock markets in the U.S. and 13 European countries,” *Energy Economics*, 30, 2587-2608.

Pastor, L. and P. Veronesi (2012), “Uncertainty about government policy and stock prices,” *Journal of Finance*, 67, 1219–1264.

Peersman, G. and I. Van Robays (2012), “Cross-country differences in the effects of oil shocks,” *Energy Economics*, 34, 1532–1547.

Rahman, S. and A. Serletis (2011), "The asymmetric effects of oil price shocks," *Macroeconomic Dynamics,* 15, 437-471.

Sadorsky, P. (1999), "Oil price shocks and stock market activity," *Energy Economics*, 21, 449-469.

Sims, C.A. (1996), "Comment on Glenn Rudebusch's 'Do measures of monetary policy in a VAR make sense?'" *International Economic Review*, 39, 993-941.

Sims C.A., J.H. Stock and M. Watson (1990), "Inference in linear time-series models with some unit roots," *Econometrica*, 58, 113-144.

Yoon, K.H. and R.A. Ratti (2011), "Energy price uncertainty, energy intensity and firm investment," *Energy Economics,* 33, 67-78.

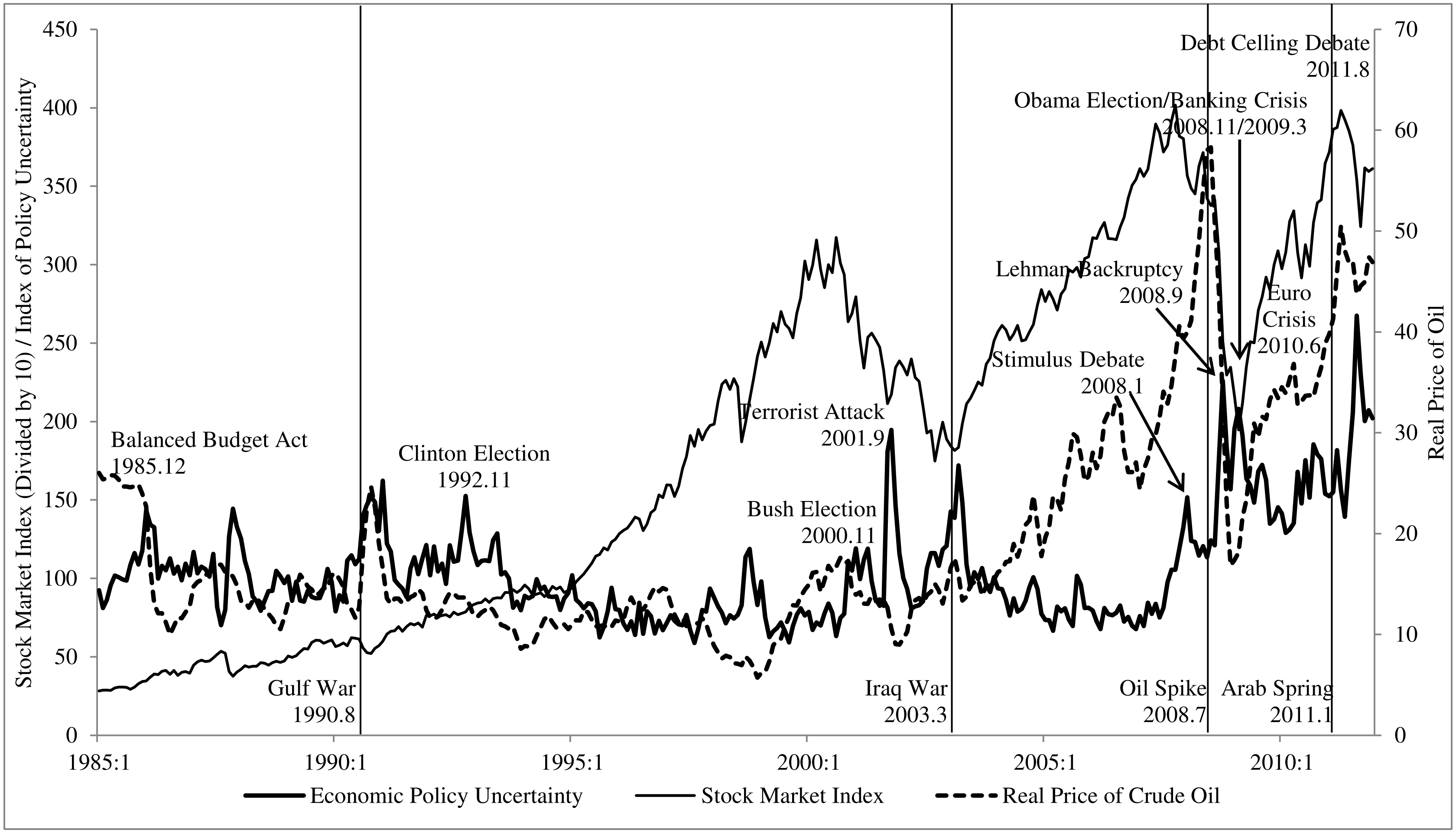
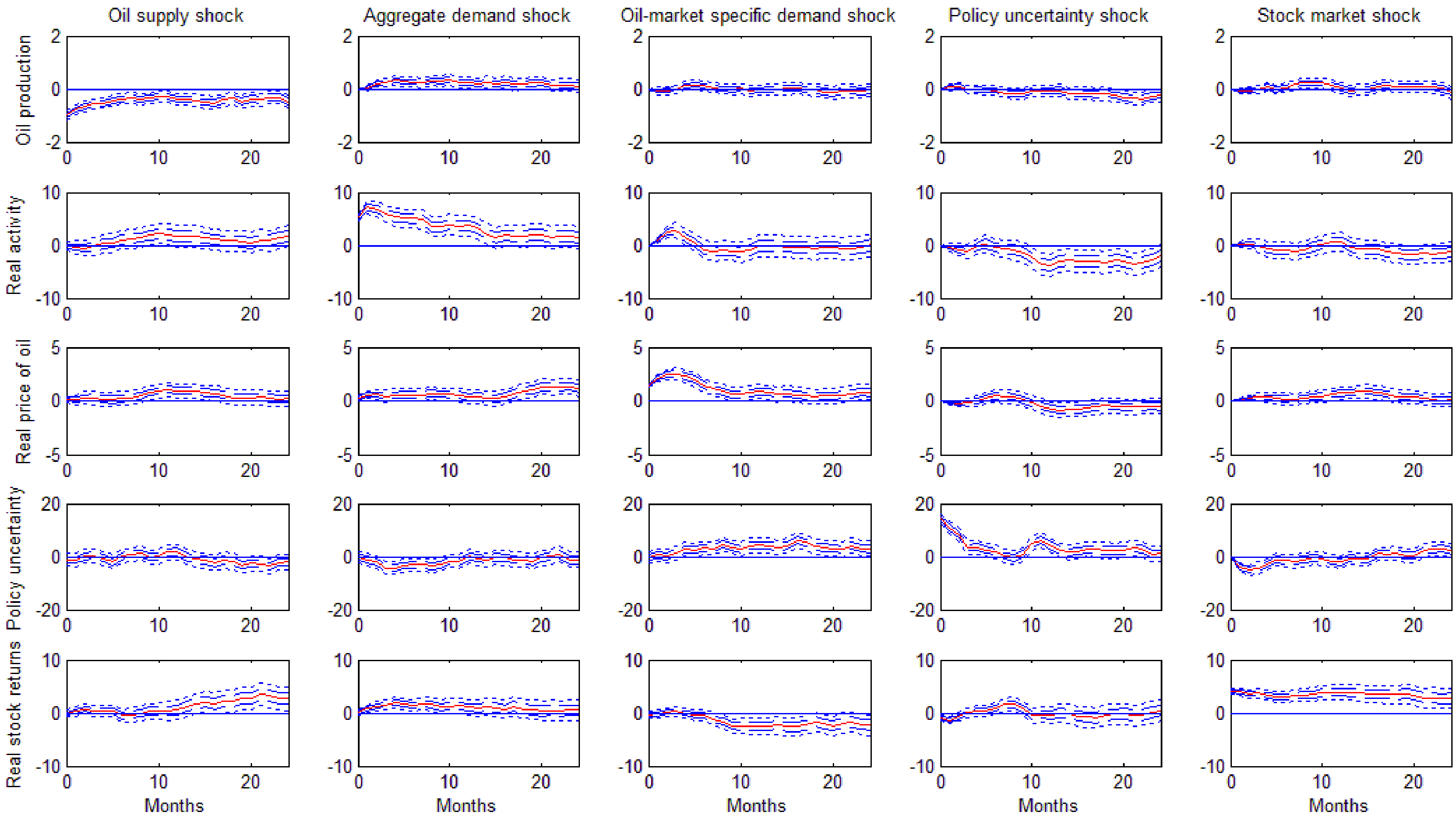


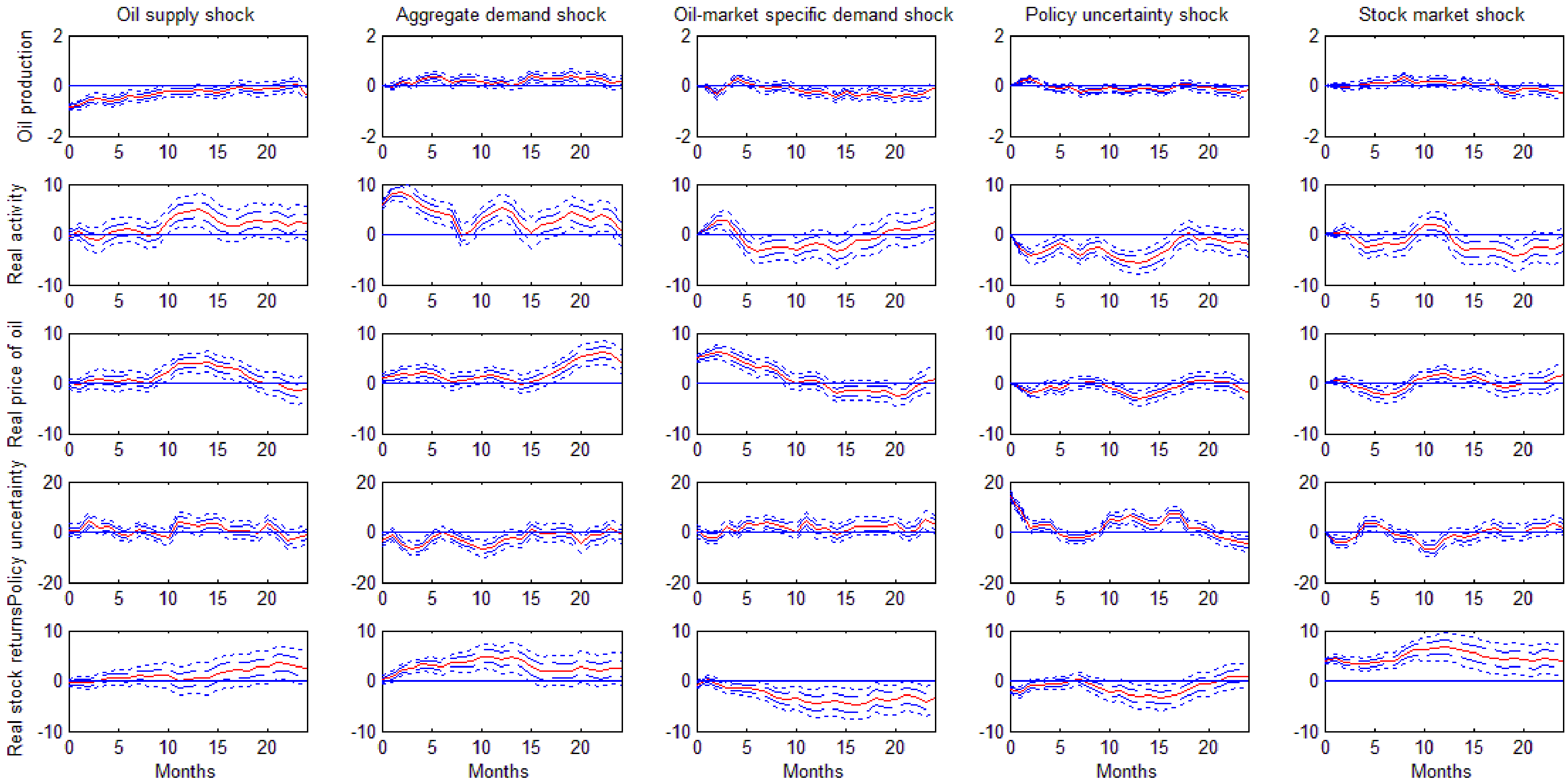
Figure 1. Stock market index (divided by 10), real price of crude oil and economic policy uncertainty, 1985:1-2011:12 in United States.
Notes: the index of economic policy uncertainty is drawn from Baker et al. (2011), the real price of oil is the nominal price of oil deflated by the U.S. CPI from the Bureau of Labor Statistics, and the aggregate U.S. market stock index is from CRSP database.

Figure 2. Responses to One-Standard Deviation Structural Shocks, 1985:1-2011:12 in United States



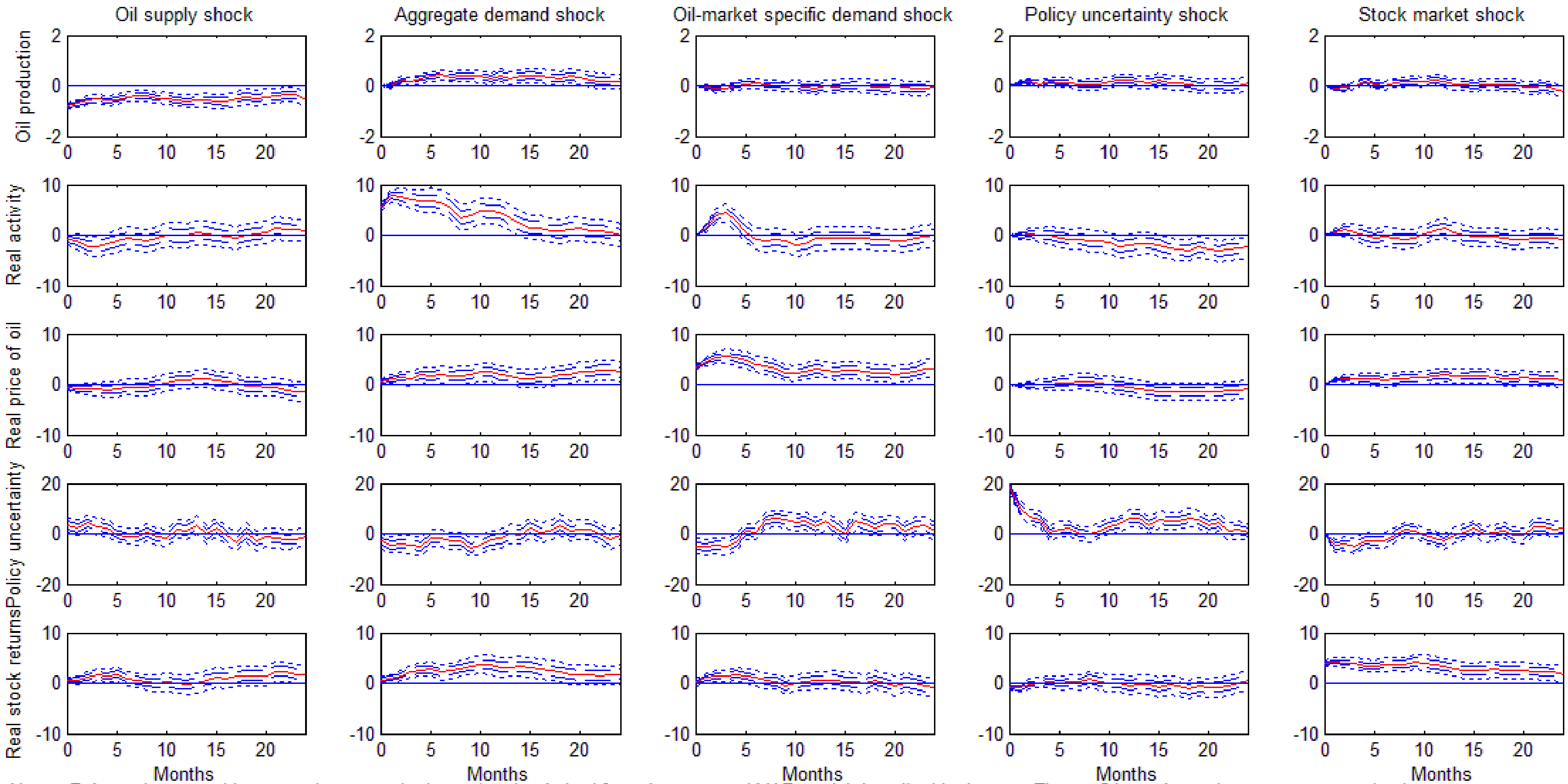
Notes: Point estimates, with one- and two-standard error bands, derived from the structural VAR model described in the text. The confidence intervals were constructed using a recursive-design wild bootstrap. Responses to real stock returns are cumulative.

Figure 3. Responses to One-Standard Deviation Structural Shocks, 1997:1-2011:12 in Europe



Notes: Point estimates, with one- and two-standard error bands, derived from the structural VAR model described in the text. The confidence intervals were constructed using a recursive-design wild bootstrap. Responses to real stock returns are cumulative.

Figure 4. Responses to One-Standard Deviation Structural Shocks, 1990:1-2011:12 in Canada



Notes: Point estimates, with one- and two-standard error bands, derived from the structural VAR model described in the text. The confidence intervals were constructed using a recursive-design wild bootstrap. Responses to real stock returns are cumulative.

Table 1. Forecast Error Variance Decomposition (FEVD) of Real U.S. Stock Returns

Horizon	Oil Supply Shock		Aggregate Demand Shock		Oil-Market Specific Demand Shock		Economic Policy Uncertainty Shocks		Other Shocks	
Panel A. Overall Policy Uncertainty										
1	0.000	(0.03)	0.002	(0.14)	0.005	(0.29)	0.054	(1.47)	0.939	(21.27)
3	0.021	(0.80)	0.034	(1.29)	0.012	(0.57)	0.077	(1.95)	0.857	(16.18)
12	0.054	(1.50)	0.054	(1.91)	0.067	(2.20)	0.192	(3.97)	0.634	(11.21)
24	0.108	(2.90)	0.072	(2.46)	0.101	(3.27)	0.192	(4.72)	0.527	(10.87)
60	0.114	(3.43)	0.099	(3.27)	0.116	(3.88)	0.188	(5.20)	0.483	(11.00)
∞	0.115	(3.49)	0.100	(3.19)	0.119	(3.87)	0.190	(5.24)	0.477	(10.91)
Panel B. News-Based Policy Uncertainty										
1	0.002	(0.12)	0.003	(0.20)	0.004	(0.25)	0.073	(1.69)	0.918	(18.51)
3	0.018	(0.73)	0.030	(1.15)	0.012	(0.60)	0.105	(2.30)	0.834	(14.90)
12	0.057	(1.59)	0.067	(2.15)	0.066	(2.21)	0.189	(3.94)	0.621	(11.01)
24	0.108	(2.95)	0.085	(2.78)	0.102	(3.31)	0.188	(4.61)	0.517	(10.79)
60	0.116	(3.52)	0.109	(3.53)	0.116	(3.87)	0.191	(5.21)	0.469	(10.71)
∞	0.117	(3.58)	0.109	(3.43)	0.118	(3.86)	0.194	(5.21)	0.462	(10.53)
Panel C. Expenditure Dispersion										
1	0.000	(0.00)	0.003	(0.14)	0.001	(0.09)	0.007	(0.39)	0.990	(32.26)
3	0.035	(1.23)	0.028	(1.03)	0.012	(0.57)	0.014	(0.70)	0.911	(20.16)
12	0.052	(1.71)	0.066	(2.04)	0.063	(2.07)	0.045	(1.69)	0.775	(16.04)
24	0.093	(2.94)	0.093	(2.93)	0.092	(3.00)	0.054	(2.07)	0.668	(15.03)
60	0.103	(3.45)	0.112	(3.55)	0.110	(3.56)	0.060	(2.39)	0.615	(14.24)
∞	0.103	(3.45)	0.116	(3.64)	0.114	(3.56)	0.061	(2.40)	0.606	(13.96)
Panel D. CPI Disagreement										
1	0.000	(0.02)	0.002	(0.12)	0.000	(0.00)	0.002	(0.18)	0.995	(35.34)
3	0.020	(0.78)	0.020	(0.84)	0.007	(0.40)	0.006	(0.36)	0.947	(23.12)
12	0.041	(1.41)	0.083	(2.43)	0.095	(2.81)	0.023	(1.05)	0.757	(14.45)
24	0.092	(2.95)	0.103	(3.13)	0.125	(3.78)	0.040	(1.65)	0.640	(13.44)
60	0.098	(3.35)	0.120	(3.66)	0.138	(4.25)	0.057	(2.23)	0.588	(12.82)
∞	0.099	(3.37)	0.125	(3.70)	0.138	(4.15)	0.060	(2.32)	0.578	(12.54)
Panel E. Tax Code Expiration										
1	0.000	(0.01)	0.004	(0.25)	0.004	(0.25)	0.006	(0.42)	0.986	(29.86)
3	0.025	(0.89)	0.026	(0.96)	0.005	(0.29)	0.014	(0.72)	0.930	(20.91)
12	0.051	(1.51)	0.072	(2.20)	0.052	(2.05)	0.052	(1.87)	0.772	(14.90)
24	0.122	(3.29)	0.096	(3.08)	0.087	(3.14)	0.054	(2.18)	0.642	(13.13)
60	0.125	(3.57)	0.101	(3.38)	0.106	(3.82)	0.076	(2.81)	0.592	(12.61)
∞	0.126	(3.63)	0.106	(3.47)	0.107	(3.79)	0.082	(2.84)	0.580	(12.37)

Notes: Table 1 shows percent contributions of demand and supply shocks in the crude oil market and overall/component policy uncertainty to the overall variability of real stock returns. The forecast error variance decomposition is based on the structural VAR model described in the text. The values in parentheses represent the absolute t-statistics when coefficients' standard errors were generated using a recursive-design wild bootstrap.

Table 2. Forecast Error Variance Decomposition (FEVD) of Economic Policy Uncertainty in United States

Horizon	Oil Supply Shock		Aggregate Demand Shock		Oil-Market Specific Demand Shock		Stock Market Shocks		Other Shocks	
Panel A. Overall Policy Uncertainty										
1	0.006	(0.28)	0.001	(0.07)	0.001	(0.05)	0.000	(0.00)	0.992	(32.08)
3	0.007	(0.26)	0.013	(0.49)	0.001	(0.06)	0.096	(2.17)	0.883	(15.27)
12	0.016	(0.48)	0.129	(1.94)	0.123	(1.69)	0.104	(1.98)	0.628	(7.17)
24	0.063	(1.11)	0.096	(1.86)	0.255	(2.55)	0.098	(2.09)	0.489	(5.20)
60	0.057	(0.92)	0.087	(1.26)	0.487	(3.95)	0.116	(1.60)	0.253	(2.77)
∞	0.123	(1.35)	0.136	(1.37)	0.569	(3.70)	0.058	(0.83)	0.114	(1.18)
Panel B. News-Based Policy Uncertainty										
1	0.009	(0.41)	0.002	(0.13)	0.000	(0.01)	0.000	(0.00)	0.989	(33.73)
3	0.009	(0.37)	0.019	(0.58)	0.000	(0.02)	0.114	(2.34)	0.859	(14.15)
12	0.019	(0.59)	0.087	(1.58)	0.139	(2.00)	0.123	(2.23)	0.632	(7.60)
24	0.061	(1.20)	0.081	(1.69)	0.192	(2.41)	0.112	(2.29)	0.554	(6.44)
60	0.048	(0.97)	0.083	(1.42)	0.397	(3.93)	0.121	(1.95)	0.352	(4.15)
∞	0.066	(0.85)	0.083	(0.91)	0.588	(4.06)	0.078	(1.08)	0.185	(1.84)
Panel C. Expenditure Dispersion										
1	0.005	(0.24)	0.032	(0.97)	0.020	(0.87)	0.000	(0.00)	0.943	(21.05)
3	0.006	(0.24)	0.027	(0.80)	0.012	(0.59)	0.002	(0.18)	0.953	(20.34)
12	0.031	(0.62)	0.340	(3.01)	0.023	(0.61)	0.006	(0.24)	0.600	(5.38)
24	0.098	(1.21)	0.387	(3.45)	0.061	(0.94)	0.008	(0.21)	0.447	(4.13)
60	0.128	(1.61)	0.318	(3.03)	0.116	(1.45)	0.053	(0.90)	0.386	(4.05)
∞	0.084	(1.09)	0.418	(3.20)	0.169	(1.77)	0.074	(1.08)	0.255	(2.76)
Panel D. CPI Disagreement										
1	0.001	(0.04)	0.003	(0.16)	0.002	(0.14)	0.000	(0.00)	0.995	(39.27)
3	0.004	(0.18)	0.014	(0.45)	0.009	(0.38)	0.001	(0.08)	0.973	(21.32)
12	0.023	(0.65)	0.037	(0.90)	0.039	(0.87)	0.016	(0.57)	0.886	(12.79)
24	0.033	(0.96)	0.085	(1.73)	0.150	(2.41)	0.052	(1.50)	0.680	(9.32)
60	0.040	(1.04)	0.124	(2.04)	0.251	(3.53)	0.114	(2.24)	0.471	(6.55)
∞	0.039	(0.86)	0.247	(2.67)	0.240	(3.08)	0.098	(1.88)	0.376	(4.79)
Panel E. Tax Code Expiration										
1	0.000	(0.04)	0.022	(0.83)	0.002	(0.10)	0.000	(0.00)	0.976	(31.48)
3	0.001	(0.07)	0.054	(1.12)	0.005	(0.23)	0.002	(0.21)	0.938	(17.00)
12	0.029	(0.58)	0.054	(0.74)	0.104	(1.52)	0.039	(0.90)	0.775	(7.39)
24	0.069	(1.15)	0.109	(1.42)	0.239	(2.83)	0.035	(0.86)	0.549	(5.29)
60	0.095	(1.37)	0.443	(3.36)	0.104	(1.71)	0.036	(0.72)	0.322	(2.88)
∞	0.125	(1.46)	0.574	(3.73)	0.080	(1.20)	0.026	(0.49)	0.195	(1.62)

Notes: Table 2 shows percent contributions of demand and supply shocks in the crude oil market and stock market shocks to the overall variability of overall/component policy uncertainty in United States. The forecast error variance decomposition is based on the structural VAR model described in the text. The values in parentheses represent the absolute t-statistics when coefficients' standard errors were generated using a recursive-design wild bootstrap.

Table 3. Forecast Error Variance Decomposition (FEVD) of Real Stock Returns in Europe/Canada

Horizon	Oil Supply Shock		Aggregate Demand Shock		Oil-Market Specific Demand Shock		Economic Policy Uncertainty Shocks		Other Shocks	
Panel A. Overall Policy Uncertainty in Europe										
1	0.009	(0.16)	0.003	(0.05)	0.031	(0.44)	0.167	(1.43)	0.791	(6.02)
3	0.008	(0.14)	0.085	(1.15)	0.075	(1.05)	0.211	(1.98)	0.622	(5.67)
12	0.049	(0.85)	0.120	(1.84)	0.141	(2.09)	0.210	(2.80)	0.480	(5.86)
24	0.085	(1.54)	0.172	(2.94)	0.166	(2.71)	0.218	(3.55)	0.360	(5.67)
60	0.130	(2.22)	0.261	(3.90)	0.183	(3.01)	0.184	(3.11)	0.242	(4.38)
∞	0.105	(1.42)	0.355	(3.75)	0.107	(1.52)	0.245	(2.87)	0.188	(2.88)
Panel B. Overall Policy Uncertainty in Canada										
1	0.018	(0.54)	0.027	(0.70)	0.003	(0.12)	0.031	(0.89)	0.921	(14.96)
3	0.028	(0.83)	0.047	(1.17)	0.045	(1.13)	0.062	(1.43)	0.819	(11.99)
12	0.085	(2.17)	0.101	(2.43)	0.103	(2.34)	0.076	(2.08)	0.636	(10.58)
24	0.118	(3.24)	0.105	(2.81)	0.148	(3.50)	0.121	(3.47)	0.508	(9.98)
60	0.119	(3.73)	0.138	(3.77)	0.160	(4.17)	0.134	(4.16)	0.450	(10.34)
∞	0.114	(3.63)	0.145	(3.78)	0.176	(4.27)	0.135	(4.13)	0.430	(9.98)

Notes: Table 3 shows percent contributions of demand and supply shocks in the crude oil market and overall/component policy uncertainty to the overall variability of real stock returns in Europe/Canada. The forecast error variance decomposition is based on the structural VAR model described in the text. The values in parentheses represent the absolute t-statistics when coefficients' standard errors were generated using a recursive-design wild bootstrap.