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The Impact of Oil Price Shocks on the U.S. Stock Market: A Note on the Roles of U.S. and Non-U.S. Oil Production [*]

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Abstract

Kilian and Park (IER 50 (2009), 1267–1287) find shocks to oil supply are relatively unimportant to understanding changes in U.S. stock returns. We examine the impact of both U.S. and non-U.S. oil supply shocks on stock returns in light of the unprecedented expansion in U.S. oil production since 2009. Our results underscore the importance of the disaggregation of world oil supply and of the recent extraordinary surge in the U.S. oil production for analysing impact on U.S. stock prices. We also show that stock returns respond very differently at the industrial level to non-U.S. and U.S. oil supply shocks.

JEL codes: E44, G12, Q43

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1. Introduction

Kilian and Park (2009) present a novel method for examining the relationship between stock market behaviour and oil price shocks. Building on the seminal contribution in Kilian (2009), which demonstrates that demand and supply shocks in the market for oil have different effects on the U.S. economy and the real oil price, they show that the reaction of U.S. real stock returns to an oil price shock depends on the source of the underlying cause of the oil price change. One of the major conclusions in Kilian and Park (2009) is that global oil supply shocks are less important than global aggregate and oil-specific demand shocks in understanding aggregate U.S. stock market behaviour. This inference is accentuated by sector-specific U.S. stock returns varying significantly in response to demand side shocks in the crude oil market and not reacting significantly to shocks to world oil production.

After several decades of steady decline in the U.S. oil production, innovations and new technologies in the extraction of crude oil have resulted in an unprecedented expansion in U.S. oil production in recent years.[1] This development is significant because an increase in U.S. crude oil production directly boosts U.S. domestic income compared with an increase in non-U.S. crude oil production. The recovery of U.S. oil production in recent years is illustrated in Figure 1. Figure 1 shows the behaviour of monthly U.S. crude oil production, and for comparison, non-U.S. crude oil production. The contribution of shale oil output to U.S. oil production is indicated by the shaded area in Figure 1. After U.S. oil output trended upwards to a maximum in November 1970 of 10.044 million barrels per day (not shown), production gradually fell to 8.854 million barrels per day in January 1977, before rising to a local maximum in January 1986 of 9.137 million barrels per day. After January and February

[1]Driven by the "Shale Revolution", the Energy Information Agency (EIA) estimates that by 2015, U.S. oil production has almost doubled compared with the levels observed only five and six years earlier. Kilian (2015) provides a detailed analysis of the shale oil revolution and the implications for U.S. oil prices. Baumeister and Kilian (2015) and Kilian (2015) provide a detailed analysis of the shale oil revolution and the implications for U.S. oil prices.

1986 U.S. oil production successively fell to below 6 million barrels per day in January 1999 and remained below this level until November 2011. U.S. oil output in January 2015 amounted to 9.305 million barrels per day, up from production of 5.497 million barrels per day in January 2011, representing an increase of over 69%.[2]

Where Kilian and Park (2009) consider the role of world oil supply, we examine the impact of both U.S. and non-U.S. crude oil supply shocks on U.S. real stock returns in light of the exceptional increase in U.S. oil production. While the influence of real oil price on U.S. stock returns is informed by whether global aggregate and oil-specific demand shocks are the driving force of oil price change, U.S. real stock returns might well be influenced by the source of innovation in crude oil production. In this study we revisit Kilian and Park's (2009) major paper to examine the effect of world oil supply shocks on U.S. real stock market returns. Our study is concerned with the questions: Do U.S. oil supply shocks affect U.S. real stock market returns? How do U.S. oil supply shocks affect real stock market returns of major industries?

To assess whether U.S. real stock returns are influenced by the source of innovation in crude oil supply shocks, we build on Kilian and Park's (2009) Vector Autoregressive model (VAR) by disaggregating world crude oil supply shocks in that model into U.S. and non-U.S. oil supply shocks. We find that both the disaggregation of world oil supply and the unprecedented surge in the U.S. oil production since 2009 are important factors in determining U.S. real stock returns. Variance decomposition analysis show that by disaggregating world oil production into U.S. and non-U.S. oil production, supply shocks are

[2] Not shown in Figure 1, in April 2015 U.S. oil output amounted to 9.701 million barrels per day, a monthly output level only previously exceeded by seven months during 1970-1971. Sharp drops U.S. oil output are associated with hurricane Katrina in 2005:09 and with hurricanes Gustav & Ike in 2008:09. Monthly U.S. oil production fell by 18.96% in 2005:09 and by 20.53% in 2008:09. The Katrina production losses took several months to recover from, while the recovery from hurricanes Gustav & Ike was more rapid with a rise in production in 2008:10 of 19.02%. U.S. and non-U.S. crude oil production have exhibited dissimilar behavior over time. Non-U.S. crude oil production in contrast has largely stagnated over the last ten years, after trending upwards over 1985-2003, following a trough in output over 1981-1985 relative to output levels over 1976-1981.

comparable to demand shocks (in contrast to Kilian and Park' (2009) results) in explaining U.S. real stock returns. In particular, for the period 1973:02-2006:12 (the original sample in Kilian and Park (2009)) supply shocks explain 14.1% of the U.S. real stock returns, while demand shock explain 16.8%. For the period 1973:02-2014:12, supply and demand shocks account for 11.9% and 11.6%, respectively, of the variation in U.S. real stock returns.

At the industrial level, we find that stock returns can respond very differently to a shock to U.S. oil production compared with a shock to non-U.S. oil supply. Real stock returns for the U.S. automotive industry are negatively affected by negative U.S. oil supply shocks, while they are relatively unresponsive to non-U.S. supply shocks. Precious metal's real stock returns are much more positively affected by negative U.S. supply shocks than they are by negative non-U.S. supply shocks.

The data and methodology are discussed in Section 2. The empirical results are presented in Section 3. Section 4 concludes.

2. Data and Methodology

We utilize monthly stock and oil market data and examine the two periods: January 1973 to December 2006, and January 1973 to December 2014. The first period is examined in Kilian and Park (2009) and the second is an update that incorporates the oil production expansion in the U.S. in more recent years. The aggregate U.S. real stock market return (ret_t) is obtained by subtracting the CPI inflation rate from the log returns on the CRSP value-weighted market portfolio.[3] The oil supply proxy variables are given by the per cent changes in non-U.S. oil production ($\Delta prod_t^{nonUS}$) and in U.S. oil production ($\Delta prod_t^{US}$) from the U.S.

[3] The CRSP data are available at http://wrds.wharton.upenn.edu.

Department of Energy.[4] The global real economic activity proxy is the index of real economic activity (rea_t) constructed by Kilian (2009).[5] The real price of oil (rpo_t) is U.S. refiner acquisition cost of imported crude oil, from the U.S. Department of Energy since 1974:1 deflated by the U.S. CPI, with the series extended back to 1973:1 following Barsky and Kilian (2002).

A structural VAR model of order p is utilized to extract the separate supply and demand-side sources underlying oil price changes and their relation to the U.S. stock market return:

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

where $y_t = (\Delta prod_t^{nonUS}, \Delta prod_t^{US}, rea_t, rpo_t, ret_t)$ is 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.[6]

To construct the structural VAR model representation, the reduced-form VAR model is consistently estimated using the least-squares method and is obtained by multiplying both sides of Equation (1) by A_0^{-1}. The reduced-form error term is $e_t = A_0^{-1}\varepsilon_t$ and $e_t \sim N(0,\Sigma)$.

The identifying restrictions on A_0^{-1}, as a lower-triangle coefficient matrix in the structual VAR model, follows the setup in Kilian (2009). Kilian (2009) argues that oil production does not respond to contemporaneous changes in oil demand within a given month because of the high adjustment cost of changing oil production. Fluctuation in the real

[4] The set-up with two oil supply variables is similar to a set-up used in the 2006 CEPR working paper version of Kilian (2009), except that the author used OPEC and non-OPEC oil production. The author found that the distinction made little difference for the determination of oil prices.
[5] The index is available at http://www-personal.umich.edu/~lkilian/paperlinks.html.
[6] We follow Kilian and Park (2009) in setting p=24 which allows for a potentially long-delay in effects of structural oil price shocks on the economy and for a sufficient number of lags to remove serial correlation.

price of oil will not affect global economic activity within a given month due to the sluggishness of aggregate economic reaction. The real stock return ordered after oil shocks is motivated by Kilian and Vega (2011), who argue that oil prices are predetermined with respect to U.S. macroeconomic aggregates within a given month.

We assume that non-U.S. oil production does not respond to U.S. oil supply shock within a given month. The U.S. is an oil importing country whose oil production averages 11.5% of the global oil production over January 1973 to December 2014. The alternative assumption, that U.S. oil production does not respond to non-U.S. oil supply shock immediately and that non-U.S. oil production could respond to the disruption of U.S. oil production within the same month, will be examined in robustness analysis.

3. Empirical Results

3.1. Impulse responses of the U.S. real stock returns to different oil supply shocks

In Figure 2 the cumulative impulse responses over a 25-month horizon of U.S. real stock returns to one-standard-deviation structural oil production shocks are shown. One-standard error bands indicated by dashed lines are computed by conducting recursive-design wild bootstrap with 2,000 replications proposed by Gonçalves and Kilian (2004). In Figures 2a and 2b results are shown for the five variable model described in Equation (1), where oil supply shocks are disaggregated between non-U.S. and U.S. oil supply shocks. To examine the influence of recent oil production developments in the U.S., Figure 2a reports results for Kilian and Park's (2009) original sample ending in 2006, and Figure 2b reports results for data updated until December 2014. In Figure 2c we show results for the original Kilian and Park (2009) model with aggregate world oil supply shocks, with the data updated to December 2014.

The results in Figures 2a and 2c are in line with the Kilian and Park (2009) paper in that oil supply shocks are relatively unimportant in determining U.S. real stock returns. However, Figure 2b shows a more distinctive result as a negative U.S. oil supply shock is associated with a negative response in U.S. real stock returns that is statistically significant over most of the horizon. The response of U.S. real stock returns to a negative shock to U.S. oil supply is markedly different from that to a negative shock to non-U.S. oil supply. In Figure 2b a negative innovation in non-U.S. oil supply is mostly associated with a rise U.S. real stock returns that are statistically significant in the fourth through eighth months. These results underscore the importance when examining U.S. real stock returns of the disaggregation of world oil production into U.S. and non-U.S. oil supply components following the "Shale Revolution".

The full sets of impulse response functions from Equation (1) estimated over 1973:01-2006:12 and 1973:01-2014:12 and the Kilian and Park model (2009) estimated over 1973:01-2014:12, of which Figure 2 only represents a part of the results, are provided in the Appendix. These results reinforce Kilian and Park's (2009) findings that the effect on U.S. real stock returns of an oil price shock is contingent on the source of change in the oil market. In particular, the updated sample shows that a positive oil market specific demand shock significantly reduces U.S. real stock returns and that a positive aggregate demand shock significantly increases U.S. real stock returns. It is also seen that the differentiation of supply shocks between those originating in U.S. oil production and non-U.S. oil production, even though they have different effects on U.S. real stock returns, does not change the results concerning demand side influences.

3.2. Contributions of different oil supply shocks to U.S. real stock returns

In this subsection we compute the forecast error variance decomposition to address the important question of how much of the variation in U.S. real stock returns is attributed to each structural shock in the crude oil market. Table 1 and Table 2 show the average contributions of each structural shock to the total variation in U.S. real stock returns over 1973:02-2006:12 and over 1973:02-2014:12 respectively.

In Tables 1 and 2, it can be seen that by disaggregating world oil supply into U.S. and non-U.S. oil supply shocks, demand and supply shocks are comparable in explaining the variation in U.S. real stock returns. In the period 1973:02-2006:12, supply shocks explain 14.1% of the variation in U.S. real stock returns, while demand shocks explain 16.8% after 60 months. Over 1973:02-2014:12, supply shocks account for 11.9% and demand shocks account for 11.6% of variations of U.S. real stock returns after 60 months. By contrast, using a model in which oil production is consolidated as world oil production, supply shocks forecast 6.4% of the variation in U.S. real stock returns (as reported by Kilian and Park (2009)).

In Tables 1 and 2, the variation in U.S. real stock returns attributed to U.S. oil supply shocks and to non-U.S. oil supply shocks are about equal, at 6.7% and 7.4% over 1973:02-2006:12 respectively. Over the period 1973:02-2006:12, the differentiation of shocks to U.S. oil production and to non-U.S. oil production does not change the results concerning the variation in U.S. real stock returns credited to the demand side influences (reported by Kilian and Park (2009)). Over 1973:02-2014:12 compared with 1973:02-2006:12, there is decline in the contribution of oil-market specific demand shock in forecasting variation in U.S. real stock returns from 10.3% to 6.7% (both results statistically significant at the 1% level).

Tables 3 and 4 show forecast error variance decomposition results from application of the Kilian and Park (2009) model in which the oil supply shock is to world oil production. The average contributions of each structural shock to the total variation in U.S. real stock returns over 1973:02-2006:12 appear in Table 3. When U.S. and non-U.S. oil supply shocks are not distinguished, the demand and supply shocks in the oil market account for 23.4% of the long-term variation in U.S. real stock returns in Table 3, compared with the 30.8% reported in Table 1 when U.S. and non-U.S. oil supply shocks are differentiated. Over 1973:02-2014:12, a comparison of results in Figures 2 and 4 indicate that differentiation of a world oil supply shock into U.S. and non-U.S. components results in demand and supply shocks in the oil market which account for 23.4% of the long-term variation in U.S. real stock returns rather than 18.2%.[7]

3.3. *Industry Results*

Kilian and Park (2009) examine whether the effects of the structural oil market shocks differ across industries as a means to establish whether for the U.S. stock market oil shocks are best viewed as aggregate supply shocks or aggregate demand shocks. Lee and Ni (2002) argue that oil price shocks primarily influence activity at industry level through demand side effects. Kilian and Park focus on four industries in the data provided by Kenneth French: the automotive industry, because it may be sensitive to energy prices; the precious metals sector, where high oil prices might be associated with political uncertainty; the petroleum and natural gas industry, because of possible ownership of oil resources; and the retail industry, because of effect of oil price on discretionary income.

The impulse response results for returns in these four sectors to negative shocks in non-U.S. oil production and U.S. oil production are shown in Figure 3.[8] In Figure 3 a negative shock to U.S. oil supply causes a negative impact on the real return in the automotive industry that is statistically significantly over the 2nd through 8th months and 14th through 22th months. A shock to non-U.S. oil supply does not significantly impact return in the automotive industry. In the precious metal sector, real stock return is positively affected

[7] Over 1973:01 – 2006:12 the root mean squared forecast errors of real stock returns upon the demand and supply shocks are 3.6364 and 3.7642 when U.S. and non-U.S. oil supply shocks are differentiated (the five variable VAR model) and when they are not (the four variable VAR model), respectively. The root mean squared forecast errors when the models are estimated over 1973:01 – 2014:12 are 3.8516 and 3.9718 for the 5-variable model and the 4-variable model, respectively.

[8] In generating results, a U.S. sector real return replaces U.S. real stock return in equation (1). The data are at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

by a negative shock to both non-U.S. and U.S. oil supply, but the effect of the latter is much more persistent and statistically significant for a much longer time period.

Returns in the petroleum and natural gas industry do not respond significantly to shocks to U.S. oil supply. A negative shock to non-U.S. oil production is associated with positive response over the first seven months returns in the petroleum and natural gas industry, followed by negative response thereafter, with returns being intermittently statistically significant. In the retail sector, negative shocks in non-U.S. oil production and U.S. oil production are associated with positive returns and negative returns, respectively, in the U.S. retail sector. The outcomes for sector stock returns indicate that it matters whether a negative oil supply shock has its origin in disruption to U.S. oil production or in disruption to non-U.S. oil production.

4. Robustness

To examine the robustness of results we also conduct a rolling sample analysis, which yields similar results to those reported across rolling window width, the forecast horizon, and the ordering of the VAR. We find that the effects of the four structural oil price shocks on the U.S. real stock market returns do not greatly vary from those reported earlier. In particular, changing the order of non-U.S. and U.S. oil production variables in the structural VAR model, show similar results for the two oil supply side shocks effects on U.S. real stock market returns to those portrayed in Figure 2 and Table 1. The change in ordering means that U.S. oil production does not respond contemporaneously to a non-U.S. oil supply shock and that non-U.S. oil production could respond to a shock to U.S. oil production within the same month. Estimating the model over 1973:02-2014:12 with the assumption that U.S. oil production does not respond to non-U.S. oil supply shock, for example, yields the result that a negative innovation in U.S. oil production is associated with a fall in U.S. real stock returns that is statistically significant over most of the 24 month horizon (as before). The results are not reported and are available on request.[9]

5. Conclusion

In this paper we show the importance of distinguishing between U.S. and non-U.S. oil supply shocks for understanding the impact of structural shocks in the oil market on U.S. real stock returns. When U.S. and non-U.S. oil supply shocks are distinguished, the demand and supply shocks in the oil market account for 30.8% of the long-term (60 months) variation in U.S. real stock returns (over 1973:01- 2006:12). When U.S. and non-U.S. oil supply shocks are not differentiated, the demand and supply shocks in the oil market account for 23.4% of the long-term variation in U.S. real stock returns.

A positive U.S. oil supply shock has a statistically significant positive impact on U.S. real stock returns, a result which differs from that in response to a non-U.S. oil supply shock. In contrast to the results reported in Kilian and Park (2009), oil demand and supply shocks are of comparable importance in explaining U.S. real stock returns when supply shocks from U.S. and non-U.S. oil production are identified. We highlight the importance of recognizing the source of oil supply shocks by examining responses of industry specific U.S. stock returns. Negative shocks to U.S. oil supply cause negative impacts on the portfolio returns of automotive and retail sectors and significant positive impact on portfolio returns in the precious metals sector.

[9] We also considered subsample periods in estimation of the SVAR model and find that results do not greatly differ from those reported earlier. The negative effect of U.S. oil supply shocks on real stock returns is intensified in the 2010.1-2014.12 sample. We examined the impulse responses and variance decompositions to real stock returns by taking 1, 2, or 3 lags in the structural VAR model when reviewing the 2010.1-2012.14 sample. The results are available on request.

References

Barsky, R.B. and L. Kilian (2002), “Do we really know that oil caused the great stagflation? A monetary alternative,” In *NBER Macroeconomics Annual 2001*, 16, 137 – 198.

Baumeister, C. and L. Kilian (2015), “Understanding the Decline in the Price of Oil since June 2014,” CFS Working Paper No. 501.

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

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.

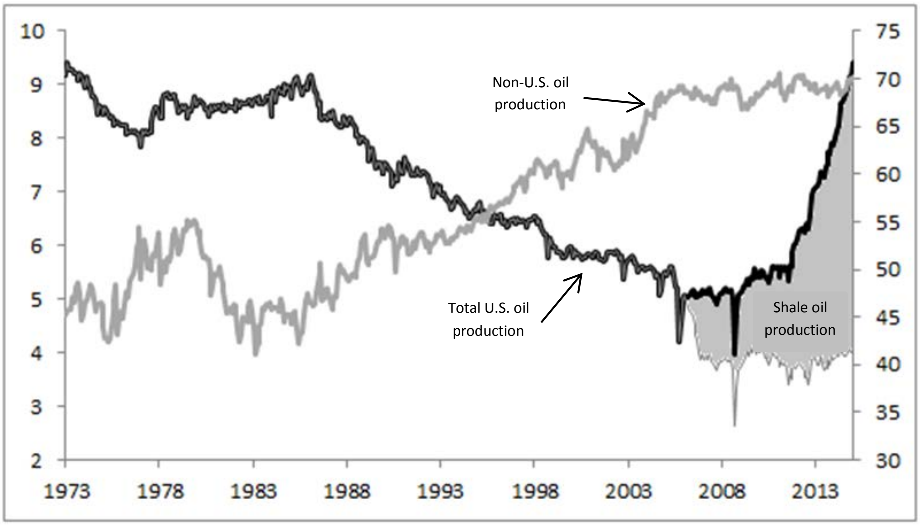
Kilian, L. (2015), “The Impact of the Shale Oil Revolution on U.S. Oil and Gasoline Prices,” manuscript, University of Michigan.

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

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.

Figure 1. Monthly U.S. and Non-U.S. oil production, 1973:01 – 2014:12

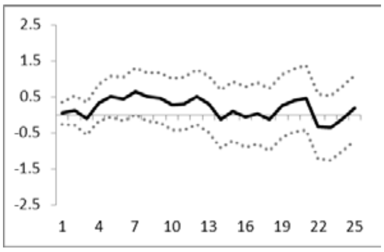


Notes: Data from the U.S. Department of Energy.

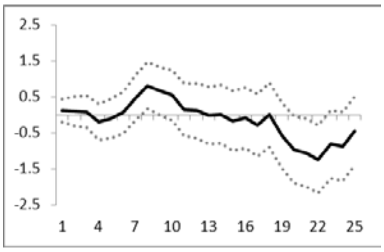
Figure 2. Response of U.S. real stock return to different oil production shocks

a. Sample 1973:01-2006:12 (5 variables model)

Non-US oil production

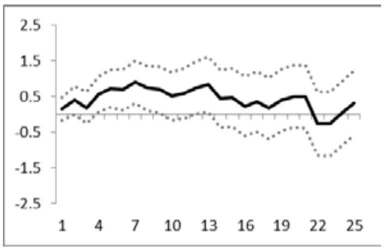


US oil production

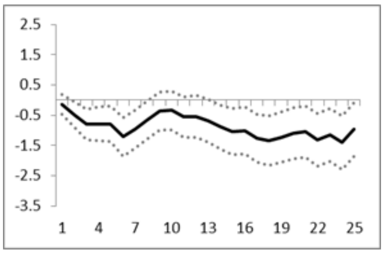


b. Sample 1973:01-2014:12 (5 variables model)

Non-US oil production

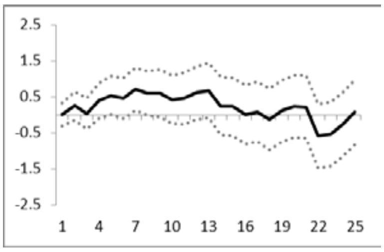


US oil production



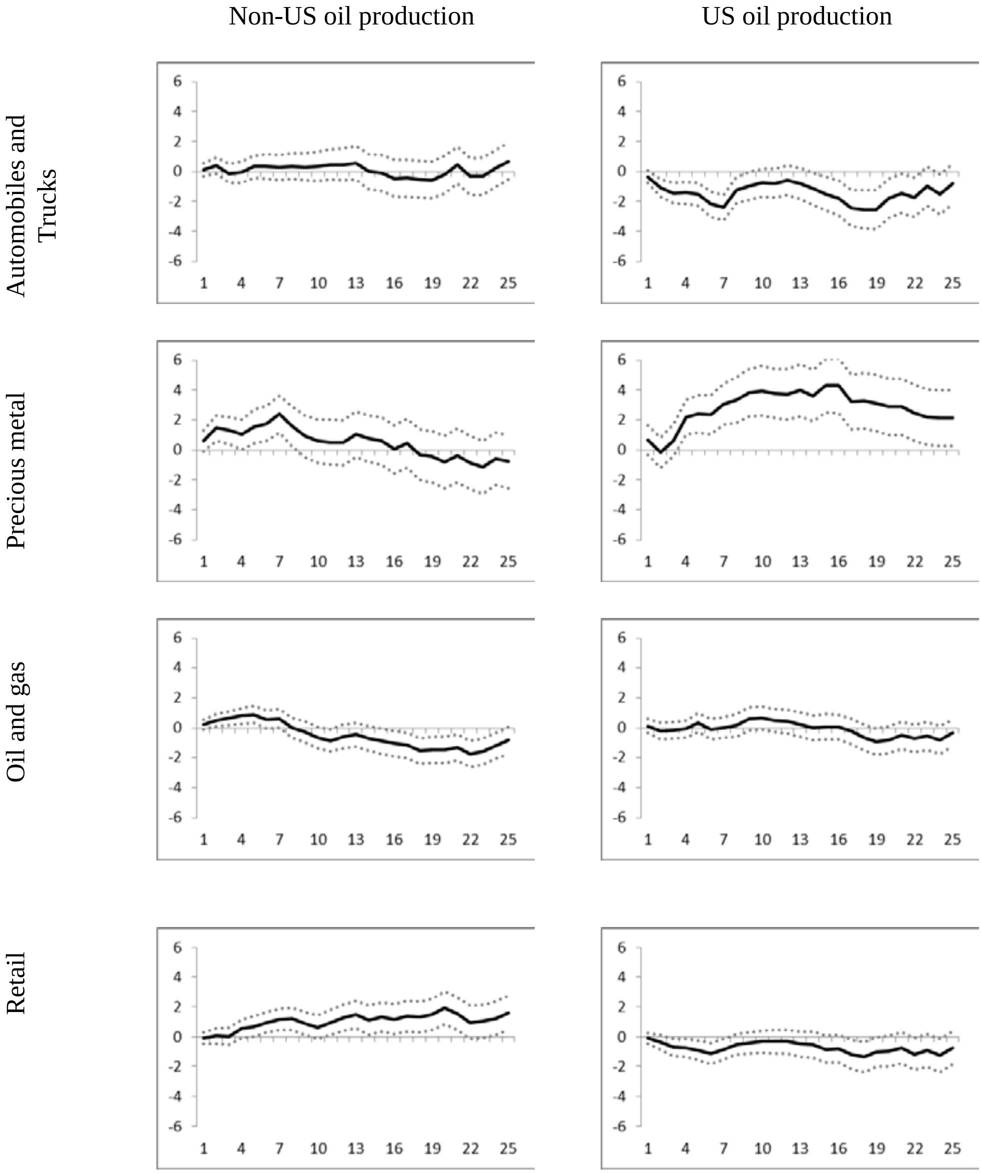
c. Sample 1973:01-2014:12 (4 variable model (Kilian and Park (2009))

World oil production



Notes: Each diagram of Figure 2 shows the cumulative impulse response of U.S. real stock return to one standard deviation structural shock in the variable in the column derived from the VAR model in equation (1). Point estimates with one-standard error bands constructed using a recursive-design wild bootstrap.

Figure 3. Response of U.S. real stock return across industries to different oil production shocks, 1973:01-2014:12.



Notes: Each diagram shows the cumulative impulse response by the U.S. real stock return for the industrial sector indicated in the row to one standard deviation structural shock in the variable in the column derived from the VAR model in equation (1). Point estimates with one-standard error bands constructed using a recursive-design wild bootstrap.

Table 1. Forecast error variance decomposition (FEVD) of real U.S. stock market return with different supply shocks, 1973-2006

Horizon	Non-US oil supply shock		US oil supply shock		Aggregate demand shock		Oil-market specific demand shock		Other shock	
Panel 1. All stocks										
1	0.000	(0.01)	0.001	(0.07)	0.005	(0.36)	0.041	(1.22)	0.954	(25.36)
3	0.003	(0.25)	0.001	(0.06)	0.009	(0.55)	0.061	(1.63)	0.926	(21.73)
12	0.019	(0.99)	0.028	(1.30)	0.029	(1.40)	0.074	(2.09)	0.850	(18.96)
24	0.061	(2.63)	0.056	(2.00)	0.053	(2.42)	0.095	(2.89)	0.735	(16.22)
60	0.067	(2.92)	0.074	(2.26)	0.065	(2.89)	0.103	(3.38)	0.692	(14.92)

Notes: Table 1 shows percent contributions of demand and supply shocks in the crude oil market and shocks to the overall variability of real stock market return. 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 real U.S. stock market return with different supply shocks, 1973-2014

Horizon	Non-US oil supply shock		US oil supply shock		Aggregate demand shock		Oil-market specific demand shock		Other shock	
Panel 1. All stocks										
1	0.001	(0.09)	0.001	(0.09)	0.002	(0.24)	0.006	(0.48)	0.990	(44.90)
3	0.006	(0.48)	0.012	(0.61)	0.005	(0.49)	0.012	(0.74)	0.966	(33.62)
12	0.019	(1.14)	0.031	(1.25)	0.027	(1.56)	0.037	(1.79)	0.885	(23.76)
24	0.056	(2.59)	0.042	(1.69)	0.042	(2.22)	0.063	(2.71)	0.798	(20.71)
60	0.063	(2.86)	0.056	(2.10)	0.049	(2.54)	0.067	(2.95)	0.766	(19.16)

Notes: Table 2 shows percent contributions of demand and supply shocks in the crude oil market and shocks to the overall variability of real stock market return. 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 U.S. stock market return with world supply shock, 1973-2006

Horizon	World oil supply shock		Aggregate demand shock		Oil-market specific demand shock		Other shock	
Panel 1. All stocks								
1	0.001	(0.10)	0.005	(0.35)	0.029	(1.05)	0.965	(31.24)
3	0.003	(0.26)	0.007	(0.43)	0.057	(1.62)	0.934	(24.81)
12	0.016	(0.84)	0.030	(1.37)	0.072	(2.08)	0.883	(21.51)
24	0.061	(2.47)	0.052	(2.21)	0.091	(2.60)	0.796	(18.73)
60	0.069	(2.72)	0.063	(2.54)	0.102	(2.93)	0.766	(17.41)

Notes: Table 1 shows percent contributions of demand and supply shocks in the crude oil market and shocks to the overall variability of real stock market return. The forecast error variance decomposition is based on the structural VAR model in Kilian and Park (2009). The values in parentheses represent the absolute t-statistics when coefficients' standard errors were generated using a recursive-design wild bootstrap.

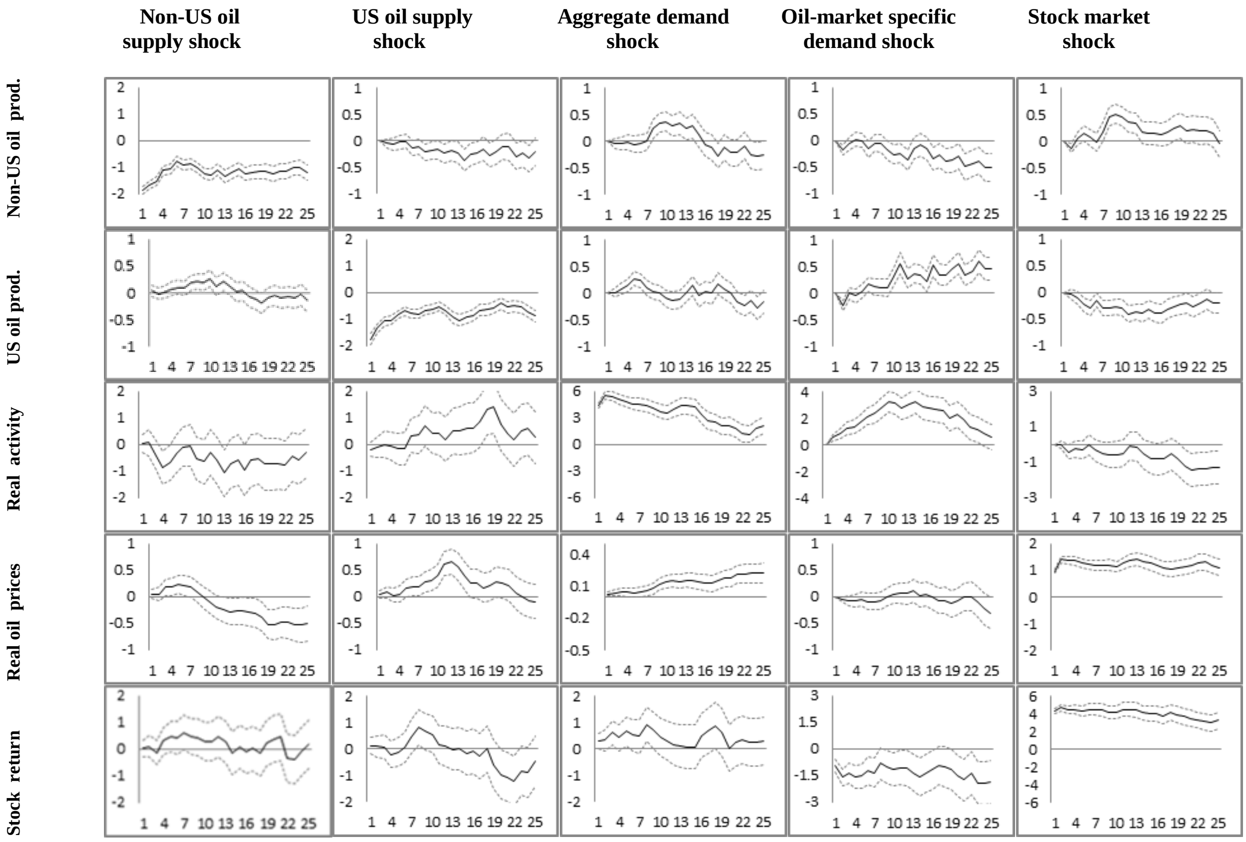
Table 4. Forecast error variance decomposition (FEVD) of real U.S. stock market return with world supply shock, 1973-2014

Horizon	World oil supply shock		Aggregate demand shock		Oil-market specific demand shock		Other shock	
Panel 1. All stocks								
1	0.000	(0.00)	0.001	(0.08)	0.001	(0.10)	0.998	(61.98)
3	0.005	(0.43)	0.004	(0.34)	0.005	(0.38)	0.986	(48.61)
12	0.018	(1.05)	0.031	(1.56)	0.027	(1.47)	0.925	(30.16)
24	0.060	(2.60)	0.046	(2.18)	0.055	(2.47)	0.840	(23.89)
60	0.068	(2.83)	0.053	(2.43)	0.061	(2.62)	0.818	(21.98)

Notes: Table 1 shows percent contributions of demand and supply shocks in the crude oil market and shocks to the overall variability of real stock market return. The forecast error variance decomposition is based on the structural VAR model described in Kilian and Park (2009). The values in parentheses represent the absolute t-statistics when coefficients' standard errors were generated using a recursive-design wild bootstrap.

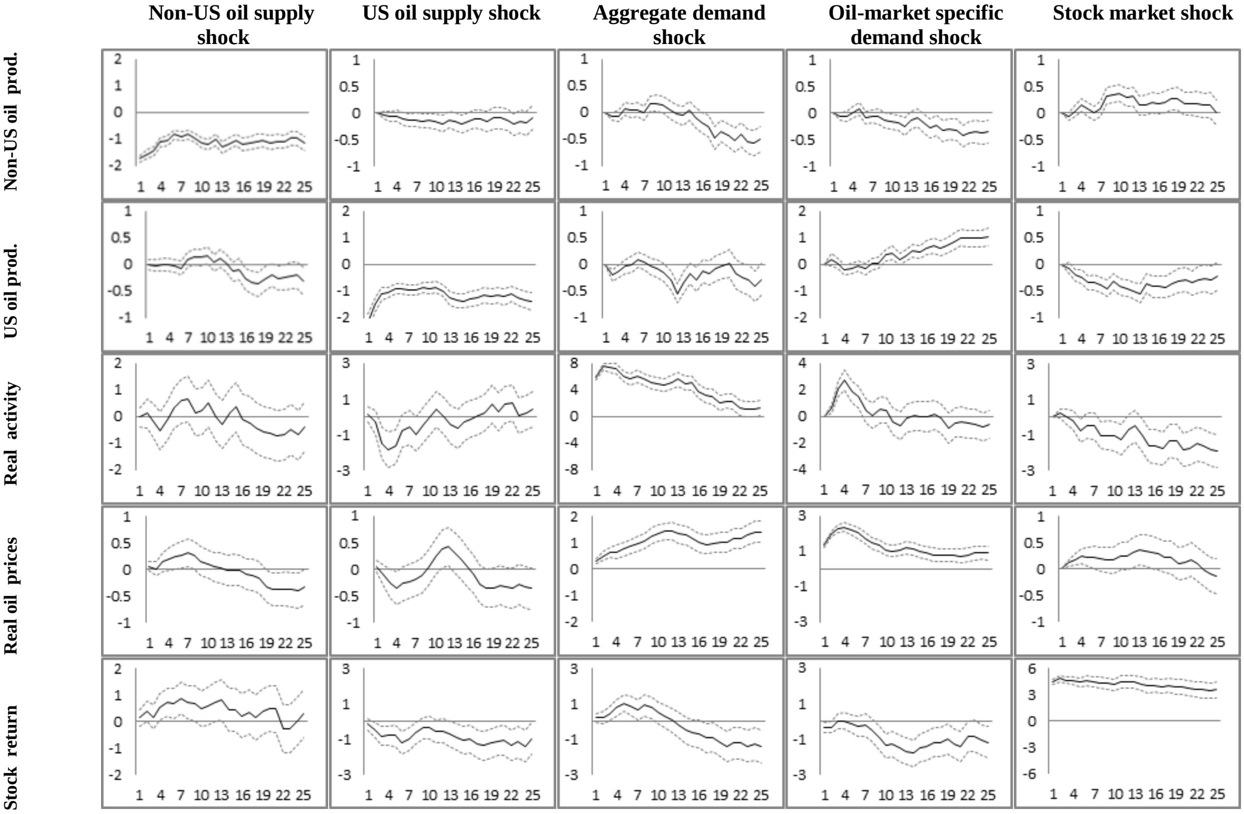
Appendix

Figure A-1: Responses to one-standard deviation structural shocks, 1973:01-2006:12



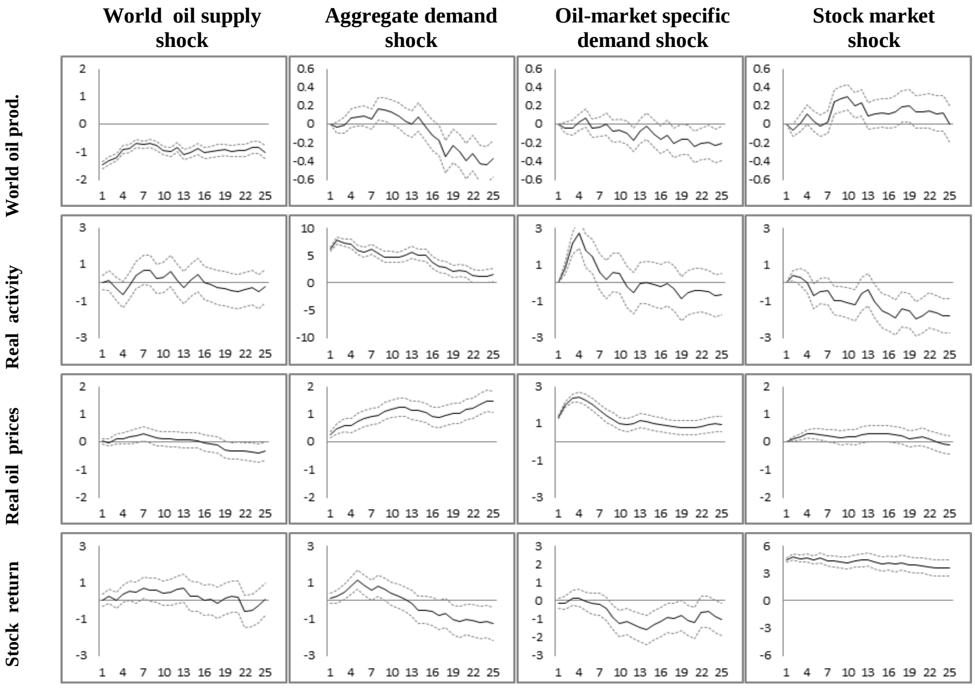
Notes: Each diagram shows the cumulative impulse response by the variable in the row to one standard deviation structural shock in the variable in the column derived from the VAR model in equation (1). Point estimates with one-standard error bands constructed using a recursive-design wild bootstrap.

Figure A-2: Responses to one-standard deviation structural shocks, 1973:01-2014:12



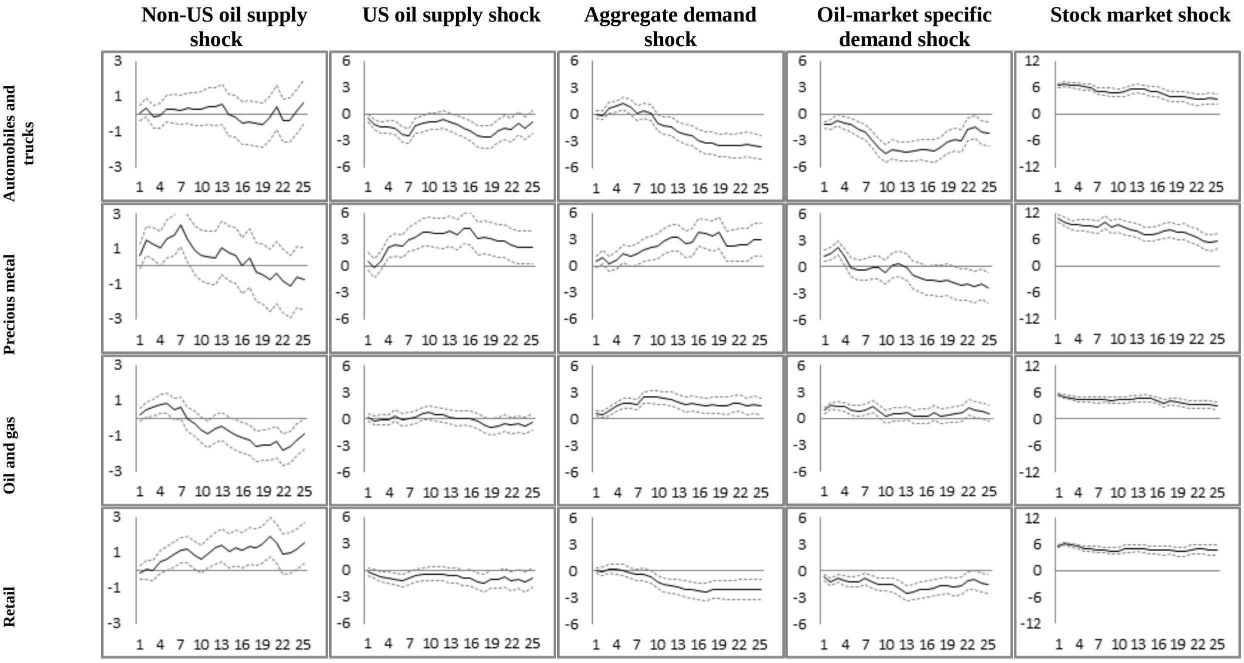
Notes: Each diagram shows the cumulative impulse response by the variable in the row to one standard deviation structural shock in the variable in the column derived from the VAR model in equation (1). Point estimates with one-standard error bands constructed using a recursive-design wild bootstrap.

Figure A-3: Responses to one-standard deviation structural shocks, 1973:01-2014:12



Notes: Each diagram shows the cumulative impulse response by the variable in the row to one standard deviation structural shock in the variable in the column for the four variable VAR model in Kilian and Park (2009). Point estimates with one-standard error bands constructed using a recursive-design wild bootstrap.

Figure A-4. Responses of U.S. real stock returns across industries, 1973:01-2014:12



Notes: Each diagram shows the cumulative impulse response by the U.S. real stock return for the industrial sector indicated in the row to a one-standard deviation structural shock in the variable in the column derived from the VAR model in equation (1) in which U.S. real stock return is replaced in turn by U.S. sector real stock return. Point estimates with one-standard error bands constructed using a recursive-design wild bootstrap.