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Abstract

Edelstein and Kilian (2009) point out that the oil price shock involves a reduction in consumer spending, which results in a decrease in the demand for goods and services. This paper empirically evaluates this argument by empirically investigating effects of the oil price shock on six CPI sub-indices in the US. We find substantial decreases in the relative price in less energy-intensive sectors, but not in energy-intensive sectors. Our findings are consistent with those of Edelstein and Kilian (2009) in the sense that spending adjustments play an important role in price dynamics.

Key Words: Oil Price Shocks; Pass-Through Effect; Consumer Price Sub-Index; Consumption Expenditures; Income Effect

JEL Classification: E21; E31; Q43

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1 Introduction

As Barsky and Kilian (2002) argue that oil price shocks are unambiguously inflationary, especially when one use the consumer price index (CPI) inflation rate to measure the pass-through effect of the shock. On the other hand, Edelstein and Kilian (2009) point out that the oil price shock may have a substantial income effect on the demand for goods and services.

This paper estimates the pass-through effect of the oil price shock on six CPI sub-indices in the US. We find strong evidence of spending adjustment effects that *limit* the pass-through effect of the shock on the apparel, food, housing, and medical care price indices (less energy-intensive sectors), but not on the energy and transportation price indices. That is, consumer welfare loss is primarily driven by a strong pass-through effect in *energy-intensive* sectors.

The rest of our manuscript is organized as follows. Section 2 provides a data description and preliminary findings. In Section 3, we provide our main findings. Section 4 concludes.

2 Data Descriptions and Preliminary Findings

We obtained all data from Federal Reserve Economic Data (FRED). The oil price is the spot western Texas intermediate (WTI). Six CPI sub-indices include: Apparel (CPIAPPSL), Energy (CPIENGSL), Food (CPIUFDSL), Housing (CPIHOSSL), Medical Care (CPIMEDSL), and Transportations (CPITRNSL).[1] Observations are monthly and

[1] We omit the Food and Beverage index because we obtained similar results as that from the Food index. Other categories such as Education and Recreations are omitted due to lack of observations.

span from 1974 M1 to 2011 M3.[2] We also use Personal Consumption Expenditures (PCE) to investigate expenditure adjustment effects in augmented models.

We first report the impulse response function of the US CPI to an oil price shock in Figure 1 as a benchmark.[3] As in Barsky and Kilian (2002), we observe a strong and significant pass-through effect on aggregate CPI. It should be noted, however, that relatively weak pass-through effects are observed for some CPI sub-indices as we can see in Figure 2. We obtain insignificant responses for the apparel, food, and medical care indices, while strong and significantly positive responses are observed for the energy and transportation indices. The significant positive effect on the housing price, however, was short term and lasts only for about one year.

Figures 1 and 2 around here

3 Responses of the Relative Price

Let op_t and x_t be the spot oil price and a CPI sub-index, respectively. All variables are expressed in natural logarithms and deflated by the aggregate US CPI. That is, we construct the following bivariate VAR(p) model for relative prices with deterministic trends.[4]

$$\boldsymbol{y}_t = \boldsymbol{A}\boldsymbol{d}_{\boldsymbol{t}} + \boldsymbol{B}(L)\boldsymbol{y}_{t-1} + \boldsymbol{C}\boldsymbol{u}_{t,} \tag{1}$$

where

$$\boldsymbol{y}_t = \begin{bmatrix} op_t \\ x_t \end{bmatrix}, \boldsymbol{d}_{\boldsymbol{t}} = \begin{bmatrix} 1 \\ t \end{bmatrix},$$

[2] Observations prior to 1974 are not used due to the collapse of the Bretton Woods system in 1973 that creates a structural break in oil price dynamics. We are not interested in this particular issue.
[3] We obtain the *accumulated* impulse-response function from a bivariate vector autoregressive model with differenced variables. The oil price inflation is ordered first with an assumption that the US CPI inflation does not contemporaneously affect the oil price inflation within one month.
[4] All eigenvalues are within the unit circle, implying the system is jointly trend stationary.

$\boldsymbol{A}$ is a coefficient matrix for the deterministic terms, $\boldsymbol{B}(L)$ denotes the lag polynomial matrix, $\boldsymbol{u}_t$ is a vector of normalized underlying shocks, and $\boldsymbol{C}$ is a matrix that describes the contemporaneous relationships among op_t and x_t. We obtain the conventional orthogonalized impulse-response function (OIRF) by Sims (1980) and the variance decomposition analysis is implemented from this framework.[5]

Responses to the oil price shock are reported in Figure 3. We note that the relative price (price share) exhibits significantly negative movements at least in the short-run for the apparel, food, housing, and medical care sub-indices. We observed very persistent upward movements of relative prices in energy-intensive sectors.

Our findings are consistent with that of Edelstein and Kilian (2009) in the sense that the spending adjustment effect plays an important role in determining the price dynamics. Unexpected changes in the oil price shift not only the supply but also the *demand* curve of goods and services to the left due to a decrease in purchasing power of discretionary income. If the oil shock results in a persistent negative effect on income growth, consumer spending will be further depressed over time. When the demand responds substantially, relative price in that sector is likely to fall, which might explain a limited or weak pass-through effect on prices in less energy-intensive sectors.

Insert Figure 3 around here

We also implement the variance decomposition analysis to see how much variations of each sub-index are explained by the oil price shock. We observe a dominant role of the oil shock only for the energy and transportation sub-indices, while limited roles of the shock were observed for the apparel, food, housing, and medical care sub-indices especially in the short-run.

[5] Kim (2012) shows that the OIRF is the same as the generalized impulse-response function (GIRF) by Pesaran and Shin (1998) for the response to the variable ordered first, which is the oil price in our model.

Next, we augment the current system to a trivariate VAR model by adding the personal consumption expenditures (PCE), again deflated by the CPI, to see if the oil price shock results in a non-negligible adjustment effect in consumer spending. It should be noted that all response function estimates of relative prices in Figure 4 are qualitatively similar to those from the bivariate model, while we observe significantly negative responses of the real consumption expenditures in all cases.[6] These findings provide further evidence of substantial role of the negative income effect. [7]

Insert Figure 4 around here

VI. Concluding Remarks

This paper empirically evaluates the role of spending adjustment when there is an oil price shock using six CPI sub-indices in the US. We find limited pass-through effects of the oil shock on apparel, food, housing, and medical care prices compared with those on the energy and transportation prices. We propose an explanation for such discrepancies from spending adjustment effects. These findings are consistent with the work of Edelstein and Kilian (2009), who point out a negative income effect caused by unexpected changes in the oil price.

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[6] We further experimented with an augmented VAR with the industrial production. Results confirm prolonged recessionary effects over time. All results are available upon request from authors.

[7] The variance decomposition analysis results with trivariate VAR models are available upon request. We obtained similar results as those from bivariate models.

References

Barsky, Robert and Lutz Kilian (2002), "Do we really know that oil caused the great stagflation? A monetary alternative," in *NBER Macroeconomics Annual 2001*, Benjamin Bernanke and Kenneth Rogoff (Eds.), 137-183.

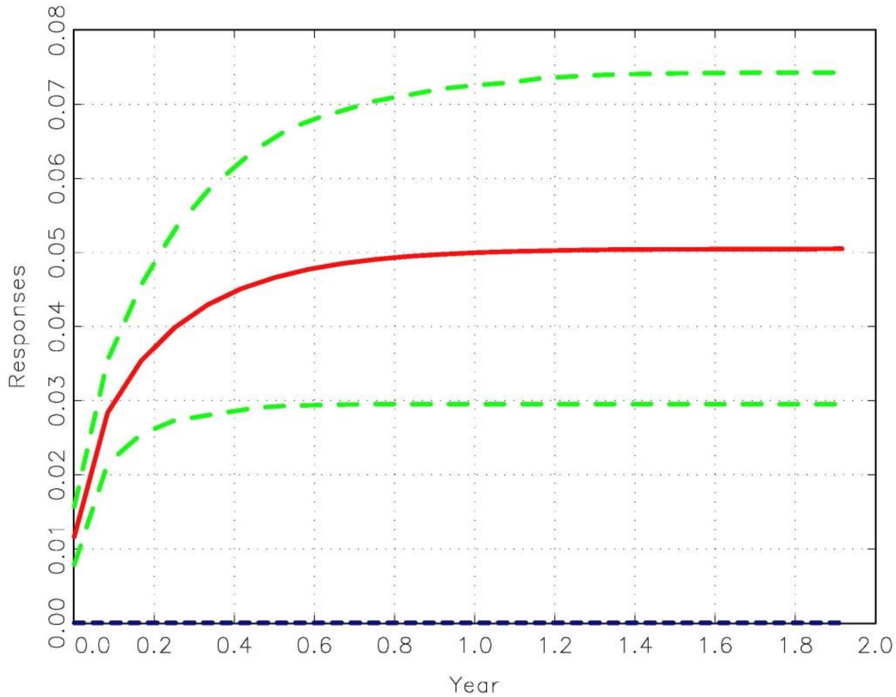
Edelstein, Paul and Lutz Kilian (2009), "How sensitive are consumer expenditures to retail energy prices?" *Journal of Monetary Economics* 56, 766-779.

Kim, Hyeongwoo (2012), "Generalized impulse response analysis: General or extreme?" *Auburn Economics Working Paper* No. 2012-04.

Pesaran, M. Hashem, Yongcheol Shin (1998), "Generalized impulse response analysis in linear multivariate models," *Economics Letters* 58, 17-29.

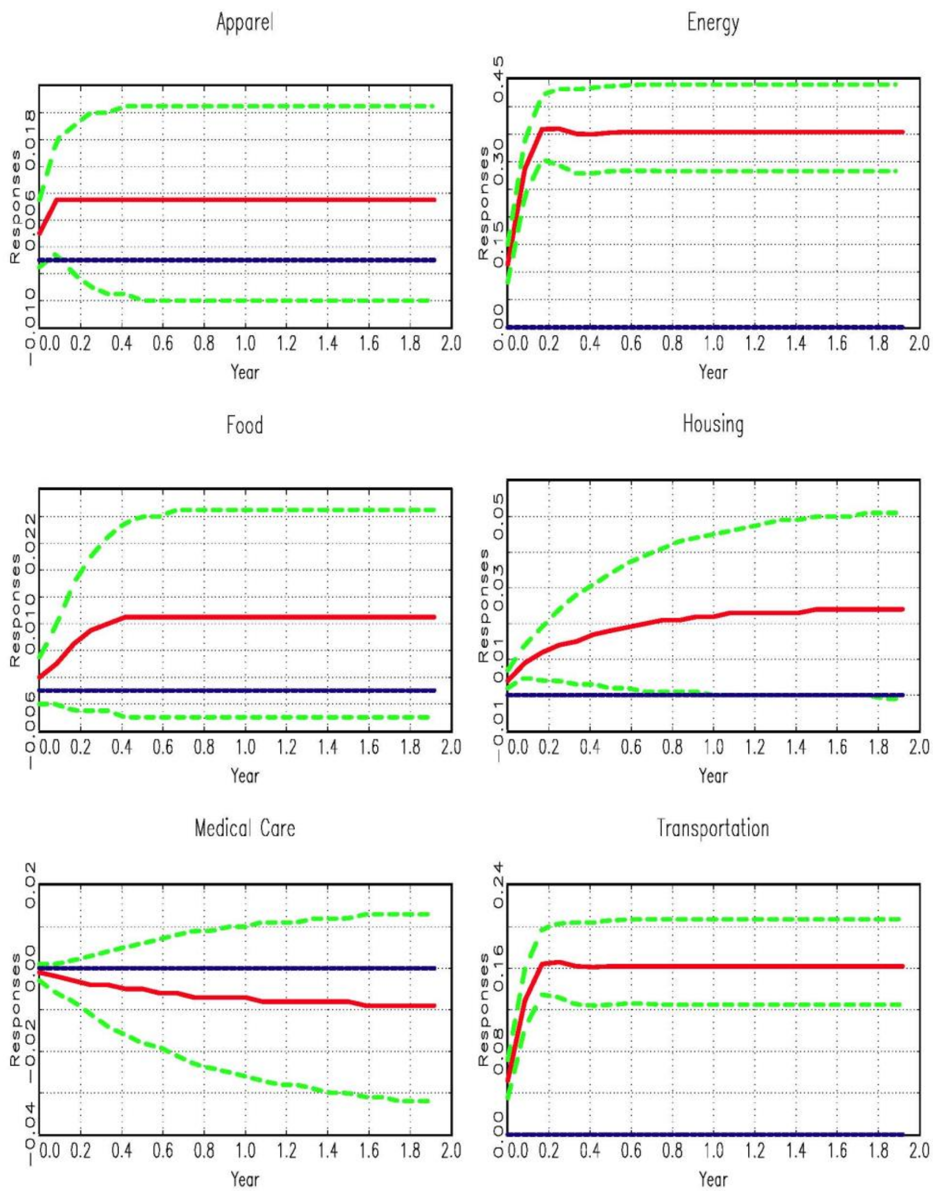
Sims, Christopher A. (1980), "Macroeconomics and reality," *Econometrica* 48, 1-48.

Figure 1. Consumer Price Index Response to an Oil Price Shock



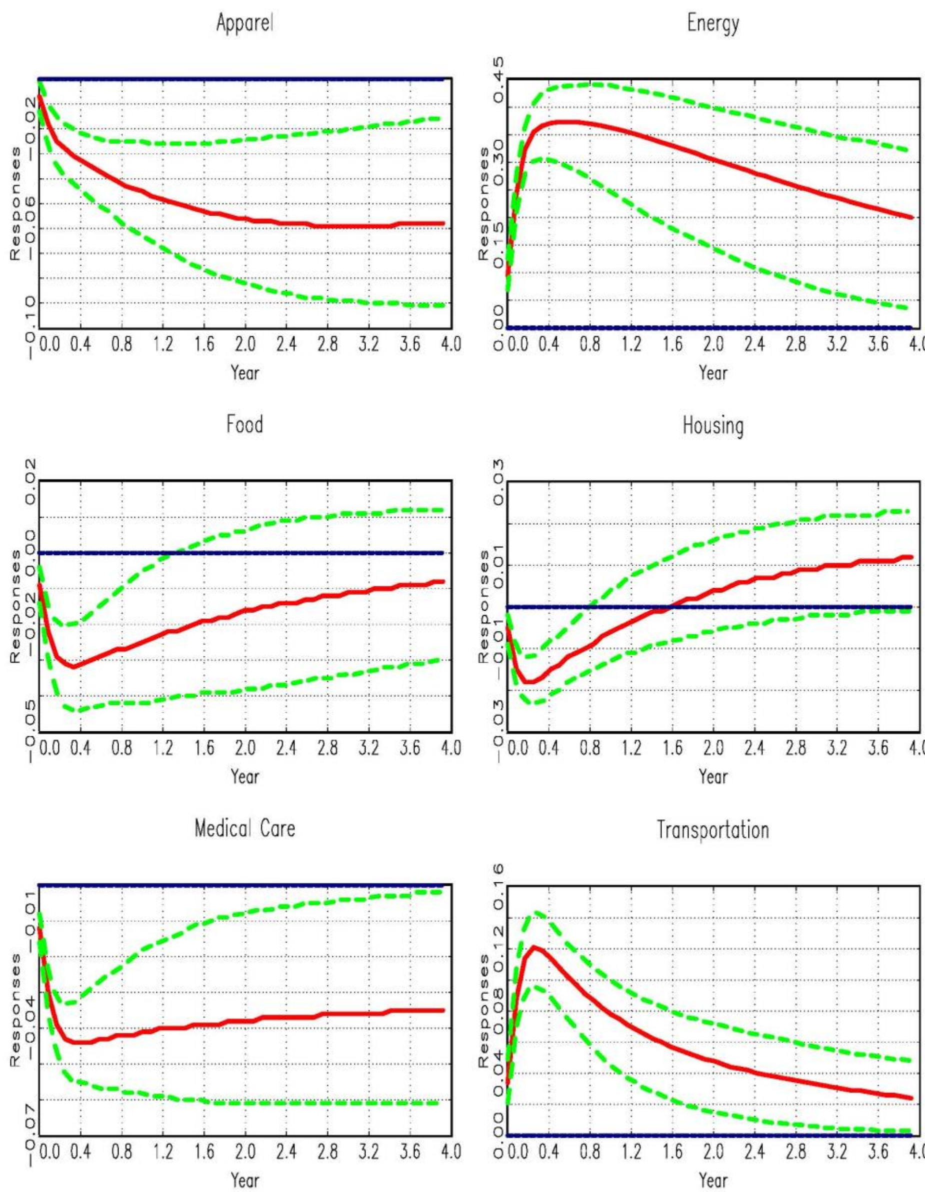
Note: Accumulative response functions are obtained from a bivariate vector autoregressive model with the oil price inflation ordered first. The 95% confidence bands (dashed lines) are obtained from 2,000 nonparametric bootstrap simulations.

Figure 2. Sectoral Responses to an Oil Price Shock



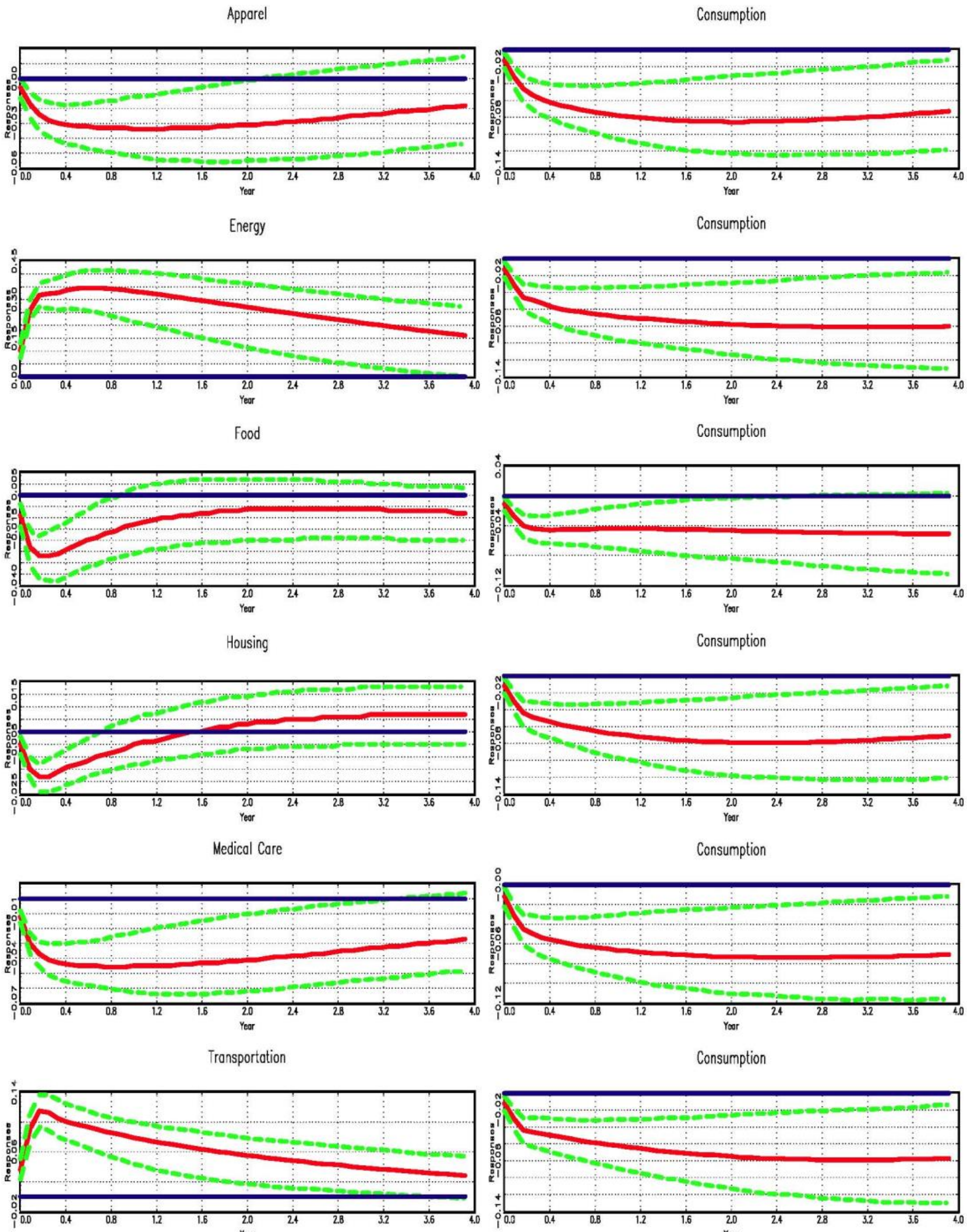
Note: Accumulative response functions are obtained from a bivariate vector autoregressive model with the oil price inflation ordered first. The 95% confidence bands (dashed lines) are obtained from 2,000 nonparametric bootstrap simulations.

Figure 3. Price Share Responses to an Oil Price Shock



Note: Response functions are obtained from a bivariate vector autoregressive model with the real oil price ordered first. The 95% confidence bands (dashed lines) are obtained from 2,000 nonparametric bootstrap simulations.

Figure 4. Price Share Responses to an Oil Price Shock: Trivariate Models



Note: Response functions are obtained from a trivariate vector autoregressive model with the real oil price is ordered first, while the real consumption expenditure is ordered last. The 95% confidence bands (dashed lines) are obtained from 2,000 nonparametric bootstrap simulations.

Table 1. Variance Decomposition Analysis for $E_t x_{t+k}$

k	Oil	Apparel	se	k	Oil	Energy	se
1	0.012	0.988	0.011	1	0.178	0.822	0.037
3	0.076	0.924	0.030	3	0.563	0.437	0.047
6	0.140	0.860	0.046	6	0.729	0.271	0.050
12	0.237	0.763	0.072	12	0.833	0.167	0.056
24	0.383	0.617	0.115	24	0.896	0.104	0.060
36	0.479	0.521	0.141	36	0.916	0.084	0.060
48	0.542	0.458	0.155	48	0.925	0.075	0.061
60	0.584	0.416	0.163	60	0.930	0.070	0.061

k	Oil	Food	se	k	Oil	Housing	se
1	0.039	0.961	0.019	1	0.026	0.974	0.017
3	0.129	0.871	0.039	3	0.146	0.854	0.042
6	0.168	0.832	0.051	6	0.179	0.821	0.052
12	0.177	0.823	0.064	12	0.153	0.847	0.055
24	0.165	0.835	0.084	24	0.106	0.894	0.046
36	0.153	0.847	0.098	36	0.108	0.892	0.055
48	0.144	0.856	0.106	48	0.141	0.859	0.078
60	0.137	0.863	0.111	60	0.182	0.818	0.098

k	Oil	Medical Care	se	k	Oil	Transportation	se
1	0.087	0.913	0.025	1	0.119	0.881	0.034
3	0.279	0.721	0.047	3	0.394	0.606	0.050
6	0.356	0.644	0.061	6	0.530	0.470	0.058
12	0.375	0.625	0.086	12	0.630	0.370	0.066
24	0.365	0.635	0.123	24	0.701	0.299	0.071
36	0.354	0.646	0.145	36	0.718	0.282	0.073
48	0.346	0.654	0.157	48	0.722	0.278	0.074
60	0.341	0.659	0.165	60	0.723	0.277	0.076

Note: Variance decomposition analysis is implemented from a bivariate vector autoregressive model with the real oil price ordered first. $E_t x_{t+k}$ is the k-period (month) ahead forecast of the variable x (each sub-index) at time t and k denotes the forecast horizon in months. Standard errors (se) are obtained from 2,000 nonparametric bootstrap simulations.