Review of Economic Dynamics 14 (2011) 199–223

Contents lists available at ScienceDirect

Review of Economic Dynamics

www.elsevier.com/locate/red

Oil price shocks and the optimality of monetary policy ☆

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ARTICLE INFO

Article history:
Received 28 April 2009
Revised 1 November 2010
Available online 5 November 2010

JEL classification:
C68
E52
Q43

Keywords:
Oil prices
Optimal monetary policy
DSGE model

ABSTRACT

The observed tightening of interest rates in the aftermath of the post-World War II oil price hikes led some to argue that U.S. monetary policy exacerbated the recessions induced by oil price shocks. This paper provides a critical evaluation of this claim. Within an estimated dynamic stochastic general equilibrium model with the demand for oil, I contrast Ramsey optimal with estimated monetary policy. I find that monetary policy amplified the negative effect of the oil price shock. The optimal response to the shock would have been to raise inflation and interest rates above what had been seen in the past.

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Oil prices and interest rates have increased prior to almost every recession in the U.S. after the Second World War. However, energy constitutes a small share of the gross domestic product (GDP), so many observers doubt that oil price shocks themselves could generate sizeable recessions; instead monetary policy is blamed for exacerbating the recessions. A common explanation, such as that offered by Bernanke et al. (1997), states that the Federal Reserve raises interest rates too much in response to high oil prices, which depresses economic activity, beyond the negative effect of oil price shocks. In this paper, I critically reevaluate this statement, and find that monetary policy indeed amplifies the negative effects of oil price shocks. In addition, I find that an optimal monetary policy response to oil price shocks would raise inflation and interest rates above what has been seen in the past. This finding differs from the argument provided by Bernanke et al. (1997), and contradicts Leduc and Sill (2004) who claim that a better monetary policy is one that stabilizes inflation.

I obtain these results using an estimated theoretical model that features the demand for oil. With this model, I can compare the dynamics of the baseline economy with the dynamics of a model, in which monetary policy is socially optimal.[1] The theoretical model combines a medium-scale Dynamic Stochastic General Equilibrium (DSGE) model with a version of the oil demand model by Finn (2000), where oil is necessary for capital use. Unlike Finn, I assume that the price of oil follows a non-stationary process. The DSGE model features habit formation through consumption, investment costs, endogenous depreciation rates, and sticky prices and wages.

I also estimate key structural parameters of the model by applying the Markov Chain Monte Carlo (MCMC) estimation approach of Chernozhukov and Hong (2003) to the Impulse Response Function Matching estimator. To obtain empirical impulse responses, I identify the oil price shock in a structural vector autoregressive (SVAR) model of the U.S. business

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☆ I am highly indebted to my advisor, Stephanie Schmitt-Grohé. I am thankful to Craig Burnside, Riccardo DiCecio, Barbara Rossi, Juan Rubío-Ramirez, and Martín Uribe for their guidance and valuable advice and to Denis Nekipelov for helpful discussions. I thank the participants of the Duke Macro Reading Group for their comments and suggestions and the Federal Reserve Bank of St. Louis for dissertation support. All errors are my responsibility.

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[1] I focus on the optimal monetary policy from a timeless perspective, *à la* Woodford (2003).

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doi:10.1016/j.red.2010.11.001

cycle. The SVAR model predicts that in response to an oil price shock, GDP, investments, hours, capital utilization, and real wages fall, while the interest rate and inflation rise. These findings are economically intuitive and in line with existing research (Blanchard and Gali, 2007; Herrera and Pesavento, 2009; Peersman, 2005; Leduc and Sill, 2004; Rotemberg and Woodford, 1996; and Hamilton, 1983).

This research engages most closely with the arguments of Bernanke et al. (1997, 2004) who claim that the large negative effect of historical oil shocks on the U.S. economy is not due to the oil shocks but rather is the result of the systematic tightening of monetary policy in response to oil price increases. To evaluate the effects of oil price shocks that are due to the systematic monetary policy response, Bernanke et al. (1997) run counterfactual experiments in the VAR model that identifies the oil price shock. The experiments eliminate monetary policy by setting the coefficients of a monetary policy equation in the VAR to zero; thus the authors can study how the response of output to oil shocks changes in this restricted model. Bernanke et al. (1997) further show that systematic monetary policy is responsible for a substantial fraction of the output drop.[2]

However, empirical VAR models are not suitable for policy experiments, according to the Lucas critique. That is, the estimated coefficients of the VAR model would differ under alternative policies, especially if those policies are very different from the observed ones. Trying to minimize the distortion associated with the Lucas critique, Bernanke et al. (2004) consider another counterfactual: a *temporary* shutdown of the response of the Federal funds rate to an oil price shock. However, Carlstrom and Fuerst (2006) argue that the Lucas critique must be quantitatively important there as well. In this paper, I overcome the Lucas critique by running counterfactual experiments within a theoretical model of the oil price shock that replicates the predictions of the empirical SVAR model.

Leduc and Sill (2004) and Carlstrom and Fuerst (2006) study a related question in the context of a theoretical model. To evaluate the contribution of systematic monetary policy, these authors compare the effects generated in the economy with a Taylor-type monetary policy rule to an alternative unresponsive, or "constant," monetary policy.[3] Leduc and Sill (2004) find that monetary policy is responsible for 40 percent of the cumulative output drop over five years. Carlstrom and Fuerst (2006) estimate that monetary policy is responsible for 30 percent or less of output drop over a two-year period, depending on the "neutral" monetary policy in place. They emphasize the importance of defining a "neutral" policy correctly. In the context of a theoretical model, it seems more appropriate to compare monetary policy with an alternative that might do the least harm to the society trying to accommodate oil price shocks. Unlike Leduc and Sill (2004) and Carlstrom and Fuerst (2006), I therefore consider the effect of the systematic monetary policy compared with a policy that is optimal from a welfare point of view. I show that, indeed, optimal policy is associated with a smaller output drop than the model predicts. Leduc and Sill (2004) claim they could not find a monetary policy rule that would help to fully eliminate the negative effect of the oil price shock on output. I demonstrate that such a policy is not desirable from the welfare point of view.

Another drawback of the models presented by Leduc and Sill (2004) and Carlstrom and Fuerst (2006) is that their conclusions derive from calibrated, rather than estimated models. For this paper, unlike extant literature, I estimate the parameters of the model to match empirical evidence about the effect of an oil price shock. Moreover, unlike most theoretical papers that model oil prices, I introduce price as a growing, rather than a stationary process. This assumption is in line with most empirical studies in this area.[4] Overall, the estimated model describes the empirical evidence more precisely than have prior theoretical models of the oil price shock.

The remainder of this paper is organized as follows: in Section 1, I describe the empirical strategy to identify the oil price shock. Section 2 presents the theoretical model. In Section 3, I describe the estimation strategy and the results of the estimation of the model parameters. In Section 4, I explain the propagation mechanism for the oil price shock. Section 5 focuses on the monetary policy contribution to the effects of the oil price shock, and Section 6 concludes.

1. An empirical model of the effects of oil price shocks

To estimate the effects of the oil price shock, I rely on an SVAR model. In this model, I use quarterly data about the price of oil P_t^{oil}, output GDP_t, labor H_t, GDP deflator P_t, capital utilization CU_t, real wage rate W_t, personal consumption expenditures C_t, investment I_t and the nominal interest rate R_t over the period 1954:III–2006:IV.[5] Table 1 provides more details about the data.

I assume that the vector of $n = 9$ random variables Y_t evolves according to the following dynamic process

$$A^0 Y_t = \alpha + A(L)Y_t + \epsilon_t,$$

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[2] Bernanke et al. (1997, 2004) attribute at least 50 percent of output drop to systematic monetary policy response to the oil price shock.

[3] According to Leduc and Sill (2004), "constant" policy is a k-percent money growth rule. Carlstrom and Fuerst (2006) find that the estimated output effect of a given monetary policy rule depends crucially on the choice of "constant" monetary policy. In addition to the money growth peg considered by Leduc and Sill (2004), Carlstrom and Fuerst (2006) suggest two other alternatives for constant policy: an interest rate peg and Wickselian monetary policy, which adjusts the interest rate so that the real economy behaves as if there were no nominal rigidities. This policy, however, is not optimal from a welfare point of view because it does not consider that nominal rigidities generate output losses.

[4] See Blanchard and Gali (2007) and Bernanke et al. (1997), among many others.

[5] The choice of the initial date is determined by data availability.

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