Effects of Oil Shocks on Oil-importing Emerging Economies

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Annotation

The aim of the project is to study the impact of oil price fluctuations on oil-importing emerging economies focusing on a relevant subset of CIS plus Georgia. We use structural vector autoregressive models to gauge the responses of key macroeconomic variables to the oil-price shocks. Furthermore, we match the estimated responses with those from the dynamic stochastic general equilibrium (DGSE) model that we use for more detailed investigation. In particular, we study the monetary channel and assess its role in the transmission of the oil price shocks in emerging economies; the trade-off faced the monetary authority between inflation and output stabilization in the presence of oil in consumption and production; and the optimality of the monetary actions based on simple monetary policy rules (Natal, 2012).

Keywords: New Keynesian models, Business Cycles, Energy, Oil Shocks

JEL classification: E32, E52, Q43
Objectives

The focus of the current project is the analysis of the importance of oil price volatility for the economic performance of the emerging countries.

Developments in oil prices are closely followed by the economists and policymakers around the world. Such special attention is motivated by several observations: large fluctuations of the energy prices and oil prices in particular; low demand elasticity stemming from the key role of the energy for the economy; and the historical experience of the 70’s when the dual oil shock episodes were accompanied by the recession and soaring inflation in the U.S.A. and many other developed economies (Kilian, 2008).

The effects of the oil price swings may propagate through various channels. The direct channel runs thought the effect of the oil price shocks on aggregate demand. One the one hand, the consumption is affected due to reduced disposable income, increased precautionary savings, and delayed purchases of consumer durables. On the other hand, investment responds as a result of the reduced demand faced by the firms (Kilian, 2008; Bernanke, 2006).

Another important factor in the transmission mechanism of the oil shocks is the endogenous reaction of the monetary policy (Bernanke et al., 1997; Blanchard and Galí, 2010; Segal, 2011). Monetary authority may loosen or tighten its stance depending on anticipated effect on aggregate demand and pass-through of the price increase to the domestic inflation.

More traditional mechanism is the cost channel faced by the firms that may be amplified by the effects on markups and capital utilization (Rotemberg and Woodford, 1996; Finn, 2000; Segal, 2011). Finally, the reallocation effects stressed by Hamilton (2005) and Davis and Haltiwanger (2001) may also be important.

The early studies based on the data from the 70’s argued in favor of the cost and reallocation channels and systematic monetary policy as an important transmission mechanism of oil price shifts. More recent research based on updated data revealed reduced quantitative effect of oil shocks on key macroeconomic variables. These studies explain the difference from the 70’s experience by improved monetary policy, diminishing frictions in labor market, and more flexible and less energy-intensive economy (Blanchard and Galí, 2010). An alternative explanation focuses on the endogeneity of the oil price with respect to global economic activity implying that the original cause of particular oil shock is the key for the reaction of the economy (Kilian, 2008, 2009).

Existing literature mainly covers developed countries with the U.S. being the most popular. The studies do not reach consensus regarding the comparative importance of alternative channels, especially the role of the monetary policy (Blanchard and Galí (2010) compared to series of papers by Kilian mentioned above). More limited number of studies analyzes the issue for the emerging economies. In particular, only a handful of studies (e.g. Rasmussen and Roitman (2011)) offer a systematic treatment of this question and provide only limited analysis of the transmission mechanism what makes this area open for further investigation.

The monetary authorities of the emerging economies often refer to the changes in world oil prices as an important factor for the decision-making process in their policy reports. Usually the emphasis is on the pass-through to the inflation rather than the effect on aggregate demand. However, oftentimes it is not clear whether the conclusions are reached based formal analysis or prior experience.

One would expect the channel through which the oil shocks propagate may be different than that of developing countries due to less effective monetary policy (weaker interest rate channel), different structure of the economy and different energy intensity. In this first case the impact of oil price swings may be more detrimental for the economy as the monetary authority is limited in...
counteracting to the shock. However, different economy structure or energy intensity may make the emerging countries less susceptible to the adverse consequences.

The focus of the present study is to look at the transmission mechanism in a subset of emerging oil importing economies in CIS plus Georgia. In particular we concentrate on Armenia, Georgia and Moldova as examples of small and open economies in the region. Our objective is to identify the effect of oil price fluctuations on key aggregate variables and look at the role of the monetary policy.

We utilize the structural vector autoregressive (SVAR) models and the dynamic stochastic general equilibrium (DSGE) models as the primary tools of the analysis. First, we identify the responses of the key variables to the oil price shifts based on the SVARs and match such responses using the DGSE models.\(^1\) The SVAR models allow to identify the impact of the shocks based on minimal assumptions, while the DGSE model in New Keynesian spirit makes it possible to analyze more closely different channels of the transmission mechanism. In particular we are interested in the following points:

- The impact direction and magnitude of the effect of oil price swings on aggregate variables such as GDP, inflation, policy rate, and exchange rate;
- The importance of oil shocks in driving aggregate fluctuations;
- The role of the monetary policy, its response to the energy shocks, and the trade-off faced by the monetary policy between inflation and output stabilization in the presence of oil in consumption and production;
- Comparison of the effect across the countries under study and to the results from the studies on the developed economies;
- Assessment of the effectiveness of the monetary policy.

\section{Practical Contribution of the Research}

The results of the project are intended to be of interest for the policymakers in the region. It is well known that central banks closely follow the developments in external markets including the changes in the world price of oil. The implications and impact of such changes are assessed drawing on previous historical experience in an informal way as well as through the lens of the macroeconomic models used for projections and counterfactual policy simulations. Oil and other important commodity prices enter such models as external variables that affect the dynamics of the domestic economy. A unified treatment of the topic may provide a convenient comparison through the region and an opportunity to assess the consistency of existing models.

More specifically we provide the empirical estimates of the effects and transmission channels of the oil price shifts. Since we utilize a structural model, we can in general assess the monetary policy in the emerging economies based on the model. Furthermore, we can investigate more specific aspects of this channel such as the role of the weak interest rate channel and its implication for the transmission of the oil shocks. Since the DSGE model that we intend to use contains the energy component in both consumption and production, we are able to assess the trade-off between inflation and output stabilization; as emphasized by Natal (2012) in a distorted economy with the

\(^{1}\)Please see the section on methodology for further details

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presence of oil in consumption amplifies the policy trade-off. Finally, we intend to investigate the optimal monetary policy in this setting and assess the policy recommendations based on simple set of monetary policy rules.

### 3 Literature Review

The role of oil price fluctuation in the world market attracted considerable attention of researchers after two waves of oil shocks in the 70’s that was followed by the widespread recession and high inflation in the advanced economies. Hamilton (1983) found that all U.S. recessions were preceded by significant jumps in oil prices up to 1980. A number of studies that followed found similar results for many other developed economies (see Segal (2011) and references therein). Some textbook examples from the 80’s would ‘blame’ oil shocks for the breakdown of the Phillips curve relationship and for observed stagflation. However, as new data points became available through the 90’s and the 2000’s the impact of oil price shocks has diminished (Blanchard and Galí, 2010). Despite the fact that several incidents of sizable oil price jumps were recorded through that period, no recession and high inflation rates of the magnitude observed in the 70’s have followed in the developed economies.

Different strands of literature have analyzed the various mechanisms that would account for the impact of the oil price changes on the economy and the diminishing pattern of the impact.

As the standard neoclassical model was not able to quantitatively account for the observed decline in output in the 70’s, a number of studies tried to extend the model to add the mechanism that would amplify the impact of the oil price changes. Rotemberg and Woodford (1996) added imperfect competition and time-varying mark-ups, while Finn (2000) augmented the standard model with variable capital utilization. These studies found that their models were able to account for some shortfall compared to the benchmark case. Models with capital-energy complementarities and capital adjustment cost were also tested and shown to imply larger effects of energy price fluctuations on the output (Atkeson and Kehoe, 1999).

Another related strand of research focuses on the reallocation effects induced by the energy price shifts to account for the asymmetric response of the output (Hamilton, 1988; Davis and Haltiwanger, 2001; Lee and Ni, 2002).

Since the actions of the monetary authority influence the dynamics of the economy (at least in the short and medium run) and react to various external developments that may affect the economy, it is interesting to investigate their role in the transmission of oil price shocks. The seminal paper by Bernanke et al. (1997) studies the importance of systematic monetary policy in accounting for the response of output and inflation to the oil shocks of the 70’s using semistructural vector autoregressions as a primary tool. They argue that a significant part of the fall in output may be attributed to the reaction of the monetary policy during the second oil shock episode in 1979-81 but find little evidence for the causal effect of 1974-75 recession. The counterfactual simulations show that the endogenous response of the monetary policy is responsible for a significant decline in output but also for a substantial reduction in inflation. However, Hamilton and Herrera (2004) criticized the study due to the sensitivity of the results on the selection of lag length as well as susceptibility to Lucas critique of the counterfactual policy experiments considered.

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2Our model is an extension of the model used by Natal (2012) to an open economy setting.

3Hamilton (2005); Kilian (2008); Segal (2011) provide a comprehensive summary on the effects of the oil shocks for the developed countries although from different perspectives.
More recently Kilian and Lewis (2011) replicated the analysis using more recent data and updated model. They find that the effect of the fluctuations in real price of oil on economic activity, inflation, and short-term interest rate is different for earlier and more recent–post Volker sample periods. The latter specification does not find strong effects of swings in real oil prices on either the federal funds rate or the economic activity. The effect on inflation is also muted in this subsample.

The results regarding the role of monetary policy in amplifying the oil shocks based on DSGE models is mixed. Some studies find that a large part of the response of GDP to oil shocks is due to the endogenous monetary policy (Leduc and Sill, 2004) while others find no quantitatively important role (Carlstrom and Fuerst, 2006).

Blanchard and Gali (2010) use structural vector autoregressive models to confirm the oil shocks have had lower impact on inflation, output, and wages in more recent sample for a number of developed countries. Utilizing a simple New Keynesian models with oil sector they argue that the reduced effect is due to reduced real wage frictions, more credible monetary policy, and lower share of energy.

Recently in a series of papers Kilian has argued that the changes in the world oil prices may have different impact on the economy depending on the original source of the change of the price (Kilian, 2008, 2009; Kilian and Lewis, 2011). According to the author the analysis of the response of the economy to the oil price shocks is complicated by the fact that the dynamics of the oil prices is in fact endogenous to developments in the U.S. (and other large economies). Increased global economic activity exerts upward pressure on energy prices. In turn higher energy prices depress individual country economic activity which translates in depressed global economic activity.

Kilian (2009) identifies three specific shocks behind the changes in oil prices: oil supply, global economic activity, and oil market specific demand shocks. Moreover, he finds that supply shocks play relatively minor role in oil price fluctuations, while world demand and oil market demand specific shocks have large contributions. The letter shock is a catch-all shock that captures market expectations and precautionary motives of buyers. Though these findings may be important for large countries, from a small open economy perspective we are interested of the marginal effect of the change of the oil price, while the source behind the change may be accounted by controlling the external environment such as global demand conditions (Segal, 2011).

The comprehensive analysis of the energy price swings on emerging economies and the associated transmission channels is rather limited. Rasmussen and Roitman (2011) study a large set of developed and developing countries (including oil-importers and oil-exporters) using dynamic panel data methods to control for the endogeneity of the oil prices. They look at the response of the cyclical component of GDP, imports, and exports and find relatively small effect of oil price jumps on oil-importing economies, though the effects increases as the energy intensity of imports increases. Interestingly, the raw correlations with GDP and trade variables is positive and sizable for most of the economies considered highlighting the importance of controlling for global economic activity.

4 Methodology

We identify the effects of oil shocks on key macroeconomic variables and analyze the significance of different channels using two tools often found in the literature. On the first stage we employ recursively identified semistructural vector autoregressive model to gauge the reaction of inflation, output, policy rates or monetary aggregates, and exchange rates to the oil price shocks as well as
the importance of the shock in overall volatility of the series. Although the SVARs may be used to conduct counterfactual policy experiments (Bernanke et al., 1997), we impose more structure by estimating a DSGE model in the New Keynesian spirit with Bayesian methods on the second stage. The results from the first stage are used as benchmark to match and as an evaluation criteria for selecting the priors for the parameters for the model.

SVAR models are often employed in the field under different identifying assumptions. The recursiveness assumption is a relatively mild restriction often used in the literature (Bernanke et al., 1997; Kilian, 2011) and requires that the variables ordered in the SVAR do not respond to certain innovations instantaneously. As a standard example consider a SVAR with four variables ordered in the following manner (and appropriately rendered stationary): world oil price, CPI, index of economic activity, and the policy rate. Under the recursiveness assumption, we would required that the world oil prices do not respond to the innovations to the other three variables in the same period. Given that the frequency of the series is high enough, this is a reasonable assumption even for the large developed economies where the dynamics of the local economy may in general influence the global prices (Kilian and Vega, 2011). We also use identification by long-term and sign restriction as an alternative identification schemes and robustness check.

The DSGE model used in the second step of the analysis is a small open economy version of the canonical New Keynesian model (Goodfriend and King, 2001; Woodford, 2003) augmented with the oil sector. The model is similar to the model used by Medina and Soto (2005) with some additional features such as incomplete pass-through to import prices and alternative assumptions regarding empirical implementation. The choice of the model is motivated by the fact that it is widely accepted and used in the field as well as due to its simplicity that would make the intuitive comparisons across the countries feasible.

What follows is a brief summary of key elements of the model; a prototype version of the Dynare model file may be found as a separate attachment.

The economy is populated by a large number of representative households that consume composite consumption good \( (C) \) consisting of domestically produced \( (C_H) \) and imported goods \( (C_F) \). Oil that is imported from abroad enters consumption and is used in domestic production.\(^4\) The aggregate consumption variable is characterized by external habit formation that is often used to account for the empirical high persistence of consumption and output. Different components of consumption are nested through CES aggregator:

\[
C_t = \left( (1 - \delta)^{\frac{1}{\eta}} Z_t^{\frac{\eta-1}{\eta}} + \delta^{\frac{1}{\eta}} O_{Ct}^{\frac{\eta-1}{\eta}} \right)^{\eta-1}
\]

\[
Z_t = \left( (1 - \gamma)^{\frac{1}{\theta}} C_{H,t}^{\frac{\theta-1}{\theta}} + \gamma^{\frac{1}{\theta}} C_{F,t}^{\frac{\theta-1}{\theta}} \right)^{\theta-1}
\]

Here \( Z \) is a combined domestically produced and imported non-energy consumption. \( \delta \) is the share of oil and its derivative products in consumption, and \( \eta \) is the relevant elasticity of substitution between energy and non-energy consumption. Similarly \( \gamma \) is the share of imported non-energy products purchased from domestic importers, and \( \theta \) is the elasticity of substitution between the home-produced and imported non-energy products.

On the income side the households receive wage for the labor services that they provide to the firms and dividends from the profits of domestic producers and importers. The consumers are able to trade state-contingent nominal claims domestically that makes them homogeneous inside the

\(^4\) As argued by Natal (2012) presence of shocks both in production and consumption in a distorted economy generates additional trade-off between inflation and output stabilization.
economy. They also have access to non-contingent foreign debt markets with the country premium depending on the level of domestic debt.

Domestic goods are produced by a large number of domestic oligopolistic producers that use labor \( (L_t) \) and imported oil \( (O_{H,t}) \) to manufacture intermediate goods that are supplied to domestic consumers or exported to the world markets. The following equation is a production function of a typical intermediate producer. \( Y_t \) is the output of the intermediate good, \( \alpha \) is the share of oil in production and \( \omega \) is the elasticity of substitution between the two production factors. \( A_t \) is a stationary technology shock common to all intermediate firms.

\[
Y_t(i) = A_t \left( (1 - \alpha)^{\frac{1}{\omega - 1}} L_t(i)^{\frac{\omega - 1}{\omega}} + \alpha^{\frac{1}{\omega}} O_{H,t}(i)^{\frac{\omega - 1}{\omega}} \right)^{\frac{\omega}{\omega - 1}}
\]

The producers set the prices in the Calvo-Yun manner, implying that every period a typical producer faces a fixed probability \( (\phi_h) \) that it will not be able to set the price on their product optimally but rather just adjust it for past and long-term inflation. However, when the price is set optimally, such a possibility is explicitly taken into account. This leads to the inflation dynamics described by the New Keynesian Phillips curve.

The imported intermediate goods are not immediately available to the consumers but only through the domestic importers that purchase the foreign produced goods at world prices, repackage them and offer the final product at a markup. This element is used to achieve imperfect pass-through of world commodity price changes to domestic economy. Similar to the domestic producers, the importers are also subject to frictions in setting the prices on imported merchandise.

5 Participants

I hold an MA in Economics from Central European University (CEU). Now, I am Ph.D candidate in Economics at CERGE-EI. I successfully passed the comprehensive exams at CERGE-EI that were held in August, 2008. The tentative date of graduation is expected end of 2013. I intend to stay in Georgia during the project period.

6 Project Timetable

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<tr>
<th>Planned activity and progress chronology</th>
<th>Completion month</th>
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<tbody>
<tr>
<td>Collect data, and estimate the SVARs using different approaches</td>
<td>2</td>
</tr>
<tr>
<td>Formulate, solve, and calibrate the DSGE model</td>
<td>3</td>
</tr>
<tr>
<td>Estimate the model</td>
<td>4</td>
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<tr>
<td>Analyze the results, provide economic intuition and policy advice</td>
<td>6</td>
</tr>
<tr>
<td>Submit the paper as CERGE-EI working paper series, internalize the feedback</td>
<td>7</td>
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<td>Submit the final CERGE-EI working paper version to EERC</td>
<td>8</td>
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References


