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OPEC's oil exporting strategy and macroeconomic (in)stability ☆

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ABSTRACT

Aguiar-Conraria and Wen (2008) argued that dependence on foreign oil raises the likelihood of equilibrium indeterminacy (economic instability) for oil importing countries. We argue that this relation is more subtle. The endogenous choices of prices and quantities by a cartel of oil exporters, such as the OPEC, can affect the directions of the changes in the likelihood of equilibrium indeterminacy. We show that fluctuations driven by self-fulfilling expectations under oil shocks are easier to occur if the cartel sets the price of oil, but the result is reversed if the cartel sets the quantity of production. These results offer a potentially interesting explanation for the decline in economic volatility (i.e., the Great Moderation) in oil importing countries since the mid-1980s when the OPEC cartel changed its market strategies from setting prices to setting quantities, despite the fact that oil prices are far more volatile today than they were 30 years ago.

1. Introduction

The empirical literature has suggested that oil price shocks have an important effect on economic activity (see, e.g., Aguiar-Conraria and Wen, 2007; Burbidge and Harrison, 1984; Gisser and Goodwin, 1986; Hamilton, 1983, 1996, 2003; and Kilian, 2008). It is also known that there was a structural change for the macroeconomic impact of oil, which occurred at some point in the mid-1980s (see, e.g., Aguiar-Conraria and Soares, 2011; Hamilton, 1996, 2003; Hooker, 1996; and Mork, 1989). This has been interpreted as evidence of a nonlinear or time-varying relationship between oil prices and economic activity.

We do not dispute these interpretations. However, we do call attention to a change in the behavior of the Oil Price Exporting Countries (OPEC) that occurred in the mid-1980s. On their official website, it is written that "OPEC did in fact set crude oil prices from the early 1970s to the mid-1980s", but that they stopped doing so thereafter. We also read that OPEC imposes production quotas to its members and meets twice a year to define their oil production policies. This change in OPEC's behavior is not unexpected. Deneckere (1983), Lambertini and Schultz (2003), Majerus (1988), and Rothschild (1992)argue that, as long as the produced goods are substitutes for each other, a quantity-setter cartel is more stable than a price-setter. Given that crude oil extracted in any particular country is a perfect substitute for crude oil extracted in other countries, it is optimal for the cartel to rely on quantities as the control variable.

It is known that tariffs and quotas are not equivalent instruments; unless perfect competition is assumed everywhere in both domestic and foreign markets (see Bhagwati, 1965). From the perspective of the exporters, it is also known that setting prices and setting production quotas are not equivalent (e.g. see Cooper and Riezman, 1989; and Weitzman, 1974). Given that 60% of the crude oil traded internationally comes from OPEC members, their strategic decisions are bound to have important implications. In this paper we study the implications of such behavior on equilibrium indeterminacy.

Aguiar-Conraria and Wen (2008) argued that dependence on foreign oil raises the likelihood of equilibrium indeterminacy. In this paper, we show that this result depends crucially on the cartel's choice of the control variable: price or quantity. To be more precise, we show that different cartel strategies create different macroeconomic propagation mechanisms for oil shocks. If the exporting cartel fixes the price of oil, then the likelihood of macroeconomic indeterminacy in the importing country is dramatically increased, while exactly the reverse happens if the cartel chooses to fix the quantity of oil production.

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2. The importance of equilibrium indeterminacy

Dynamic Stochastic General Equilibrium (DSGE) models are one of the modern workhorses in macroeconomics. In standard DSGE models with perfect competition and constant returns, there exists a unique rational expectations equilibrium. Therefore, there is no independent role for beliefs to influence the economic fundamentals. However, the pioneering work of Benhabib and Farmer (1994) has shown that a standard neoclassical growth model with externalities or increasing returns to scale may exhibit a continuum of rational expectations equilibria — equilibrium indeterminacy. In such models, beliefs can be self-fulfilling and affect resource allocations in equilibrium, thus can serve as an independent source of the business cycle. However, this first generation of belief-driven business cycle models was considered empirically implausible because they required externalities larger than empirical estimates. Subsequent works have shown that features such as additional sectors of production, durable consumption goods, small open economy, variable capacity utilization, high elasticity of substitutions between capital and labor can reduce the degree of externalities required for indeterminacy to an empirically plausible range (see, e.g., Benhabib et al., 2000; Bian and Meng, 2004; Meng, 2003; Meng and Velasco, 2003; Pintus, 2006; Wang and Wen, 2008; Weder, 2001; and Wen, 1998; among many others).[1]

Equilibrium indeterminacy implies that optimism and pessimism about the future can be self-fulfilling. In such a model, a fear or speculation of an increase in the imported oil price, say due to political instability in the foreign country, can trigger pessimism, generating a recession (Aguiar-Conraria and Wen, 2008). Economies with equilibrium indeterminacy will, ceteris paribus, exhibit higher volatility than an economy with equilibrium determinacy.

It is now a well-received stylized fact that the volatility of GDP has significantly decreased since the mid-1980s in the United States and other industrialized countries (e.g. see Blanchard and Simon, 2001; Gallegati and Gallegati 2007and McConnell and Pérez-Quirós, 2000; among others). If one could make a case arguing that developed economies had equilibrium indeterminacy before the mid-1980s, then this would be an intriguing explanation for the Great Moderation after the mid-1980s.[2]

There is a second important implication of equilibrium indeterminacy. Aguiar-Conraria and Wen (2007) showed that the macroeconomic propagation mechanism for oil shocks was quite different in a model with indeterminacy from a standard model. In fact, an endogenous multiplier-accelerator mechanism can emerge, giving rise to persistent and hump-shaped fluctuations in aggregate output. For example, after a negative oil-price shock, output not only decreases in the impact period but also continues to decrease over time until a turning point, leading to a deeper and U-shaped slump. However, after the turning point the propagation mechanism reverses itself, leading to a cumulative process of recovery and expansion. This type of fluctuations is not to be expected in a model with equilibrium determinacy. Given that the propagation mechanism is so different from that of standard DSGE models, optimal monetary policy is also expected to be different. Nakov and Pescatori (2010) provide some evidence that oil shocks may have had a prominent role in explaining the 'Great Moderation'. Our argument in this paper provides yet another explanation for why this might be the case.

[1] For a general analysis of this class of models regarding mechanisms giving rise to local indeterminacy, see Wen (2001). For the broader literature on sunspots and self-fulfilling prophecies, please see Azariadis (1981), Azariadis and Guesnerie (1986), Cass and Shell (1983), Shell (1977, 1987), Shell and Smith (1992), and Woodford (1986a, 1986b, 1991).

[2] A related point was made by Lubik and Schorfheide (2004), who concluded that the U.S. monetary policy before 1982 was consistent with indeterminacy, while after 1982 it was consistent with a unique rational expectations equilibrium.

3. The model

Our baseline model is a continuous time version of Aguiar-Conraria and Wen (2007 and 2008). In the model a representative agent[3]chooses a trajectory of consumption (c_t), working hours (n_t), capacity utilization (u_t), quantity of oil demand (e_t), and capital accumulation (k_t) to solve:

$$\max_{c,n,u,e,k} \int_0^\infty \exp(-\rho t)\left(\log(c_t) - \frac{n_t^{1+\gamma}}{1+\gamma}\right)dt \tag{1}$$

subject to

$$\dot{k}_t = -\delta_t k_t + y_t - c_t - p_t e_t \tag{2}$$

$$y_t = \Phi_t (u_t k_t)^{\alpha_k} n_t^{\alpha_n} e_t^{\alpha_e}, \qquad \alpha_k, \alpha_n, \alpha_e \geq 0, \text{ and } \alpha_k + \alpha_n + \alpha_e = 1 \tag{3}$$

$$\delta_t = \frac{1}{\theta} u_t^{\theta}, \quad \theta > 1; \tag{4}$$

where p_t denotes oil price and e_t the quantity of imported oil. The agent pays $p_t e_t$ in terms of output to foreigners to receive oil imports. Note that this is not a model of international trade. The international trade balance is always zero. Foreigners are paid in goods. This is clear in the budget constraint, according to which domestic production is divided between consumption, investment and oil imports. So part of what is produced domestically is used to pay for the imports ($p_t e_t$). This is the interpretation of Aguiar-Conraria and Wen (2007 and 2008), Finn (2000), and Wei (2003) in similar models. The rate of capital depreciation, δ_t, is time varying and is endogenously determined in the model by Eq. (4), which states that capital depreciates faster if used more intensively. Agents take as given the aggregate productivity Φ_t:

$$\Phi_t = (u_t k_t)^{\alpha_k \eta} n_t^{\alpha_n \eta} e_t^{\alpha_e \eta}. \tag{5}$$

With this assumption, note that the economy exhibits increasing returns to scale of degree $1+\eta$. From the standard first order conditions, we can obtain the optimal demand equation for oil:

$$p_t e_t = \alpha_e y_t. \tag{6}$$

To close the model, we consider two extreme assumptions (we will relax them later) about the oil producer's decision. Our first hypothesis states that the oil cartel is a quantity-setting cartel and, therefore, prices will adjust. In this scenario, the oil importing country will take the quantity of oil as given: $e_t = \bar{e}$. Our second hypothesis assumes that the cartel fixes prices: $p_t = \bar{p}$.

The first order conditions with respect to $\{c_t, n_t, e_t, u_t, k_t\}$ and the budget constraint can be simplified to the following system:

$$\frac{\dot{c}_t}{c_t} = \left(\frac{\theta-1}{\theta}\alpha_k \frac{y_t}{k_t} - \rho\right) \tag{7}$$

$$\dot{k}_t = \left(\alpha_k \frac{\theta-1}{\theta} + \alpha_n\right) y_t - c_t \tag{8}$$

$$c_t = \alpha_n \frac{y_t}{n_t^{1+\gamma}} \tag{9}$$

[3] Our representative-agent model can be mapped into a decentralized Dixit–Stiglitz style model where heterogeneous firms are monopolists with increasing returns technology. For details of such a mapping, see Benhabib and Wen (2004).