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Energy price shocks and medium-term business cycles

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ABSTRACT

Energy price shocks pose sudden challenges to economies. This paper examines how oil price shocks have influenced the U.S. economy over the last decades and especially focuses on the productivity slowdown in the years following an oil price shock. We extend the existing literature by considering medium-term business cycles, which consist of high-frequency components ("conventional" business cycles, up to 8 years) and medium-frequency components (8–50 years). We find that the medium-frequency consequences of energy price shocks are considerable and explain a significant part of the productivity slowdown.

1. Introduction

Sudden large increases in the price of oil pose severe challenges to economies. Although there is general consensus about the short-term effects, the medium-term consequences have so far been less analyzed. In particular with regard to the productivity slowdown which occurred in the decades following the shocks, uncertainty still exists. Current research has mainly analyzed a short time period after the shocks, while applying exogenous growth assumptions. However, U.S. economic data reveal that the slowdown lasted for two decades.

A thorough analysis of the medium-term consequences of shocks to the price of oil offers valuable insight both for a better understanding of past economic dynamics and for an assessment of future effects. The paper shows that the consequences of the oil price shocks did not abate after a few years. On the contrary, total factor productivity and labor productivity suffered a slowdown of two decades and might have stayed low if the New Economy and the Dot-Com-Bubble had not changed the economic equilibrium again.

Furthermore, we show that the oil price shows medium-frequency fluctuations between 8 and 50 years and that these move inversely to the oscillations of output. This important relationship sheds new light on business cycle analysis and shows that the limitation of fluctuations up to 32 quarters reveals only a small part of the economic dynamics that link the price of oil and output.

Business cycles over the medium-term horizon have been analyzed to date by a small group of authors, including Blanchard (1997), Evans et al. (1998), Caballero and Hammour (1998), and Solow (2000). These authors have focused on medium-frequency fluctuations, which are defined in this paper as fluctuations of 32–200 quarters. Recently Comin and Gertler (2006) have analyzed medium-term business cycles on the basis of endogenous growth theory. Their approach is different in that it not only limits the analysis to medium-frequency fluctuations in the data, but also includes both the

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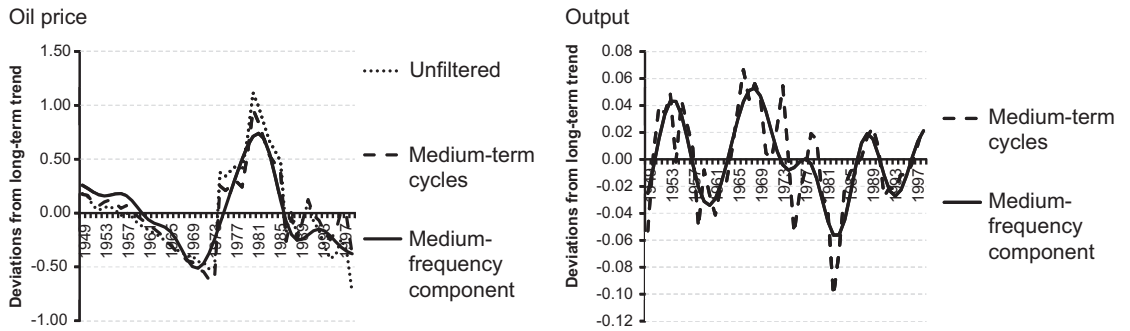

Fig. 1. Left: Detrended unfiltered real oil price, indexed in 1992 US-Dollars per barrel (dotted line). Filtered detrended real oil price. Right: Filtered detrended nonfarm business output. Medium-term cycles are fluctuations of 1–50 years. Medium-frequency components are fluctuations of 8–50 years.

conventional business cycles and medium-frequency variations. Their particular approach is that both types of frequencies are not treated as mutually independent but rather as interconnected by endogenous dynamics.

Combining short- and medium-frequency dynamics by means of endogenous growth theory is very well suited for analyzing the impact of energy price shocks on macroeconomic behavior. As a result, reactions of an economy to an energy price shock in the short term also have impacts on medium-term dynamics by changing investment incentives in research and development and thus by directly influencing the underlying economic dynamics.

The literature has made some attempts to generate larger effects of energy shocks in models by assuming low substitutability of production factors. In our setup we can show that the relatively small energy share in the economy can generate longer lasting and strong effects even with a high substitutability between the production factors.

The next section describes the empirical background to medium-term business cycles, to energy price fluctuations, and to the productivity slowdown. Section 3 describes the model and the equilibrium conditions in more detail. Section 4 shows the simulation results for a shock to the oil price and a sensitivity analysis. Section 5 concludes.

2. Empirical background

Substantial evidence suggests that oil price increases are directly linked to economic activity and even to the onset of recessions (e.g., Hamilton, 1983, 1996, 2003; Hall, 1988; Blanchard and Quah, 1989; Mork, 1989). Several authors have contributed by partially explaining conventional business cycles after an energy shock (such as Rotemberg and Woodford, 1996; Finn, 2000; Barsky and Kilian, 2004; Leduc and Sill, 2004; Aguiar-Conraria and Wen, 2007). Additionally, research on the impact of energy shocks on the great moderation (a period of remarkable macroeconomic stability) (e.g., Nakov and Pescatori, 2007) as well as on terms of trade (such as Backus and Crucini, 2000) has shown similar results.

2.1. Oil price and medium-term cycles

Looking at the behavior of the real oil price in absolute levels (cf. Fig. 1, dotted line),[1] we can see that two main surges occurred, which took place in the 1970s and thus coincided with the two largest recessions in U.S. history (measured according to the loss of GDP; Temin, 1998). The emergence of the dot-com-bubble after 1998 was not a consequence of the oil price shocks, so we limit our analysis to the period up to 1998.

Another possibility of analyzing the oil price is to filter it and look at fluctuations of different frequencies: high- and medium-frequencies. High-frequency oscillations correspond to conventional business cycles with a frequency of 2–32 quarters (analyzed by, e.g., Long and Plosser, 1983; King et al., 1988; Christiano and Eichenbaum, 1992; Fiorito and Kollintzas, 1994; Baxter and King, 1999; King and Rebelo, 1999). To model medium-frequency fluctuations, we follow Comin and Gertler (2006) and filter for 32–200 quarters. The resulting long-term trend corresponds to frequencies of 50 years and less. The idea is that this trend is influenced by factors that change only slowly, such as demographics.

Taking a closer look at the real oil price after detrending and filtering in the medium run, Fig. 1 [2] shows that there have been large fluctuations during the last several decades. The dashed line shows the percentage deviation of per capita output from the trend for the medium-term cycle. The continuous line gives the medium-frequency component. Consequently, the difference between the two lines is the high-frequency component, which is the subject of conventional business cycle analysis.

The medium-term frequencies of the oil price decreased until about 1969, and then started a large increase in the next decade. Then they dropped again until the late 1990. The medium-term cycle was quite stable at the beginning of the period

[1] Annual data from 1953 to 2005 from Federal Reserve Bank San Louis.

[2] We use a band pass filter similar to Rotemberg (1999) which is a two-sided moving average filter in which the moving average depends on the frequencies of the data that one wishes to isolate.