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Leif Anders Thorsrud

International business cycles and oil market dynamics

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by

Leif Anders Thorsrud

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Chapter 1

Introduction

This dissertation is about understanding business cycle fluctuations in an international perspective. What causes them, and how do they transmit across borders? In essence the motivation for the dissertation can be summarized with two words, globalization and regionalism. Globalization is a collective term describing the increasingly integrated and interdependent world economy. Regionalism, on the other hand, is used to describe an almost opposite development where what happens globally becomes less important relative to what is happening at the regional level.

By now, a long standing literature has investigated the causes of globalization and its impact on business cycle synchronization, inflation and interest rates. See, e.g., Backus et al. (1995), Kose et al. (2003a), and Baxter and Kouparitsas (2005) on business cycle synchronization and Mumtaz and Surico (2008), Monacelli and Sala (2009) and Ciccarelli and Mojon (2010) on the co-movement of inflation rates. While studies such as Kose et al. (2003a) seemed to confirm that one common world economic indicator, or factor, was indeed sufficient to describe the evolution of domestic business cycles, studies covering more recent periods find support for an increase in the role of regional factors. In particular, Clark and Shin (2000), Stock and Watson (2005a), Moneta and Rüffer (2009) and Mumtaz et al. (2011) find that regional factors play a prominent role in explaining the evolution of the business cycle in different countries and regions, especially in North America, Europe and Asia, motivating the hypothesis of business cycle decoupling and regionalism.

However, studies in the international business cycle synchronization literature almost exclusively study the co-movement among real and nominal variables separately. This distinction overlooks how shocks transmit into the economy and impedes the identification of the common sources of macroeconomic fluctuations. Moreover, empirical and theoretical studies of business cycle fluctuations in general do not account for the evidence brought forward by the synchronization literature, leaving a void between structural investigations of business cycle fluctuations and

the observed patterns in the data. Thus, questions such as: What is driving international business cycles?, Through which channels do international shocks transmit to small open economies?, can not be adequately addressed.

A prime candidate for answering these questions is the price of oil. Indeed, since the seminal work by Hamilton (1983), a large body of literature has suggested that there is a significant negative relationship between oil price increases and economic activity in a number of different countries, see, e.g., Burbidge and Harrison (1984), Gisser and Goodwin (1986), Bjørnland (2000) and Hamilton (1996, 2003, 2009) among many others. Motivated by the rapid growth in emerging market economies and the sharp increase in the price of oil without any apparent severe negative effects on the real economy, an intense research effort is also undertaken to quantify the importance of the reverse causality, i.e., the effect of global demand on the real price of oil, see e.g., Kilian (2009).

Still, most of the research on oil price changes has focused on quantifying the effects on a small number of developed countries, and overlooked the separation between global and regional business cycle dynamics and their importance for the oil market.

Furthermore, just as individual countries are highly interconnected so are likely also the sectors of a given economy. Thus, to fully understand how international shocks like, e.g., unexpected innovations in the real price of oil, transmit to domestic economies, production networks, sectoral trade and potentially shared productivity dynamics between the different sectors in the economy might all be important. If the researcher overlooks these and other potential interactions, questions regarding within country spillovers are difficult to answer, but no less important for understanding aggregate business cycle fluctuations and the transmission of international and domestic shocks. Long and Plosser (1983) and Long and Plosser (1987) provide early examples of theoretical and empirical studies where sectoral interconnections are analysed explicitly. After a period of stillness, this line of multi-sector research has again become fashionable, exemplified by, e.g., Foerster et al. (2011).

This dissertation consists of four papers, which all relate to the literature and questions above:

1. "Global and regional business cycles. Shocks and propagations"

2. "The world is not enough. Small open economies and regional dependence"

3. "What drives oil prices? Emerging versus developed economies"

4. "Boom or gloom? Examining the Dutch disease in a two-speed economy"

Three common features are representative for these papers: They are all empirical investigations of, in general international and in particular domestic, business cycle fluctuations. It is my hope that each paper contributes to enhance our understanding of how and why such cycles occur. The methodological framework

used for inference utilize large data sets, combining both the time and cross sectional dimension of the information set available. Lastly, all the papers build on the findings in the business cycle literature of a high degree of cross country synchronization, but extends this line of research by identifying common shocks. As a result the questions: What is driving international business cycles?, and: Through which channels do international shocks transmit to small open economies?, are addressed.

In the rest of this chapter I elaborate on the three common features and their motivation, before I briefly summarize the specificities of each individual paper.

1.1 Understanding business cycle fluctuations

Despite the declarations from some famous economists about the demise of business cycles, the business cycle is far from dead. As the financial crisis starting in 2007 has all to clearly illustrated, understanding the (exogenous) sources of business cycle fluctuations is more important than ever: not only for developing theoretical business cycle models, but also for conducting macroeconomic policy.

Since Sims (1980) seminal contribution, the workhorse model for empirical macroeconomic modelling, and business cycle analysis, has been the vector auto-regression (VAR). Within this framework, the time-series properties of a limited set of endogenous variables is modelled simultaneously. By suitable identification restrictions the reduced form VAR can be given a structural, or causal, interpretation, yielding the structural vector auto-regression (SVAR), wherein the co-movement among the endogenous variables in response to exogenous shocks can be studied.

Accordingly, the SVAR approach has been widely used to identify and measure the effects of unexpected innovations on macroeconomic variables in a diverse range of settings. Among an enormous range of applications some examples are: Blanchard and Quah (1989) who investigates the dynamic effects of aggregate demand and supply disturbances, Ahmed et al. (1993) who uses the SVAR approach in an international business cycle setting, Kilian (2009) who uses an agnostic identification scheme to identify the effect of various shocks in the oil market, and Bjørnland (2009) who separately identifies monetary policy and exchange rate innovations in a SVAR setting.

The popularity of the VAR approach among researchers and policy makers is mainly due to two features of the approach: The joint distribution of a set of endogenous variables is modelled simultaneously, and the identification restrictions are typically rather agnostic. As such, inference is more data driven than in general equilibrium models derived solely based on economic theory.

However, the simplicity of the standard VAR (or SVAR) approach also comes at a cost: only a limited set of endogenous variables can be modelled simultaneously. In empirical models this is due to the curse of dimensionality problem. The vector auto-regressions are heavily parametrized. With only a limited set of

observations there are not enough degrees of freedom to estimate large, and more realistic, systems. The manifestation of this problem leads to at least four potential problems with the VAR results: First, as argued by, e.g., Bernanke et al. (2005), agents in the economy might use an information set that is much larger than the one included in the empirical VAR when making choices, leading to a problem of identification. Second, and related to the argument just given, are the findings in the business cycle literature referred to above. Common shocks are likely an highly important source for explaining business cycle fluctuations. Within the standard framework such shocks are impossible to identify. Third, within standard empirical VARs only the interaction among a limited set of macroeconomic variables can be studied, which generally constitute only a small subset of the variables that the researcher or policy maker care about. Fourth, when the system expands, so does the number of shocks the researcher needs to separately identify. Thus, tractability in terms of the ability of the researcher or the researcher's audience to evaluate an expanding list of theoretical interactions is undermined.

To address these methodological issues, and provide a better understanding of the sources of business cycle fluctuations, I depart from the standard framework in two ways: First, I utilize large cross sectional data sets (information sets) in a dynamic setting by employing dynamic factor modelling techniques. Second, I keep the identification restrictions agnostic and parsimonious by allowing for common factors and shocks.

1.1.1 Large data sets and the dynamic factor model

The factor models employed in this dissertation can all be categorized as dynamic factor models (DFM). Common for all the different versions of the DFM is that the co-movement of a large cross section of variables is assumed to be driven by a few latent factors, facilitating analysis in data rich environments.[1] Moreover, macroeconomic data are often measured with noise and errors. In the factor model framework, the idiosyncratic (noise) components are separated from the underlying economic signal, which is what the researcher is after.

The DFM has a long history in empirical economics, with early contributions by, e.g., Geweke (1977), and more recent applications by, e.g., Bernanke et al. (2005) and Mumtaz et al. (2011), to mention just three of many. However, giving the latent factors an economic interpretation has been difficult and therefore discredited statistical factor models on the ground that they can not provide a causal interpretation of the results. Newly developed econometric methods, described in, e.g., Bai and Ng (2013) and Bai and Wang (2012), provide solutions to this problem. In this dissertation these methods are employed.

[1] The exact specification, estimation, and identification of the DFM varies with the research question being asked. Thus, the DFM will sometimes be referred to as a factor augmented vector-autoregression(FAVAR), which is a special case of the DFM.

1.1.2 Common shocks

The dynamics of the latent factors are assumed to follow vector auto-regressive processes. Thus, within the DFM framework the tractable properties of the VAR is combined with the parsimonious data representation property of factor models. That is, shocks to the factors can be identified using the standard VAR machinery, and given a causal interpretation. By definition, these shocks will be common shocks. The responses of the observable macro economic variables can be computed though their exposure to the latent factors.

In sum, the DFM framework alleviates many of the problems with standard VAR analysis described above, i.e., the limited information set, the difficulty of identifying common shocks, and the tractability issue. The papers in this dissertation exploit these favourable characteristics: Two of the papers in the dissertation focus almost exclusively on the international dimension of economic fluctuations, complementing the work by Crucini et al. (2011) and Mumtaz et al. (2011), and identify business cycle shocks, such as, e.g., aggregate- demand and supply shocks and oil market shocks. The other two papers in this dissertation also account for purely (common) domestic shocks and spillovers between the sectors within the domestic economy. In line with the related literature referred to above, all papers in this dissertation emphasize the truly international nature of business cycle variations, and investigate its causes and consequences.

Finally, as discussed in, e.g., Boivin and Giannoni (2006), there is a close resemblance between theoretical general equilibrium models and the DFM. In fact, the DFM can be looked upon as a reduced form representation of a typical dynamic stochastic general equilibrium (DSGE) model. During the last decades such models have become more and more fashionable, not only for theoretical work, but also as models used for policy. However, one problem with these models is that they are not able to reproduce the high degree of cross country correlations found in the data, see, e.g., Justiniano and Preston (2010). Therefore, the results reported in this dissertation should be helpful for developing theoretical business cycle models that match the data better, informative for policy makers, and, in the spirit of Burns and Mitchell (1946), contribute to the literature documenting business cycle facts.

1.2 Summary

In the following I present the main questions, results and contributions of each individual paper in this dissertation.

1.2.1 Global and regional business cycles. Shocks and propagations

This paper asks two related questions: How important are common global and regional business cycle components to activity and prices across nations and regions, and what are the primary forces driving these business cycles components? To answer the last question, I distinguish between global and regional demand and supply shocks and study the relative contributions of these shocks to explaining macroeconomic fluctuations and synchronization.

Within a DFM framework, I entertain a large panel of activity and price variables from four different regions of the world, Asia, Europe, North and South America, covering 32 different countries. I show that regional factors and shocks account for roughly 50 percent of the variation in GDP growth and inflation across countries. The results support the decoupling hypothesis advanced in recent business cycle studies and yields new insights regarding the causes of business cycle synchronization. In particular, global supply shocks cause more severe activity fluctuations in European and North American economies than in Asian and South American economies, whereas global demand shocks shift activity in the different regions in opposite directions at longer horizons, reinforcing the degree of decoupling. Finally, only innovations to the Asian activity and inflation factors have significant spillover effects on shared global factors, demonstrating the growing importance of Asia in the global economy.

The study complements two recent papers by Crucini et al. (2011) and Mumtaz et al. (2011). As in both of these studies, I employ a factor model approach that considers a large set of countries and estimate common factors. However, in contrast to Crucini et al. (2011), who focus exclusively on real variables, I investigate the interaction between common real and nominal factors simultaneously in an international context. In contrast to Mumtaz et al. (2011) I identify the shocks driving the common business cycle components. Furthermore, the study is conducted using quarterly data, while the above mentioned studies consider yearly observations that are less informative for business cycle analysis.

1.2.2 The world is not enough. Small open economies and regional dependence

In this paper we explicitly combine global and regional factors with a large panel of domestic data in a Dynamic Factor Model, thereby combining new open economy factor model studies emphasizing global shocks with the recent findings of regional importance in the business cycle synchronization literature. The analysis is applied to four small open economies (Canada, New Zealand, Norway and the UK). The inclusion of a large panel of domestic data allows us to answer more clearly the question: Through which channels and variables do global and regional shocks transmit to small open economies? We find that the foreign shocks combined

explain roughly 50 percent of the business cycle variation in all countries. Regional shocks play an important role, explaining on average around 20 percent of the variance. The trade channel stand out as a particularly important channel for transmitting global shocks, while regional shocks explain a relatively large fraction of the variation in cost variables.

The paper builds on the global FAVAR framework proposed by Mumtaz and Surico (2009), but extends this work along two directions: We include regional factors and shocks, and we let the dynamics of the domestic variables be a linear function of both international and domestic factors. We show that both of these features are supported by the data.

1.2.3 What drives oil prices? Emerging versus developed economies

The real price of oil is a natural candidate for a truly global business cycle determinant. This paper explores the role of demand from emerging and developed economies as drivers of the real price of oil. Using a FAVAR model that allows us to identify and compare demand from different groups of countries across the world, we find that demand from emerging economies (most notably from Asian countries) is more than twice as important as demand from developed countries in accounting for the fluctuations in the real price of oil and in oil production. Furthermore, we find that different geographical regions respond differently to adverse oil market shocks that drive up oil prices, with Europe and North America being more negatively affected than emerging economies in Asia and South America. We demonstrate that this heterogeneity in responses is not only attributable to differences in energy intensity in production across regions but also reflects country structures, such as degree of openness and investment share in GDP.

The paper extends the literature in three ways. First, this is the first paper to explicitly analyse the contribution of demand from developed and emerging countries on the real price of oil. Second, the identification strategy adopted to isolate the various demand shocks is novel in the oil literature, as is the use of the FAVAR model for this purpose. Finally, given the large number of countries included in the analysis, this is also the most comprehensive analysis to date of the relationship between oil prices and macroeconomic activity.

1.2.4 Boom or gloom? Examining the Dutch disease in a two-speed economy

Much theoretical work has analysed the benefits and costs of energy discoveries, popularly called the Dutch disease, see, e.g., Bruno and Sachs (1982), Corden (1984) and van Wijnbergen (1984). However, there have been relatively few empirical studies. Of the few that exists, almost none account for the cross sectional co-movement of variables within a country. That is, the spillovers between sectors

of the economy can be substantial due to production networks, sectoral trade, and potentially shared productivity dynamics between the different sectors in the economy.

The last paper in this dissertation identifies and quantifies the spillovers caused by a booming energy sector using a Bayesian Dynamic Factor Model (BDFM). The model allows for resource movements and spending effects through a large panel of variables at the sectoral level, while also identifying disturbances to the real oil price, global demand and non-oil activity.

Using Norway as a representative case study, we find that a booming energy sector has substantial spillover effects on the non-oil sectors. Furthermore, windfall gains due to changes in the real oil price also stimulates the economy, but primarily if the oil price increase is caused by global demand. Oil price increases due to, say, increased geopolitical risks, while stimulating activity in the technologically intense service sectors and boosting government spending, have small spillover effects on the rest of the economy, primarily because of reduced cost competitiveness. Yet, there is little evidence of Dutch disease. Instead, we find evidence of a two-speed economy, with non-tradables growing at a much faster pace than tradables.

Our results suggest that traditional Dutch disease models with a fixed capital stock and exogenous labour supply do not provide a convincing explanation for how petroleum wealth affects a resource rich economy. Instead, our results are more in line with the theoretical predictions given in Torvik (2001), where productivity spillovers between sectors play an important role. Finally, our results highlight the importance of separating between shocks to the booming energy sector itself and commodity price shocks.

The papers of this dissertation (pages 9-159) are not available in BI Brage, due to copyright matters:

- Paper 1:
  Global and regional business cycles. Shocks and propagations
  Author: Leif Anders Thorsrud

- Paper 2:
  The world is not enough! Small open economies and regional dependence
  Authors: Knut Are Aastveit, Hilde C. Bjørnland and Leif Anders Thorsrud

- Paper 3:
  What drives oil prices? Emerging versus developed economies
  Authors: Knut Are Aastveit, Hilde C. Bjørnland and Leif Anders Thorsrud

- Paper 4:
  Bloom or gloom? Examining the Dutch disease in a two-speed economy
- Authors: Hilde C. Bjørnland and Leif Anders Thorsrud

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