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Forecasting using DSGE models with financial frictions

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ABSTRACT

This paper compares the quality of forecasts from DSGE models with and without financial frictions. We find that accounting for financial market imperfections does not result in a uniform improvement in the accuracy of point forecasts during non-crisis times, while the average quality of density forecast actually deteriorates. In contrast, adding frictions in the housing market proves very helpful during times of financial turmoil, outperforming both the frictionless benchmark and the alternative that incorporates financial frictions in the corporate sector. Moreover, we detect complementarities among the analyzed setups that can be exploited in the forecasting process.

1. Introduction

Over the last decade, dynamic stochastic general equilibrium (DSGE) models have become the workhorse framework in both academic and policy circles. Following advances in Bayesian estimation methods, these models began to be used not only for business cycle and policy analyses, but also for forecasting (see Del Negro & Schorfheide, 2013, for a review). A number of papers have evaluated the accuracy of point forecasts generated by DSGE models and found that they are at least competitive with time series models or even professional forecasters (see e.g. Adolfson, Lindé, & Villani, 2007; Edge & Gurkaynak, 2010; Edge, Kiley, & Laforte, 2010; Kolasa, Rubaszek, & Skrzypczynski, 2012; Rubaszek & Skrzypczynski, 2008; Smets & Wouters, 2003; Wieland & Wolters, 2013). However, it has also been pointed out that the accuracy of DSGE model-based forecasts is rather poor in the absolute sense: they tend to be biased and inefficient, and are usually calibrated badly (Edge & Gurkaynak, 2010; Herbst & Schorfheide, 2012; Kolasa et al., 2012). Finally, yet another weakness of DSGE models was exposed during the recent crisis, as their predictions were clearly at odds with the observed output collapse.

One of the reasons for these failures could be that a standard DSGE setup assumes frictionless financial markets, and also, importantly in the context of the recent financial crisis, does not include housing. A growing body of literature has responded to this deficiency by adding financial frictions to the standard framework, usually building upon concepts proposed before the crisis. This trend has also affected the structure of models developed by central banks and other policy-making institutions (Gerke et al., 2013). However, the literature on the effect of these modeling developments on the forecasting performance of DSGE models is very incomplete, as the contributing papers only report marginal likelihoods for the considered alternative specifications, if anything.

One of very few exceptions is the study by Christiano, Trabandt, and Walentin (2011), who demonstrate that augmenting a medium-sized DSGE model of the Swedish economy with frictions á la Bernanke, Gertler, and Gilchrist (1999, chap. 21) increases the accuracy of point forecasts. It is not clear, however, whether the reported differences are statistically significant, and density forecasts are not

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discussed at all. More recently, Del Negro, Giannoni, and Schorfheide (2013) and Del Negro and Schorfheide (2013) show that a similar extension to the Smets and Wouters (2007) model helps to forecast the US economy during the Great Recession, especially if the forecasts are conditioned on the available data on short-term interest rates and credit spreads. However, these two papers are silent about the effect of financial frictions on forecasts produced in normal times. Moreover, and most importantly, given our main findings, there is no evidence in the literature on the effect of including frictions in the housing market on the forecasting performance of DSGE models.

The aim of this paper is to investigate the extent to which adding two popular types of financial frictions can improve the quality of DSGE model-based forecasts. To this end, we consider two extensions to the benchmark New Keynesian setup, exemplified by the work of Del Negro, Schorfheide, Smets, and Wouters (2007), both of which can be considered the state of the art for modeling frictions which affect non-financial firms and households respectively. More specifically, the first addition introduces frictions between firms and banks using the financial accelerator setup developed by Bernanke et al. (1999, chap. 21). The second extension follows Iacoviello (2005) and incorporates housing and collateral constraints into the household sector. We next analyze the performances of point and density forecasts generated by the three variants of the model, as well as by their equally weighted pool.

We find that accounting for financial frictions in either the corporate or household sectors does not result in a uniform improvement in the accuracy of point forecasts for the main macroeconomic variables during normal, non-crisis times, while the average quality of the density forecasts actually deteriorates. In contrast, the extensions considered for the benchmark DSGE model have been found to be relatively successful during times of financial turmoil. This is particularly true for the variant featuring imperfections in the housing market: it clearly outperforms both the benchmark and the alternative that incorporates financial frictions in the corporate sector when only the period of the Great Recession and thereafter is considered. Moreover, there seem to be interesting complementarities among the analyzed setups that can be exploited in the forecasting process. In particular, pooling the predictions from all three models usually results in point and density forecasts that are more accurate than those from the frictionless benchmark even during tranquil times, and the optimal weights on models exhibit a substantial degree of variation over time.

The rest of this paper proceeds as follows. Section 2 presents the models. The results of the forecasting contest are discussed in Section 3. The last section concludes. Finally, the detailed equations of the models, a description of the data and various estimation issues are reported in the Appendix.

2. The DSGE models

In this section, we briefly describe the models that are used in our forecasting competition: a baseline New Keynesian setup, its two extensions incorporating financial frictions, and the pool of the models. A full list of model equations is presented in Appendix A.

2.1. Baseline New Keynesian model (DSSW)

Our baseline New Keynesian DSGE model is identical to that documented by Del Negro et al. (2007), which is essentially a slightly modified version of the microfounded setup developed by Christiano, Eichenbaum, and Evans (2005) and estimated using Bayesian methods by Smets and Wouters (2003). As the results of Wolters (in press) suggest, this framework is particularly good at forecasting relative to other standard DSGE specifications, and hence, constitutes a benchmark that is relatively difficult to beat.

The DSSW model features a standard set of nominal and real rigidities that have been found to be crucial for ensuring a reasonable data fit. These include: consumption habits, investment adjustment costs, time-varying capacity utilization, and wage and price stickiness with indexation. Government spending is exogenous and is financed by lump sum taxes, while monetary policy is conducted according to a Taylor-type rule.

Seven stochastic disturbances drive the model economy. Labor-augmenting technology is assumed to be a unit-root process, and hence generates a common trend in output, consumption, investment, capital and real wages. The remaining shocks are stationary and disturb the rate of time preference, relative price of investment, disutility of labor, price markup, government purchases and monetary policy.

The model is estimated using seven key macroeconomic time series: output, consumption, investment, labor, real wages, inflation and the short-term interest rate. The trending variables are expressed in growth rates.

2.2. Financial frictions in the corporate sector (DSSW+FF)

The first extension of the baseline model introduces financial frictions into the corporate sector. We use the financial accelerator framework developed by Bernanke et al. (1999, chap. 21), except that, following Christiano, Motto, and Rostagno (2003), the financial contract is specified in nominal terms. Our choice of the model specification is based on the results of Brzoza-Brzezina, Kolasa, and Makarski (2013), who indicate that this way of modeling frictions in financing firm investments fits the US data better than the popular alternative based on collateral constraints, as per Kiyotaki and Moore (1997). The main features of the DSSW+FF extension are as follows.

Unlike in the baseline DSSW setup, capital is managed by an additional type of agent, called entrepreneurs. They possess special skills in operating capital, and hence find it optimal to borrow additional funds over their net worth to finance their operations. The management of capital is risky, as entrepreneurs are hit by idiosyncratic shocks after they have signed a debt contract with a bank. Depending on the shock draw, an entrepreneur may or may not have enough resources to repay the loan. In the latter case, she declares default and the bank seizes all of her assets, having paid a proportional auditing cost. Since entrepreneurs are assumed to be risk neutral and banks are owned by risk