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Estimating Financial Frictions under Learning

Patrick A. Pintus[*]

CNRS - InSHS and Aix-Marseille University

Jacek Suda[†]

Narodowy Bank Polski and Warsaw School of Economics and GRAPE

M. Burak Turgut[‡]

Bocconi University and GRAPE

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[*]*Email:* papintus@gmail.com. *Address*: CNRS, EHESS, Centrale Marseille, Marseille, France.

[†]*Email:* jacek.suda@nbp.pl. *Address*: Swietokrzyska 11/21, 00-919 Warsaw, Poland.

[‡]Corresponding author. *Email*: mehmet.turgut@unibocconi.it. *Address*: Via Roentgen 1, 20136 Milan, Italy.

Abstract

The collapse of housing market in the second half of 2000s triggered credit crisis and impelled the U.S. economy into the Great Recession. The crisis underscored the importance of the role that financial markets (and housing market in particular) play in the economy and brought back the interest in understanding the links between these markets and the macroeconomy.

The recent literature introduces credit-constrained agents and house or land as collateral and achieves to explain positive co-movements between house prices and consumption or land prices and investment observed in data (Iacoviello and Neri, 2010; Liu et al., 2013; Guerrieri and Lorenzoni, 2017). The prevalent assumption in most models examining the nexus of housing (or financial) market and the macroeconomy is is rational expectations. It implies implicitly that economic agents know (or their actions are consistent with) the exact knowledge of the structural form, the parameters and the stochastic structure of the economy. However, endowing agents with such knowledge may be unrealistic since evidence from forecasting surveys (Coibion and Gorodnichenko, 2015; Pancrazi and Pietrunti, 2018) and laboratory experiments (Hommes, 2013, Pfajfar and Žakelj, 2018) often suggest deviation from rationality. While in some models agents are allowed not to be fully rational (e.g. Pintus and Suda, ming) there are hardly any studies that perform quantitative evaluation of the importance of this assumption.

In order to understand the quantitative implications of the departure from the rational expectations, we introduce a constant-gain adaptive learning into a medium scale DSGE model with credit-constrained agents of Liu et al. (2013) and Pintus et al. (2016). In that model the economy consists of a representative household derives utility from consumption, housing and leisure and a representative entrepreneur derives utility from consumption and the former one is more patient than the latter one. The entrepreneur uses labor, capital and land to produce final good and the entrepreneur needs external financing for investment. The entrepreneur's borrowing capacity is limited by the value of collateral, sum of land and capital holdings.

In our paper we relax the assumption of rational expectations and assume instead that while the agents form expectations using correctly specified economic models, they do not have perfect knowledge about the model parameters but rather use historical data to learn these parameters. In other words, agents are uncertain about the "true" parameters governing the random shocks that affect the economy and update their beliefs about these parameters when new data arrives. The recent work finds that such setting results in improvement of model-fit to data (Milani, 2007; Slobodyan and Wouters, 2012) and the ability to capture survey forecasts of macroeconomic aggregates (Ormeño and Molnár, 2015).

Even though our model is similar to the existing models that use housing or land as collateral, the key difference in our model is that the agents behave as econometrician and form expectations

of future macroeconomic variables as a linear functions of past model variables. As new data become available every period, the agents update the coefficients of these linear functions using constant-gain recursive learning algorithm. Hence, the expectations of the agents depend on these time-varying coefficients that represents beliefs, and we insert these expectations into the structural model. This method has two important implications; first, depending on the size of the gain agents may have long memory in endogenous variables that creates persistence in long-run and second, the interconnectedness of structural parameters through the non-linear cross-equation restrictions may be significantly altered.

We estimate the model both under rational expectations and adaptive learning using Bayesian techniques. We consider both Random Walk Metropolis Hasting and Sequential Monte Carlo algorithms. The latter one is proposed by Herbst and Schorfheide (2014) for medium and large-size DSGE models in which posteriors may display bi-modality. Since we find that our model with learning features bi-modal distributions for a number of parameters we resort to the SMC. We assess the joint role of financial frictions, collateral constraints and the departure from the full rationality assumption in explaining both the regular pattern of US business cycle as well as recent financial crisis. We evaluate and compare the model fit, estimated parameters and the transmission mechanism in models with Rational Expectations and adaptive learning. In addition, we consider several learning schemes that differ in terms of the information set used by agents to form their expectations. Moreover, we evaluate the role of alternative structural sources and learning in propagation of collateral and non-collateral shocks. Finally, using the estimated model as well as simulation exercises we assess the ability of alternative learning algorithms to modify the transmission mechanism relative the Rational Expectations model with collateral constraints and generate additional macroeconomic fluctuations in line with real data.

Our results point to the different dynamics of the economy under adaptive learning. We find that the large negative collateral shock observed in the 2008Q3 had a long and significant effect on output during Great Recession. We also find that using survey expectations as observable variable in the model with learning allows to better identify the influence of financial markets on the economy.

To interpret our results in terms of policy input, we seek to derive the implications of our findings for monetary and macro-prudential policy. We aim to find robust policy-mix that minimizes the consumption loss when a negative collateral shock hits the economy. We believe this would be another important contribution of our paper from the policy perspective.

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