Discussion of "House Prices, Credit Growth, and Excess Volatility: Implications for Monetary and Macroprudential Policy"*

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1. Introduction

The U.S. financial crisis of 2007–09 has engendered considerable research effort seeking to understand the interaction of the housing sector with the real economy. A primary obstacle to understanding this matter is the absence of a coherent model of the housing market. Justiniano, Primiceri, and Tambalotti (2012) make clear that standard dynamic stochastic general equilibrium models—of the kind proposed by Iacoviello (2005)—fail to account for basic macroeconomic facts central to the crisis. In the same model class, Iacoviello and Neri (2010) raise questions about the magnitude of possible spillover effects from housing markets to the real economy. Such failures obviously limit both positive and normative analyses relevant to the crisis.

The paper by Gelain, Lansing, and Mendicino (in this issue) represents an attempt to address this deficiency. The analysis poses two questions: (i) can a business-cycle model be developed that accounts for observed house-price dynamics? and (ii) what are the implications of such model for monetary and macroprudential policy? Building on Iocavelli (2005), the authors propose non-rational expectations as a source of amplification and propagation of primitive disturbances. Some fraction of agents have adaptive expectations. The remaining fraction have rational expectations. This modification of beliefs represents the central modeling departure from earlier

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work and is similar in spirit to other recent work on house prices by Adam, Kuang, and Marcet (2012). The paper concludes that it is indeed possible to model the amplitude of observed house-price movements, and while the nature of policy trade-offs are complex, countercyclical loan-to-valuation policies are desirable.

Researchers interested in macroeconomic analysis without rational expectations will find this an interesting and informative first step. While I am highly sympathetic to the goals and approach of the analysis, the following comments cast a critical view with the intent of identifying future lines of inquiry within this field, rather than to diminish the contribution at hand. The comments will proceed as follows. Section 1 details the structure of beliefs and provides an example of their implications. Section 2 details the mechanism in the context of the model of the paper. Section 3 discusses conceptual issues relating to economics with non-rational expectations. Section 4 assesses the model's implications for policy design.

2. Beliefs

To understand the specification of beliefs, consider a simple asset-price model,

$$p_t = \beta \tilde{E}_t \left[p_{t+1} + d_{t+1} \right],$$

where p_t is the price; d_t is some known, exogenously given, dividend process; and $0 < \beta < 1$. The expectations operator $\tilde{E}_t$ represents the aggregate conditional expectations held by agents in the economy, given by the weighted average of rational and non-rational expectations. Letting $0 < \omega < 1$ denote the fraction of agents with adaptive expectations, aggregate expectations are determined as

$$\tilde{E}_t p_{t+1} = \omega \hat{E}_t p_{t+1} + (1 - \omega) E_t p_{t+1},$$

where

$$\begin{aligned} \hat{E}_t p_{t+1} &= (1 - \lambda) \hat{E}_{t-1} p_t + \lambda p_t \\ &= \lambda \sum_{j=0}^{\infty} (1 - \lambda)^j p_{t-j} \end{aligned}$$

denotes those expectations formed adaptively, with $0 < \lambda < 1$ governing the sensitivity of beliefs to past forecast errors. The property of adaptive expectations that current forecasts are a function of the geometrically weighted infinite past history of observed prices, given by the second equality, lies at the heart of the model's amplification properties.

From these expressions the asset price is governed by

$$p_t = \frac{\beta\left(\omega\left(1-\lambda\right)\hat{E}_{t-1}p_t + \left(1-\omega\right)E_t p_{t+1}\right)}{\left(1-\omega\beta\lambda\right)} + \frac{\beta\rho}{\left(1-\omega\beta\lambda\right)}d_t,$$

a standard linear rational expectations model. An important feature of the model environment is evident in this expression: rational agents account for the non-rational expectations of adaptive agents. When forming assessments about future economic conditions, rational agents extrapolate the low-frequency implications of adaptive agents, embedded in the term $\hat{E}_{t-1}p_t$, into the indefinite future. Applying standard methods provides a solution of the form

$$p_t = \Xi\left(\hat{E}_{t-1}p_t, p_{t-1}, d_t\right) = \tilde{\Xi}\left(p_{t-1}, p_{t-2}, p_{t-3}, \ldots, d_t\right).$$

Comparing this with the solution under rational expectations, which has the form

$$p_t = \Gamma\left(d_t\right),$$

makes evident the consequences of the proposed beliefs assumption. For an i.i.d. dividend process, the price is given by an infinite-order ARMA process rather than white noise. It is this property that serves to amplify and propagate shocks in the model.

3. The Mechanism

Amplification and propagation of fundamental shocks come from two model features: the fact that some proportion of agents have adaptive expectations and the fact that the remaining proportion rationally account for this. Rational agents extrapolate adaptive beliefs into the indefinite future when forming their own expectations. A central question is, which component is more important? What precisely are the economics of amplification?

Such questions are relevant to a complete understanding and interpretation of results. Answering them would elucidate how distorted beliefs alter standard income and substitution effects attached to decisions in specific markets. The authors attempt to give perspective on these details. For example, a quote from Greenspan (2002) is used as motivation in the paper: "Bubbles are often precipitated by perceptions of real improvements in the productivity and underlying profitability of the corporate economy. But as history attests, the investors then too often exaggerate the extent of the improvement in economic fundamentals." But looking at the impulse response functions for a technology shock presented in figure 6 suggests the impact effect of the hybrid expectations model is, if anything, smaller than that observed in a rational expectations model. Moreover, casual inspection suggests that the additional variance generated by the hybrid expectations model appears to come from low-frequency movements in beliefs and that the timing of these movements is somewhat at odds with recent developments. They suggest an initial boom in output but a decline in housing prices, with a real-estate boom, characterized by higher housing prices and household debt, only occurring after output weakens after twenty quarters. Is this the right narrative to attach to the financial crisis?

There are certainly learning papers in the literature that are consistent with Greenspan's quote. For example, Eusepi and Preston (2011) show that learning dynamics can generate self-fulfilling periods of optimism and pessimism from i.i.d. technology shocks. Agents mistakenly attribute the shock as being partly permanent, leading to an increase in the perceived long-term return to capital holdings. This leads to amplification of standard substitution effects, which in turn gives amplification in response to shocks. Importantly, dynamics are self-fulfilling in that expectations of returns rise, and returns actually rise by more in equilibrium; and implied forecast errors are consistent with survey data.

A further question regarding the assumed belief structure is, what features of the crisis do they seek to capture? On the one hand, it certainly is plausible that an important part of observed dynamics was the presence of optimistic housing investors that were exploited by more rational market participants. To the extent that this is true, a tighter connection between model and data concepts would bolster basic assumptions. A tension arises here, as all markets are inhabited by equal numbers of non-rational and rational participants. The model assumes the existence of both non-rational buyers and sellers in equal proportion. Can the model speak to the profits gained by sophisticated market participants? On the other hand, it seems plausible to assert the crisis was in part due to financial market innovation which, combined with optimism, led to a boom, terminated by subsequent tightening in lending standards. A valuable exercise would be to follow the analysis proposed by Justiniano, Primiceri, and Tambalotti (2012). These authors conclude that models of the kind developed here, with rational expectations, cannot generate dynamics consistent with data when subject to a period of financial deregulation and subsequent tightening. Can learning better reconcile model predictions with data?

A final related issue concerns the assumption that only certain fixed segments of the market were non-rational at all times. It seems plausible that agents might have available a suite of forecasting models with different information costs. In periods of relative calm, it suffices to have a low-cost simple predictive model. In periods of relative turbulence, it may be valuable to have a more sophisticated rational predictor. Brock and Hommes (1997) explore a simple environment of this kind in which agents choose between two possible predictors on the basis of some criterion, such as a profit or utility cost. Rational expectations can be formed at a cost C. Otherwise, adaptive expectations can be utilized at no cost. In their model, if all agents pick the rational predictor, then the economy converges to a unique stable steady state. If all agents pick the second predictor, there is expectational drift and aggregate dynamics diverge from steady state. The interesting insights of their model lie in the dynamics between these two possibilities.

Suppose the economy starts with prices near steady state with almost all agents using the simple predictor. Due to drift in beliefs, forecast errors associated with adaptive expectations tend to rise. This provides incentives to switch predictors. When the value of net profit is sufficiently high, most will switch predictors, leading to convergence to steady state. Endogenously, periods of relative calm are initially associated with the simple predictor but can lead to booms. These booms are sharply terminated as agents switch to rational predictors. This dynamic appears consistent with the idea that there was optimism regarding the market price of risk in the run-up to the recent crisis. Quick revaluation of risk led to a substantial fall in asset values. To the extent the dynamic structural equilibrium models fail to capture salient features of financial crisis dynamics in the housing market, it seems likely that some combination of non-rational beliefs and financial deregulation is promising.

4. The Decision Problem of Adaptive Agents

The paper lays out a microfounded model which requires agents to construct forecasts of various objects relevant to their decisions. Because agents solve an infinite-period intertemporal problem, forecasts of prices and other variables exogenous to their decision problem are required into the indefinite future. Yet, despite these decision problems, economic behavior is based solely on Euler equations. As shown by Preston (2005) and Woodford (2012), such an approach to implementing models of learning dynamics is inconsistent with the assumed microfoundations. Indeed, Preston (2005) discusses, in a closely related model, why economic decisions based solely on Euler equations are not optimal and, in particular, imply failure to satisfy future flow budget constraints for arbitrary beliefs.

Perhaps most importantly, the Euler-equation approach makes it difficult to meaningfully discuss wealth and substitution effects, and is likely to minimize the role of wealth effects which are central to consumption plans of impatient borrowers in this model. In the current context, optimism about the entire future sequence of house prices might lead to a substantial increase in borrowing given a shock to the economy, relative to a model where only beliefs about next-period prices are relevant to current borrowing capacity.

5. Stabilization Policy

Somewhat frustrating for the authors are the negative conclusions of the policy analysis. Simple interest rate rules that respond to house-price growth or to credit growth provide limited stabilization advantages in terms of reducing the volatility of household debt or house prices, while significantly increasing the volatility of inflation and interest rates. Similarly the macroprudential policies have limited effect on most variables, though they do lower the volatility of household debt.

Part of the difficulty here lies in the fact that while the model better accounts for volatility than does the rational expectations model, it remains unclear in exactly what dimensions fit is improved. The only statistics provided are standard deviations of the hybrid expectations model relative to the rational expectations model. However, one critical dimension is that of co-movement and how shocks originating in the housing sector are transmitted to the real economy. Iacoviello and Neri (2010) underscore the lack of co-movement: disturbances that are important to house-price developments have little consequence for the broader economy. Given the absence of co-movement, it seems unsurprising that policies targeted at ameliorating fluctuations in house prices or household debt might create instability in other sectors. In other part, neither the basic mechanisms of the paper nor the true welfare-theoretic objectives of policy are sufficiently clear. Clarifying both these matters might lead to sharper conclusions.

For example, interest rate rules might perform poorly because they create instability in long rates. Take the standard New Keynesian model and assume all agents have forecasts that are formed according to an adaptive learning algorithm, discussed below. It is easy to show that aggregate demand is determined by

$$
\begin{aligned}
x_t = & -\hat{E}_t \sum_{T=t}^{\infty} \beta^{T-t} \left(i_T - \pi_{T+1}\right) \\
& + \bar{s}_C^{-1}(1-\beta)\hat{E}_t \sum_{T=t}^{\infty} \beta^{T-t} \left[\left(\frac{\theta-1}{\theta}\right)\left(1+\gamma^{-1}\right) w_{T+1} + \theta^{-1}\Gamma_{T+1}\right]
\end{aligned}
\quad (1)
$$

and aggregate supply by

$$
\begin{aligned}
\pi_t = & \, \psi\left(\gamma+1\right)\left(x_t+u_t\right) \\
& + \hat{E}_t \sum_{T=t}^{\infty} \left(\alpha\beta\right)^{T-t} \left[\psi\alpha\beta\left(w_{T+1}+u_{T+1}\right) + \left(1-\alpha\right)\beta\pi_{T+1}\right], \quad (2)
\end{aligned}
$$

where x_t is the output gap, i_t the period interest rate, π_t the inflation rate, w_t the wage rate, Γ_t dividends, and u_t a cost-push shock. The model parameters satisfy $0 < \alpha, \beta, \bar{s}_C < 1$, $\theta > 1$, and $\psi, \gamma > 0$. Following Woodford (2001) there is a debt instrument with payment structure $\rho^{T-(t+1)}$ for $T > t$ and $0 \leq \rho \leq 1$. The asset can be interpreted as a portfolio of infinitely many bonds, with weights along the maturity structure given by $\rho^{T-(t+1)}$. Varying the parameter ρ varies the average maturity of debt.[1] For example, when $\rho = 0$ the portfolio comprises one-period debt, and when $\rho = 1$ the portfolio comprises console bonds. To log-linear approximation, that asset is priced according to

$$P_t^m = -\hat{E}_t \sum_{T=t}^{\infty} (\rho\beta)^{T-t} \, i_T.$$

See Eusepi, Giannoni, and Preston (2012) for further details. This price, along with the price for one-period debt, defines the interest rate spread discussed below.

For simplicity, assume agents construct identical forecasts of inflation, wages, profits, interest rates, and bond prices according to

$$\hat{E}_t X_{t+T} = a_{t-1}^X, \tag{3}$$

where $X = \{\pi, w, \Gamma, i, P^m\}$ for any $T > 0$. In period t, forecasts are predetermined. The belief parameters constitute state variables. Beliefs are updated according to the constant-gain algorithm

$$a_t^X = (1-g)a_{t-1}^X + gX_t, \tag{4}$$

where $g > 0$ is the constant-gain parameter.

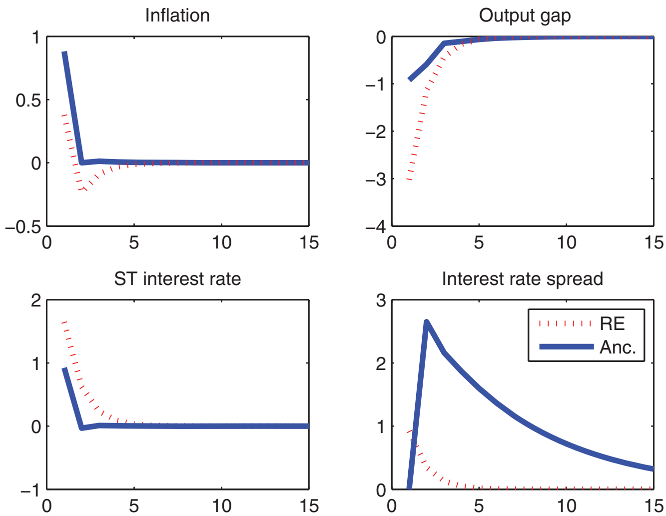
To complete the model, consider a central bank minimizing the welfare-theoretic loss

$$L_t = \pi_t^2 + \lambda_x x_t^2$$

subject to the constraints (1), (2), (3), and (4). Solving the central bank's problem reveals that optimal policy faces additional constraints relative to rational expectations. Beliefs are themselves an additional distortion that confronts policy. To show this, figure 1 plots dynamics of this economy in response to a cost-push shock under the learning and rational expectations assumptions. The parametric assumptions are $\beta = 0.99$, $\gamma = 0.5$, $\theta = 8$, $\alpha = 0.75$, and $\rho = 0.96$. The final parameter is determined from $\psi_\pi = (1-\alpha\beta)(1-\alpha)\alpha^{-1}$.

[1] An elegant feature of this structure is that it permits discussion of debt maturity with the addition of a single-state variable.

Figure 1. Impulse Response Functions for a Cost-Push Shock with Optimal Policy



Note: The solid line gives the model under learning, and the dashed line gives the model under rational expectations.

It is immediate that the optimal policy under learning dynamics mandates a less aggressive adjustment of interest rates on impact. The reason for this is that aggressive adjustment of interest rates can lead to aggregate volatility because slow adjustment of interest rate beliefs makes long rates adjust with a lag. Changing interest rates today leads to revised beliefs and subsequently higher long rates because beliefs are at least temporarily consistent with a permanent increase in interest rates. This leads to excessively restrained demand and inflation. The volatilities observed in table 4 of the paper seem consistent with this to some degree.

6. Conclusion

The paper represents a promising start to an interesting and important research agenda. The hypothesis that non-rational beliefs were an important part of observed dynamics in the lead-up to the financial crisis is appealing and plausible. It raises interesting policy questions about the efficacy of traditional monetary policy and the scope of macroprudential policies to achieve stabilization goals. As the paper stands, a more thorough explication of the basic mechanisms by which distorted beliefs amplify primitive disturbances would assist in interpreting dynamics and associated policy exercises.

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