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Imperfect knowledge, liquidity and bubbles

William A. Branch

University of California, 3151 Social Science Plaza, Irvine, CA 92697, United States

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ABSTRACT

Insufficient liquidity can lead to substantial movements in asset prices. There is a single asset traded in a centralized market that facilitates exchange in decentralized trade. If the asset is in short supply the price includes a liquidity premium. Traders have imperfect knowledge about future asset prices and estimate, in real-time, an econometric forecasting model. A permanent decrease in the supply of assets, or an increase in collateral requirements, can lead to over-shooting of the price. When price includes a liquidity premium there can be recurrent bubbles and crashes. Liquidity and adaptive learning play key roles in fitting the empirical distribution of price–dividend ratios.

1. Introduction

It has long been recognized that financial assets have important roles beyond a store-of-value including the provision of liquidity services. Assets that can be considered safe are increasingly viewed to be in short supply: liquid assets are used as collateral in over-the-counter transactions and bilateral agreements while a rise in global demand by investors, governments and central banks, and changes to macro-prudential policies, are likely to exacerbate supply imbalances. When financial assets play a similar liquidity role as money, variations in the supply of assets can affect asset prices. For example, Krishnamurthy and Vissing-Jorgensen (2012) show that changes in the (relative) supply of treasury debt, corporate and agency bonds affect the prices of these assets. Equities play a role, as well, in secured lending markets, such as bilateral and trilateral repo markets.[1] Caballero et al. (2008) link global capital flows to a shortage in the supply of assets.

Search-and-matching models of asset pricing are useful environments for studying prices in economies with a shortage of liquid assets since they make explicit the liquidity properties of assets: assets can serve as collateral to facilitate bilateral, or over-the-counter, trade when limited enforcement or imperfect recognizability preclude unsecured credit arrangements as a means of payment. In search models, when the amount, or supply, of the asset is sufficiently low, the asset price will reflect its dual roles as a store of value and as a provider of liquidity services. The component of the asset price attributable to a liquidity premium, is sometimes referred to as a rational bubble.[2] Although search-based models have been useful in explaining certain empirical properties of asset prices, such as the risk-free rate and equity premium puzzles (see, Lagos,

E-mail address: wbranch@uci.edu

[1] Krishnamurthy et al. (2014) and Copeland et al. (2011) estimate 5–10% of the collateral in the very large U.S. repo markets comes from equity.

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2010), to date, they have not been successful in generating other salient features of asset prices such as excess volatility and the rapid price appreciations and depreciations typically attributed to speculative bubbles.

This paper presents a search-based asset pricing model with imperfect knowledge and adaptive learning that explores the role that liquidity plays in generating asset price bubbles and crashes.[3] The economic environment is an extension of Lagos (2010) and Rocheteau and Wright (2013): there is a single asset, similar to a Lucas Tree, that pays an i.i.d. dividend and is traded in a centralized, competitive market. The supply of this asset is subject to occasional, small iid shocks that captures asset float and other exogenous factors that affect asset supply. Absent trading frictions, this asset would price at the discounted present value of the dividend flow. However, the economy also consists of a decentralized market where buyers and sellers are bilaterally matched and buyers submit to sellers a "buyer-takes-all" offer. Unsecured credit is not available in these pairwise meetings because of limited enforcement. Instead, the "safe" asset can serve as collateral for secured credit – equivalently, exchanged *quid pro quo* for goods – giving rise to an endogenous liquidity role for financial assets. In a stationary (rational expectations) equilibrium, the asset price consists of two components: the expected present-value of future dividends and a liquidity premium.

In the model, the asset price is determined, in part, by the expected future price of the asset. The departure point of this paper is to replace rational expectations with price expectations formed from an adaptive learning rule as in Evans and Honkapohja (2001).[4] The imperfect knowledge environment under consideration assumes that individuals understand a lot about the economic environment, but they do not know – or harbor some doubt about – the particular values of the dividend process, the asset supply process and other values/coefficients that determine asset prices. As a result, individuals draw inferences about the asset price process from recent data by adopting an econometric forecasting model that nests the rational expectations equilibrium. These agents are Bayesian and, because of uncertainty about their model, they place a prior on structural change in their econometric model. This imperfect knowledge framework implies that individuals forecast via an AR(1) econometric model whose parameters are updated in real time with a form of discounted least squares "constant gain learning" The priors for this Bayesian model are specified in such a manner that beliefs are, on average, close to rational expectations.

This paper identifies several channels through which liquidity and imperfect knowledge, or adaptive learning, interact to affect asset prices. First, although over time beliefs tend to converge toward rational expectations, the combination of constant gain learning and a positive liquidity premium can lead individuals to temporarily believe that asset prices follow a random walk without drift. Random walk beliefs arise for a very intuitive reason. Suppose there is a slight (temporary) upward drift to asset prices, perhaps arising from a tightening of financial frictions. Individuals' econometric models will pick up that drift, leading to higher expectations about future asset prices that feed back onto higher asset prices. Thus, random-walk beliefs are nearly self-fulfilling and, consequently, such beliefs tend to persist for a substantial length of time. Furthermore, these beliefs generate excess volatility in asset prices, characterized by significant bursts and collapses in asset prices that are reminiscent of speculative bubbles and crashes. During a bubble episode, the asset becomes more liquid in over-the-counter markets as sellers are willing to part with more goods in exchange for the asset; a bubble leads to greater economic activity. Conversely, during a crash episode, the asset becomes less liquid and, as a result, there is less economic activity.

Second, a decline in the quantity of liquid assets will introduce just the type of drift in asset prices that can lead to random-walk beliefs and cause a substantial overshooting of the new stationary equilibrium price. Third, structural changes to the economic environment that increase the demand for collateral can also lead to a drift in asset prices that lead to random-walk beliefs and an over- or under-shooting of the equilibrium price. For example, a financial innovation – such as securitization – that increases sellers' willingness to accept the asset as collateral will increase its liquidity properties. Or, substitution away from assets no longer perceived to be safe will increase the demand for the liquid asset as collateral. Alternatively, financial innovations that relax the collateral constraint have an ambiguous effect on price that depends, in part, on the strength of expectational feedback. It is shown that relaxing the borrowing constraint will lead to either over or under shooting of asset prices.

It is tempting to conclude that the liquidity premium is just another fundamental factor, like dividends, driving asset prices. However, the paper demonstrates that assets in a search-based asset pricing model have both a direct and an indirect effect with important theoretical implications. The direct effect is the liquidity premium that arises absent any learning dynamics. The indirect effect is that the liquidity role of the asset alters the way expectations about future prices and dividends affect the contemporaneous asset price. To assess the relative significance of the liquidity channel, Section 5 turns to an extension of the benchmark model that is calibrated to match key properties of U.S. financial data. It is shown that the

[2] There is a long history of interpreting fiat monetary equilibria as a rational bubble and extending that interpretation to assets, more broadly, since fiat money is an asset with a constant, zero payment forever. See, Tirole (1985).

[3] Models such as Lagos and Wright (2003) feature cycles that are interpetable as bubbles and crashes. Similar to there results in this paper, crashes feature welfare reducing collapses in consumption. A key distinction of the learning dynamics introduced here is the more gradual run-up of asset prices that can be an empirical feature in some asset prices.