Disagreement, speculation, and aggregate investment ☆

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ABSTRACT

When investors disagree, speculation between them alters equilibrium prices in financial markets. Because managers maximize firm value given financial market prices, disagreement alters firms' value-maximizing investment policies. Disagreement therefore impacts aggregate investment, consumption, and output. In a production economy with recursive preferences and disasters, we demonstrate that static disagreement among investors generates dynamic aggregate investment that is positively correlated with capital shocks, leading to stochastic volatility in aggregate consumption, investment, and equity returns. The direction of these effects is consistent with business cycle facts, and with several features of the 2008 financial crisis.

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1. Introduction

It is the summer of 2007 in the United States. High capital investment has accompanied rising equity valuations. An optimistic shareholder, anticipating strong economic growth, increases his risk exposure. His pessimistic counterparty reduces his risk exposure. Then, growth disappoints. Equity plummets, bonds appreciate. For now, the pessimists have won. Although the firm's optimistic shareholders may yet expect the economy to recover, they nevertheless agree to steps by management to restore the firm's value. The firm must attract wealth from those who have it, i.e., from the pessimists with low risk exposure. Management reduces investment and the pessimists approve the change. By the summer of 2009, aggregate private investment had dropped by 30%, following an even larger decline in the Standard and

Poor's (S&P) 500 index. In this way, investment policy may follow market sentiment, in the small and in the large. If the optimists are shrewd, whatever their beliefs about growth, then they will assess this source of risk before they invest: that if growth is worse than they expect, investment policy may shift against them also.

Our paper is about that source of risk: that behavioral biases alter fundamentals through speculative trade. In an otherwise standard production economy, we demonstrate that static disagreement among financial market participants introduces new dynamics into aggregate capital investment. We analyze the mechanism in an economy with two types of investor: an optimist and a pessimist. Investors are able to speculate on their beliefs in a complete and frictionless financial market, where the only exogenous sources of risk are shocks to capital growth. As periods of high or low growth are realized, the shifting fortunes of each investor type are reflected in the pricing kernel. The firm responds with a dynamic investment policy that maximizes its value under that pricing kernel. This occurs even though each investor type would, in isolation, prefer a constant investment policy.

The effect is of particular interest because changes in investment policy correlate with capital growth shocks, and so may either amplify or dampen the impact of the shocks on aggregate consumption or investment. The volatility of fundamentals results endogenously through speculative trade in financial assets. For example, dogmatic disagreement can produce an aggregate investment–capital ratio that is positively correlated with capital growth shocks. This increases the volatilities of investment and stock returns, but smooths aggregate consumption.

In our model economy, investors disagree about the expected growth rate in normal times, and about the likelihood of disasters. Although optimists always speculate with pessimists, the degree of speculation varies over time. Because the size of the bets riding on capital growth shocks varies, the magnitude of the investment policy response to a given shock varies also. Investment, consumption, and stock return volatilities, which would be constant absent disagreement, become stochastic. Brownian shocks cause smooth variation in wealth shares and consumption during normal times, whereas disasters cause sudden wealth transfers, leading to large and immediate changes in consumption.

Stochastic volatility in consumption is an important source of risk supporting a high and time-varying equity premium, e.g., in the long run risk literature following Bansal and Yaron (2004). Our model's ability to generate endogenous stochastic volatility from static primitives provides a theoretical scaffold supporting a crucial assumption of many consumption-based asset pricing models.

The ingredients of our theoretical model are orthodox, but novel in combination. We model disagreement as a difference in the perceived average rate of capital accumulation in normal times, and in the perceived arrival rate of disasters. The complete markets equilibrium is the solution to a planner's problem, which corresponds to a competitive market equilibrium where optimists expect higher stock returns than pessimists. All investors in our economy have the same recursive preferences. Finally, investment is subject to a capital

adjustment cost. Because of this cost, when the investment rate is high, incremental investment is more expensive so the value of assets in place, or Tobin's q, is high. As a consequence, the stock market is sensitive to changes in the investment rate. Together these assumptions imply that the investment rate, interest rate, and price–dividend ratio are procyclical.

Our model suggests that disagreement influences stock returns through fundamentals, rather than despite them. Disagreement drives returns through its effects on the investment–capital ratio. Cochrane (1991) shows empirically that the investment–capital ratio negatively predicts long horizon excess stock returns. In our model, the investment–capital ratio also negatively predicts the equity premium. Arif and Lee (2014) show empirically that aggregate corporate investments are affected by, and indeed mirror, waves of investor optimism and pessimism, in line with our model.

There has been a steadily growing literature on models with disagreement amongst investors. Basak (2005) shows how to characterize equilibrium asset prices, and Bhamra and Uppal (2014) solve for asset prices with heterogeneous preferences and disagreement. Gallmeyer and Hollifield (2008) study the impact of a short-sales constraint with disagreement, whereas Osambela (2015) studies how asset prices and liquidity are impacted by disagreement given limited commitment. David (2008) shows that disagreement can significantly increase the equity premium with a low level of risk aversion. Dumas, Kurshev, and Uppal (2009) characterize the impact of disagreement on investors' optimal portfolios and asset prices, and Dumas, Lewis, and Osambela (2014) show that disagreement can help explain several empirical regularities in international finance. Dieckmann and Gallmeyer (2005) and Chen, Joslin, and Tran (2012) study the effects of disagreement about disasters on asset prices. In a model with recursive preferences and disagreement, Borovička (2013) shows that a stationary equilibrium exists for the appropriate choice of parameters.

All these papers are set in endowment economies, in which aggregate consumption follows an exogenous process. Our paper builds upon these works, but turns the central question on its head. Rather than asking how disagreement about fundamentals can drive trade and returns in financial markets, we ask how disagreement manifested as trade in financial markets can drive fundamentals.

Detemple and Murthy (1994) study a production economy with disagreement without capital adjustment costs in which all investors have logarithmic utility. The investment–capital ratio, consumption volatility, stock return volatility, and Tobin's q are constant and unaffected by disagreement, while the interest rate and the market price of risk are affected. Our model allows for non-logarithmic investors and capital adjustment costs so that the investment–capital ratio, consumption volatility, stock return volatility, Tobin's q, interest rate, and market price of risk are all affected by disagreement.

Sims (2009) studies a two-period economy in which disagreement about inflation influences investors' portfolios and aggregate investment. Much of the intuition from the model in Sims (2009) extends to our infinite horizon economy, in which investors disagree about the growth of