



Asset pricing with heterogeneous beliefs and relative performance



Shiyang Huang^a, Zhigang Qiu^{b,*}, Qi Shang^b, Ke Tang^b

^a LSE, Houghton Street, London WC2A 2AE, London, United Kingdom

^b Hanqing Advanced Institute of Economics and Finance, Renmin University of China, China

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ABSTRACT

We propose an equilibrium asset pricing model in which agents with heterogeneous beliefs care about relative performance. We find that the concern with relative performance leads agents to trade more similarly, a development that has two effects. First, similar trading directly decreases volatility. Second, similar trading decreases the impact of dominant agents. The second effect dominates the first when agents expect large differences between their final performances, and vice versa when agents expect small differences between their final performances. Compared with the case in which agents are unconcerned about relative performance, the stock return volatility is higher when the second effect dominates, and lower when the first effect dominates. This paper also demonstrates that the concern about relative performance influences investors' holdings, stock prices and risk premia.

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1. Introduction

Fund managers care about their performance relative to that of their peers. In the fund management industry, compensation for money managers is normally a fixed proportion of the assets under management. Thus, managers care not only about trading profits but also about fund flows. Realistically, the decisions made by fund investors (fund flows) depend on the fund managers' rankings. More importantly, empirical evidence, as in [Chevalier and Ellison \(1997\)](#), [Sirri and Tufano \(1998\)](#), and [Huang et al. \(2007\)](#), shows a positive and convex relationship between fund flows and relative performances. In the literature of delegated portfolio management, most researchers focused on how concern about relative performance affects the risk taking behavior and the implications for equilibrium asset prices (as discussed below). However, how the concern about relative performance affects the trading generated by the agents' heterogeneous beliefs is unknown. Because it is difficult to solve for asset pricing implications with endogenous fund flows, we instead use a reduced-form of fund flows by assuming that managers receive a bonus/penalty based on their performance relative to that of their peers. Using a dynamic general equilibrium model with heterogeneous beliefs, we analyze the effects of the concern over relative performance on the equilibrium quantities.

We consider a continuous time, finite horizon economy with two assets: a risky stock and a risk-free bond. Two groups of risk-averse agents exist and are interpreted as fund managers, who optimally allocate wealth between the two assets with the goal of maximizing their utility at a given final date. The agents within each group are identical and have CRRA utility functions over both final wealth and individual performance relative to the agents in the other group. We adopt a standard exchange economy with the [Lucas \(1978\)](#) type of aggregate dividends, which follow a geometric Brownian motion process. Heterogeneous beliefs arise from the different opinions of the two groups with respect to the drift process of the dividend.

We solve the model in closed form by assuming that the risk aversion coefficient is an integer. To illustrate our result and compare it with that of the benchmark case with heterogeneous beliefs but without relative performance, we focus on a special case in which the risk aversion coefficient is 2. We first analyze the stock holdings and find that concern about relative performance leads agents to trade more similarly. When concern about relative performance is infinite, the two groups of agents display identical asset allocations. The result is thus the same as in an economy with one representative agent whose beliefs represent an average over the economy. The concern about relative performance affects the manner in which the two groups of agents share the final dividend and hence their expectations for final wealth. Note that the expectations are conditional on the current state of the world. When both groups of agents believe that the optimistic group of agents

* Corresponding author. Tel.: +86 13699199099.

E-mail addresses: s.huang5@lse.ac.uk (S. Huang), zhigang.qiu@ruc.edu.cn (Z. Qiu), q.shang@ruc.edu.cn (Q. Shang), ketang@ruc.edu.cn (K. Tang).

will receive a larger fraction of the final dividend, the pessimistic agents will hold more shares when the agents are more concerned about relative performance than when agents are unconcerned with relative performance, whereas the optimistic group of agents will hold fewer shares. Thus, in this case, the pessimistic group has a greater impact than in the benchmark case. Perceiving this effect, the optimistic group of agents will tend to demand fewer shares than in the benchmark case, and the pessimistic group of agents will also demand less. When both groups of agents believe that the pessimistic group of agents will receive the larger fraction of the final dividend, the opposite is true. In certain cases, the two groups of agents may disagree on how the final dividend will be shared. Thus, the optimistic group will tend to demand fewer shares, whereas the pessimistic group will tend to demand more.

With respect to the market price of risk, we show that when the optimistic group expects to receive a larger portion of the final dividend, it possesses less wealth when agents care about relative performance than they do not. Therefore, although the optimistic group still dominates the market, the stock is less overvalued when agents are concerned with relative performance. Hence, the market price of risk is higher in this case. When the pessimistic group expects to receive more of the final dividend, by a similar logic, the market price of risk is lower when agents care about relative performance than they do not. In addition, the model also indicates that the market price of risk is counter-cyclical for both groups.

The stock price is also affected by concerns about relative performance. When the optimistic (pessimistic) group expects to receive a larger portion of the final dividend, the stock price is lower (higher) when relative performance matters than when it does not. When both groups believe that the optimistic group will receive the larger portion of the final dividend, all agents hold fewer shares relative to the benchmark case, and hence, the aggregate demand is less and the stock price is lower. When both groups of agents believe that the pessimistic group of agents will receive the larger portion of the final dividend, the opposite is true. When the two groups disagree on the state of the economy, the stock price could be either higher or lower than it would be if agents were unconcerned with relative performance.

Concern about relative performance also affects the stock volatility. In particular, we find that this concern leads agents to trade similarly, which has two effects. First, it directly decreases the volatility. Second, it diminishes the impact of the dominant agents. The second effect dominates the first when agents expect the difference between the two groups' final performances to be large, and vice versa. Compared with the case in which agents are unconcerned about relative performance, stock return volatility is higher when the second effect dominates, and lower when the first effect dominates.

One application of our model addresses the impact on asset price and the survival of irrational traders. This issue can be examined by assuming that one group of agents is rational, i.e., correct in its beliefs, whereas the other group of agents is irrational, i.e., incorrect in its beliefs. The case in which agents do not care about relative performance is analyzed by Kogan et al. (2006), who indicate the conditions under which the irrational traders can survive. In our paper, irrational traders have a higher survival probability when agents care about relative performance because they trade similarly to rational traders in that case.

Our paper is closely related to the asset pricing literature with heterogeneous beliefs and delegated portfolio management. For asset pricing with heterogeneous beliefs, the general framework is that of Basak (2000, 2005); in which two agents disagree on the drift of the dividend process. Other researchers consider a framework in which one agent holds the correct belief and the other an incorrect belief; e.g., the work of Kogan et al. (2006) and Yan (2008). These papers examine the mis-pricing caused by

agents with the incorrect beliefs. Moreover; Scheinkman and Xiong (2003) combine heterogeneous beliefs and short-sale constraints to show that this combination could generate bubbles. Our paper combines Basak's framework with concern about relative performance and examines equilibrium asset prices.

The delegated portfolio management literature represents a growing field of research. According to Allen (2001), a large fraction of financial assets are held by institutional investors in the modern financial market, thus reflecting the importance of financial institutions. It is therefore important to consider how the behavior of the institutions affects the asset prices. In the literature, most researchers consider models with a single representative fund manager. For example, Vayanos (2004), Vayanos and Woolley (2013), He and Krishnamurthy (2012), and He and Krishnamurthy (2013) belong to this category. Because there is only one agent, relative performance does not matter.

To investigate the effect of concern about relative performance, researchers use performance relative either to an exogenous benchmark or to a peer group. For example, Cuoco and Kaniel (2011), Shang (2008), and Basak and Pavlova (2012) consider performance relative to a passive benchmark, e.g., the S&P 500. In contrast, Kapur and Timmermann (2005), Basak and Makarov (2012a,b), and Kaniel and Kondor (2013) consider relative performance within a peer group of managers. However, all of these papers only consider how concern about relative performance might affect the risk-taking behaviors of investors. To the best of our knowledge, this paper is the first to investigate how concern about relative performance can affect the trading behavior generated by heterogeneous beliefs.

Several papers have examined the asset pricing model with asymmetric information in which agents either observe signals or do not. For example, Dasgupta and Prat (2006) and Dasgupta and Prat (2008) show that career concerns could increase the amount of uninformed trading and slow the information revelation process, and Guerrerri and Kondor (2012) show that career concerns can generate a 'reputation premium' on bond returns and hence increase the volatility of bond prices. In a certain sense, relative performance concerns are similar to reputation concerns. In contrast, our paper considers the case in which agents either agree or disagree on each other about the state of the economy, based on respective observations (i.e., heterogeneous beliefs).

In general, our paper is also related to the literature on 'social status', which considers the asset pricing implications of concern among investors about their wealth relative to the average wealth in the society. For example, Bakshi and Chen (1996) examine the impact of concern about social status on portfolio and consumption choices. In our model, two groups of agents attempt to beat the average (or each other), a concern that is similar to concern about social status. In Bakshi and Chen (1996), the average wealth level of the society is exogenously given, whereas it is endogenous in our model. Thus, our model can be treated as a special case of 'social status' if we relax the assumption that the agents are fund managers. Moreover, some papers consider 'catching up with the Joneses', e.g., Chan and Kogan (2002), a situation that also resembles concern about social status. Our model thus captures selected features of these models.

Recent empirical evidence shows that cross-sectional hedge fund returns can be explained by systematic risk factors. For example, Bali et al. (2011) and Bali et al. (2012) find that hedge fund managers adjust their portfolios with respect to the market or economic conditions. Furthermore, managers with active trading strategies based on market conditions outperform those with passive trading strategies. Thus, fund managers do hold different beliefs related to the systematic risk factors. With concerns for relative performance, empirical predictions from our model can

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