Academic Affairs Excellence Awards

Application Form

GEORGIA COLLEGE

GEORGIA'S PUBLIC LIBERAL ARTS UNIVERSITY

Name: Leng Ling

Rank: Professor of Finance

Department: Economics and Finance

Award applying for:
(Check one)

	Excellence in Teaching Award*
	Excellence in Online Teaching Award*
X	Excellence in Scholarship & Creative Endeavors Award*
	Excellence in University Service*
	Excellence in Scholarship of Teaching & Learning Award*
	Department/Program Excellence Award^
	Irene Rose Community Service Award^
	Laurie Hendrickson McMillian Faculty Award^

*college selection required before being forwarded to university
^university awards
College nominees' final applications received by Center for Teaching and Learning (ctl@gcsu.edu) by March 1.

Please insert the required documentation in the pages below for the award category you have noted above. Detailed information associated with each award is available online at the Center for Teaching and Learning website.

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Excellence in Scholarship and Creative Endeavors February 25, 2021

Letter of Nomination for Dr. Leng Ling

I am writing to nominate Dr. Leng Ling for the Award for Excellence in Scholarship & Creative Endeavors. Over the last five years, Leng has had seven articles published for publication. These articles have appeared in peer reviewed finance and economics journals that are highly respected in each discipline. Dr. Ling's publication history is exceptionally impressive, and his output during the last five years is indicative of his consistent performance.

Leng's most impressive recent publication is an examination of the effects of physical attractiveness on the promotion of regional political leaders in China. This research was published in the *Journal of Economic Behavior and Organization*, which is one of the top journals in the field and is considered an A* rated journal. It is tremendously difficult to publish in a journal of this caliber in the field of economics.

He has published six other papers in the last five year, examining topics ranging from the behavior of mutual fund managers to the effects of political connections. He has also presented his work at a variety of international conferences. The Global and China Accounting and Finance Conference recognized him for the quality of his work in 2019, when he received the best paper award for the conference.

Leng is a fine colleague with an impressive publication record that I am certain will continue to grow. Leng's research has been featured in prominent and well-respected journals, raising awareness of Georgia College as a rising source of important economics and finance research. Recognizing and rewarding faculty members like Leng moves us along the path to preeminence.

Sincerely,

Christopher Clark, Professor
Department of Economics and Finance

GEORGIA COLLEGE
GEORGIA'S PUBLIC LIBERAL ARTS UNIVERSITY

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March 1, 2021

Dear Committee Members,

I have known Dr. Leng Ling for more than two years. He has been a good colleague and we have discussed a great deal about different research topics. I have seen his development in research and can attest to his research skill and expertise. He has published research in many highly-ranked finance journals and all of them are peer-reviewed journals. Most business schools globally rely on Australian Business Deans Council Journal Quality List or "ABDC Journal List" to assess the quality of publications. The rating of A* on the ABDC Journal List is the highest rating a business journal can receive followed by A, B, and C. A* rating is given to only seven percent of all the journals on the ABDC Journal List. Currently, there are 2,682 journals on the list. Despite one of the most challenging tasks to publish in an A* journal, Dr. Ling managed to publish his paper in an A* journal in 2019. In addition, he also published other three "A" papers rated by ABDC Journal List in the past five years. This is an evidence of his high-quality scholarship. In finance field, publishing one A* and three A papers of the ABDC Journal List within five—year time frame is regarded as highly challenging. However, I believe that, with his consistency and passion to contribute his research outcome to the broad research field, he will consistently continue to produce more high-quality research. Furthermore, it is challenging to compare the journal impact factor in finance with other disciplines. Finance is a subfield of Economics. This means finance publications are disseminated in much narrow scope than other fields. To illustrate this point, based on *Scimago Journal Rank*, the most prestige journal in finance, *Journal of Finance*, has an impact factor of 17 whereas the top three journals with the highest impact factor among all disciplines have the impact factor in the range of 30-80 (e.g., Nature, A Cancer Journal for Clinicians).

Regarding his area of publications, most of his publications are in the area of mutual fund, investment, and behavioral finance. He is very well-known in the mutual fund area as his publications in this area are highly cited and impactful. His recent publications also focus on behavioral finance which is a very hot field in the past five years as evidenced by the recipient of Noble Prize for Economics in 2017 that emphasized on behavioral economics. This is an evidence that he is highly capable of conducting research not only on the topics that he is originally an expert in, but also on the topic that is in demand for more research output. For example, in 2019, one of his behavioral finance papers, "Judging a Book by Its Cover: The Influence of Physical Attractiveness on the Promotion of Regional Leaders", was published *in Journal of Economic Behavior and Organization*, rated A* on the ABDC Journal list.

He has published papers every year in the past five years. The fact that he has published papers every year is an evidence that he is a very active researcher. In finance field, publishing a paper every year is considered highly productive. Most finance journals have long turnaround time of one to three years from the date of submission to publication. His research productivity has increased over time. In the past two years, 2019 and 2020, he published a total of four papers. In addition, one of the papers he published in 2019, "Unobserved Ties between Executive and Mutual Fund Manager", received the best paper award in the Global and China Accounting and Finance

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Conference. Therefore, his reputation in the field is not only recognized in the US, but also internationally. The paper was later published in *Accounting and Finance* which is an "A" journal on the ABDC Journal list. His paper illustrates that when corporate executives move to another company, mutual fund managers tend to move funds to the new company following the executives to reduce the information cost. This is a very interesting finding and is also another evidence of his mutual fund and investment expertise in the finance field.

One of his papers "Political Connections, Overinvestments and Firm Performance" has been cited more than 50 times in just between 2016 to present. The paper shows several impactful findings in political connection and corporate performance. One of the findings is that political connections are actually negatively related to firm's performance, not positive. The paper also has several contributions. For instance, the paper constructs a composite score measure based on the relative strength of political connections of all chief officers and board members. He and his coauthor show that the composite score measure is superior to indicator measures originally used in the literature because it incorporates political background of all members in the top management team. The paper is the first to document the evidence of a causality relation between political connections and corporate overinvestments.

In conclusion, he is one of the best researchers I know for the following reasons. His research productivity is high. He has published at least a paper every year and published four papers in the past two years. Based on my record, in finance field, this is very impressive. He is highly productive and at the same time his works are of high quality. His publications are in the top journals of finance evidenced by his publications in the journals rated A* and "A" by the ABDC Journal List which is well-known and widely used in most business schools globally. His research is recognized not only in the US but also internationally as one of his papers received the best paper award from one of the top conferences abroad. As for his personality and contribution to others in terms of research, he is a good colleague and never tired of discussing new ideas and making new friendships. From our research discussions, he has ton of knowledge and energy to produce great research for the finance field and continue to be an excellent representative of Georgia College in terms of both academic and research. Therefore, without reservation, I strongly support him for the Excellence in Scholarship and Creative Endeavors Award. Please contact me if you need additional information.

Sincerely,

Isarin Durongkadej
Assistant Professor of Finance
Department of Economics and Finance
J. Whitney Bunting College of Business
Georgia College and State University

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March 8, 2021

Jim Berger, Ph.D.
Director, Center for Teaching and Learning
Georgia College & State University
Milledgeville, GA 31061

Dear Dr. Berger,

With unequivocal support, we are so pleased to nominate Professor Leng Ling for the Excellence in Scholarship and Creative Endeavors Award. I, Dr. Arias, have known Leng for over eleven years since he first came to Georgia College, and he has always been an active and productive researcher. The quantity and quality of his most recent peer-reviewed publications are the culmination of a career of excellent scholarship. I, Dr. Arias, worked with Professor Ling as a co-author on a paper published in 2013 in a B-level journal, and I can attest that he has consistently sought to publish high-quality research. This is a risky strategy outside of a Research 1 university, but it has paid off with a number of impressive publications that help raise the national and international profile of Georgia College.

In the last five years, Professor Ling has published seven peer-reviewed journal articles, including publications in one A plus-level journal and three A-level journals. In finance—as in economics—journal articles are the main outlet for scholarship. The journal rankings are from the Australian Business Deans Council (ABDC), which is a widely-used ranking among top business schools and colleges. His work has been cited a number of times: "Political Connections, Overinvestments and Firm Performance," has been cited 55 times. He has also won the Best Paper award in the Global and China Accounting and Finance Conference in 2019.

Besides publishing in top journals, his research is relevant and often related to important social issues. For example, "Judging a Book by Its Cover: The Influence of Physical Attractiveness on the Promotion of Regional Leaders," looks at the promotion of regional political leaders in China and finds evidence of appearance-based discrimination. "Managerial overconfidence, firm transparency and stock price crash risk: Evidence from an emerging market," finds that firms with overconfident managers are more likely to experience future stock price crashes than firms without overconfident managers.

The quantity and quality of his research is uncommonly superior for a public liberal arts university. Based on this outstanding record of scholarship, we confidently nominate Dr. Leng Ling for the Excellence in Scholarship and Creative Endeavors Award.

Sincerely,

J. J. Arias, Ph.D.
Chair and Professor of Economics
Department of Economics and Finance, J. Whitney Bunting College of Business

Micheal T. Stratton, Ph.D.
Dean and Professor of Management, J. Whitney Bunting College of Business
President, Management and Organizational Behavior Teaching Society (mobts.org)

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Dr. Leng Ling's Letter of Support for the Excellence in Scholarship and Creative Endeavors Award

February 26, 2021

To the Award Committee:

This letter is in support of Dr. Leng Ling's application for the Excellence in Scholarship and Creative Endeavors Award. Dr. Ling has been with us since 2008 upon the completion of his Ph.D. work in Finance at Georgia State. He has been an outstanding researcher in all of his time with us. Since he joined our department he has published eleven scholarly journals (seven in the last five years; one A+ and three A list journals). Many of his papers have appeared in the top journals in the field of finance and economics (six A+ or A list journals and one B list journals). He has presented at numerous professional meetings both domestically and abroad (with one of his 2019 presentations, *Unobserved Ties between Corporate Executives and Mutual Fund Managers*, winning the best paper award at the 2019 Global and China Accounting and Finance Conference). His work has been recognized by multiple organizations for its quality. He also has a healthy pipeline of projects in various stages of completion. Since earning tenure in 2013 and achieving rank of full professor the amount and quality of his work has grown impressively. Obviously, there is a temptation for some researchers, particularly at an institution that emphasizes teaching over research, to take their foot off the gas pedal once certain career milestones are reached. Dr. Ling is not one of those researchers. Therefore, I heartily endorse his candidacy for this award.

Dr. Ling's research represents not just an impressive body of work, but also a level of work that is of much higher quality than many of his colleagues. As he has indicated in his vita, most of his published work appears in A or B ranked journals within Finance and Economics. The field of finance and economics is highly competitive. To maintain the quality of his publications is impressive. Both *Accounting and Finance* and *Journal of Economic Behavior and Organization* are greatly respected journals. He has also collaborated with the economists in our department. His work with Dr. Arias landed in a very good economics journal, *the Quarterly Review of Economics and Finance.* Again, this is a highly regarded journal.

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The work Dr. Ling has done has also garnered international attention. While all of the journals he has published in have international readership, some are also published abroad. He has kept research relationships with scholars in both North America and Asia. This has helped him maintain a well-rounded international perspective.

In summation, I can think of no one more deserving of the Excellence in Scholarship and Creative Endeavors Award at Georgia College.

Sincerely,

John R. Swinton, PhD
Professor of Economics
Book Review Editor, *The American Economist*
Director, Center for Economic Education
Georgia College

LENG LING, Ph.D.
Professor of Finance
J. Whitney Bunting College of Business

AWARDS

Best Paper, Global and China Accounting and Finance Conference, 2019

PUBLICATIONS

1. "Does performance ranking affect mutual funds' investment in lottery stocks?" (June 2020), with Wei-Xing Wu, Xiao-Ting Sun, *China Journal of Econometrics* 1, 1-24. [in Chinese]
    - Double-blind review process

2. "Managerial overconfidence, firm transparency, and stock price crash risk: Evidence from an emerging market" (2020), with Quanxi Liang, Jingjing Tang, Haijian Zeng and Mingming Zhuang, *China Finance Review International* 10, 271-296.
    - 4 citations
    - Double-blind review process
    - C journal in the journal quality ranking list released by the Australian Business Deans Council (ABDC);

3. "Unobserved Ties between Corporate Executives and Mutual Fund Managers" (2019), with Jing Lin and Mingshan Zhou, *Accounting and Finance* 59, 2961-2991.
    - Double-blind review process
    - **A** journal in the list of ABDC
    - Impact factor of journal: 2.217

4. "Judging a Book by Its Cover: The Influence of Physical Attractiveness on the Promotion of Regional Leaders" (2019), with Danglun Luo and Guoman SHE, *Journal of Economic Behavior and Organization* 158, 1-14.
    - Leading article
    - 14 citations
    - Double-blind review process
    - **A*** journal in the list of ABDC
    - 5-year impact factor of journal: 2.240

5. "Corporate Financial Policies under Heterogeneous Beliefs" (2018), with Wei-Ning Niu, Wu Wei-Xing Wu, and Rong-Xi Zhou, *Journal of Management Science and Engineering* 3, 101-124.
    - 2 citations
    - Double-blind review process

6. "Dynamic Autocorrelation of Intraday Stock Returns" (2017), with Xi Dong, Shu Feng and Pingping Song, *Finance Research Letters* 20, 274-280.
    - 3 citations
    - Double-blind review process

- **A** journal in the list of ABDC
- Impact factor of journal: 3.527

7. "Political Connections, Overinvestments and Firm Performance" (2016), with Xiaorong Zhou, Quanxi Liang, Pingping Song and Haijian Zeng, *Finance Research Letters* 18, 328-333.
    - **55** citations
    - Double-blind review process
    - **A** journal in the list of ABDC
    - Impact factor of journal: 3.527

CONFERENCE PRESENTATIONS

"The Value of Alumni Networks: Evidence from the Mutual Fund Industry in China"

- Academy of Financial Service (AFS) meeting, October 2018
- Chinese Economist Society (CES) China conference, June 2018

"Unobserved Ties between Corporate Executives and Mutual Fund Managers"

- Global and China Accounting and Finance Conference, May 2019
- Eastern Finance Association (EFA) meeting, April 2018
- Financial Management Association (FMA) meeting, October 2017
- Chinese Economist Society (CES) China conference, June 2017

"Judging a Book by Its Cover: The Influence of Physical Attractiveness on the Promotion of Regional Leaders"

- Academy of Management (AOM) meeting, August 2016
- Southern Economics Association (SEA) meeting, November 2016

"Dynamic Autocorrelation of Intraday Stock Returns"

- Academy of Financial Service (AFS) meeting, October 2016

"Political Connection, Overinvestment and Firm Performance"

- Chinese Economics Society (CES) North America conference, March 2016
- Southern Finance Association (SFA) meeting, November 2015

Statement on Integrating Research and Teaching

Leng Ling Ph.D.

J. Bunting College of Business

Teaching and research are the two main components of a faculty's academic life. As a faculty in this career for over 14 years, I highly value research-informed teaching because the novel findings from recent research can expand college students' horizon and enrich their leaning experience in classroom.

My main research areas are mutual funds, corporate finance, and behavioral economics and finance. Since these topics are closely related to business and especially the finance discipline, I am able to incorporate my research outcomes into the content of my finance courses. For instance, mutual fund is one of the important topics covered in my Investment Analysis (FINC4101) course, a required finance elective for finance minors. Students may learn from textbooks that mutual fund is an important investment vehicle that provides the benefit of diversification and that portfolio managers shall undertake their fiduciary duty in the best interest of fund investors. However, textbooks seldom address fund managers' unethical and illegal activities in the mutual fund industry. My published scholarship documents that a few fund managers are engaged in self-serving activities --- they try to mislead investors by window dressing their investment portfolios, i.e., buying stocks that has performed well and unloading poorly performing stocks before disclosing portfolio holdings to the publics. To help students have a better understanding on this managers' unethical behavior, I gave a lecture on this topic in class, presenting details on data mining and methodology with the purpose of showing students how to implement the knowledge and skills they learned from the Business Statistics course in empirical research. A couple of students were extremely interested in data analysis, which is intuitive and also quantitative. I wish my research experience can inspire students with the slightest interest in conducting research, as either an undergraduate or graduate in the future. In addition to lectures, I asked students to read financial news and articles about window-dressing, and contribute to an in-class discussion on whether and how investors can effectively monitor managers' unethical behaviors.

In another article on mutual fund managerial behaviors, I examine relationships between fund managers and top executives of companies that the funds invested. This article shows that, after corporate executives relocate from origin firms to destination firms, a small number of fund managers follow the departing executives: they divest from origin firms while initiating investments in destination firms. More importantly, comigrating fund managers have access to earnings information before this information is disclosed to the public and thereafter obtain superior investment returns, suggesting the existence of insider trading. I presented this research in all my finance courses (FINC3131, FINC3132, FINC3830, and FINC4101). Although laws and business ethics are not my fields, I wish to promote business ethics and integrity among my

students by sending a very clear message that insider trading is a crime that will be punished by monetary penalties and incarceration and that, to gain trust from investors and consumers, business ethics and integrity is important for all companies as well as business professionals.

My research in the financial market inspired me to design my finance courses with certain projects that require students to apply what they learn from class to investments. In the microstructure paper published in 2017, I investigate the dynamics of high frequency, intraday stock return autocorrelation during different daytime periods as well as across different trading days of the week when the relative importance of information and liquidity are likely to differ. The evidence suggests that the intraday return autocorrelation differ depending on whether trades occur in the morning or the afternoon, as the relative importance of information and liquidity differ significantly across these two periods. Further, the return autocorrelation on other weekdays is more negative than on Mondays. These findings provide investors a foundation to design better investment strategies that produce lucrative trading profits. Based on conclusions from this paper, I designed a project in both Investment Analysis and Financial Markets & Institutions courses that provides students close-to-real experience of trading stocks. Specifically, with stock trading simulator, students participate in an investment competition, in which they trade stock frequently at different daytime and weekdays. The expertise and experience derived from this research also allows me to serve as the academic advisor for students who participated in the Southeastern Hedge fund Competition (2020-2021), which offers participants a great opportunity to apply theory to practical strategies. In the competition, student teams submit hedge fund strategy proposals that will be evaluated by a panel of investment professionals from the hedge fund industry. Under my close supervision, the student team from Georgia College had been working on the project in the fall semester of 2020, and successfully submitted the strategy proposal on February 26, 2021. Basically, we propose that investors can arbitrage if there is discrepancy between the observed volatility and theoretical level of implied volatility computed from options' market prices, and the average return of the strategy can reach 20% per year.

In summary, I aim to incorporate my scholarship into teaching with the purpose of expending students' horizon in the finance discipline and providing them real-life experience in investments. I wish students learn from college educators not only those theories from textbooks, but also practical applications and, more importantly, the value of ethics and integrity.

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基金业绩排名与彩票型股票投资

吴卫星 [1], 孙晓婷 [1], LING Leng[2]

(1. 对外经济贸易大学金融学院, 北京 100029; 2. Bunting College of Business, Georgia College & State University, Milledgeville, GA 31061)

摘　要　本文基于我国 2005–2017 年主动管理型股票基金和混合偏股基金样本数据, 分析了历史业绩排名对基金投资组合中的彩票型股票占比的影响。本文发现, 从整体上来看业绩排名越靠后的基金越倾向于在下一期持有更高比重的彩票型股票, 同时基金这种投资偏好在下半年或者股市处于下跌时期时更为显著。另外从时间趋势上看, 长期表现处于同类基金平均水平以下的基金在近期业绩压力得不到缓解的情况下也会更多地投资彩票型股票。采用不同的业绩考量指标都可以得出一致的结论。针对上述结果, 本文从基金经理缓解自身职位危机的动机入手进行了分析, 发现持基比重较低, 无管理团队的, 或者在任时间低于历任基金经理平均在任时间的经理人的在面临前期业绩表现不佳的情况下呈现出了对彩票型股票更强烈的偏好。

关键词　彩票型股票; 主动管理型股票基金和混合偏股基金; 基金业绩排名

Does Performance Ranking Affect Mutual Funds' Investment in Lottery Stock?

WU Weixing[1], SUN Xiaoting[1], LING Leng[2]

(1. School of Banking and Finance, University of International Business and Economics, Beijing 100029, China; 2. Bunting College of Business, Georgia College & State University, Milledgeville, GA 31061, USA)

Abstract　With a sample of actively managed open-end mutual funds in China (including equity funds and stock-oriented hybrid funds) from 2005 to 2017, we study the impact of fund's past performance on the proportion of fund asset invested in lottery stocks. Our empirical analysis shows that there is a causal relationship between the fund's investments in lottery stocks and fund performance relative to other funds. That is, the lower the ranks of fund performance, the greater proportion of fund as-

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set invested in lottery stocks. This phenomenon is more obvious when it is near to the year-end and when the stock market is on the down trend. Further, funds with long-term under-performance allocate more capital to lottery stocks. These results are robust to various proxies for fund performance. We also find that the incentive to invest in lottery stocks is higher for solo managers, managers who invest less of their own money in the funds, and managers whose tenure is shorter than the average tenure of their predecessors..

Keywords lottery stock; actively managed stock funds and stock-oriented hybrid funds; performance ranking

1 引言

自 20 世纪 50 年代开始, 学术界对人们投资行为中折射出的赌博偏好 (Friedman and Savage (1948)) 的关注程度越来越高. 按照 Markowitz 的经典理论, 在做出投资决策时如果仅仅权衡资产的期望收益和风险水平, 理性的投资者应该不会参与到购买彩票等赌博行为之中, 但这显然与现实中繁荣的彩票市场相矛盾. Kahneman and Tversky (1979) 的前景理论认为, 赌博偏好使得人们高估了小概率事件的发生概率, 对资产风险收益情况的判断产生了偏差, 从而在进行投资决策时, 赋予资产尾部风险及收益以较大的权重, 产生了赌博行为. Golec and Tamarkin (1998) 为即使是对风险采取规避态度的投资者, 也可能会牺牲一些收益来换取一个赢得巨额回报的机会, 因为这种潜在的巨额回报给投资者提供了额外的效用. 同时由于过度自信现象的存在, 投资者相信自己有能力获得高于市场平均回报的收益, 从而强化了投资者做出赌博策略的动机. 随后 Brunnermeier and Parker (2005), Mitton and Vorkink (2007) 的研究证实了上述观点, 他们以产品收益率的偏度衡量该产品的赌博特性, 考察了投资者对有剧烈偏度的投资产品的偏好情况, 都发现投资者偏好于牺牲投资效率以换取可获得大额收益的机会.

关于直接研究投资者在股票市场上的赌博行为, Kumar (2009) 认为存在两个主要难点: 一方面是被视为赌博对象的股票没有明确的定义, 虽然一直有股市如赌场之说, 但显然某一特定时点上并不是所有股票都具有赌博色彩. 有部分学者采用股票收益率的偏度指标筛选出具有彩票特性的股票 ((Mitton and Vorkink (2007), Barberis and Huang, (2008), Boyer et al. (2010), 陈坚和张轶凡 (2018), Jiang et al. (2020)), Kumar (2009) 复合了股票价格、股票收益率的特质性波动和特质性偏度[1] 三个指标来更为全面地体现彩票型股票特征, 这一定义被广泛应用于后续研究[2]. Bali et al. (2011) 等采用的最大日收益率指标也被广泛认可, 包括江曙霞和陈青 (2013)、朱红兵和张兵 (2020) 等在内的众多文献基于这一指标对具有彩票特性的股票进行了研究. 本文的研究正是以 Kumar (2009) 的复合指标和 Bali et al. (2011) 的最大日收益率指标作为识别彩票型股

[1]即低价格高特质性波动和高特质性偏度的股票, 采用这三个指标是因为, 就单次投资而言, 投资低价股和购买普通彩票成本都较低, 可能造成的损失都较小, 类似于彩票的以小博大特性, 有赌博倾向的投资者往往偏爱低价股; 高的特质波动率说明该股票的收益变化幅度较大, 而高的特质偏度可能意味着该股票具备大涨的可能, 显然具有这样特征的股票比较符合博彩投资者的口味.

[2]复合指标还包括最大日收益率、换手率等在内其他单一指标的各类组合郑振龙和孙清泉 (2013), 李培馨等 (2014).

票的方式进行展开. 除了彩票型股票的识别, Kumar (2009) 认为的另一个研究难点是现实中很难准确观测到相关的投资组合决策从而得到投资者博彩意愿对其投资行为的驱动数据. 为了解决这一问题, Kumar (2009) 从个人投资者特征及组合数据入手, 基于现实中个人投资者对彩票的偏好, 利用他们的社会经济特征直接刻画他们的赌博倾向, 揭示了彩票型股票比较容易受有较高赌博倾向的群体喜好的事实, 得出了股市中投资者的赌博偏好与现实中的赌博偏好具备一致性的结果. 同时作者发现, 和人们购买彩票的支出一般高于预期回报一样, 投资彩票型股票也会降低投资者的组合收益. Bradley et al. (2019), Akbas and Genc (2020) 基于基金投资者投资行为数据也发现投资者对于具有极端高收益资产的过度偏好.

基于这样的思路, 我们也可以衡量机构投资者的博彩偏好. 机构投资者管理大规模资金, 其投资行为决策会涉及到众多投资者的切身利益, 也会给市场带来巨大影响. 具体实践和学术研究中都普遍认为相对于个人投资者来说机构投资者的投资决策更为理性, 那么基于投资彩票型股票预期收益率为负的事实, 如果机构投资者的行为是理性的, 他们应该对彩票型股票采取规避态度, 那么现实是否如此呢? 相对来说机构投资者中公募基金的投资组合数据具有固定的公开时间, 数据可得性也较强, 基于此本文的研究围绕 2005–2017 年间我国的主动型开放式股票型基金和混合偏股型基金这两类展开. 主动管理型基金是指基金经理根据基金的投资理念主动配置资产, 并且跟随市场变化进行调整力求收益超越市场的基金, 其具体投资组合的形成主要受到基金管理者的主动调整, 变动比较灵活. 根据投资对象所占比重的不同, 主动管理型基金可以划分成股票型基金、混合偏股型基金、ETF、QDII、保本型基金等类型. 其中以股票型基金和混合偏股型基金的投资组合中股票资产占比相对较高, 采用这两类基金组合中彩票型股票持有比重衡量其博彩偏好相对具有代表性, 其他干扰因素的影响也相对较小. 同时, 基金管理者会依据市场变化来及时调整持有的证券种类和比例, 力求获取更大的风险调整收益, 因此股票型和混合偏股型基金能更好地体现基金经理的能力, 也能更加充分地反映基金经理人个特征对其投资决策的影响. 另外, 由于开放式基金的经理人面临巨大的赎回压力, 基金经理的雇佣风险压力可能相对要比其他类型的基金经理更为明显, 也更有动力进行投资组合的调整. 因此本文以持股比例较高, 可主动调整资产配置的开放式主动管理型股票基金和混合偏股型基金样本为研究对象.

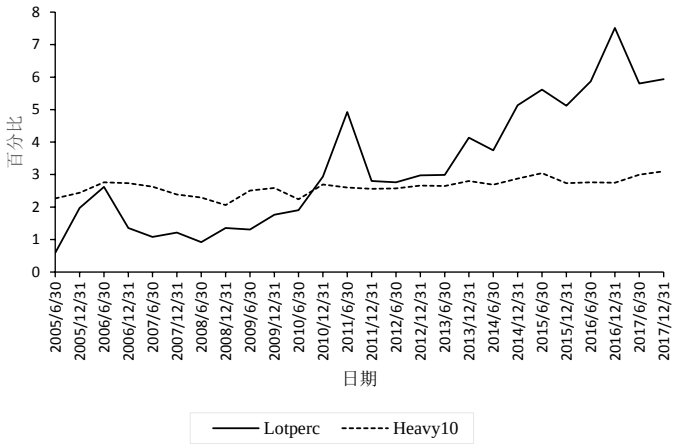

图 1　基金持有彩票型股票比重变化

根据上述两类基金半年报和年报中公布的投资组合构成数据, 本文计算了其中彩票型股票所占比重 Lotperc, 发现平均来说彩票型股票在每只基金中的占比不超过 8% (如图 1 中实线). 图 1 中虚线部分 Heavy10 表示基金投资组合中排在第十位的重仓股平均占净值比重, 可以看到我国基金普遍持股较为分散, 自 2010 年以后, 彩票型股票占基金净值比重持续高于排名第十位的股票占比, 也就是说彩票型股票的收益表现可能会对基金投资组合整体收益产生较大影响, 而且随时间变化呈现上升趋势. 同时, 仅仅关注上图中年度的平均水平是不够的, 在不同基金之间、同一基金不同时间点下持有彩票型股票占净值比重仍然存在着明显的不同, 甚至有时能达到几十倍的差别, 例如根据基金改革红利股票 (001188) 公布的半年报内容和 Kumar (2009) 识别彩票型股票的方式, 该基金在 2017 年 6 月的投资组合中持有 5.5% 的彩票型股票, 而同公司另一只股票型基金鹏华先进制造股票 (000778) 在 2017 年 6 月持有占净值 25.51% 的彩票型股票, 后者在 2016 年 12 月末的投资组合中仅持有 1.45% 的彩票型股票. 既然彩票型股票预期收益为负, 作为专业投资者, 应该尽量减少这类股票可能会给自己的投资组合业绩带来的不利影响, 为何会有基金要在投资组合中大量配置彩票型股票呢? 他们是在什么情况下选择这类股票呢? 对这类股票投资比重的剧烈变化背后反映了基金怎样的动机呢?

本文从基金历史业绩视角分析基金投资彩票型股票的动机. 首先, 彩票型股票投资行为与一般的风险投资行为不同, 风险投资行为一般是理性的决策者在资产收益和风险以及自身投资诉求之间进行权衡的过程, 无论是对风险偏好、风险厌恶还是风险中性投资者而言, 在其进行投资决策、判断风险时, 是在以风险本身不发生变化的条件下以客观的权重分析不同风险下的收益, 描述的是投资人如何对资产的不同风险及收益水平进行评价的过程. 而基于前景理论, 投资彩票型股票这类带有赌博性质的投机行为并非一般风险收益框架下的理性投资决策行为, 它描述的是投资者对资产的风险和回报进行预期的过程, 背后往往存在对小概率事件的过高估计, 反映着投资者的行为偏误, 使其侧重于关注资产的尾部收益, 从而 “有偏差” 地对资产的风险收益情况进行判断. 在这样的背景下有必要对这种行为进行针对性地研究. 而如上文中所述, 个人投资者是被普遍认同的博彩偏好强烈的投资者类型, 从彩票型股票投资角度分析投资者博彩偏好的文献也大多以个人投资者为主要研究对象, 相对来说从这一角度分析基金的彩票型股票投资行为的研究则较少. 鉴于大量基金持有越来越多的彩票型股票以及彩票型股票在风险和收益上存在极为不对称的特征, 投资彩票型股票的行为会有极大地可能性损害基金的业绩表现, 使得这些基金的业绩表现低于其他未投资彩票型股票的基金, 从而损害相应基金投资人的权益, 因此有必要针对性地对这一问题进行深入探讨.

其次, 已有研究表明在基金短期业绩压力的驱使以及我国基金经理更换频繁的现状之下, 会有前期业绩不佳的基金在后期提升组合风险水平以增加获取高收益的机会来减轻业绩压力. 提升组合风险的方式有多种, 如果仅分析基金投资组合的风险变化无法准确体现出背后的赌博心理, 而对彩票型股票的投资行为则能直接反映出基金的博彩偏好. 当基金经理由于前期业绩不佳而面临较大的业绩压力, 担心职位不保时, 其博彩心理可能会更加明显地体现在其投资组合之中. 本文正是从这一点出发, 以基金投资组合中的彩票型股票占比来作为博彩偏好的衡量, 从基金所面临的业绩压力角度探讨其博彩行为背后的动机.

本文余下的部分作如下安排: 第二部分对涉及的文献进行了回顾并提出了本文的假设; 第三

部分主要介绍了本文用到的主要数据及变量; 第四部分报告了模型的主要结果并对结果进行了分析; 第五部分对主要结果进行了稳健性检验; 第六部分对全文进行了总结.

2 文献回顾

本文主要从两个层面对已有文献进行回顾, 一方面梳理基金前期业绩表现与后期组合风险水平的相关研究成果, 另一方面针对基金等机构投资者的彩票型股票投资行为的相关研究进行整理.

与基金历史业绩影响基金投资行为相关的文献非常丰富, 其中 "竞赛假说" 是国内外关于基金业绩表现与其投资偏好、投资行为调整相关研究中最受关注的理论之一, "竞赛假说" 指的是基金业绩排名决定基金经理薪酬的机制. 这种机制可能会导致前期排名靠后的基金经理在后期采取更加冒险的投资行为, 通过增加组合风险来获取高收益从而提高未来的业绩排名, 一方面减轻职位不保的压力, 另一方面获得靠前的业绩排名有助于吸引投资者的资金投入进而扩大基金规模, 基金经理也能相应地提高自己的薪酬收入. 早期 Brown et al. (1996) 通过对美国 1976–1991 年的 334 只股票型基金业绩和组合风险调整行为的分析, 发现年中业绩排名靠后的基金经理 (输家) 在后期提高投资组合风险的程度要高于年中业绩排名靠前的基金经理 (赢家). 与 Brown 等类似, Koski and Pontiff (1999) 也发现基金上半年的业绩表现与其下半年的风险水平之间存在负相关关系. Chevalier and llison (1997) 的研究关注基金投资组合的跟踪误差, 同时改变了时间节点, 作者观察到 1–9 月业绩表现较差的且成立时间较短的基金会在同年 10–12 月期间提高组合跟踪误差的标准差. 近些年的研究进一步延长了数据区间, Chen and Pennacchi (2009) 基于美国 1962–2006 年间 6000 多只开放式股票型基金的相关数据, 发现了与 Chevalier and Ellison (1997) 相似的结论, 历史业绩表现较差的基金经理的确会提高后期投资组合跟踪误差的标准差, 但并没有发现基金经理显著提高投资组合收益的标准差.

但是也有一些研究结果与上述结论存在显著不同. 在理论层面, Taylor (2003) 考虑各个基金风险偏好和投资行为之间的相互影响, 作者构造了一个简单的两期竞赛模型, 并从博弈的角度证明了如果赢家基金经理预测输家基金经理在下一期将提高组合风险, 那么该赢家基金经理在下一期也会相应地提升自己管理的投资组合的风险水平. 在实证层面上, Busse (2001), Goriaev et al. (2005) 对 Brown et al. (1996) 的研究结果提出了质疑. Busse (2001) 基于基金日收益数据, 并采用与 Brown et al. (1996) 相同的方法对美国 1985–1995 年间的 230 只股票型基金的冒险行为进行了研究, 在对基金收益的自相关性进行了调整之后没有发现 Brown et al. (1996) 中得到的结果. 随后, Goriaev (2005) 等在认同 Busse(2001) 对基金收益数据进行自相关调整的同时认为基于基金的收益数据检验基金的业绩与风险选择之间的关系时所得结果会受到基金收益的截面相关的影响; 同时他们还在研究中对样本期进行了拓展, 使用 1976–2001 年的基金数据重复了 Brown et al. (1996) 的研究, 结果发现如果引入基金收益的截面相关特征, 同样无法得到历史业绩表现越差的基金后期提高投资组合风险的程度越大的结论.

基于中国市场的这方面研究虽然起步较晚, 但短时间内也涌现出了丰富的研究成果. 罗真和张宗成 (2004) 是国内较早从实证角度证明了基金业绩会影响不同特征的基金经理的职业忧虑水平进而改变其投资行为的文献. 基于 1999–2002 年我国封闭式基金及其基金经理的相关数据, 作

者发现当年基金业绩表现与基金经理面临降职或者离职的概率呈现出明显的负相关关系, 但是这种关系未出现在前一年的基金业绩与基金经理面临消极职业结果的概率关系之上; 面对可能发生的消极职业结果时, 相比于年长的基金经理, 年轻的基金经理在实际投资行为中更容易产生 "羊群行为". 随着近年来基金市场的快速发展, 我国开放式基金的市场份额逐渐扩大, 越来越多的研究目光聚集在开放式基金的业绩表现上. 我国基金业存在的短期业绩评价机制加剧了众多基金经理对职位的担忧, 从而可能会进一步影响其对投资组合的调整. 山立威和王鹏 (2012) 利用 2005–2010 年我国开放式股票型基金和偏股混合型基金的相关数据, 研究了基金的年度业绩排名对基金经理冒险行为的影响. 他们发现年中业绩排名靠后的基金经理在下半年提高其投资组合的风险的程度要大于年中业绩排名靠前的基金经理. 但是, 基金经理提高下半年持有的投资组合的风险并不能显著提高下半年基金的业绩, 尤其是在股票市场处于下跌时期时, 提高下半年投资组合的风险反而不利于基金业绩表现. 他们的结论支持锦标赛机制下业绩压力较大基金经理存在过度冒险行为的观点, 而业绩不良基金的过度冒险行为显然会加剧其基金经理面临被解职的风险.

在业绩评价机制的基础上, 另有一部分文献从基金经理声誉角度出发探讨基金经理投资风格的选择, 彭文平和杨蓝蓝 (2013) 综合考虑了业绩评价机制和基金经理职业声誉机制以及二者之间的相互作用, 进而分析二者对基金经理行为选择的差异化影响. 研究发现当前的业绩评价机制使得基金经理存在一定程度的短视行为和羊群行为, 同时, 声誉对职业生涯表现不同的基金经理具有不同的激励效应, 任职时间较短的基金经理更易出现短视行为和羊群行为. 孟庆斌等 (2015) 更关注基金经理的职业忧虑对投资风格的影响, 文中采用基金经理的声誉水平衡量其职业忧虑程度 (基金经理声誉水平越低, 其职业忧虑水平越高), 结果发现基金经理声誉水平与基金投资风格的冒险程度之间呈现出非线性关系: 声誉水平处于两极的基金经理会倾向于通过承担更高风险获取高投资收益; 相比之下声誉在中等水平的基金经理投资风格会更加保守. 考虑到既然薪酬激励和解职风险是业绩排名和声誉的主要作用方式, 而二者对基金投资风格的选择可能存在相互抵消的作用, 肖继辉等 (2016) 认为可以通过股市表现和股市强度这些外生变量来区分二者的相对强弱, 作者以 2006–2012 年我国开放式基金为样本, 检查了年中业绩排名以及上半年意外风险对下半年预期风险调整的影响, 发现牛市阶段, 基金经理主要受到薪酬的激励, 上半年业绩为赢家的基金在下半年风险选择上较为保守, 输家基金则相对更为冒险; 熊市阶段则更加重视保住现有职位, 赢家相对于输家更为冒险. 这种现象会随着牛熊市强度的增加而更为明显.

基于上述分析, 我们可以看到关于前期业绩表现对基金投资风格选择影响的文献研究已较为丰富, 总的来看前人主要是从薪酬激励和职业忧虑两个角度分析业绩竞赛机制作用于基金投资风格的结果, 但由于在不同情况下二者的相对重要程度以及作用方向存在不同, 前人的观点和实证研究结果也有所不同. 相比之下关于基金等机构投资者博彩行为的研究起步较晚, 数量相对较少, 但是相对来说结论较为一致. 国内外研究结果都表明, 个人投资者的组合中过多配置了彩票型股票, 不利于其组合的表现 (Kuma (2009), Green and Hwang (2012), 廖理 (2016)). 部分学者从彩票型股票收益发生反转的角度分析了博彩行为损害组合收益的原因, 如江曙霞和陈青 (2013) 采用最大日收益率指标对中国市场上的彩票型股票进行识别, 得到最大日收益率较高的股票组合未来收益较低的结论. 朱红兵和张兵 (2020) 基于我国 1995–2017 年 A 股数据从投资者博彩投机心理角度探讨了股票最大收益率异象的形成机制, 发现当月最大日收益率越小的股票下个月收

益率越高, 基于最大日收益率指标构造股票多空投资组合可获得年化 15.72% 的收益. 孔东民等 (2010) 基于 Kumar (2009) 的复合指标也发现基于彩票型股票构建的组合在随后的三个月平均下跌 2.5%. 同样参考 Kumar (2009) 对彩票型股票的定义指标, 李培馨等 (2014) 利用我国股票数据在个股层面构建了彩票型股票指数, 发现彩票型股票的收益率比非彩票型股票每年低 10% ∼ 12%. Barinov (2018) 指出彩票型股票具有负的预期收益的一个解释是持有这类股票可以对冲股票市场波动. 相比个人投资者, 机构投资者持有更少的彩票型股票, 同时持有彩票型股票同样对其业绩产生了不利影响. 比如孔高文等 (2015) 以及胡锋和李媛媛 (2015) 等探究了我国 A 股市场上基金和机构投资者整体对彩票型股票的持股偏好, 以及持有彩票型股票对他们的投资业绩的影响, 都得出了持有彩票型股票不利于组合长期业绩表现的结论.

通过前面的文献梳理我们也可以看到, 由于业绩排名和声誉等作用机制的复杂性, 前人的观点和实证研究结果也有所不同, 从而影响到基金对彩票型股票的投资行为. 对于历史业绩表现优异排名靠前的基金来说, 基金经理面临的职业忧虑程度较低, 相对来说购买彩票型股票是一种较为低效率的投资方式, 部分基金经理可能会因为短视行为而购买彩票型股票, 但是这种行为会以更高的可能遭受损失, 显然大部分业绩优异的基金尤其是长期表现优异的基金不会做出这样的决策. 而对于对于那些职业忧虑程度较高的基金经理, 在保住现有职位的强烈动机下, 这些基金经理可能愿意冒着出现小规模损失的风险来换取一个赢得巨额回报的机会, 从而挽救自己的职业生涯, 尤其是我在国基金经理普遍较为年轻, 投资理念相对成熟度不高的情况下, 博彩行为发生的概率会进一步上升, 综合这两方面的分析, 本文得出假设 1: 历史业绩排名越靠后的基金越会在组合中配置更多的彩票型股票.

进一步来说, 相对于年中, 每年年底基金可能面临更为关键的业绩考核, 如果基金希望通过投资彩票型股票在短时间内增加收入或者摆脱职业危机的话, 那么对于上半年表现不佳的基金来说, 下半年增加彩票型股票投资的动机更加强烈. 由此本文提出假设 2: 在下半年, 落后的业绩排名会促使基金更大幅度提升组合中的彩票型股票占比.

另外, 在不同的股票市场周期下基金经理冒险行为所受到的主要驱动因素往往存在差异. 国内外学者在探讨基金经理在不同市场环境下的冒险行为时大多认为, 在股市处于上涨时期时, 基金经理在进行风险决策时更多考虑的是获取更高的薪酬, 前期业绩不佳的基金可能会选择提升组合的风险水平, 而股市处于下跌时期时, 前期业绩不佳的基金经理将面临更加严重的职业忧虑, 从而更可能采取较为保守的投资方式 (Kempf et al. (2009), 肖继辉 (2016)). 但是, 博彩偏好与上述基金经理理性的风险收益权衡行为不同, 基于对投资者现实中的彩票偏好的研究以及 Kumar (2009) 对个人投资者对彩票型股票的偏好研究都发现在经济走势不佳的时期, 投资者赌博偏好更为明显. 那么在股市处于下跌时期时基金经理也可能呈现出这样的行为偏好, 尤其是前期业绩排名靠后职业忧虑程度更高的基金经理可能会在这样的压力之下产生赌博心理. 因此, 本文对此提出两个对立假设: 假设 3a 为在股市上涨时期, 历史业绩排名越靠后的基金越会在组合中配置更多的彩票型股票; 假设 3b 为在股市下跌时期, 历史业绩排名越靠后的基金越会在组合中配置更多的彩票型股票.

从时间趋势角度来看, 职业忧虑程度较高的基金经理往往长期表现不佳, 如果基金在过去半年业绩表现不佳的压力下试图通过投资彩票型股票获取极端收益来缓解业绩压力, 那么这种动机

也应该在长期业绩表现低于同类基金平均水平的基金中更为强烈, 也就是说基金业绩趋势的变化会影响其对彩票型股票的持有. 基于这样的分析本文提出假设 4: 相对来说长期排名靠后的基金在近期业绩压力没有得到缓解的情况下会更明显地增加组合中彩票型占比.

3 样本数据与变量定义

3.1 彩票型股票的识别

本文分别从单一指标和复合指标中选择一种最为常用的方式识别我国 A 股市场上的彩票型股票, 即 Bali et al. (2011) 提出的最大日收益率指标和 Kumar (2009) 提出的综合股票价格、股票收益率的特质性波动率和特质性偏度三种变量的指标, 指标频率都为月度. 其中, 最大日收益率指标的定义方法是根据股票过去一个月的最大日收益率将所有股票进行十等分, Bali et al. (2011) 的研究中主要关注位于最高和最低最大日收益率组别的股票, 本文考虑到我国 A 股市场上的股票数量以及和 Kumar (2009) 的指标的可比性, 做了八等分并主要关注位于最高最大日收益率组别的股票, 即最具备彩票特性的一类股票. Kumar (2009) 识别彩票型股票的具体方法是在 t 月选取每只股票第 $t-1$ 月最后一个交易日的收盘价作为股票的月度股票价格, 采用 Carhart (1997) 四因子模型中残差项的方差作为股票的月度特质性波动指标, 计算特质性偏度指标则采用 Harvey and Siddique (2000) 的方法, 即用股票超额收益率对市场超额回报及其平方项做回归得到的残差项的三阶矩作为股票的月度特质性偏度指标. 通过上述计算得到了特质性波动、特质性偏度和股票价格三个指标后再对股票进行分类, 每个月将其中股价低于中位数以及特质性波动和特质性偏度高于中位数的股票归为彩票型股票. 考虑到研究需要, 股票样本中剔除了带有 ST 或 PT 标识的股票和交易月份不足 6 个月的股票, 以及所有股票上市首日复牌首日等不设涨跌幅限制的交易日的观测值.

3.2 基金持有彩票型股票份额

在上文中识别出的彩票型股票的基础上, 再结合基金每半年公布的投资组合构成数据计算该基金 i 在 t 时期持有的彩票型股票占净值比重, 采用的计算公式如下:

$$\text{Lotperc}_t^i = \sum_s w_{t-\tau}^s \times l_{t-\tau}^s, \tag{1}$$

其中, $l_{t-\tau}^s$ 为取值为 0 或者 1 的虚拟变量, 当基金 i 投资组合中股票 s 在时刻 $t-\tau$ 为彩票型股票时则取 1, 否则取 0. $w_{t-\tau}^s$ 表示股票 s 在时刻 $t-\tau$ 占基金净值的比重, 二者之积为单只彩票型股票所占基金净值比重, 再做加和即为基金 i 在 t 时刻持有的彩票型股票所占净值比重. 参考文献中的常见做法, 本文在计算变量 Lotperc 时基于最新公布的信息, 即基金在 t 时刻的 Lotperc 取值为采用距离 t 最接近时点的已公开投资组合数据计算得到. 由于基金每半年报告一次完整的投资组合情况, 根据该数据可以计算彩票型股票占基金净值比重变量, 作为下一时期基金持有彩票型股票比重的度量.

在通过上述计算过程得到变量 Lotperc 后, 本文还构建了平均投资于每只彩票型股票的资金占比变量 Perlot, 原因是一方面考虑彩票型股票投资更多反映了一种投机倾向, 而如果基金投资了多只彩票型股票, 但平均每只股票上分配的资金比重较低, 那么和仅投资了个别的彩票型股

票, 但平均在每只股票上的资金比重较高的基金相比, 可能二者的 Lotperc 数值相近, 采用变量 Perlot 可以对这种情况加以区分. 另一方面相对来说可以减少采用不同的彩票型股票识别方式对结果产生的可能影响.

3.3 基金业绩排名指标

现有文献中大多同时采用基金原始回报率和风险调整后的回报率衡量基金业绩, 本文进行类似的操作, 采用一种原始收益率以及一种风险调整后的收益率两种指标对基金业绩进行度量. 具体来说, 其中一种业绩度量指标是包含红利再投资的基金净值增长率, 净值增长率是最容易被投资者直接观测到的基金业绩, 它衡量了投资者的绝对回报或损失, 为了分析不同时间段历史业绩不同影响, 本文分别计算了基金过去半年和过去一年的净值增长率平均值. 其二是基于 Cahart (1997) 四因子模型调整后的基金过去半年和过去一年风险调整收益, 具体公式如下:

$$R_{it} - R_{ft} = \alpha_i + \beta_{i1}(R_{mt} - R_{ft}) + \beta_{i2}\mathrm{SMB}_t + \beta_{i3}\mathrm{HML}_t + \beta_{i4}\mathrm{MOM}_t + \varepsilon_{it}, \tag{2}$$

其中 R_{it} 表示基金日净值增长率, R_{ft} 表示无风险利率, 采用了银行一年期定期存款基准利率; R_{mt}、SMB_t、HML_t 和 MOM_t 分别表示市场因子、规模因子、账面市值比因子和动量因子. 基于上述步骤计算得到基金净值增长率和超额回报率指标后, 接下来对其进行排序, 获得基金业绩排序指标. 即在每个时间点根据过去半年和过去一年的基金净值增长率、经过四因子模型调整后的基金超额回报率按照基金投资风格类别 (基金类别划分是依据常见的晨星分类方式将基金分为成长型、价值型和平衡型基金) 从高到低进行排序, 并除以各个分类下的样本数目进行标准化得到取值在 $0 \sim 1$ 之间的变量, 从而得到基金业绩排序指标.

3.4 控制变量

除了以上主要的解释变量和被解释变量外, 本文在模型中还包含了其他基金特征作为控制变量. 其中包括:

1) 基金成立年限 (LnFundage): 是指基金至样本期间末期的成立年限, 然后对其取自然对数. 基金成立时间越长所积累的声誉水平可能也越高, 面对前期不良业绩表现时的紧迫程度可能相对于成立时间较短的基金更低, 由此引发持有的彩票型股票份额更为有限.

2) 基金规模 (LnTNA): 是通过对基金期末资产净值再取自然对数得到. 规模庞大的基金通过投资彩票型股票提升整体业绩的难度相对更大, 从而可能对彩票型股票的偏好相对更低.

3) 基金管理费率 (Feeratio): 管理费率越高的基金越需要更好的业绩表现吸引及留住投资者资金, 基金持有的彩票型股票比重可能也越高.

4) 基金换手率 (Turnover): 通过计算期间内基金证券总购买或总卖出量之中的较小值与基金平均总资产规模的比率得到. 换手率越高的基金可能更加追逐股票短期收益, 从而可能更加偏好彩票型股票.

5) 基金资产中股票资产占比 (Stockperc): 基金持有的股票资产占比越高, 彩票型股票占比往往也越高.

3.5 变量汇总及数据来源

本文采用了 2005–2017 年我国主动型开放式股票基金和偏股混合型基金半年报和年报中公

布的完整投资组合数据计算彩票型股票所占基金净值比重,并且为保证有足够的基金历史业绩数据, 样本中剔除了成立年限不足两年的基金样本. 为避免幸存者偏差问题, 样本中包含了已经清盘的基金, 最终得到包含 1185 只样本基金的非平衡面板数据. 为减少异方差问题的影响, 本文对模型进行广义最小二乘法估计. 另外, Hausman 检验结果表明随机效应的原假设被显著拒绝, 因此本文采用固定效应模型进行回归分析. 上述基金相关数据均可在锐思数据库和国泰安数据库中获取, 文中用到的主要的变量名称、含义以及对应的符号表示如表 1 所示.

表 1 变量定义与符号表示

变量符号	变量名称及计算方式
Lotperc1	基金投资于彩票型股票的资金占净值比例一 (基于 Bali et al. (2011) 方法)
Lotperc2	基金投资于彩票型股票的资金占净值比例一 (基于 Kumar (2009) 方法)
Perlot1	基金平均投资于每只彩票型股票的资金占净值比例一 (基于 Bali et al. (2011) 方法)
Perlot2	基金平均投资于每只彩票型股票的资金占净值比例二 (基于 Kumar (2009) 方法)
Navghy	基金过去半年月净值增长率平均值
Navghyr	基金过去半年月净值增长率排名
Navgy	基金过去一年月净值增长率平均值
Navgyr	基金过去一年月净值增长率排名
Alphahy	基金过去半年超额收益率
Alphahyr	基金过去半年超额收益率排名
Alphay	基金过去一年超额收益率
Alphar	基金过去一年超额收益率排名
Lnfundage	基金成立时间, 以年度计算 (精确到日), 再取自然对数.
Feeratio	基金的管理费率
LnTNA	基金规模, 用基金份额的自然对数衡量.
Turnover	基金持有的投资组合中股票资产的换手率
Stockperc	基金持有的股票资产占比

4 实证结果及分析

4.1 描述性分析

表 2 是回归分析中涉及到的主要变量的描述性分析, 从表中结果可以看出, 采用第一种彩票型股票识别方式得到基金资产中平均有 6.4% 的比例投资于彩票型股票, 第二种方式下这一数字为 5.5%, 数值上较为接近, 其他分位点对应数值也相近. 采用平均投资在每一只彩票型股票上的资金占比时两种方式得到的结果则更加接近, 说明虽然两种识别方式下得到的基金所投资的彩票型股票构成可能略有不同, 但是在平均水平上是一致的. 另外, 基金成立年限的自然对数平均值为 1.629, 基金规模的自然对数平均值为 20.491. 基金换手率平均为 2.236, 符合我国基金换手率普遍较高的现象. 样本基金中股票资产占比平均为 81%, 上述变量值均在已有文献得到的结果合理变化范围之内.

表 2　变量描述性统计

变量	均值	最小值	$P25$	中位数	$P75$	最大值	标准差
Lotperc1	0.0637	0	0.0155	0.0410	0.0894	0.503	0.0475
Lotperc2	0.0554	0	0.0130	0.0306	0.0806	0.476	0.0467
Perlot1	0.0152	0	0	0.0124	0.0216	0.109	0.0122
Perlot2	0.0158	0	0	0.0135	0.0217	0.115	0.0126
Navghy	0.00892	−0.127	−0.0112	0.0443	0.0242	0.352	0.0334
Navgy	0.00704	−0.0808	−0.00769	0.00465	0.0173	0.191	0.0250
Alphahy	0.00183	−2.899	−0.00046	0.00026	0.00084	11.671	0.141
Alphay	0.00213	−1.449	−0.00061	0.00028	0.00093	15.836	0.175
Lnfundage	1.629	0.695	1.186	1.650	2.055	2.790	0.526
Feeratio	0.015	0.005	0.015	0.015	0.015	0.015	0.113
LnTNA	20.491	14.846	19.419	20.657	21.603	24.356	1.553
Turnover	2.236	0.0150	0.651	1.299	2.743	26.437	2.699
Stockperc	0.808	0.538	0.745	0.840	0.892	0.947	0.115

4.2　回归结果分析

4.2.1　基金过去半年业绩排名与彩票型股票投资

本文接下来探讨基金过去半年净值增长率排名以及过去半年超额收益率排名对投资组合中彩票型股票占净值总比重和平均比重的影响, 采用的基本模型如式 (3) 和式 (4) 所示. 式中变量的角标 i 表示第 i 只基金, 被解释变量 $\mathrm{Lotperc}_{it}$ 和 Perlot_{it} 分别包括表 1 中定义的 $\mathrm{Lotperc1}_{it}$、$\mathrm{Lotperc2}_{it}$ 和 $\mathrm{Perlot1}_{it}$、$\mathrm{Perlot2}_{it}$ (回归中为了减少变量前系数的小数点位数采用了百分数形式的被解释变量). 变量 Perfr_{it} 表示上文中定义的两种衡量基金过去半年业绩排序的变量. 式中其他变量为回归中控制的基金 i 的基本特征变量, 包括基金成立时长 $\mathrm{LnFundage}_{it}$、换手率 $\mathrm{Turnover}_{it}$、管理费率水平 $\mathrm{Feeratio}_{it}$、基金规模 LnTNA_{it} 和基金资产中股票资产占比 $\mathrm{Stockperc}_{it}$. 另外 $\sum \beta_q \mathrm{Fund}_q$ 和 $\sum \gamma_l \mathrm{Time}_l$ 分别表示控制了基金固定效应和时间固定效应, 基于上述变量得到的回归结果如表 3 所示.

$$\begin{aligned}\mathrm{Lotperc}_{it} =& \beta_0 + \beta_1 \mathrm{Perfr}_{it} + \beta_2 \mathrm{LnFundage}_{it} + \beta_3 \mathrm{Turnover}_{it} + \beta_4 \mathrm{Feeratio}_{it} + \\ & \beta_5 \mathrm{LnTNA}_{it} + \beta_6 \mathrm{Stockperc}_{it} + \sum \beta_q \mathrm{Fund}_q + \sum \gamma_l \mathrm{Time}_l + \varepsilon_{it}.\end{aligned} \tag{3}$$

$$\begin{aligned}\mathrm{Perlot}_{it} =& \beta_0 + \beta_1 \mathrm{Perfr}_{it} + \beta_2 \mathrm{LnFundage}_{it} + \beta_3 \mathrm{Turnover}_{it} + \beta_4 \mathrm{Feeratio}_{it} + \\ & \beta_5 \mathrm{LnTNA}_{it} \beta_6 \mathrm{Stockperc}_{it} + \sum \beta_q \mathrm{Fund}_q + \sum \gamma_l \mathrm{Time}_l + \varepsilon_{it}.\end{aligned} \tag{4}$$

表 3 中前四列是以两种彩票型股票识别方式下的以 Lotperc 作为被解释变量进行回归得到的结果, 后四列则是以相应两种 Perlot 作为被解释变量得到的结果. 可以看到, 无论哪种彩票型股票识别方式, 基金过去半年净值增长率排名变量 Navghyr 前的系数在 1% 的水平上都显著为正, 由于本文按照基金业绩水平从高到低进行排名, 这就表明基金过去半年业绩排名越靠后, 下一期的投资组合中彩票型股票占比也越高, 排名每下降 1%, 基金投资组合中彩票型股票占比上升 0.35% 左右. 采用过去半年超额收益率排名变量 Alphahyr 得到了一致的结果, 这与假设 1 较为一致. 表中后四列以 Perlot 作为被解释变量得到的历史业绩变量前的系数也证实了前面的结

论, 即过去半年业绩排名相对靠后的基金, 其投资在平均每只彩票型股票占比越高. 控制变量之中, 基金规模变量 LnTNA 前的系数显著为负, 表明规模越小的基金投资组合中彩票型股票占比越高, 正如我们在前文中所说, 规模庞大的基金通过投资彩票型股票提升业绩的难度更大, 使得大基金相对缺乏动力持有彩票型股票. 基金成立时间变量 LnFundage 前的系数显著为负, 即成立时间越短的基金持有的彩票型股票也越多, 一种可能的解释是基金成立时间越短对于业绩排名更为敏感和重视 (Duong and Meschke (2019)), 可能具有更强的动机持有彩票型股票. 另外, 股票资产占比变量 Stockperc 前的系数显著为正也符合前文中的预测.

表 3 基金过去半年业绩对变量 Lotperc 和 Perlot 的回归结果

解释变量	被解释变量: Lotperc				被解释变量: Perlot			
	(1) Lotperc1	(2) Lotperc1	(3) Lotperc2	(4) Lotperc2	(5) Perlot1	(6) Perlot1	(7) Perlot2	(8) Perlot2
Navghyr	0.346***		0.351***		0.259***		0.260***	
	(3.05)		(3.48)		(2.98)		(2.75)	
Alphahyr		0.276**		0.282**		0.194***		0.203***
		(2.32)		(2.25)		(3.06)		(4.00)
LnTNA	−0.218***	−0.213**	−0.252***	−0.302***	−0.228***	−0.243***	−0.170***	−0.193***
	(−3.64)	(−2.54)	(−3.83)	(−5.32)	(−8.94)	(−5.07)	(−6.42)	(−8.35)
Lnfundage	−1.171***	−1.152**	−1.164***	−1.168***	−0.316***	−0.305***	−0.320***	−0.318***
	(−2.70)	(−2.22)	(−3.03)	(−2.98)	(−8.55)	(−8.29)	(−6.93)	(−6.37)
Turnover	0.0444***	0.0452***	0.0453***	0.0439***	0.0273***	0.0311**	0.0418***	0.0454***
	(5.11)	(4.89)	(4.97)	(3.45)	(3.04)	(2.44)	(4.97)	(4.74)
Feeratio	0.0866	0.0946	0.104	0.134	0.0145***	0.0148***	0.0137***	0.0130**
	(0.07)	(0.48)	(0.24)	(0.77)	(3.06)	(2.94)	(3.22)	(2.26)
Stockperc	3.574***	3.485***	3.431***	3.522***	2.415***	2.226***	2.366***	2.134***
	(9.54)	(7.43)	(8.38)	(7.76)	(9.92)	(4.54)	(9.41)	(7.75)
基金固定效应	控制	控制	控制	控制	控制	控制	控制	控制
年份固定效应	控制	控制	控制	控制	控制	控制	控制	控制
N	7742	7434	7742	7434	7742	7434	7742	7434
Adj_R2	0.309	0.323	0.291	0.293	0.200	0.204	0.127	0.162

注: 表中 *** 表示在 1% 的水平下显著, ** 表示在 5% 的水平下显著, * 表示在 10% 的水平下显著, 括号内为回归变量系数的 t 值, 下同.

如果基金是在业绩考核压力和职业忧虑的驱使下进行彩票型股票投资, 那么相对于年中来说, 每年年末基金可能面临更为关键的业绩考核, 此时的职业忧虑水平将更为突出. 也就是说如果基金希望通过投资彩票型股票在短时间内获取极端高收益摆脱职业上的危机的话, 那么这一动机应该在面临关键业绩考核的年末更加强烈. 为了对这一猜想加以验证, 本文在这里引入了一个虚拟变量 Sechalf, 即当样本基金所处时间段为下半年时, 变量 Sechalf 取值为 1, 否则则取值为 0, 并将这一虚拟变量和基金业绩排名变量相乘得到交互项, 随后将虚拟变量和交互项一同放入回归方程 (3) 和 (4) 中. 基于上表中基金业绩排名越靠后持有的彩票型股票越多的结果, 在下半年相对更加关键的业绩考核背景下, 回归得到的业绩排序变量与变量 Sechalf 的交乘项前系数应显著为负, 变量 Sechalf 前的系数应为正.

表 4 中呈现了分别以 Navghyr 和 Alphahyr 作为解释变量衡量基金业绩所在排序得到的结果. 与表 3 结构相似, 表 4 中前四列以彩票型股票股票总占比 Lotperc 为被解释变量, 后四列以平均占比 Perlot 为被解释变量. 可以看到变量 Sechalf 前的系数都显著为正, 表明下半年基金投资组合中彩票型股票总占比和平均占比均显著高于上半年, 与前文的预期相一致, 下半年基金经理的博彩动机更加强烈. 无论采用基金净值增长率还是超额收益率对基金业绩排序都得到了相似的结果, 不再赘述. 上述结果可以证明本文假设 2 中的猜测.

表 4　基金过去半年业绩对变量 Lotperc 和 Perlot 的回归结果 —— 区分年中和年末

解释变量	被解释变量: Lotperc				被解释变量: Perlot			
	(1) Lotperc1	(2) Lotperc1	(3) Lotperc2	(4) Lotperc2	(5) Perlot1	(6) Perlot1	(7) Perlot2	(8) Perlot2
Navghyr	0.235**		0.232*		0.105		0.101	
	(1.99)		(1.85)		(1.52)		(1.63)	
Alphahyr		0.110**		0.104*		0.191**		0.186**
		(2.01)		(1.77)		(2.48)		(2.53)
Navghyr×Sechalf	0.172***		0.177***		0.199**		0.123***	
	(3.39)		(3.76)		(2.04)		(3.10)	
Alphahyr×Sechalf		0.164***		0.164***		0.0893***		0.0887***
		(4.18)		(3.85)		(3.82)		(2.90)
Sechalf	1.303***	1.285***	1.222**	1.214**	0.275***	0.261***	0.272***	0.263***
	(4.79)	(5.16)	(2.08)	(2.56)	(5.04)	(3.19)	(5.51)	(4.88)
控制变量	控制	控制	控制	控制	控制	控制	控制	控制
基金固定效应	控制	控制	控制	控制	控制	控制	控制	控制
年份固定效应	控制	控制	控制	控制	控制	控制	控制	控制
N	7742	7742	7742	7742	7742	7742	7742	7742
Adj_R2	0.362	0.353	0.351	0.354	0.212	0.209	0.188	0.187

4.2.2　考虑股票市场周期变化的影响

接下来本文对假设 3 中的两个对立假设进行验证. 对于股票市场周期的划分, 研究中常常采用的方法是设置一个阈值并将股票市场的收益率与其进行比较, 高于该阈值为上涨周期, 低于该阈值则为下跌周期. 为了得到更为可靠的结论, 本文同时基于 0 和无风险利率两个阈值进行分析. 第一种情况下, 如果过去半年的沪深 300 指数月均增长率大于 0, 则认为市场处于上涨周期 (记为 Up1); 相反地, 如果月均增长率小于 0, 则认为市场处于下跌周期 (记为 Down1). 第二种方式与第一种类似, 参考了 Fabozzi and Francis (1997) 和李琛等 (2017) 的做法, 将一段时间内市场平均收益率超过无风险利率的时间段定义为市场处于上涨周期 (记为 Up2), 将市场平均收益率低于负的无风险利率的时间段定义为市场处于下跌周期 (记为 Down2). 与第一种方法相比, 第二种方法无疑是一种更为严格的股市周期定义方法, 能够兼顾到我国股市波动幅度较大的特征.

对样本基金按照上述股市周期划分方式进行分组后再进行前文中的回归分析得到的结果如表 5a 和 5b 所示, 分别为被解释变量 Lotperc1 和 Lotperc2 对应的结果. 可以发现, 在股市处于下跌时期时, 变量 Navghyr 和 Alphahyr 前的系数值更大, 显著性水平也越高, 表明过去半年业

绩排名越靠后的基金越会持有更多的彩票型股票, 同时在两种股市周期分类方式下, 解释变量前的系数符号和显著性水平较为相似, 但是更加严格定义下解释变量前的系数数值更大, 即当股市下跌趋势更加明显时, 基金投资组合中彩票型股票占比对其历史业绩排名的敏感程度更高, 显示出了基金经理更高的职业忧虑程度, 从而验证了假设 3b.

表 5a 划分股市周期下彩票型股票占比对基金历史业绩排名的回归结果 1

解释变量	被解释变量: Lotperc1							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Up1	Down1	Up1	Down1	Up2	Down2	Up2	Down2
Navghyr	0.129	0.385***	0.240**	0.422***				
	(1.23)	(3.17)	(2.08)	(3.96)				
Alphahyr					0.0969	0.339***	0.184*	0.380***
					(0.67)	(2.76)	(1.77)	(3.01)
控制变量	控制	控制	控制	控制	控制	控制	控制	控制
基金固定效应	控制	控制	控制	控制	控制	控制	控制	控制
N	4727	3037	3809	2126	4325	2637	3406	1879
Adj_R2	0.173	0.192	0.177	0.214	0.154	0.183	0.158	0.198

表 5b 划分股市周期下彩票型股票占比对基金历史业绩排名的回归结果 2

解释变量	被解释变量: Lotperc2							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Up1	Down1	Up1	Down1	Up2	Down2	Up2	Down2
Navghyr	0.125	0.379***	0.237**	0.414***				
	(1.12)	(3.66)	(1.99)	(3.83)				
Alphahyr					0.0992	0.332***	0.191*	0.376***
					(0.89)	(3.25)	(1.69)	(4.40)
控制变量	控制	控制	控制	控制	控制	控制	控制	控制
基金固定效应	控制	控制	控制	控制	控制	控制	控制	控制
N	4727	3037	3809	2126	4325	2637	3406	1879
Adj_R2	0.173	0.191	0.180	0.208	0.155	0.187	0.156	0.212

4.2.3 考虑基金长期业绩排名压力的影响

前文中主要以基金过去半年的业绩表现衡量基金面临的业绩压力, 以此讨论业绩对其下一期彩票型股票占比的影响, 虽然我国基金经理面临着相对更大的短期业绩压力, 但只有将基金的短期业绩与相对更长期的业绩表现相结合才能更为全面准确地反映真实的业绩压力, 同时业绩变化趋势也能反映基金业绩压力的动态变化从而改变基金的投资偏好. 在这一部分, 本文引入了基金更长期的历史业绩表现. 具体来说, 回归分析中的解释变量仍采用过去半年的历史业绩, 只是在样本选择上发生了变化, 以每半年为一个时间节点, 选择解释变量对应时点过去一年和过去一年半 (也即被解释变量对应时点过去一年半和过去两年) 业绩都排在中位数以下的基金样本, 来分析基金过去半年的业绩表现如何影响彩票型股票投资比重的变化, 采用的回归方程与前文中类似, 结果见表 6a 所示.

表 6a 中前两列是以过去一年都排在同类基金业绩中位数以下的基金作为样本, 可以看到表

示基金过去半年业绩排序的变量 Navghyr 和 Alphahyr 前的系数均在 1% 的水平上显著为正, 表明在这部分基金样本中, 在过去半年业绩排名仍然靠后的情况下会越多投资于彩票型股票, 而且通过与表 3 中全样本下对应系数进行比较可以发现, 在更长时间段内 (过去一年半) 表现低于同类平均水平的基金其过去半年业绩排序变量前的系数绝对值会更大, 表中后四列以更长时间段下都排在同类基金业绩中位数以下的基金作为样本得到了类似的结果, 与前文中的分析一致. 也就是说历史业绩持续低迷的基金表现出了对彩票型股票更为强烈的追逐, 从而证实了本文提出的假设 4.

表 6a　长期表现不佳的基金业绩排名对彩票型股票占比的影响

解释变量	过去一年				过去一年半			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Lotperc1	Lotperc2	Lotperc1	Lotperc2	Lotperc1	Lotperc2	Lotperc1	Lotperc2
Navghyr	0.415***	0.404***			0.469***	0.458***		
	(4.22)	(4.62)			(5.48)	(5.80)		
Alphahyr			0.335***	0.326***			0.391***	0.399***
			(3.60)	(3.42)			(4.44)	(4.65)
控制变量	控制	控制	控制	控制	控制	控制	控制	控制
基金固定效应	控制	控制	控制	控制	控制	控制	控制	控制
时间固定效应	控制	控制	控制	控制	控制	控制	控制	控制
N	2219	2219	1880	1880	1925	1925	1435	1435
Adj_R2	0.303	0.306	0.322	0.325	0.336	0.339	0.328	0.325

表 6b　长期表现优异的基金业绩排名对彩票型股票占比的影响

解释变量	过去一年				过去一年半			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Lotperc1	Lotperc2	Lotperc1	Lotperc2	Lotperc1	Lotperc2	Lotperc1	Lotperc2
Navghyr	−1.142	−1.095			−1.274	−1.261		
	(−0.88)	(−0.92)			(−1.46)	(−1.32)		
Alphahyr			−0.874	−0.868			−0.989	−0.976
			(−1.12)	(−1.05)			(−1.44)	(−0.98)
控制变量	控制	控制	控制	控制	控制	控制	控制	控制
基金固定效应	控制	控制	控制	控制	控制	控制	控制	控制
时间固定效应	控制	控制	控制	控制	控制	控制	控制	控制
N	1549	1549	1186	1186	1328	1328	1059	1059
Adj_R2	0.260	0.262	0.281	0.276	0.248	0.248	0.239	0.235

接下来, 为了更全面地反映不同业绩排名的基金经理对彩票型股票的偏好, 本文还在表 6b 中对比了长期业绩处于中位数以上的基金样本的相关结果, 同样采用了两种度量基金过去半年业绩排名的指标. 从表中结果可以看到以长期业绩表现高于同类平均水平的基金为样本, 其结果相比于表 6a 发生了较为明显的变化. 其中前四列以过去一年业绩高于同类基金中位数的基金为样本, 可以看到变量 Navghyr 和 Alphahyr 前的系数为负但不显著, 表明在前一年表现优异的情况下, 过去半年业绩排名越为靠前的基金持有的彩票型股票比重会略高, 但并不明显, 正如本文在前文

中的分析, 这可能是部分基金在薪酬激励之下所做的决策. 而后四列基于更长时间段业绩表现优异的基金样本得到的结果与前四列较为一致, 解释变量前的系数同样为负但不显著, 同时系数绝对值略高于前四列对应值, 表明这部分样本中可能会有更多的基金基于自身积累的更高声誉水平而实施赌博行为以获取更高回报.

4.3 影响机制探讨

如果说是基金经理出于对自身职位以及未来职业生涯的担忧而持有更多的彩票型股票, 那么在其他能够加剧或者缓解基金经理职业忧虑的因素的作用之下, 同样的业绩排名压力对基金彩票型股票持有比重的影响也应该因为受到这些因素的影响而有所不同. 接下来本文将基于已有研究成果, 从基金管理者特征角度对上述逻辑进行验证.

4.3.1 基金经理数量与彩票型股票投资

表 7 基金管理团队特性与彩票型股票投资

解释变量	是否单人管理		持基与否		持基比重	
	(1)	(2)	(3)	(4)	(5)	(6)
	Lotperc1	Lotperc2	Lotperc1	Lotperc2	Lotperc1	Lotperc2
Navghyr	0.121	0.119	0.375***	0.373***	0.398***	0.403***
	(1.01)	(1.06)	(2.94)	(3.08)	(4.00)	(4.11)
Navghyr×Indiv	0.216***	0.209***				
	(4.66)	(4.24)				
Navghyr×Manaind			−0.089*	−0.092*		
			(−1.82)	(−1.85)		
Navghyr×Manarind					−0.103**	−0.097**
					(−2.03)	(−1.99)
Indiv	1.829**	1.810*				
	(1.98)	(1.87)				
Manaind			−0.808	−0.813		
			(−1.52)	(−1.41)		
Manarind					−1.064	−1.049
					(−1.63)	(−1.55)
控制变量	控制	控制	控制	控制	控制	控制
基金固定效应	控制	控制	控制	控制	控制	控制
年份固定效应	控制	控制	控制	控制	控制	控制
N	7742	7742	7742	7742	7742	7742
Adj_R2	0.409	0.391	0.339	0.292	0.413	0.390

以管理团队形式管理基金投资决策的现象越来越普遍, 学术界也对团队管理和单人管理两种模式对基金投资风格的影响进行了大量讨论研究. Bliss et al. (2008), Bar et al. (2009, 2011) 基于美国股票型基金数据发现多位基金经理管理的基金相比于单基金经理管理的基金风险更小, 采取极端投资手段的概率也较低. Karagiannidis (2012) 的研究结果也表明基金管理团队成员数越多, 任期越长, 该基金越倾向于持有风险较小的投资组合. 结合本文中得到的结果, 既然本文认为当业绩表现不佳时, 基金增加组合中彩票型股票占比是基金经理出于职业忧虑所作出的投资决策, 那

么这种行为应该在被单一基金经理管理的基金身上更加有所体现. 因为一方面当多个基金经理管理同一只基金时, 业绩表现不佳的压力被相互分担, 出于这种动机产生的对彩票型股票的偏好也相对较弱, 而单人管理的基金经理则要独自承担, 赌博行为的动机相对会更加强烈. 另一方面, 正如文献中已有结论, 团队管理的基金投资风格相对稳健, 在业绩不佳时进行带有赌博色彩的投资的概率也相对较低, 相对于团队管理而言, 单独管理的基金经理投资决策自主权更大, 彩票型股票投资行为也更容易实现. 基于这样的分析, 本文在这一部分构造一个虚拟变量 Indiv, 即当样本基金为单人管理时, 变量 Indiv 取值为 1, 否则则取值为 0, 并将这一虚拟变量和基金排名业绩变量相乘得到交互项, 随后将虚拟变量和交互项一同放入回归方程中. 根据我们的设想, 变量 Indiv 和变量 Navghyr × Indiv 前的系数均应显著为正. 得到的结果见表 7 中第 (1) 列和第 (2) 列.

4.3.2 基金管理人持基与彩票型股票投资

基金管理人持基是指基金管理人员购买一定金额其所管理的基金产品的行为. 2004 年《美国共同基金改革法案》要求基金公司披露基金管理人员是否持有其所管理的基金份额以及持有的比例情况. 关于基金投资风险控制, Ma and Tang (2019) 认为基金管理层持有基金份额能够降低投资者持有基金的风险和面临的收益风险. 不久后我国证监会颁布了关于基金从业人员投资证券投资基金的相关规定和通知, 鼓励基金从业人员购买自己的基金, 并对基金管理人员的持基行为以及披露事项做出了相应的规定, 目前越来越多的基金公司引入了基金管理人员的持基激励机制. 曹兴等 (2012) 通过建立理论模型分析持基激励对基金经理投资行为的影响, 证明了基金经理购买自己所管理的基金产品能够有效降低基金的风险. 本文认为如果基金管理人持有该基金的比重较高, 即使面对业绩一定的业绩压力, 基金经理也会相对较少配置彩票型股票这类预期收益为负的股票, 或者说在业绩压力不足以威胁到职位时会较少选择彩票型股票, 以减少这类股票对基金管理公司利益的损害. 上述逻辑如果成立也能在侧面证明前文中关于业绩压力影响基金博彩行为的结论. 为了证实以上观点, 基于锐思基金数据库中相关数据, 本文引入表示基金管理人持基与否的虚拟变量 Manaind, 当基金管理人持有基金份额时 Manaind 取 1, 否则取 0; 以及基金管理人持基比重变量 Manaratio, 即基金管理人公布的累计持有份额占基金总份额的比重, 为了便于分析变量 Manaratio 的影响, 本文构造了关于持基比重的虚拟变量 Manarind, 当 Manaratio 高于同类基金持基比重的中位数时, 变量 Manarind 取 1, 否则取 0. 再将这两个虚拟变量与业绩排名变量 Navghyr 构造交乘项放入回归方程中, 得到结果如表 7 中第 (3) ∼ (6) 列所示.

表 7 中前两列结果显示, 正如前文中所预期的, 变量 Indiv 前的系数显著为正, 同时交乘项 Navghyr × Indiv 前的系数均在 1% 的水平上显著为正, 表明相比于团队管理的基金, 由单人基金经理管理的基金面临前期落后的业绩排名时会更多地在投资组合中配置彩票型股票, 与上文中的分析具有一致性. 表 7 中后四列为基金管理人持基比重不同对彩票型股票投资的影响, 可以看出, 两个虚拟变量 Manaind 和 Manarind 前的系数都为负, 这表示与上文中的分析一致, 管理人持基以及持基比重较高的基金持有的彩票型股票较少. 同时, 交乘项 Navghyr × Manaind 和 Navghyr × Manarind 前的系数都显著为负, 表明管理人持有基金份额或者持有较高比重的基金份额时, 面对业绩排名落后而产生的对彩票型股票的偏好低于管理人未持有基金份额或者持有较低比重的基金份额时的情形, 也就是说管理人持基能在一定程度上抑制基金经理在业绩压力下进

行的彩票型股票投资行为, 符合我们的预期.

4.3.3 基金经理任期与彩票型股票投资

接下来, 本文将从基金经理的任期角度分析业绩压力下的彩票型股票投资行为. 这里的任期指的是基金经理自开始管理现有基金产品以来的时间, 通常认为任期更长的基金经理归属感更强, 会更加关注基金的长期表现. Israelsen (1998) 发现任期较长的基金经理所管理的基金普遍换手率较低, 更为重视长期投资决策. 任期更长也在一定程度上反映了该基金经理过去的业绩的被认可程度, Golec (1996), 徐琼和赵旭 (2008) 基于基金经理投资行为的实证研究都发现基金经理任职时间与基金风险呈现负相关关系, 同时任职期限在一定程度上反映了基金经理的能力, 能力和业绩表现较差的基金经理会在较短时间内被淘汰. 另外, 任期更短的基金经理替代成本也相对较低. 结合上述研究结论, 本文认为在任时间较短的基金经理在业绩表现不佳的情况下会呈现出更加明显的对彩票型股票的偏好.

为了准确衡量任期的影响, 本文选取由单一经理管理的基金样本, 以基金经理管理现有基金产品的时间与该基金产品各任基金经理平均在职时间相比较, 据此将样本分为任期长和短两组, 本文认为以各基金产品对应管理人的平均在职时间为比较基准更能准确反映相应基金经理面临的职位压力. 同时, 为了能够有充分的数据反映基金经理的历史业绩情况, 本文进一步选取基金经理上任时间超过一年的基金样本. 综合上述考虑, 在回归分析中本文将样本分为四部分, 与上文中做法类似, 如果当前为 t 期, 以半为时间间隔, 那么样本分别为基金经理任期高于平均任期以及 $t-2 \sim t-1$ 期业绩高于同类基金平均水平 (分组 1), 基金经理任期低于平均任期以及 $t-2 \sim t-1$ 期业绩高于同类基金平均水平 (分组 2), 基金经理任期低于平均任期以及 $t-2 \sim t-1$ 期业绩低于同类基金平均水平 (分组 3) 和基金经理任期高于平均任期以及 $t-2 \sim t-1$ 期业绩低于同类基金平均水平 (分组 4) 这四部分. 同时回归中还控制了基金经理特征变量, 包含性别、学历和从业时间等. 根据前文中的分析, 基金经理任期低于平均任期以及 $t-2 \sim t-1$ 期业绩低于同类基金平均水平时 (分组 3), 如果 $t-1$ 期业绩表现仍不佳则会投资更多的彩票型股票, 即 $t-1$ 期业绩变量前的系数应显著为正, 所得回归结果如表 8 所示. 可以看到, 分组 3 中两种彩票型股票识别方式下业绩排序变量 Navghyr 前的系数分别为 $1.019(t=3.48)$ 和 $1.025(t=3.83)$, 且均在 1% 的水平上显著为负, 即基金经理任期低于该基金平均任期时, 在面临不利的业绩排名

表 8 基金经理任期与彩票型股票投资

解释变量	分组 1		分组 2		分组 3		分组 4	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Lotperc1	Lotperc2	Lotperc1	Lotperc2	Lotperc1	Lotperc2	Lotperc1	Lotperc2
Navghyr	−0.873	−0.862	0.158*	0.157*	1.019***	1.025***	0.0147	0.0153
	(−1.33)	(−1.30)	(1.90)	(1.86)	(3.48)	(3.83)	(0.98)	(0.91)
控制变量	控制	控制	控制	控制	控制	控制	控制	控制
基金固定效应	控制	控制	控制	控制	控制	控制	控制	控制
年份固定效应	控制	控制	控制	控制	控制	控制	控制	控制
N	332	332	803	803	835	835	314	314
Adj_R2	0.478	0.440	0.444	0.387	0.540	0.532	0.551	0.583

时会持有更多的彩票型股票, 符合前文中的分析, 从而从任期角度证实了基金经理在业绩压力下出于对自身职位的担忧进行彩票型股票投资的结论.

5 稳健性检验

5.1 关键排名处基金的彩票型股票投资行为

在基金业绩锦标赛机制下, 年度业绩排名是否排在一些关键区间往往会显著影响基金经理的年终奖励或者被更换的概率. 如李祥文和吴文锋 (2018) 在研究中提到, 决定我国公募基金行业中基金经理年终所能获得的奖金的重要因素是基金的年度业绩排名是否排进一些关键区间, 如果基金年度排名排在前 1/2、前 1/3 或前 1/10 其所能获得的年终奖金通常会有大幅提高. 同样地, 如果年度排名位于后 1/3 或后 1/10 的基金其基金经理则面临着更高的雇佣风险. 排名略低于 2/3 或者 9/10 的基金希望能够挤到这些关键位置之前, 而排名略高于 2/3 或者 9/10 的基金则担心被超越落入到不利位置, 因此位于 2/3 或者 9/10 处的基金可能具备更加强烈的赌博动机, 为了降低自身的雇佣风险增加组合中彩票型股票占比. 基于这样的研究思路, 本文接下来关注位于这两处关键排名的基金的彩票型股票投资行为.

参照李祥文和吴文锋的研究, 本文对位于关键排名处的基金样本进行定义. 具体来说, 在每年年底, 将基金按照前 11 个月的累计收益率 Navg 进行排序, 从高到低分成 30 组, 将位于关键位置处以及前后加减 1 组的基金样本定义为关键排名处基金, 即定义第 19 ∼ 21 组的基金为排在 2/3 处基金, 定义第 26 ∼ 28 组的基金为排在 9/10 处的基金, 若基金位于上述组别则变量 Keygroup 取 1, 否则取 0, 然后将变量作为解释变量, 被解释变量仍为 Lotperc, 其他控制变量与方程 (3) 中的相同, 得到的回归结果如表 9 中第 (1) 和 (2) 列所示. 在无论采用哪种彩票型股票识别方式, 变量 Keygroup 前的系数均在 1% 的水平上显著为正, 从而证明了上文中的分析, 即位于 2/3 或者 9/10 处的基金呈现出对彩票型股票更加强烈的偏好.

表 9　关键排名处基金的彩票型股票投资行为

解释变量	被解释变量: Lotperc			
	(1)	(2)	(3)	(4)
	Lotperc1	Lotperc2	Lotperc1	Lotperc2
Keygroup	0.614***	0.607***	0.575**	0.559**
	(2.86)	(3.09)	(2.01)	(1.98)
Keygroup×Navgdif			−7.703***	−7.714***
			(−3.74)	(−3.56)
Navgdif			−0.139	−0.133
			(−1.02)	(−1.06)
控制变量	控制	控制	控制	控制
基金固定效应	控制	控制	控制	控制
年份固定效应	控制	控制	控制	控制
N	4231	4231	4231	4231
Adj_R2	0.210	0.213	0.244	0.250

基于上述结果, 本文进一步考虑处于关键排名处的基金提高其排名的难易程度, 即这些基金

样本相邻排名基金之间的业绩差距. 相邻排名基金的业绩越为接近, 他们之间的竞争越为激烈, 从而可能导致基金更加强烈的赌博动机. 因此类似李祥文和吴文锋的做法, 本文基于前文中的业绩排名结果构建变量 Navgdif 来衡量基金的业绩差距, 计算公式如下所示:

$$\text{Navgdif}_{nt} = \frac{1}{2} \times (\text{Navgr}_{n-1t} + \text{Navgr}_{n+1t} - 2 \times \text{Navgr}_{nt}), \tag{5}$$

式中, n 表示基金业绩排名, t 表示时间. Navgr_{n-1t}、Navgr_{n+1t} 和 Navgr_{nt} 分别表示在每年 12 月份, 前 11 个月排在第 $n-1$、$n+1$ 和 n 名的基金累积收益率.

接着构建关键排名变量 Keygroup 与相邻排名基金业绩差距变量 Navgdif 的交乘项 Keygroup ×Navgdif, 将其放入回归方程中得到如表 9 中第 (3) 和第 (4) 列的结果, 可以看到该交乘项前的系数在 1% 的水平上显著为负, 即排在相邻位置的基金之间业绩差距越小, 这些基金在年末持有的彩票型股票占比越高.

5.2 采用动态面板模型

考虑到基金的彩票型股票投资行为可能具有连续性, 即当期的彩票型股票持有与上期的持有量可能存在一定相关性, 因此本文在原有模型中引入滞后一期的彩票型股票持有比重作为解释变量, 建立动态面板模型, 并采用系统广义矩估计方法对模型进行估计, 结果如表 10 所示. 从表中结果可以看到, 被解释变量滞后项前的系数显著为正, 表明基金的彩票型股票投资行为确实具有一定时间上的连续性, 滞后一期的彩票型股票占比对当期占比存在明显正向的影响, 在动态面板模型下, 基金历史业绩变量前的系数以及显著性水平都与前文的静态面板回归结果相近, 从而证实了结果的可靠性.

表 10 动态面板模型回归结果

解释变量	被解释变量: Lotperc				被解释变量: Perlot			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Lotperc1		Lotperc2		Perlot1		Perlot2	
Navghyr	0.332***		0.326***		0.227***		0.219***	
	(3.63)		(3.55)		(4.15)		(3.99)	
Alphahyr		0.267***		0.260***		0.166***		0.166***
		(2.90)		(3.01)		(3.83)		(3.40)
Lotperc1_l	0.0854**	0.0826**						
	(2.56)	(2.54)						
Lotperc2_l			0.0893*	0.0923**				
			(1.93)	(2.02)				
Perlot1_l					0.168	0.174		
					(1.46)	(1.29)		
Perlot2_l							0.171	0.165
							(0.97)	(0.74)
控制变量	控制	控制	控制	控制	控制	控制	控制	控制
基金固定效应	控制	控制	控制	控制	控制	控制	控制	控制
年份固定效应	控制	控制	控制	控制	控制	控制	控制	控制
N	7742	7406	7742	7406	7742	7406	7742	7406
Adj_R2	0.329	0.342	0.310	0.314	0.209	0.214	0.132	0.166

5.3 基于基金股票买卖数据

通过观察基金每半年公布的股票买卖数据可以发现, 我国基金普遍换手率比较高, 存在大量当期买入又全部卖出的买卖操作, 结合本文的研究主题, 如果只关注基金在期末公布的投资组合静态数据, 那些当期买入又卖出的股票则会被忽略, 从而可能导致误差的出现. 因此, 在这一部分基于基金买卖股票的交易数据计算了各基金期间买入彩票型股票的金额与该基金期间平均资产净值之比, 得到变量 Buyperc (与前文一致, 同样采用两种彩票型股票识别方式得到 Buyperc1 和 Buyperc2), 以及期间买入与卖出的彩票型股票金额之比 Buypsell (同理, Buypsell 和 Buypsell2), 并将二者作为被解释变量替换回归方程 (3) 中的被解释变量进行回归分析. 如果前文中的结论成立, 那么基金过去半年业绩排名变量 Navghyr 和 Alphahyr 前的系数仍应显著为正.

表 11　基于彩票型股票买卖数据的回归结果

解释变量	被解释变量: Buyperc				被解释变量: Buypsell			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Buyperc1		Buyperc2		Buypsell1		Buypsell2	
Navghyr	0.855***		0.856***		1.319***		1.344***	
	(6.02)		(6.14)		(4.72)		(3.68)	
Alphahyr		0.687***		0.685***		1.242***		1.205***
		(5.51)		(5.23)		(3.19)		(3.28)
控制变量	控制	控制	控制	控制	控制	控制	控制	控制
基金固定效应	控制	控制	控制	控制	控制	控制	控制	控制
年份固定效应	控制	控制	控制	控制	控制	控制	控制	控制
N	4578	4229	4578	4229	4578	4229	4578	4229
Adj_R2	0.162	0.158	0.207	0.206	0.066	0.048	0.057	0.039

可以看到, 在两种彩票型股票识别方式下, 表中基金过去半年的业绩排名变量 Navghyr 和 Alphahyr 前的系数都在 1% 的水平上显著为正, 表明业绩排名越靠后的基金会越多买入彩票型股票, 与前文以投资组合中彩票型股票占比为被解释变量得到的结果类似, 从而进一步证明了本文主体部分的结论.

6 结论

本文基于我国 2005–2017 年主动型开放式股票型基金和偏股混合型基金样本的业绩和投资组合彩票型股票占比数据, 计算了组合中彩票型股票占基金净值的比重, 并采用了不同时间长度的基金净值增长率和经过四因子模型调整后的超额收益率指标衡量了基金业绩锦标赛机制下历史业绩表现对基金组合中彩票型股票配置比例的影响. 整体上来看, 研究结果显示在职业忧虑的作用下, 历史业绩排名靠后的基金在下一期的投资组合中会持有更多的彩票型股票, 而分时点来看, 相对来说上述结果在时间处于下半年阶段时更为明显, 即上半年排名靠后的基金会在下半年投资更多的彩票型股票; 相比于股市上涨时期, 股市处于下跌时期时, 历史业绩排名靠后的基金会持有更多彩票型股票. 同时长期处于同类基金业绩平均水平以下的基金在近期业绩压力得不到缓解的情况下也会更多投资彩票型股票. 采用不同时长的历史业绩或者不同的业绩考量指标

总体上都可以得出与上述一致的结论. 针对上述结果, 本文从基金经理投资彩票型股票的动机、利弊权衡以及投资彩票型股票的受约束程度等角度进行了分析, 通过区分不同的基金管理人持基比重、基金管理人数量以及基金经理在任时间, 发现管理人持基比重较低或者由单一经理管理或者在任时间低于该基金产品历任基金经理平均在任时间的基金样本, 在面临前期业绩排名不佳的情况下呈现出了对彩票型股票更强烈的偏好, 从而通过详细探讨基金在彩票型股票这一类型股票上的投资决策明确了基金经理为缓解自身职业压力而进行的高风险低收益投资行为.

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Managerial overconfidence, firm transparency, and stock price crash risk

Evidence from an emerging market

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Abstract

Purpose – The purpose of this paper is to empirically analyze whether and how managerial overconfidence affects stock price crash risk.

Design/methodology/approach – Based on a large sample of Chinese non-state-owned firms from 2000 to 2012, this study employs methods including multiple linear regression model, Heckman two-stage treatment effect procedure, firm fixed effects model and event study to clarify the causality relationship between managerial overconfidence and crash risk.

Findings – The authors find that firms with overconfident managers (chief executive officer or board chairs) are more likely to experience future stock price crashes than firms with non-overconfident managers. The effect of overconfidence on crash risk is more pronounced for firms with low transparency, suggesting that firm opacity facilitates overconfident managers' bad news hoarding activities, which, in turn, increases stock price crash risk. The authors also show evidence that overconfident managers tend to disclose good news in a timely manner.

Originality/value – The authors add to the growing literature on stock price crash risk. Specifically, the authors find that the cognitive bias of board chair plays an important role in the bad news hoarding activities, thereby increasing the likelihood of stock price crash. This study also contributes to the literature that addresses the effects of managerial overconfidence on corporate finance issues.

Keywords China, Managerial overconfidence, Stock price crash risk, Firm transparency

Paper type Research paper

1. Introduction

Stock price crash risk is a topic of significant interest in financial economics. Prior studies have demonstrated that stock price crash risk is closely related to leverage effect (Christie, 1982), volatility feedback (Campbell and Hentschel, 1992; French *et al.*, 1987), stochastic bubbles (Blanchard and Watson, 1982) and differences among investors' beliefs (Hong and Stein, 2003; Chen *et al.*, 2001). Considerably recent research provides new evidence that stock

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price crash could be caused partially by agency conflicts between firm managers and outside investors. Ball and Shivakumar (2008), Graham *et al.* (2005) and Kothari *et al.* (2009) argue that managers may strategically conceal negative information due to their concerns regarding, for example, reputation, compensation and career development. When bad news accumulates to a level that is considerably costly to hide, the release of clustered negative information triggers a collapse of stock prices (Hutton *et al.*, 2009; Jin and Myers, 2006; Kim *et al.*, 2011a, b). In the theoretical framework proposed by Jin and Myers (2006), poor investor protection and firm opacity are considered as two key factors leading to crash risks, because the opaque information environment provides the necessary condition for the entrenched managers to hide bad news. Jin and Myers argue that opacity alone will not affect crash risks if the manager is loyal to shareholders. They add that when a firm is completely transparent, a lack of investor protection will not also cause a stock price crash.

This paper investigates the impact of managerial overconfidence on stock price crash risk and how firm opacity may affect this relation in China. Unlike prior scholars who analyzed the determinants of stock price crash risk from the agency conflict perspective, we study the influence of managers' personal traits, in this case, overconfidence, on their bad news hoarding behavior. Although substantial evidence has proved the existence of overconfidence in human judgment (Alicke, 1985; Baker and Wurgler, 2012), this cognitive bias is considerably prominent among top managers (Cooper *et al.*, 1988; Graham *et al.*, 2013). The finance literature documents that managerial overconfidence has a significant influence on financial reports and information disclosure. Schrand and Zechman (2012) document that overconfident managers are more likely to be involved in accounting frauds. Further, Ahmed and Duellman (2013) find that overconfident managers tend to delay the release of bad news but disclose good news in a timely manner. These findings imply that managerial overconfidence could be one of the driving forces for managers' hoarding bad news, thereby resulting in an increasing stock price crash risk.

China provides a favorable environment for studying the impact of managerial overconfidence and firm opacity on stock price cash risk. On the one hand, China's Confucian culture and its economic transition cultivate overconfidence among Chinese managers. The psychology and sociology literature has provided extensive evidence that respondents under the influence of Asian cultures (e.g. in China) exhibit markedly higher degrees of overconfidence than do respondents affected by western cultures (e.g. in the USA) (Yates *et al.*, 1989, 1996, 1997). Asian cultures and the China's Confucian culture in particular are thought to make people behave in such a manner that has been characterized in the literature as "Asian overconfidence" (Seok, 2007). The Confucian culture advocates an organizational hierarchy that emphasizes the absolute authority of a leader. Therefore, leaders of different kinds of organization in China often possess overwhelming power, which leads to managerial overconfidence (Jiang *et al.*, 2009; Fast *et al.*, 2012). Meanwhile, numerous entrepreneurs have emerged from China's economic reforms. Many of these rich executives may overestimate their abilities and skills (Jiang *et al.*, 2009). On the other hand, the information environment in China is considerably less transparent than that of developed countries (Jin and Myers, 2006; Piotroski and Wong, 2012), providing a good setting to test the influence of firm opacity on the risk of stock price crash.

For firms in developed countries such as the USA, chief executive officer (CEO) is usually the person in charge of day-to-day business. For most of Chinese firms, however, the person who is in charge is not the CEO. Oftentimes, it is chairman of the board of directors (Jiang and Kim, 2016). In China, the board chair is the legal representative of the firm and entitled a lot of legal power. He/she is appointed by the largest shareholder of the firm (Kato and Long, 2006), and given that ownership structure is highly concentrated in China, this arrangement suggests that board chair has a lot power in effect, not just legally (Jiang and Kim, 2016).

In particular, in the study of Kato and Long (2006), when the CEO is also the board chair, they designate that person as the CEO. However, when the CEO is not the board chair and if the board chair is (is not) on the payroll, the board chair (CEO) is designated as the CEO. Therefore, in this study, we consider overconfidence of both CEO and board chair.

We explore a large sample of Chinese non-state-owned firms from 2000 to 2012 and find that firms with overconfident managers (CEOs or board chairs) are associated with substantially high stock price crash risk. Moreover, the predictive power of managerial overconfidence with respect to crash risk is more pronounced for firms that have low earnings quality; have been audited by non-international Big 4 auditors; have a large dispersion in analysts' earnings forecasts; and have a low rating on information disclosure. These findings suggest that an opaque information environment facilitates overconfident managers' bad news hoarding activities, which contribute to a future stock price crash. In addition, we determine a negative association between managerial overconfidence and future positive jump risk in stock price. This finding indicates that overconfident managers tend to disclose good news in a timely manner, and thus increase the crash risk of stock prices.

Our findings contribute to the literature in several ways. First, we add to the growing literature on stock price crash risk (e.g. Benmelech *et al.*, 2010; Bleck and Liu, 2007; Callen and Fang, 2013; Hutton *et al.*, 2009; Jin and Myers, 2006; Kim *et al.*, 2011a, b; Xu *et al.*, 2014). In particular, we find that managers' cognitive bias (i.e. managerial overconfidence) is an important driving force for their bad news hoarding behavior, thereby contributing to a stock price crash. Our work is most closely related to Kim *et al.* (2016). Kim *et al.* (2016) also find that CEO overconfidence is positively associated with future stock price crash risk in US market. There are, however, significant differences that distinguish our work from Kim *et al.* (2016). The most notable difference is that we consider not only CEO overconfidence, but also that of board chair. An investigation on chairperson is important given that for most of Chinese firms, board chair is actually the person who is the active controller in charge of the day-to-day business (Jiang and Kim, 2016). We find that the cognitive bias of board chair also plays an important role in the bad news hoarding activities, thereby increasing the likelihood of stock price crash.

Second, this study contributes to the literature that addresses the effects of managerial overconfidence on corporate finance issues. Numerous studies using data from developed countries have examined the overconfidence of CEOs and overlooked the influence of this cognitive bias of the chairperson of the board. However, in certain countries such as China, it is the board chairperson who actively controls and runs the firm (Jiang and Kim, 2016). Along this line, we provide evidence that CEO overconfidence and chairperson's overconfidence both have significant and positive effects on stock price crash risk.

Finally, this study also corresponds to Xu *et al.* (2013), who find that optimistic analysts tend to release positive information to investors and ignore negative news, thus increasing the stock price crash risk. Our research differs from theirs in that we consider overconfident managers rather than financial analysts.

The rest of the paper is organized as follows. Section 2 presents the related literature and develops the research hypotheses. Section 3 describes the sample data and explains the measurement of the key variables used in the empirical analysis. Section 4 presents and discusses the main results. Section 5 reports the results of the robustness checks and additional analyses. Section 6 concludes the paper.

2. Related literature and hypothesis development

Economics and social psychology literature have provided extensive evidence that human perception and decision making are subject to cognitive biases; a typical example is overconfidence, which can lead to irrational judgment in social and economic activities

(Alicke, 1985; Baker and Wurgler, 2012; Camerer and Dan, 1999). In the field of psychology, the effect of overconfidence is defined as a well-established bias, in which a person's subjective confidence in his or her judgments is reliably higher than the objective accuracy of those judgments. Overconfident people tend to overestimate their probability of success and underestimate the likelihood of failure (Weinstein, 1980). Furthermore, they are inclined to attribute success to their abilities and failure to bad luck (Miller and Ross, 1975).

Several studies illustrate that overconfidence is considerably prominent among corporate managers. Cooper *et al.* (1988) conducted a survey on managers of US firms and found that these managers perceived the probability of success for their own business is 81 percent, compared with a 58 percent probability of success for other companies. However, 66 percent of the sample firms performed worse after the survey. Graham *et al.* (2013) find that overconfidence is more common among CEOs than among other people. Various studies show that managers' overconfidence has an influential impact on their decision making. In particular, managerial overconfidence is associated with low investment efficiency (Jiang *et al.*, 2009; Malmendier and Tate, 2005), investments in high-risk projects (Campbell *et al.*, 2011; Galasso and Simcoe, 2011; Hirshleifer *et al.*, 2012), value-destroying mergers and acquisitions (Malmendier and Tate, 2005), aggressive debt financing policy (Graham *et al.*, 2013) and overoptimistic earnings forecasts (Libby and Rennekamp, 2012). Schrand and Zechman (2012) analyze 49 firms subject to SEC Accounting and Auditing Enforcement Releases and find that approximately 75 percent of the initial misstatements reflect a managerial optimistic bias that is not necessarily intentional. Ahmed and Duellman (2013) argue that overconfident managers tend to overestimate cash flows from firms' investments, delay loss recognition and use less conservative accounting. They also document robust evidence of a negative relation between CEO overconfidence and accounting conservatism.

Based on the extant literature, we contend that managerial overconfidence may affect stock price crash risk in two ways. First, overconfident managers tend to overestimate their abilities: they may be overoptimistic about the prospect of the firm while underestimating the risk of failure, and thus overestimate the free cash flows in the future (Heaton, 2002; Malmendier and Tate, 2005). In other words, overconfident managers are more likely to invest in negative NPV projects. Moreover, a rational manager should revise his or her expectations on cash flows generated by a project and terminate the project if necessary. By contrast, an overconfident manager tends to overemphasize positive signals and cast doubts on negative signals (Taylor and Gollwitzer, 1995). This situation suggests that overconfident managers could irrationally respond to a negative signal of information. They may ignore the negative information and believe that the poor performance is temporary. Thus, the value-destroying project will not be suspended or terminated until bad news accumulates and eventually reaches a threshold that triggers stock price crash. Although Bleck and Liu (2007) relate stock price crash to the agency conflict between rational managers and outside investors, our proposed explanation for stock price crash does not build on this agency conflict. Instead, we assume that managers act in the best interest of firm owners. Managers invest in or delay the termination of negative NPV projects because they suffer from the effects of overconfidence.

Second, even if overconfident managers are loyal to shareholders, they differ in the manner by which they disclose good news vs bad news. On the one hand, overconfident managers may underestimate the severity of bad news and refrain from disclosing it in a timely manner. Schrand and Zechman (2012) argue that overconfident managers are more likely to be in a position in which they are compelled to intentionally misstate earnings, although the initial misstatement is not necessarily intentional. Consistently, Myers *et al.* (2007) find that managers have incentives to window-dress performance through earnings management in the hope that performance would improve and offset the

unintended misstatements. However, if a firm's performance fails to improve as expected, then the manager will be forced to undertake more aggressive earnings management to alleviate the pressure of reporting bad news.

On the other hand, overconfident managers may maintain their confidence in the project (which is actually value destroying) even when they observe certain losses or problems. To relieve the board of directors' and shareholders concerns, and obviate their queries, managers may opt to strategically delay the disclosure of bad news, providing the timely release of good news to convince investors of a good prospect. Consequently, bad news is stockpiled within the firm up to a certain point at which withholding the bad news becomes impossible for managers. At this moment, all the hitherto unreleased news will come out simultaneously, resulting in a stock price crash. Based on the preceding analysis, we propose the first hypothesis as follows:

H1. All else being equal, firms with overconfident managers are more likely to experience future stock price crashes than firms with non-overconfident managers.

If a firm is completely transparent, then any bad news will be released in a timely manner to the public and subsequently incorporated into the stock prices. This scenario suggests that an overconfident manager is unable to withhold bad news within the firm. Thus, he or she is unlikely to accumulate negative information until the tipping point that leads to a large adjustment in stock prices. However, an overconfident manager in an environment with limited transparency would be considerably successful in hiding bad news. In this case, stock prices do not have an opportunity to adjust to each instance of bad news, thereby resulting in an increase in crash risk. Therefore, the extent of firm transparency plays an important role in the effect of managerial overconfidence on stock price crash risk. We predict that the impact of managerial overconfidence on crash risk is more pronounced for firms with low transparency. This prediction leads to our second hypothesis as follows:

H2. All else being equal, the positive relation between managerial overconfidence and crash risk is more pronounced for firms with more opaque information environment.

3. Sample and research design

3.1 Sample construction

Our sample consists of 1,243 non-state-owned firms listed in the Shanghai Stock Exchange and Shenzhen Stock Exchanges from 2000 to 2012. We obtain these sample firms after the following screening procedures: following Hutton *et al.* (2009) to exclude firms with stocks that were traded less than 26 weeks in a given year; excluding firms in the financial and insurance industries; and excluding firms that have missing values in the main variables used in the analysis. The final sample includes 5,996 firm-year observations that are associated with 1,243 unique firms. The firm-level financial data are collected from the China Stock Market & Accounting Research database (http://csmar.gtadata.com/). We hand-collect the information regarding the CEO's educational background. All continuous variables are winsorized at 1 and 99 percentiles to reduce the potential impact of outliers.

3.2 Measurement of stock price crash risk

We follow prior studies, such as Hutton *et al.* (2009) and Kim *et al.* (2011a), to compute the firm-specific crash risk. Specifically, we first estimate the following extended market model:

$$RET_{i\tau} = \alpha_i + \beta_{i1}MKRET_{i\tau-1} + \beta_{i2}INDRET_{i\tau-1} + \beta_{i3}MKRET_{i\tau} + \beta_{i4}INDRET_{i\tau} + \beta_{i3}MKRET_{i\tau+1} + \beta_{i6}INDRET_{i\tau+1} + \varepsilon_{it}, \quad (1)$$

where *RET* is the weekly stock return; *MKRET* the weekly value-weighted average return

of the market (excluding the return of the pertinent stock); *INDRET* the weekly value-weighted average return of all stocks in the same industry (excluding the return of the pertinent stock)[1]; ε the error term; and subscript i and τ refer to the firm and trading week, respectively. The leading and lagged terms of the market and industry returns are employed to ease the concern of potential nonsynchronous trading that may cause estimation bias (French *et al.*, 1987). Thereafter, we define firm-specific weekly return as $w = \log(1+\hat{\varepsilon})$, where $\hat{\varepsilon}$ is the residual from the estimation of Equation (1). We construct two measures of crash risk based on the firm-specific weekly return.

Following Jin and Myers (2006), our first measure of crash risk, *COLLAR*, accounts for the frequency and severity of crashes. We use the firm-specific weekly returns as basis to create an option portfolio with a long put and short call option. The strike prices are set to the mean minus 3.2 standard deviations for the former and the mean plus 3.2 standard deviations for the latter. Under a lognormal distribution, the initial investment for the aforementioned strategy is zero. Thereafter, *COLLAR* is computed as the actual profits or losses from this strategy as a percentage of the stock price. Accordingly, high values indicate more frequency or more severity of crashes.

Following Chen *et al.* (2001) and Kim *et al.* (2011a, b), negative skewness of the firm-specific weekly returns, *NCSKEW*, is also used to measure the crash risk. The larger *NCSKEW* is, the greater probability that the crash will happen. For firm i in year t, *NCSKEW* is defined as follows:

$$NCSKEW_{it} = -\left[n(n-1)^{3/2}\sum w_{it}^{3}\right] / \left[(n-1)(n-2)\left(\sum w_{it}^{2}\right)^{3/2}\right], \tag{2}$$

where n is the number of trading weeks over a year and τ indicates the week of the year.

3.3 Measurement of managerial overconfidence

Prior studies have developed various measures of managerial overconfidence, most of which are constructed based on stock options exercised by managers (Campbell *et al.*, 2011; Malmendier and Tate, 2005, 2008), executives' personal characteristics (Puri and Robinson, 2005; Schrand and Zechman, 2012), media coverage (Hirshleifer *et al.*, 2012), biases between manager-forecasted earnings and actual earnings (Huang *et al.*, 2011), CEO's relative salaries (Huang *et al.*, 2011) and the firm's investment and financing activities (Campbell *et al.*, 2011; Schrand and Zechman, 2012).

We aim to disentangle the effect of overconfidence on stock price crash from that of agency conflict. The measurement of overconfidence based on stock options exercise, management compensation, earnings forecast errors and investment/financing activities may capture the information of agency conflicts. Thus, we construct our overconfidence measure with the information provided by the manager's personal characteristics. In China, most listed firms are controlled by large shareholders. As spokesperson for large shareholders, the chair of the board of directors is similar to the CEO of firms in developed countries, and is actively involved in the company's daily operations (Jiang *et al.*, 2009). Therefore, we also measure the chair's overconfidence apart from that of the CEO.

For each CEO and chair, we first create several dummies based on the following five personal characteristics:

(1) Gender: the psychology and finance literature show that males are more likely to be overconfident than females, especially when they are making investment decisions (Barber and Odean, 2001; Estes and Hosseini, 2001). We create a dummy variable *GenderDum*, which equals 1 when the executive is male, and 0 otherwise.

(2) Age: Taylor (1975) and Forbes (2005) explain that older managers collect more information and spend more time before making decisions. They are more conservative when assessing the outcome of a decision. They are also less likely to overestimate their abilities because they have more experience than younger managers. Accordingly, younger managers are more likely subject to overconfidence than older managers do. *AgeDum* is created as a dummy variable that takes the value of 1 if the CEO's (chairman's) age is below the sample mean, and 0 otherwise.

(3) Expertise: the psychology literature contends that experts or professionals are more confident than common people (Griffin and Tversky, 1992). While experts/professionals intuitively have more field knowledge than common people to make better decisions, they tend to believe that they can achieve "better than average" performance (Schrand and Zechman, 2012), that is, being overconfident. Following Puri and Robinson (2005) and Schrand and Zechman (2012), we create two dummy variables, *EduDum* and *MajorDum*, to indicate managers' education degrees and academic majors, respectively. *EduDum* equals 1 if a CEO (chair) has obtained a master's degree or higher, and 0 otherwise. *MajorDum* has a value of 1 if the executive pursued a business or economics major, and 0 otherwise.

(4) Tenure: although overconfident managers tend to overestimate their own abilities, this cognitive bias decreases in their management experience as they learn from past experience (Fraser and Greene, 2006). We define a dummy variable, *TenDum*, which equals 1 if the manager's tenure is below the sample median, and 0 otherwise.

(5) CEO duality: prior studies have obtained evidence that CEOs with substantial decision-making power tend to be overoptimistic (Adams *et al.*, 2005). CEO duality may reinforce a CEO's self-esteem, thereby leading to a strong sense of overconfidence in decision making. *DualDum* is defined as an indicator that equals 1 if the CEO also holds the position of the chair of the board, and 0 otherwise.

Thereafter, we construct a composite measure of managerial overconfidence, that is, *OC*, based on the aforementioned six dummy variables. For each firm year, *OC_CEO* (*OC_CHM*) is defined as an indicator that equals 1 if the added value of the six dummy variables is equal to or higher than 4, and 0 otherwise.

3.4 Measurement of firm transparency

Bushman *et al.* (2004) define firm transparency as the degree to which outside investors can effectively obtain specific information about a listed company through annual reports, announcements, analyst reports and voluntary information disclosure, among others.

Following Hutton *et al.* (2009), the first measure of firm opacity is earnings quality, which is defined as the prior three-year moving sum of the absolute value of discretionary accruals. First, we use the modified Jones model (Dechow *et al.*, 1995) to estimate discretionary accruals. For each industry and fiscal year, we run the following cross-sectional regression model:

$$\frac{TA_{it}}{A_{it-1}} = \beta_1 \frac{1}{A_{it-1}} + \beta_2 \frac{\Delta REV_{it}}{A_{it-1}} + \beta_3 \frac{PPE_{it}}{A_{it-1}} + \xi_{it}^1, \tag{3}$$

where $TA_{it} = (\Delta CA_{it} - \Delta CASH_{it}) - (\Delta CL_{it} - \Delta CLD_{it}) - DEP_{it}$. ΔCA_{it} is the change in current assets; $\Delta CASH_{it}$ the change in cash and cash equivalent; ΔCL_{it} the change in current liabilities; ΔCLD_{it} the change in the current portion of long-term debt; ΔDEP_{it} the annual depreciation and amortization; A_{it-1} the lagged total asset; ΔREV_{it} the change in sales; and PPE_{it} the property, plant and equipment. After estimating Equation (3), we use the estimated

coefficients to compute the discretionary accruals as follow:

$$DiscAcc_{it}\frac{TA_{it}}{A_{it-1}} = \hat{\beta}_1\frac{1}{A_{it-1}} - \hat{\beta}_2\left(\frac{\Delta REV_{it}}{A_{it-1}} - \frac{\Delta REC_{it}}{A_{it-1}}\right) - \hat{\beta}_3\frac{PPE_{it}}{A_{it-1}}, \quad (4)$$

where ΔREC_{it} is the change in net account receivable and *DD* is defined as the moving sum of the absolute value of discretionary accruals over the last three years (year $t-1$, $t-2$ and $t-3$):

$$DD_{it} = \text{AbsV}(DiscAcc_{it-1}) + \text{AbsV}(DiscAcc_{it-2}) + \text{AbsV}(DiscAcc_{it-3}). \quad (5)$$

For easy interpretation, we multiply *DD* with −1 so that a greater value of *DD* indicates a higher level of earnings quality.

The second proxy for firm transparency is auditor quality (*BIG4*). Prior literature shows that the quality of the auditing reports conducted by the international Big 4 auditors is higher than that of reports conducted by other auditors. Lang and Maffett (2010) argue that hiring the Big 4 can serve as a signal that a firm is willing to go through a strict auditing procedure, which is associated with a high level of firm transparency. We define *BIG4* as a dummy variable that equals 1 if a firm is audited by one of the joint ventures of international Big 4 audit firms and domestic audit firms, and 0 otherwise.

Following Jin and Myers (2006), the third measure of firm transparency, *DIVSTY*, is the standard deviation of analysts' forecasts of a firm's earnings in the following year. In particular, we provide the following definition:

$$DIVSTY = \frac{\hat{\sigma}/\hat{\mu}}{\sqrt{N}}, \quad (6)$$

where $\hat{\mu}$ and $\hat{\sigma}$ are the mean and standard deviation, respectively, of the earnings forecast by financial analysts; and N the number of analysts covering the firm. Firms followed by fewer than three analysts are excluded. We multiply *DIVSTY* by −1 so that a higher value indicates a smaller variation in earnings forecasts, thereby suggesting higher information transparency.

The fourth transparency proxy is built on the Information Disclosure Ratings released annually by the Shenzhen Stock Exchange. Since 2001, the Shenzhen Stock Exchange has assessed all listed firms every year with respect to the quality of the information disclosed to the public, and ranked them into four categories: excellent, good, qualified and unqualified. We collect this information from the exchange's website and construct a discrete variable, *DSCORE*, which has values of 4, 3, 2 and 1 for firms ranked into the respective four categories.

3.5 Regression models

To test the relation between managerial overconfidence and stock price crash risk, we estimate the following regression model:

$$CrashRisk_t = \beta_0 + \beta_1 OC_{t-1} + \sum_k \varphi CONTROL_{t-1}^{(k)} + YearDum + IndustryDum + \xi_t, \quad (7)$$

where $CrashRisk_t$ is the stock price crash risk proxied by $COLLAR_t$ or $NCSKEW_t$; OC_{t-1} refers to the overconfidence variables, OC_CEO_{t-1} and OC_CHM_{t-1}; *CONTROL* a set of control variables; *YearDum* and *IndustryDum* represent the year and industry dummy variables, respectively; and ξ_t the random error term. *H1* predicts a positive coefficient of OC_{t-1}.

Following Chen *et al.* (2001), Hutton *et al.* (2009) and Kim *et al.* (2011a), we control a set of variables that are deemed to be associated with crash risk, including lagged firm size

($SIZE_{t-1}$); return on net assets (ROE_t); lagged market-to-book ratio ($MtoB_{t-1}$); lagged financial leverage (LEV_{t-1}); detrended stock turnover ratio in year $t-1$ ($DTURN_{t-1}$); lagged negative skewness ($NCSKEW_{t-1}$); average firm-specific weekly returns in year $t-1$ ($FSRET_{t-1}$); the volatility of firm-specific weekly returns in year $t-1$ ($SIGMA_{t-1}$); and an indicator for ST (PT) firms ($STPT_t$)[2]. Year and industry fixed effects are included. The Appendix presents all the variable definitions.

To test *H2*, we expand Equation (7) with firm transparency variables and their interactions with managerial overconfidence variables as follows:

$$CrashRisk_t = \beta_0 + \beta_1 OC_{t-1} + \beta_2 OC_{t-1} \times TRANS_{t-1} + \beta_3 TRANS_{t-1} + \sum_k \varphi_k CONTROL_{t-1}^{(k)} + YearDum + IndustryDum + \xi_t, \quad (8)$$

where $TRANS_{t-1}$ refers to firm transparency, measured by DD_{t-1}, $BIG4_{t-1}$, $DIVSTY_{t-1}$ and $DSCORE_{t-1}$, respectively. We expect that when a firm is more transparent, the effect of managerial overconfidence on the crash risk is less pronounced, that is, $\beta_2 < 0$.

4. Empirical results

4.1 Descriptive statistics and univariate analysis

Table I reports the descriptive statistics of the key variables used in analysis. The mean value of *COLLAR* is −0.081, standard deviation is 0.450 and maximum (minimum) value is 3.617 (−7.526). As per *NCSKEW*, its mean (median) is −0.270 (−0.251), the standard deviation is 0.677 and maximum (minimum) value is 3.526 (−3.537). These results indicate that our sample firms have a large variation in stock price crash risk. The mean values of *OC_CEO* and *OC_CHM* are 0.201 and 0.167, respectively, suggesting that approximately 20 percent of the CEOs and 17 percent of the chairs in our sample firms exhibit overconfidence. The unreported analysis shows that the correlation coefficient between *OC_CEO* and *OC_CHM* is 0.369.

Variables	n	Mean	SD	Min.	25th Pctl.	Median	75th Pctl.	Max.
$COLLAR_t$	5,996	−0.081	0.450	−7.526	0.000	0.000	0.000	3.617
$NCSKEW_t$	5,996	−0.270	0.677	−3.537	−0.628	−0.251	0.106	3.750
OC_CEO_{t-1}	5,996	0.201	0.401	0.000	0.000	0.000	0.000	1.000
OC_CHM_{t-1}	5,996	0.167	0.373	0.000	0.000	0.000	0.000	1.000
DD_{t-1}	4,788	−0.219	0.155	−1.050	−0.282	−0.176	−0.109	−0.007
$BIG4_{t-1}$	5,996	0.040	0.195	0.000	0.000	0.000	0.000	1.000
$DIVSTY_{t-1}$	2,389	−0.092	0.094	−0.527	−0.112	−0.061	−0.033	0.000
$DSCORE_{t-1}$	2,956	2.782	0.685	1.000	2.000	3.000	3.000	4.000
$SIZE_{t-1}$	5,996	14.690	0.921	12.101	14.050	14.610	15.235	18.747
ROE_t	5,996	0.047	0.230	−1.687	0.022	0.069	0.125	0.504
$MtoB_{t-1}$	5,996	1.823	1.187	0.773	1.124	1.422	2.042	9.109
LEV_{t-1}	5,996	0.471	0.190	0.095	0.331	0.480	0.610	0.990
$DTURN_{t-1}$	5,996	−0.384	4.750	−11.640	−2.878	−0.139	2.086	11.560
$NCSKEW_{t-1}$	5,996	−0.267	0.662	−3.863	−0.631	−0.251	0.108	3.750
$FSRET_{t-1}$	5,996	−0.113	0.165	−9.664	−0.142	−0.086	−0.050	−0.001
$SIGMA_{t-1}$	5,996	0.044	0.018	0.004	0.032	0.042	0.053	0.467
$STPT_t$	5,996	0.117	0.321	0.000	0.000	0.000	0.000	1.000

Notes: This table shows the descriptive statistics of the variables measuring stock price crash risk, managerial overconfidence, firm transparency and other control variables used in analysis. The sample period is from 2000 to 2012. All variables are defined in the Appendix

Table I. Descriptive statistics

Table II presents the results of the univariate test on the relation between managerial overconfidence and crash risk. Panel A of Table II reports the difference in crash risk between firms with overconfident and non-overconfident CEOs. Compared with firms with non-overconfident CEOs, firms with overconfident CEOs have higher levels of crash risk, regardless of using *COLLAR* or *NCSKEW* as the crash risk measure. The results of the *t*- and Wilcoxon rank-sum tests show that the differences are statistically significant at least at the 5 percent level. This is consistent with *H1*. In Panel B, we consider the difference between firms with overconfident and non-overconfident chairs, and the results are qualitatively similar to those reported in Panel A.

4.2 Multivariate test of H1

Table III presents the coefficient estimates for Equation (7). In Columns (1)–(3), *COLLAR* is the dependent variable and replaced by *NCSKEW* in Columns (4)–(6). The *t*-statistics reported in parentheses are based on robust standard errors clustered at the firm level. Columns (1) and (4) show that the coefficients of *OC_CEO* are highly significant with expected positive sign (0.047 with $t = 3.671$ and 0.057 with $t = 2.899$). Columns (2) and (5) present consistent results of a positive effect of the overconfidence of a chair on crash risk, as indicated by the positive and significant coefficients of *OC_CHM* (0.045 with $t = 3.210$ and 0.071 with $t = 3.383$). From Columns (3) and (6), we observe that when *OC_CEO* and *OC_CHM* are included in the regression model, the coefficients of these two variables remain positive and statistically significant. This significantly positive association between managerial overconfidence and future crash risk is consistent with *H1*, suggesting that overconfident managers are more likely to conceal negative information or maintain negative NPV projects for extended periods, which in turn leads to an increase in future crash risk.

The estimated coefficients of the control variables are generally consistent with the findings in prior studies. For example, consistent with Hutton *et al.* (2009), the coefficients of *SIZE* are all positive and significant in all columns and those of *ROE* are negative and significant when *NCSKEW* is used as proxy for crash risk. The coefficients of *MtoB* are positive in all regressions and those of *LEV* are positive in regressions where *COLLAR* is the dependent variable.

Panel A: CEO overconfidence and crash risk

	$COLLAR_t$		$NCSKEW_t$	
	Overconfident ($n = 1{,}203$)	Non-overconfident ($n = 4{,}793$)	Overconfident ($n = 1{,}203$)	Non-overconfident ($n = 4{,}793$)
Mean	−0.050	−0.089	−0.230	−0.280
Mean-Diff	0.039		0.050	
t-test	2.705***		2.310**	
Wilcoxon test	2.578***		2.174**	

Panel B: chair overconfidence and crash risk

	$COLLAR_t$		$NCSKEW_t$	
	Overconfident ($n = 999$)	Non-overconfident ($n = 4{,}997$)	Overconfident ($n = 999$)	Non-overconfident ($n = 4{,}997$)
Mean	−0.055	−0.086	−0.231	−0.278
Mean-Diff	0.031		0.047	
t-test	1.996**		2.001**	
Wilcoxon test	2.938***		1.759*	

Notes: This table presents the mean values of crash risk for the sample of firms with overconfident managers and firms with non-overconfident managers. The sample period is from 2000 to 2012. Panel A reports the difference in crash risk between firms with overconfident and non-overconfident CEOs. Panel B reports the difference in crash risk between firms with overconfident and non-overconfident chairs. All variables are defined in the Appendix. *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table II.
Univariate tests

	$COLLAR_t$			$NCSKEW_t$		
	(1)	(2)	(3)	(4)	(5)	(6)
OC_CEO_{t-1}	0.047***		0.036**	0.057***		0.037*
	(3.67)		(2.57)	(2.90)		(1.73)
OC_CHM_{t-1}		0.048***	0.034**		0.074***	0.060***
		(3.36)	(2.22)		(3.50)	(2.61)
$SIZE_{t-1}$	0.018*	0.018*	0.019*	0.037***	0.037***	0.037***
	(1.78)	(1.80)	(1.82)	(2.87)	(2.90)	(2.93)
ROE_t	−0.009	−0.009	−0.008	−0.109***	−0.109***	−0.108***
	(_0.19)	(−0.20)	(−0.18)	(−2.68)	(−2.66)	(−2.65)
$MtoB_{t-1}$	0.031***	0.031***	0.031***	0.062***	0.063***	0.062***
	(5.81)	(5.87)	(5.81)	(6.72)	(6.76)	(6.73)
LEV_{t-1}	0.053*	0.058**	0.055*	0.056	0.062	0.060
	(1.84)	(1.97)	(1.90)	(1.21)	(1.33)	(1.28)
$DTURN_{t-1}$	−0.002	−0.002	−0.002	−0.002	−0.002	−0.002
	(−0.97)	(−1.00)	(−1.00)	(−0.60)	(−0.63)	(−0.64)
$NCSKEW_{t-1}$	< 0.001	< 0.001	< 0.001	0.024*	0.025*	0.024*
	(0.01)	(0.05)	(0.01)	(1.69)	(1.71)	(1.68)
$FSRET_{t-1}$	−0.057**	−0.057*	−0.057*	−0.045	−0.044	−0.044
	(−1.96)	(−1.95)	(−1.96)	(−1.26)	(−1.25)	(−1.24)
$SIGMA_{t-1}$	−6.683***	−6.678***	−6.699***	−5.850***	−5.857***	−5.878***
	(−4.10)	(−4.10)	(−4.11)	(−4.60)	(−4.61)	(−4.62)
$STPT_t$	0.070***	0.071***	0.071***	0.154***	0.156***	0.157***
	(3.23)	(3.27)	(3.28)	(5.29)	(5.35)	(5.37)
Intercept	−0.216	−0.213	−0.222	−0.729***	−0.730***	−0.740***
	(−1.11)	(−1.09)	(−1.14)	(−3.08)	(−3.07)	(−3.12)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.071	0.071	0.072	0.089	0.089	0.089
No. of obs.	5,996	5,996	5,996	5,996	5,996	5,996

Notes: This table presents the regression results of the effect of managerial overconfidence on stock price crash risk. The sample period is from 2000 to 2012. The dependent variables are the crash risk measures *COLLAR* and *NCSKEW*. The *t*-statistics reported in parentheses are computed using the robust standard error clustered at the firm level. All variables are defined in the Appendix. *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table III. The effect of managerial overconfidence on stock price crash risk

We further examine the impact of each component of managerial overconfidence on crash risk and report the regression results in Table IV. Panels A and B document the results for CEO overconfidence. As shown in Panel A, the estimated coefficients of all components of CEO overconfidence are positively, but only the coefficients of Age and CEO duality are statistically significant at the conventional levels. The results reported in Panel B are similar, as all coefficients of overconfidence component are positive (but not statistically significant). Panels C and D report the results of regressions of Chair's overconfidence on crash risk. We find that in both panels the majority coefficients of all components are positive and statistically significant, except for that of *MajorDum*. Overall, our results suggest that the results of main regressions demonstrated in Table III are not driven by only one or two components of managerial overconfidence.

4.3 Test of H2

If opacity facilitates bad news hoarding activities for managers, then one can expect the strength of the relation to be attenuated for firms with more transparency, as proposed in *H2*. Table V shows the estimated results of Equation (8), in which the managerial overconfidence proxies are interacted with the firm transparency proxies. In

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: COLLAR$_t$						
GenderDum_CEO$_{t-1}$	0.005 (0.48)					
MajorDum_CEO$_{t-1}$		0.010 (0.60)				
EduDum_CEO$_{t-1}$			0.014 (1.16)			
TenDum_CEO$_{t-1}$				0.018 (1.51)		
AgeDum_CEO$_{t-1}$					0.030** (2.50)	
DualDum_CEO$_{t-1}$						0.025* (1.67)
Other control variables	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.069	0.069	0.069	0.069	0.070	0.069
No. of obs.	5,996	5,996	5,996	5,996	5,996	5,996
Panel B: NCSKEW$_t$						
GenderDum_CEO$_{t-1}$	−0.000 (−0.02)					
MajorDum_CEO$_{t-1}$		0.031 (1.26)				
EduDum_CEO$_{t-1}$			0.011 (0.58)			
TenDum_CEO$_{t-1}$				0.014 (0.71)		
AgeDum_CEO$_{t-1}$					0.025 (1.43)	
DualDum_CEO$_{t-1}$						0.038 (1.52)
Other control variables	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.087	0.087	0.087	0.087	0.087	0.087
No. of obs.	5,996	5,996	5,996	5,996	5,996	5,996
Panel A: COLLAR$_t$						
GenderDum_CHM$_{t-1}$	0.020 (1.54)					
MajorDum_CHM$_{t-1}$		−0.011 (−0.62)				
EduDum_CHM$_{t-1}$			0.022* (1.83)			
TenDum_CHM$_{t-1}$				0.040*** (3.34)		
AgeDum_CHM$_{t-1}$					0.047*** (3.89)	
DualDum_CHM$_{t-1}$						0.028** (2.13)
Other control variables	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.089	0.070	0.070	0.070	0.071	0.072
No. of obs.	5,996	5,996	5,996	5,996	5,996	5,996
Panel B: NCSKEW$_t$						
GenderDum_CHM$_{t-1}$	0.036* (1.81)					
MajorDum_CHM$_{t-1}$		−0.009 (−0.35)				
EduDum_CHM$_{t-1}$			0.041** (2.25)			
TenDum_CHM$_{t-1}$				0.044** (2.42)		
AgeDum_CHM$_{t-1}$					0.074*** (4.32)	
DualDum_CHM$_{t-1}$						0.039* (1.71)
Other control variables	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.088	0.087	0.088	0.088	0.090	0.088
No. of obs.	5,996	5,996	5,996	5,996	5,996	5,996

Notes: This table presents the regression results of the effect of managerial overconfidence components on stock price crash risk. The sample period is from 2000 to 2012. The dependent variables are the crash risk measures *COLLAR* and *NCSKEW*. The *t*-statistics reported in parentheses are computed using the robust standard error clustered at the firm level. All variables are defined in the Appendix. *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table IV. The effect of managerial overconfidence components on stock price crash risk

	$COLLAR_t$		$NCSKEW_t$	
	(1)	(2)	(3)	(4)
Panel A: measuring firm transparency by DD				
OC_CEO_{t-1}	−0.006 (−0.17)		0.026 (0.35)	
OC_CHM_{t-1}		0.009 (0.37)		−0.026 (−0.56)
$OC\_CEO_{t-1} \times DD_{t-1}$	−0.445** (−2.33)		−0.311 (−0.67)	
$OC\_CHM_{t-1} \times DD_{t-1}$	0.561* (2.15)		0.369 (0.57)	
$OC\_CEO_{t-1} \times DD^2_{t-1}$		−0.312** (−2.78)		−0.585** (−2.34)
$OC\_CHM_{t-1} \times DD^2_{t-1}$		0.377** (2.84)		0.347 (1.06)
DD_{t-1}	0.093 (0.55)	0.139 (1.03)	0.254 (0.86)	0.214 (0.92)
DD^2_{t-1}	−0.018 (−0.08)	−0.084 (−0.39)	−0.175 (−0.44)	−0.188 (−0.52)
Other control variables	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.071	0.070	0.100	0.101
No. of obs.	4,788	4,788	4,788	4,788
Panel B: measuring firm transparency by BIG4				
OC_CEO_{t-1}	0.049*** (4.68)		0.072*** (3.82)	
OC_CHM_{t-1}		0.050*** (4.10)		0.085*** (4.45)
$OC\_CEO_{t-1} \times BIG4_{t-1}$	−0.059*** (−3.48)		−0.082* (−2.00)	
$OC\_CHM_{t-1} \times BIG4_{t-1}$		−0.075** (−2.42)		−0.208** (−2.35)
Other control variables	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.071	0.071	0.098	0.098
No. of obs.	5,996	5,996	5,996	5,996
Panel C: measuring firm transparency by DIVSTY				
OC_CEO_{t-1}	0.027 (1.52)		−0.004 (−0.09)	
OC_CHM_{t-1}		0.017 (1.19)		−0.009 (−0.19)
$OC\_CEO_{t-1} \times DIVSTY_{t-1}$	−0.241*** (−3.89)		−0.386 (−1.10)	
$OC\_CHM_{t-1} \times DIVSTY_{t-1}$		−0.380** (−2.33)		−0.716** (−2.10)
$DIVSTY_{t-1}$	−0.154* (−1.88)	−0.142* (−1.89)	0.211 (1.27)	0.255 (1.50)
Other control variables	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.103	0.104	0.087	0.089
No. of obs.	2,389	2,389	2,389	2,389
Panel D: measuring firm transparency by DSCORE				
OC_CEO_{t-1}	0.137*** (4.32)		0.149*** (4.48)	
OC_CHM_{t-1}		0.152*** (3.83)		0.259*** (4.01)
$OC\_CEO_{t-1} \times DSCORE_{t-1}$	−0.024** (−2.43)		−0.045*** (−3.65)	
$OC\_CHM_{t-1} \times DSCORE_{t-1}$		−0.045** (−3.03)		−0.077** (−2.96)
$DSCORE_{t-1}$	−0.016 (−1.05)	0.004 (0.80)	−0.008 (−0.82)	−0.001 (−0.05)
Other control variables	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.069	0.035	0.069	0.070
No. of obs.	2,956	2,956	2,956	2,956

Notes: This table presents the regression results of the impact of firm transparency on the relation between managerial overconfidence and stock price crash risk. The sample period is from 2000 to 2012. The dependent variables are the crash risk measures *COLLAR* and *NCSKEW*. In Panels A, B, C and D, *DD*, *BIG4*, *DIVSTY* and *DSCORE* are used as proxy for firm transparency, respectively. The *t*-statistics reported in parentheses are computed using the robust standard error clustered at the firm level. All variables are defined in the Appendix. *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table V. The impact of firm transparency

Panel A, we use the measure of earnings quality *DD* as the proxy for firm transparency. Following Hutton *et al.* (2009), we control for the quadratic term of *DD* in the regression. The results are generally consistent with our expectations. Except for those under Column (3), the coefficients of *OC_CEO*×*DD* and *OC_CHM*×*DD* are negative and statistically significant at least at the 5 percent levels. The positive coefficients of $OC\_CEO \times DD^2$ and $OC\_CHM \times DD^2$ are statistically significant in Columns (1) and (2), thus suggesting the impact of transparency on the relation between managerial overconfidence and crash risk diminishes as firm transparency increases.

Panel B presents the results when we use *BIG4* to proxy for firm transparency. As seen in Table IV, the positive coefficients of *OC_CEO* and *OC_CHM* remain statistically significant in all four columns. Regardless of using *COLLAR* or *NCSKEW* as the dependent variable, the coefficients of the interaction terms *OC_CEO*×*BIG4* and *OC_CHM*×*BIG4* are negative and significant at the 5 percent level. This result implies that the effect of managerial overconfidence on crash risk is less pronounced when the firm is audited by the Big 4 auditors.

Panel C represents the results in which *DIVSTY* is used as a proxy for firm transparency. The results illustrate that, except for Column (3), the coefficients of *OC_CEO*×*DIVSTY* and *OC_CHM*×*DIVSTY* are negative and statistically significant at least at the 5 percent level, indicating a considerably weak effect of overconfidence on crash risk in firms with a large dispersion in analyst's earnings forecasts.

When firm transparency is measured by *DSCORE*, we qualitatively obtain the same results reported in Panel D. The coefficients of *OC_CEO* and *OC_CHM* are positive and significant across all columns. Moreover, the coefficients of the two interaction terms *OC_CEO*×*DSCORE* and *OC_CHM*×*DSCORE* are consistently negative and significant at least at the 5 percent level.

In summary, firm transparency measurably affects the relation between managerial overconfidence and crash risk. The marginal effect of overconfidence on the risk is more pronounced for firms with low earnings quality, audited by non-Big 4 auditors, with large dispersion in analyst earnings forecasts, and with low ratings on information disclosure. These findings are consistent with *H2*.

5. Robustness checks and additional tests

5.1 Endogeneity Issues

We first consider the potential self-selection bias that might arise from the fact that firms self-select their top managers. One cannot rule out the possibility that high-crash risk firms are more likely to hire overconfident managers. In such a case, estimating the impact of overconfident CEO (Chairman) vs non-overconfident CEO (Chairman) in a single equation context may introduce a self-selection bias into the coefficients of CEO (Chairman) overconfidence. We try to mitigate this issue using a two-stage regression approach.

In the first stage, we estimate a probit model in which the likelihood of CEO (Chairman) overconfidence, denoted by Pr(*OC_CEO/OC_CHM*), is regressed on a set of firm-specific characteristics that might influence the choice of CEO or board chair:

$$\begin{aligned}\Pr(OC\_CEO/OC\_CHM)_{it} = {} & \varphi_0 + \varphi_1 SIZE_{it} + \varphi_2 LEV_{it} + \varphi_3 MtoB_{it} + \varphi_4 ROE_{it} \\ & + \varphi_5 GROWTH_{it} + \varphi_6 RETURN_{it} \varphi_7 RISK_{it} \\ & + \varphi_8 CEOTURN_{it}/CHMTURN_{it} \\ & + \varphi_9 TOPHOLD_{it} + \varphi_{10} BSIZE_{it} + \xi_{it}. \end{aligned} \tag{9}$$

The firm-specific variables include firm size (*SIZE*), financial leverage (*LEV*), market-to-book ratio (*MtoB*), return on net assets (*ROE*), sales growth (*GROWTH*), yearly stock return

(*RETURN*), firm risk (*RISK*, measured as the volatility of weekly stock returns), CEO (Chairman) turnover (*CEOTURN/CHMTURN*), the percentage of shares held by the largest shareholder (*TOPHOLD*) and board size (*BSIZE*). Year and industry dummies are included to control for year and industry fixed effects.

In the second stage, we follow Gul *et al.* (2010) to estimate our main regression in two different ways to address potential self-selection biases. First, we follow Heckman's (1979) two-stage treatment effect procedure. In particular, we calculate the inverse Mills ratio, denoted as λ, from the first-stage probit regression of Equation (9), and then include λ in the second-stage regression. Second, we estimate our main regression with the fitted value of Pr(*OC_CEO/OC_CHM*), denoted by *PredOC_CEO/PredOC_CHM*, from the first-stage probit regression as an instrument for the managerial overconfidence variables in the second-stage regression.

Panel A of Table VI reports first-stage probit estimates. The results show that the likelihood of a firm to choose overconfidence CEO (Chairman) is positively related to leverage and CEO (Chairman) turnover and firm risk, and is insignificantly associated with firm size, market-to-book ratio, sales growth and stock return, while it has a significantly negative relation with return on net assets, firm age and ownership concentration.

Panel B of Table VI presents second-stage results with the inverse Mills ratio included in Columns (1)–(4), while Columns (5)–(8) presents those with *PredOC_CEO/PredOC_CHM* lieu of *OC_CEO/OC_CHM*. As shown in the table, the coefficients on *OC_CEO/OC_CHM* and *PredOC_CEO/PredOC_CHM* are significantly positive, suggesting that corrections for self-selection bias do not alter the main results presented in Table III.

We also employ an event study to clarify the causality relationship between managerial overconfidence and crash risk using shocks associated with manager turnover. The sample is selected based on the following procedures: identify the CEO (Chairman) turnovers that cause switches between overconfident CEO (Chairman) and non-overconfident CEO (Chairman) and require no CEO (Chairman) overconfidence status changes and CEO (Chairman) turnovers either in the prior or the subsequent year. Thus, we obtain 69 cases of managerial overconfidence status changes (*OC–NonOC*), among which 41 occur between CEOs (*OC_CEO–NonOC_CEO*) and 28 between board Chairs (*OC_CHM–NonOC_CHM*). Identify a matching firm for each event firm in the year of the CEO (Chairman) turnover. The matching firm is required to have experienced CEO (Chairman) turnover, operate in the same industry, and is closest in firm size but with no change in managerial overconfidence status during the event window [$t-1$, $t+1$].

We then compute the changes in crash risk surrounding the event year (*D_COLLAR* and *D_NCSKEW*) for event and matching firms, respectively. The changes in crash risk are computed as $year_{(t+1)}-year_{(t-1)}$ for switches from non-overconfidence CEO (Chairman) to overconfidence CEO (Chairman) and as $year_{(t-1)}-year_{(t+1)}$ for switches from overconfident CEO (Chairman) to non-overconfident CEO (Chairman). We further compute the differences in crash risk changes between event firms and matching firms. The univariate results are shown in Table VII. For event firms, crash risk increases for both groups of *OC_CEO–NonOC_CEO* and *OC_CHM–NonOC_CHM*. By contrast, matching firms do not exhibit such a pattern in their crash risk measures. The *t*-test further suggests that the differences in crash risk changes between event firms and matching firms are statistically significant for the groups of *OC–NonOC* and *OC_CEO–NonOC_CEO*, suggesting that in comparison with the matching sample, crash risk increases significantly when a firm's top manager changes from a non-overconfident one to an overconfident one, and vice versa.

Managerial overconfidence and crash risk may be simultaneously driven by a few unobserved, firm-level time-constant factors. Accordingly, the estimated coefficients from the regression might be biased. In the robustness test shown in Table VIII, we control for

	OC_CEO_t (1)	OC_CHM_t (2)
Panel A: first-stage regression		
$SIZE_t$	−0.037 (−1.54)	−0.022 (−0.81)
LEV_t	0.304*** (2.71)	0.352*** (2.80)
$MtoB_t$	0.030 (1.46)	0.005 (0.21)
ROE_t	−0.545* (−1.88)	−0.822** (−2.54)
$GROWTH_t$	0.004 (0.16)	0.029 (1.01)
$RETURN_t$	0.026 (0.65)	0.010 (0.24)
$RISK_t$	0.044 (0.89)	0.104* (1.83)
AGE_t	−0.028*** (−5.79)	−0.010* (−1.80)
$CEOTURN_t$	0.242*** (5.42)	
$CHMTURN_t$		0.195*** (3.35)
$TOPHOLD_t$	−0.290** (−2.09)	−0.166 (−1.06)
$BSIZE_t$	−0.031*** (−2.99)	−0.004 (−0.38)
Intercept	0.360 (0.69)	−0.746 (−1.28)
Industry fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Pseudo R^2	0.024	0.020
No. of obs.	5,940	5,940

Panel B: second-stage regression

	$COLLAR_t$		$NCSKEW_t$		$COLLAR_t$		$NCSKEW_t$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
OC_CEO_{t-1}	0.350***		0.449***					
	(2.89)		(2.79)					
OC_CHM_{t-1}		1.016***		1.027***				
		(4.39)		(3.39)				
$PredOC\_CEO_{t-1}$					0.367***		0.525***	
					(2.60)		(3.05)	
$PredOC\_CHM_{t-1}$						1.044**		0.840**
						(2.24)		(1.98)
λ	−0.175**	−0.517***	−0.241***	−0.534***				
	(−2.52)	(−4.19)	(−2.61)	(-3.31)				
Other control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.071	0.072	0.075	0.074	0.0704	0.071	0.074	0.073
No. of obs.	5,940	5,940	5,940	5,940	5,940	5,940	5,940	5,940

Notes: This table presents two-stage regressions to examine self-selection bias associated with managerial overconfidence. Panel A reports the first-stage probit regression results and Panel B reports the second-stage regression results. The sample period is from 2000 to 2012. The dependent variables in Panel A are the managerial overconfidence measures *OC_CEO* and *OC_CHM*. The dependent variables in Panel B are the crash risk measures *COLLAR* and *NCSKEW*. The *t*-statistics reported in parentheses are computed using the robust standard error clustered at the firm level. All variables are defined in the Appendix. *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table VI. Results of two-stage regressions to examine self-selection bias associated with managerial overconfidence

firm fixed effects to address the aforementioned endogeneity problem and conclude that the results are consistent with our previous findings.

5.2 Alternative measures of managerial overconfidence

In the main analysis, the overconfidence measures are constructed based on the personal characteristics of the CEO and chair. To assess the robustness of our main results, we redo

	Average crash risk Event sample (1)	Matching sample (2)	Difference (1)–(2)	*t*-test of (1)–(2)	*n*
Panel A: D_COLLAR					
OC–NonOC	0.196	−0.156	0.352	2.409**	28
OC_CEO–NonOC_CEO	0.267	−0.151	0.418	2.733***	41
OC_CHM–NonOC_CHM	0.091	−0.164	0.255	0.896	28
Panel B: D_NCSKEW					
OC–NonOC	0.213	−0.081	0.294	1.842*	69
OC_CEO–NonOC_CEO	0.222	−0.174	0.396	1.853*	41
OC_CHM–NonOC_CHM	0.198	0.054	0.418	0.600	28

Notes: This table presents results of the change of crash risk when a firm's CEO or Chairman changes from an overconfidence one to a non-overconfidence one, and vice versa. The event sample consists of firms that experience managerial overconfidence switches between overconfidence CEO (Chairman) and non-overconfidence CEO (Chairman) during the sample period. For each event firm, we find a matching firm also experiencing CEO (Chairman) turnover, operating in the same industry, and closest in firm size but with no change in managerial overconfidence status during the event window [t−1, t+1]. *D_COLLAR* and *D_NCSKEW* denote the changes in crash risk surrounding the event window. They are computed as $year_{(t+1)}$–$year_{(t-1)}$ for switches from non-overconfidence CEO (Chairman) to overconfidence CEO (Chairman) and as $year_{(t-1)}$–$year_{(t+1)}$ for switches from overconfidence CEO (Chairman) to non-overconfidence CEO (Chairman). The differences in the changes of crash risk between the event sample and the matching sample, *t*-Statistics associated with these differences, and the number of event are reported in the last three columns. *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table VII. Managerial overconfidence and crash risk: event study

	$COLLAR_t$ (1)	(2)	$NCSKEW_t$ (3)	(4)
OC_CEO_{t-1}	0.062*** (3.02)		0.058** (1.98)	
OC_CHM_{t-1}		0.070*** (2.70)		0.073** (2.09)
Other control variables	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.088	0.088	0.111	0.111
No. of obs.	5,996	5,996	5,996	5,996

Notes: This table presents the regression results of crash risk on managerial overconfidence after controlling for firm fixed effects. The sample period is from 2000 to 2012. The dependent variables are the crash risk measures *COLLAR* and *NCSKEW*. The *t*-statistics reported in parentheses are computed using the robust standard error clustered at the firm level. All variables are defined in the Appendix. *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table VIII. Controlling for firm fixed effects

the empirical analysis with three alternative measures of managerial overconfidence. Following Schrand and Zechman (2012), we build the first additional overconfidence variable *OC_FIRM* using four measures of firm-level investing and financing activities that prior research has found to be related to managerial overconfidence. For a given firm in a given year, *OC_FIRM* equals 1 if the firm meets the requirements of at least three of four criteria following, and 0 otherwise. First, the excess investment is higher than the industry median, where the excess investment is the residual from the regression of the total asset growth on sales growth; second, the value of the net asset acquisition is higher than the industry median, where net asset acquisition is calculated as the amount of asset acquisition minus the amount of the stripped assets; third, the debt-to-equity ratio is higher than the

industry median, where the debt-to-equity ratio is defined as the long-term debt divided by the total market capitalization of the equity; and fourth, the firm's dividend payout ratio is 0.

Following Huang *et al.* (2011), we use the relative ratio of executive salary (*OC_RS*) as another managerial overconfidence measure. For each firm in each year, we compute the relative ratio of executive salary, which is the ratio of the sum of the three highest-paid managers' salaries to the sum of all managers' salaries. Thereafter, *OC_RS* is assigned a value of 1 if the relative ratio is higher than the industry median, and 0 otherwise.

Following Lin *et al.* (2005) and Huang *et al.* (2011), the last overconfidence measure *OC_PB* is based on the difference between manager's forecast and actual earnings. If the number of incidences in which the realized earnings are lower than the forecast earnings exceeds the number of incidences in which the realized earnings are higher during the sample period, then the CEO/chair of a firm is defined as being overconfident. Thus, *OC_PB* takes a value of 1, and 0 otherwise.

Table IX presents new results with additional three measures of managerial overconfidence. The coefficients of the three alternative overconfidence variables are consistently positive and statistically significant at the 5 and 10 percent levels, except for the insignificant coefficient of *OC_CP* in Column (2). These results are generally in line with those presented in Table III.

5.3 Alternative measures of crash risk

In this section, we re-estimate Equation (7) with two alternative measures of crash risk. Following Chen *et al.* (2001) and Kim *et al.* (2011a), the first risk measure *DUVOL* measures stock return asymmetries. For each firm in each year, we identify the trading weeks with firm-specific return below the annual mean (thereafter, down weeks) and the weeks with firm-specific return above the annual mean (thereafter, up weeks). Consequently, we compute the standard deviation of the returns for down and up weeks, respectively. In the last step, we compute *DUVOL* using the following equation:

$$DUVOL_{it} = \log\left\{(n_u-1)\sum_{\text{down}} w_{i\tau}^2/(n_d-1)\sum_{\text{up}} w_{i\tau}^2\right\}, \tag{10}$$

	$COLLAR_t$			$NCSKEW_t$		
	(1)	(2)	(3)	(4)	(5)	(6)
OC_FIRM_{t-1}	0.023** (2.32)			0.035*** (3.37)		
OC_RS_{t-1}		0.020 (1.51)			0.048*** (2.66)	
OC_PB_{t-1}			0.046*** (4.40)			0.066*** (3.22)
Other control variables	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.076	0.081	0.084	0.087	0.090	0.099
No. of obs.	5,317	5,711	4,674	5,322	5,711	4,674

Notes: This table presents the regression results of crash risk on alternative measures of managerial overconfidence. The sample period is from 2000 to 2012. The dependent variables are the crash risk measures *COLLAR* and *NCSKEW*. The *t*-statistics reported in parentheses are computed using the robust standard error clustered at the firm level. All variables are defined in the Appendix. *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table IX. Alternative measures of managerial overconfidence

where w is the firm-specific weekly return and n_d and n_u are the number of down and up weeks, respectively. The higher the value of *DUVOL*, the higher the crash risk.

We also follow Jin and Myers (2006) to redefine crash risk presented by *COUNT*, which is based on the frequency of firm-specific weekly returns that exceed 3.2 standard deviations above and below the mean. In particular, *COUNT* is computed as the upside frequencies subtracted by the downside frequencies, where a high value of *COUNT* suggests a high frequency of crashes.

As indicated by the results reported in Table X, our main conclusions remain the same despite using different crash risk measures.

5.4 Controlling for the influence of corporate governance

To disentangle the effects of overconfidence from those of agency conflicts, we build our main measure of overconfidence on managers' personal characteristics. However, one cannot rule out the possibility that overconfident managers are self-selected by firms with a particular governance structure. In addition, our composite measure of managerial overconfidence includes a dummy variable for CEO duality, which may capture worse corporate governance (Cornett *et al.*, 2008)[3]. We perform two tests to mitigate the above-mentioned concerns.

First, we control for additional elements of corporate governance, including the percentage of shares held by the largest shareholder (*TOPHOLD*) and executives (*MSHAR*) and the proportion of independent directors (*OUTR*). The results presented in Columns (1)–(4) of Table XI indicate that the sign and significance level of the estimated coefficients of *OC_CHM* and *OC_CHM* do not change, and confirm the main findings presented in Table III. Second, we exclude firms with CEO duality and re-estimate Equation (7). The results shown in Columns (5)–(8) of Table XI are consistent with the previous main findings.

5.5 Additional analysis

Ahmed and Duellman (2013) find that overconfident managers are prone to disclose good news more promptly than they would disclose bad news, which suggests that good news is less likely to be concealed within a firm. Thus, a negative relationship should exist between managerial overconfidence and the probability of a positive jump in stock price. Following Hutton *et al.* (2009), we define *JUMP* as a dummy variable that equals 1 if, within a calendar year, the firm-specific weekly return is over 3.2 standard deviations above the mean, and 0 otherwise. Table XII presents the results of the regression of the positive jump risk on various measures of managerial overconfidence. Except for the insignificant coefficient of

	$DUVOL_t$		$COUNT_t$	
	(1)	(2)	(3)	(4)
OC_CEO_{t-1}	0.027*** (2.62)		0.034** (2.27)	
OC_CHM_{t-1}		0.034*** (3.14)		0.054* (1.82)
Other control variables	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.147	0.148	0.357	0.357
No. of obs.	5,996	5,996	5,996	5,996

Notes: This table presents the regression results of alternative measures of crash risk on managerial overconfidence. The sample period is from 2000 to 2012. The dependent variables are the crash risk measures *DUVOL* and *COUNT*. The *t*-statistics reported in parentheses are computed using the robust standard error clustered at the firm level. All variables are defined in the Appendix. *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table X. Alternative measures of crash risk

	Panel A: controlling for corporate governance factors				Panel B: excluding firms with CEO duality			
	$COLLAR_t$		$NCSKEW_t$		$COLLAR_t$		$NCSKEW_t$	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
OC_CEO_{t-1}	0.046***		0.058***		0.042***		0.042*	
	(3.51)		(2.93)		(2.67)		(1.80)	
OC_CHM_{t-1}		0.049***		0.077***		0.043**		0.064**
		(3.38)		(3.60)		(2.20)		(2.26)
$TOPHOLD_{t-1}$	−0.097**	−0.100**	−0.066	−0.071				
	(−2.27)	(−2.33)	(−1.10)	(−1.18)				
$MSHAR_{t-1}$	0.080**	0.084**	0.058	0.060				
	(1.97)	(2.06)	(0.87)	(0.91)				
$OUTR_{t-1}$	−0.063	−0.056	−0.089	−0.084				
	(−0.59)	(−0.52)	(−0.52)	(−0.49)				
Other control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.072	0.072	0.089	0.090	0.070	0.069	0.088	0.089
No. of obs.	5,940	5,940	5,940	5,940	4,772	4,772	4,772	4,772

Notes: This table presents the regression results of crash risk on managerial overconfidence with additional control variables of corporate governance, including the percentage of shares held by the largest shareholder (*TOPHOLD*), executive ownership (*MSHAR*) and the proportion of independent directors in the board (*OUTR*). The sample period is from 2000 to 2012. The dependent variables are the crash risk measures *COLLAR* and *NCSKEW*. The *t*-statistics reported in parentheses are computed using the robust standard error clustered at the firm level. All variables are defined in the Appendix. *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table XI. Controlling for the influence of corporate governance

	(1)	(2)	(3)	(4)	(5)
OC_CEO_{t-1}	−0.131*** (−2.77)				
OC_CHM_{t-1}		−0.166** (−2.35)			
OC_FIRM_{t-1}			−0.109 (−1.58)		
OC_RS_{t-1}				−0.136** (−2.34)	
OC_PB_{t-1}					−0.188* (−1.78)
Other control variables	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Pseudo R^2	0.146	0.146	0.153	0.149	0.114
No. of obs.	5,996	5,996	5,322	5,711	4,674

Notes: This table presents the logistic regression results of positive jump risk of stock price on the managerial overconfidence. The sample period is from 2000 to 2012. The dependent variable is *JUMP*, which takes the value of one if a firm experiences one or more firm-specific weekly returns exceeding 3.2 standard deviations above the mean within its fiscal year, and zero otherwise. The *t*-statistics reported in parentheses are computed using the robust standard error clustered at the firm level. All variables are defined in the Appendix. *,**,***Significant at 10, 5 and 1 percent levels, respectively

Table XII. The effects of managerial overconfidence on positive jump risk of stock price

OC_FIRM_{t-1}, the coefficients of the other four overconfidence measures are consistently negative and statistically significant at least at the 10 percent level.

Combined with the previous finding of a positive effect of managerial overconfidence on crash risk, this result supports our prediction that overconfident managers have incentives to hoard bad news within a firm, while they disclose good news in a timely manner.

6. Conclusion

This paper analyzes the impact of managerial overconfidence on stock price crash risk. Using a large sample of Chinese non-state-owned firms from 2000 to 2012, we find that firms with overconfident CEOs or board chairs are more likely to experience stock price crashes in the future. In addition, the effects of managerial overconfidence on crash risk are more pronounced for firms with lower transparency, indicated by lower earnings quality, being audited by non-Big4 auditors, large dispersions in analysts' earnings forecasts, and low ratings on information disclosure. This finding implies that an opaque information environment facilitates bad news hoarding activities by overconfident managers. We also find that managerial overconfidence is negatively associated with future stock price jump risk, suggesting that overconfident managers tend to release positive information in a timely manner. The main results hold after a series of robustness tests. Our study complements the research of Jin and Myers (2006), who emphasize the importance of investor protection and firm transparency in reducing crash risk.

Notes

1. We re-estimate the model with value-weighted average return of the market and value-weighted average industry return of the industry, and the results are qualitatively the same.
2. Liu and Lu (2007) state that "The stock exchanges will first label a firm in financial trouble as a special treatment (ST) firm, then designate it a particular transfer (PT) firm if it fails to turn profitable within one year" (p. 886).
3. We thank the reviewer for bringing this to our attention.

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Further reading

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Appendix. Variable definitions

Dependent variables: crash (jump) risk measures

COLLAR is the actual profits or losses from an option portfolio of buying an out-of-money put option and shorting a call option on the firm-specific weekly return, times 1,000. The strike price of the put is set to the mean minus 3.2 standard deviations and the strike price of the call is set to the mean plus 3.2 standard deviations, with 3.2 chosen to generate frequencies of 0.1 percent in the normal distribution during the fiscal year period.

NCSKEW is the negative skewness of firm-specific weekly returns over the fiscal year.

DUVOL is the natural logarithm of the ratio of standard deviations of downward week to upward week firm-specific returns.

COUNT is the difference between the numbers of firm-specific weekly returns exceeding 3.2 standard deviations below and above the mean.

JUMP is a dummy variable that equals one if a firm experience one or more firm-specific weekly returns exceeding 3.2 standard deviations above the mean within its fiscal year, and zero otherwise.

Managerial overconfidence variables

OC_CEO (*OC_CHM*) is a dummy variable that equals 1 if the CEO (chair) of a firm meets the requirements of at least four of six criteria following, and 0 otherwise. First, the CEO (chair) is male; second, the CEO's (chair's) age is below the sample mean; third, the CEO (chairman) has obtained a master's degree or higher; fourth, the CEO (chair) studied a business or economics major; fifth, the CEO's (chair's) tenure is below the sample median; and sixth, the CEO is also the chair of the board of directors.

GenderDum is a dummy variable that equals 1 when the CEO (chair) is male, and 0 otherwise.

AgeDum is a dummy variable that equals 1 if the CEO (chair) is male, and 0 otherwise.

EduDum is a dummy variable that equals 1 if a CEO (chair) has obtained a master's degree or higher, and 0 otherwise.

MajorDum is a dummy variable that equals 1 if a CEO (chair) pursued a business or economics major, and 0 otherwise.

TenDum is a dummy variable that equals 1 if a CEO's (chair's) tenure is below the sample median, and 0 otherwise.

DualDum is defined as an indicator that equals 1 if the CEO also holds the position of the chair of the board, and 0 otherwise.

Firm transparency variables

DD is the moving sum of absolute value of discretionary accruals over the last three years, multiplied by −1, where discretionary accruals are estimated from the modified Jones model (Dechow *et al.*, 1995).

BIG4 is a dummy variable that takes the value of 1 if a firm is audited by one of the joint ventures of international Big 4 audit firms and domestic audit firms, and 0 otherwise.

DIVSTY is the standard deviation of analysts' forecasts of the firm's earnings in the next year, normalized by the mean forecast, and divided by the square root of the number of analysts following that firm, and then multiplied by −1.

DSCORE is the transparency measure based on the information disclosure rating released by the Shenzhen Stock Exchange. *DSCORE* has values of 4, 3, 2 and 1 for firms ranked into the respective four categories: excellent, good, qualified and unqualified.

Other control variables

SIZE is the size of a firm, which is calculated as the natural logarithm of year-end market value of equity.

ROE is return on net assets, which is calculated as the net income divided by the book value of equity.

MtoB is market-to-book ratio, which is measured as the ratio of market value of equity to book value of equity.

LEV is leverage ratio, which represents the ratio of the book value of total liabilities to the book value of total assets.

DTURN is the detrended stock trading volume, which is measured as the difference between the average monthly share turnover over the current fiscal year period and that of the previous fiscal year, where monthly share turnover is calculated as the monthly trading volume divided by the total number of shares outstanding during the month.

FSRET represents the average firm-specific weekly return over a fiscal year, times 100.

SIGMA is the standard deviation of firm-specific weekly returns over a fiscal year.

STPT is a dummy variable that equals 1 for the ST (special treatment) firms that reported negative earnings in the past two successive fiscal years, and for the PT (particular transfer) firms that reported negative earnings in the past three successive fiscal years, and zero otherwise.

TOPHOLD is the percentage of shares held by the largest shareholder.

MSHAR is the percentage of shares held by the executives.

OUTR is the ratio of number of independent directors to board size.

GROWTH is the growth rate of sales.

RETURN is the yearly buy and hold stock return.

RISK is the standard deviation of weekly stock return.

CEOTURN is a dummy variable that equals 1 if CEO turnover occurs in a given year, and 0 otherwise.

CHMTURN is a dummy variable that equals 1 if board chair turnover occurs in a given year, and 0 otherwise.

BSIZE is the natural logarithm of the number of board directors.

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Unobserved ties between corporate executives and mutual fund managers

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Abstract

After corporate executives relocate from origin firms to destination firms, only 3.6 percent of mutual fund managers follow the departing executives: they divest from origin firms while initiating investments in destination firms. This phenomenon is more pronounced for those funds that earned superior returns from investments in the origin firms, and that demand more information regarding the destination firms. Further, comigration funds' holding changes in destination firms more accurately predict cumulative abnormal returns around earnings announcements than do their investments in other stocks and non-comigration funds' new investments. Hiring the migrating executives does not improve the destination firms' operating performance.

Key words: Information dissemination; Managerial turnover; Mutual funds

JEL classification: G11, G14, G20

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1. Introduction

Information dissemination among financial market participants is a topic of significant interest to financial economists. There is limited empirical research addressing the influence of interpersonal relationships on information sharing contributing to asset-price formation (Shiller and Pound, 1989; Hong *et al.*, 2005; Massa and Simonov, 2005; Cohen *et al.*, 2008, 2010). One reason for this relative lack of attention on the role of personal relationships in the investment industry is the challenge of credibly identifying these relationships (Brochet *et al.*, 2014). Brochet *et al.* (2014) deviated from prior research that first identified relationships and then examined their influence on market participants' behaviour, and adopted a novel method using the observable event of initiating analyst coverage to infer and investigate relationships between analysts and corporate executives. They show that corporate executives moving from one firm (origin) to another (destination) can trigger a small subset of analysts who originally followed the origin firm to initiate coverage of the destination firm. Furthermore, these analysts exhibit more accurate coverage of the origin firm than they do in other firms and compared to other analysts covering the origin firm. Our present study follows the methods of Brochet *et al.* (2014) to investigate the relationships between mutual fund managers and corporate executives. We focus on fund managers' investment decisions following the migration of a top corporate executive in a currently invested firm to a new firm.

We originally observed the following phenomenon in the Chinese capital market: certain mutual funds initiated investments in firms that had recently hired a corporate executive who had left the company (origin) previously invested by these funds. Namely, mutual funds comigrate with the departing executive. Because the investments of time, energy and money required to develop a close and valuable relationship are costly, fund managers have rational incentives to maintain established relationships with corporate executives. We posit that if a fund manager is more closely connected than his peers are to a specific corporate executive, then he or she is more likely to comigrate when the executive moves to another company (destination). By examining 223 incidents from 2006–2013 of corporate executive migration between Chinese publicly traded firms and the holdings of actively managed equity mutual funds, we find that in a significant number of cases, a corporate manager's relocation prompted mutual funds to divest from origin firms and initiate investments in destination firms. Among the mutual funds that had invested in origin firms, about 3.6 percent comigrated; this figure is significantly higher than the 2.1 percent for the funds that had invested in the controlled firms selected by migration–propensity score-based proximity to the actual

origin–destination pairs.[1] When we controlled for two types of connections, i.e., shared educational background and living locations, that can link corporate executives and fund managers, we find that if an executive with whom a fund had a prior equity relationship moves to a new firm, then the probability that the fund will initiate investment in that firm is 1.41 times greater than the probability of not investing. This comigrating behaviour is more pronounced among mutual funds that benefited from their investments in the origin firms. To be specific, a larger concentrated bet in the origin firm, combined with higher cumulative abnormal returns (CARs) around the firm's earnings announcement dates, can increase the probability of comigration.

Another interesting finding is a positive relation between mutual fund comigration and fund managers' demands for information about the destination firm. Specifically, the probability of fund comigration increases in the R^2 of the regression of the destination firm's stock returns; the probability also increases with the distance between the mutual fund's headquarters and the headquarters of the destination firm. Roll (1988) uses R^2 of the regression of stock returns on market returns to measure information asymmetry of the firm, and a larger R^2 indicates greater firm opacity. If a fund's headquarters is far from the headquarters of a firm in which the fund invests, the fund manager will be less familiar with the firm. We contend that, when firms are less transparent or when fund managers are not familiar with the firm, they need more information to make better investment decisions. As a result, an additional information source such as a connected senior manager may become a valuable resource.

We also investigate whether the comigration strategy benefits mutual funds by examining the performance of funds after they initiate investments in destination firms. A fund manager who follows a departing executive is likely to have preferred access to valuable information concerning the destination firm and thus achieve abnormal returns on those connected holdings. Our empirical results strongly support this prediction. In contrast to non-comigration funds' holding changes in firms invested after managerial departure, comigration funds' holding changes in destination firms more accurately predict CARs around earnings announcements. In addition, comigration funds' holding changes in destination firms predict subsequent CARs significantly better than their holding changes in other stocks. These findings are consistent with the presence of close relationships between the departing executives and the comigrating fund managers, who apparently receive exclusive information on the destination firm. We further compare the one-factor and three-factor

[1] In sum, we compute the propensity of managerial switch from any potential origin firm to the actual destination firm; we then pick as the control firm of origin that firm whose propensity score is the closest to that of the actual origin firm. Similarly, we compute the propensity score of the managerial move from the actual origin firm to all potential destination firms, and then choose as the control firm of destination the firm with the closest propensity score to that of the actual destination firm. Section 3 provides a detailed explanation of this propensity score matching process.

adjusted returns between comigration funds and non-comigration funds; results indicate that these funds have performed similarly, thereby suggesting that comigrating managers do not have better investment skills than the other group. Further, we find no evidence that mutual funds follow departing executives specifically for their talent, as we find that the operating performance of the destination firms does not improve after the recruitment of these executives.

Regardless of observed ongoing business relationships, the combination of revealed investment patterns of certain mutual funds and their superior investment performance implies the existence of heretofore unobserved interpersonal relationships between institutional investors and corporate executives. In this context, our paper contributes to the growing finance literature addressing the influence of personal connections on information dissemination that specifically contributes to asset-price formation in the financial markets.[2] For instance, empirical evidence exists for the effect of information disseminated among local or socially connected stock investors on their investment decisions and performance (Shiller and Pound, 1989; Hong *et al*., 2005; Ozsoylev *et al*., 2014; Pool *et al*., 2015). In addition to the social networks formed according to geographic distance and company boundaries, alumni relationships form a channel through which information may be exchanged among investors (Massa and Simonov, 2005; Cohen *et al*., 2010). Our study corresponds more closely to Cohen *et al*. (2008), who investigate college alumni connections between mutual fund managers and corporate board members. However, because we have controlled for the potential effects of location proximity and alumni relationships in our analysis, we extend the literature by providing new evidence for the influence of other forms of personal connections on investment decisions. Further, because this paper provides substantive indirect evidence consistent with the existence of selective information disclosure leading to superior investment performance, we also contribute to the strain of financial literature on insider trading (Jaffe, 1974; Jarrell and Poulsen, 1989; Meulbroek, 1992; Seyhun, 1992; Chen *et al*., 2018).

Our findings are drawn from the samples of mutual funds and companies listed in China's stock markets; therefore, we also contribute to the literature addressing important contemporary research questions concerning the Chinese capital market, which has the world's second largest stock market and the third largest bond market.[3] Unlike the US financial markets, in which trading on material non-public information is strictly prohibited, tipping with non-public

[2] The sociology and economics literatures have documented that personal relationships and social networks influence behaviour (Ellison and Fudenberg, 1995; Glaeser *et al*., 1996; Akerlof, 1997; Bala and Goyal, 1998; Bertrand *et al*., 2000).

[3] Please see Han *et al*. (2018) for a comprehensive literature review of accounting and finance research on the Chinese capital market over the past two decades.

information is a much more serious problem in China.[4] Despite recent institutional and regulatory improvements, the Chinese capital market continues to be plagued by weak investor protection and low-quality financial information in a low-transparency environment (Allen *et al.*, 2005; Berkman *et al.*, 2010; Piotroski and Wong, 2012; Chen *et al.*, 2013). In addition, both information leakage from insiders and active illegal insider trading remain common. According to the China Securities Regulatory Commission (CSRC) (http://www.csrc.gov.cn/pub/csrc_en/), between 2008 and 2013, 785 insider-trading cases were investigated, with a notable proliferation in recent years. Characterised by low transparency and weak investor protection, China's relationship-driven equity market provides a unique institutional setting in which to examine the effect on investor behaviour of a country's institutional background and culture. In this context, our paper complements prior studies investigating the importance of social networks, such as political connections, in the Chinese financial markets (Peng *et al.*, 2017; Kong *et al.*, 2019; Shen *et al.*, 2019).

The remainder of the paper is organised as follows. We develop hypotheses in Section 2. Section 3 describes the data and the propensity score matching method used to construct a control group of firms. We present in Section 4 the methodology and discussion of the empirical results. Section 5 concludes the paper.

2. Hypothesis development

In this section, we develop several hypotheses regarding the main factors affecting mutual funds' comigrating behaviours as well as the consequences of these investment decisions on fund performance.

In China, a critical factor leading to business success is *guanxi* (roughly translated into English as relationship or connection), which describes the dynamics of influence in personalised networks. *Guanxi* refers to both social connections and the benefits gained from these social connections, and the scope of *guanxi* usually encompasses the individual's extended family, alumni, workmates and fellow members of organisations. Implicit mutual obligations, reciprocity and trust are the essential foundations of *guanxi*, which is crucial for the development of the private sector that contributes most significantly to Chinese economic growth (Allen *et al.*, 2005). Combining our understanding of the Chinese institutional environment with documented evidence for exclusive information flow between connected board members and fund managers in US

[4] The Regulation Fair Disclosure (or Regulation FD) instituted by the US Securities and Exchange Commission (SEC) in August 2000 mandates that all publicly traded companies must disclose material information to all investors at the same time. As illustrated by Cohen *et al.* (2008) and Tang (2013), this regulation has significantly reduced selective information disclosure by insiders.

financial markets allows us to propose the following claim: a substantive probability obtains that a given senior manager of a Chinese firm may convey certain types of information to a mutual fund manager prior to release of this information to the general public if the two managers are strongly connected through certain social networks. This selective information disclosure by corporate executives may constitute reciprocity for benefits offered by connected mutual fund managers. As documented in Davis and Kim (2007), a positive relation exists between mutual funds' business ties with their portfolio firms and the funds' propensity to vote with corporate management. Another empirical study finds that mutual fund managers who share the same educational network as a firm's CEO are more likely than are out-of-network fund managers to vote against shareholder-initiated proposals to limit executive compensation (Butler and Gurun, 2012).

On the other hand, developing a strong relationship entails costly investments of time and energy; hence, these relationships tend to be maintained among a limited subset of corporate executives and fund managers. A connected money manager understands that he or she has a comparative advantage in collecting information and can benefit from the relationships with corporate managers, as long as the latter delivers valuable private information. If the fund manager believes that he or she will continue to receive information via the connected executive after the latter moves to a new firm, then a rational behaviour would be to follow and subsequently invest in the destination company. Meanwhile, after the executive's departure, the fund manager may lose preferred access to information regarding the origin firm, and would unload his asset allocation in the origin firm. Accordingly, our first hypothesis is:

H1: Relative to a matched sample of firms selected by propensity score-based proximity to the actual origin–destination firm pairs, a mutual fund is more likely to initiate investments in the destination firm and divest from the origin firm.

In financial markets, valuable information brings premium returns. Institutional investors spend considerable time and financial resources in search of information. If a fund manager is familiar with a firm, or if the firm itself is transparent, the manager would be less compelled to spend time and money on obtaining additional information. In the case of transparency or familiarity, personal connections with insiders may be less valuable. However, in those cases involving a firm's opacity, or the fund manager's lack of familiarity with the firm, the manager would require extra information from reliable sources such as insiders to facilitate his or her investment decisions. Along this reasoning, we posit that:

H2: The greater a mutual fund's demand on the destination firm for extra information, the greater the probability that the fund will comigrate with the departing corporate manager.

The closeness of the relationship between a fund manager and a corporate executive will directly affect the fund manager's preferred access to the information provided by the insider. Prior studies have shown that superior information channels help investors achieve higher returns (Choe *et al.*, 2005; Dvořák, 2005). We argue that a fund manager with a closer relationship to a corporate executive is more likely to receive private information (such as earnings) from the executive, and subsequently rebalance his or her portfolios prior to public release of the information, thereby enhancing portfolio performance. It is reasonable to assume that compared to their peers, fund managers benefiting from connections have a stronger incentive to comigrate with the moving executives. Our third hypothesis is as follows:

H3: A mutual fund that has benefited more from the investments in the origin firm is more likely to comigrate with the departing corporate manager.

A fund manager is more likely to access a firm's private information if he or she is more closely connected to the corporate insiders. The fund manager should purchase the pertinent stock after receiving positive information from the insiders, or unload the stock if provided with negative information. Therefore, we expect to observe patterns of his or her trading on the stock before corporate news events, and this trading activity should predict the stock returns when the news is released to the public. To be specific, we expect comigration funds to show a positive relation between changes in the stockholdings of destination firms and future stock returns around earnings announcement dates. Our final hypothesis is:

H4: Compared to non-comigration funds' holding changes, comigration funds' holding changes in destination firms are superior predictors of future abnormal returns around earnings announcement dates.

3. Data source and sample

3.1. Sample selection and variables

Wind Information Co., Ltd. (http://www.wind.com.cn/en/), headquartered in Shanghai, provides information on Chinese stocks, bonds, funds, futures and the economy. Its data are frequently cited by both Chinese and international media, as well as in research reports and academic papers. We collected from the Wind financial database employment information concerning presidents, vice presidents, CEOs and other chief officers of all companies listed on Chinese stock markets from January 2006 to December 2013, in order to use career histories to identify those managers who switched between listed firms. We consequently identified 315 instances of managerial migration between listed firms in the sample period. To be included in our final sample, managerial migration events had to meet the following two requirements: (i) the migrating

manager must have worked in the top management teams at both origin and destination firms; and (ii) at least one mutual fund must have invested in the origin firm in the calendar year prior to the event of managerial migration. The first requirement, a top management position, ensures the migrating executive will have access to inside information at the destination firm, thereby incentivising a fund manager's comigration. The second requirement ensures consistency with the intuition of fund comigration: i.e., a fund has a long position in the origin firm before comigration. After excluding unqualified observations, our final sample consisted of 223 managerial migration events.

We also use stock prices, daily returns and trade volume in our empirical analysis, and collected these variables from the China Stock Market and Accounting Research (CSMAR) database (http://csmar.gtadata.com/), which is a comprehensive financial database jointly produced by GTA Information Technology Co., Ltd., the University of Hong Kong and the China Accounting and Finance Research Center of the Hong Kong Polytechnic University. From CSMAR we also collected financial analysts' report data such as earnings forecasts and purchase/sell suggestions.

Our empirical analysis focuses on mutual funds' responses to managerial migration: we examine performance and changes in holdings. The CSMAR database provides Chinese mutual fund data including monthly net returns, total net assets under management, expense ratio, etc., as well as mutual fund stockholdings disclosed at the end of each calendar quarter. We fill in any missing value in the variables provided by the CSMAR database with supplementary data from RESSET Technology Co., Ltd. (RESSET), another leading provider of financial research data in China (http://www.resset.cn:8080/en/about/about_resset.jsp).

The main subject under investigation in this paper is mutual funds' comigrating behaviour following a corporate executive's move from an origin firm to a destination firm. A mutual fund is classified as a comigration fund if and only if it meets the following situations: (i) the fund had disclosed stockholdings of the origin firm but not the destination firm in at least two successive semi-annual reports when the migrating manager was a corporate senior manager in the origin firm; and (ii) the fund holds the destination firm's stock within a year following the corporate manager's relocation to the destination firm.[5] A dummy variable, *CoMigrate*, is defined as 1 for those comigration funds, and 0 otherwise.

[5] In China, mutual funds are required by law to disclose their complete portfolio holdings as of the end of June and the end of December, and their top-10 holdings as of the end of March and the end of September. As a mutual fund can invest in more than 10 firms, the top-10 holdings will not provide enough information regarding a fund's complete holdings. As a result, we examine the portfolio composition as of the end of June and the end of December only.

One of our hypotheses entails a mutual fund's demand on the destination firm for extra information. We use two different measures to proxy a fund manager's information demand: the geographical distance between the headquarters of a fund and that of the holding firm, and the R^2 of the regression of a stock return on the return of the market. As found in the extant literature, investors living closer to firm headquarters have an information advantage and consequently superior investment performance (Ivković and Weisbenner, 2005; Baik *et al.*, 2010). We assume that if a fund's headquarters is far from the headquarters of a firm in which the fund invests, that fund manager will be less familiar with the firm, and therefore have a greater demand for extra information about the firm.

The R^2 of the regression of stock returns on market returns is used in the literature to measure information asymmetry of the firm (Roll, 1988; Piotroski and Roulstone, 2004; Gul *et al.*, 2010); a larger R^2 indicates that the variation in stock price is comparatively better explained by non-firm-specific information rather than by firm-specific information, and therefore greater information asymmetry obtains. Following Piotroski and Roulstone (2004), we regress weekly stock returns on the current and prior week's value-weighted returns of the equity market and the current and prior week's value-weighted industry returns, and transform R^2 values obtained from regressions to the natural logarithm of $R^2/(1 - R^2)$.

Other controls used in our empirical analysis include origin and destination firms' ages, total assets, return on assets, liabilities, board size, independent director ratio, and the indicator for state-owned enterprises (SOEs), as well as characteristics of mutual funds including total assets under management, 6-month performance, the percentage of assets invested in the origin and destination firms, etc. We create a dummy variable, *Same City*, to indicate whether the headquarters of a firm and those of a mutual fund are located in the same city. Another dummy, *Same School*, indicates whether a corporate executive and a fund manager attended the same college/university. For concision, we report the definitions of all variables in the Appendix.

Table 1 reports descriptive statistics of the origin and destination firms associated with managerial migrations in our sample. We observe that mutual funds on average hold a larger percentage of common shares of origin firms than of destination firms. The mean (median) percentage of shares held by funds (measured by *FundShrP*) is 9.8 percent (3.6 percent) for origin firms vs. 8.4 percent (1.4 percent) for destination firms. Corporate managers tend to migrate to smaller firms, as the average size (*LogAsset*) of the origin firms is 22.410 while that of the destination firms is 22.115. The average book-to-market ratio (*BM*) of the origin and destination firms are 0.457 and 0.408, respectively, indicating that firm managers generally moved to firms with higher growth prospects. Larger firms are usually covered by more financial analysts; therefore, we are not surprised to see that a larger number of financial analysts (*AnaCov*) covered origin firms than covered destination firms, specifically, 16.937 vs. 15.816. However, the origin firm and the destination firm do not differ significantly from each other in terms of sales

growth (*SaleGrth*), 12-month stock return up to the month before managerial turnover (*HPR12M*), independent director ratio (*IndDir*) and the size of the board (*Boardsize*).

3.2. Hypothetical origin and destination firms as the control firm sample

Brochet *et al*. (2014) study manager–analyst comigrations. We build on their methodology and construct a control sample that consists of hypothetic origin and destination firms using propensity score-based proximity to the actual origin–destination firm pairs. Using a set of control firms will correct for potential self-selection issues in managerial migration behaviour.

First, based on the sample of actual destination firms paired with each firm in the actual origin firms' industry sector and also held by at least one mutual fund, we run a logistic regression with the following model specification:

$$\begin{aligned}\text{Probability}(Migrate_{imt}=1) = f(&FundShrP\_Ori_{it-1}, FundShrP\_Dst_{it-1},\\ &LogAsset\_Ori_{it-1}, LogAsset\_Dst_{it-1},\\ &BM\_Ori_{it-1}, BM_{Dst_{it-1}}, HPR12M\_Ori_{it-1},\\ &HPR12M\_Dst_{it-1}, AnaCov\_Ori_{it-1},\\ &AnaCov\_Dst_{it-1}, AssetGrth\_Ori_{it-1},\\ &AssetGrth\_Dst_{it-1}, SaleGrth\_Ori_{it-1},\\ &SaleGrth\_Dst_{it-1}, SOE\_Ori_{it-1},\\ &SOE\_Dst_{it-1}, IndDir\_Ori_{it-1}, IndDir\_Dst_{it-1},\\ &Boardsize\_Ori_{it-1}, Boardize\_Dst_{it-1},\\ &\text{Industry and Year Effect}),\end{aligned} \tag{1}$$

where the dependent variable *Migrate* equals 1 if the actual destination firm is paired with the actual origin firm, and 0 when paired with other firms. The subscript variable i refers to the pair of (hypothetical) origin and destination firms; m refers to the migrating manager; and t refers to the year when managerial turnover took place. All variables are defined in the Appendix. Equation 1 models the destination firm's decision to hire a manager from a certain origin firm. Based on the coefficient estimates from this regression, we compute the propensity of managerial switch from any potential origin firm to the actual destination firm and pick as the control firm the firm whose propensity score is the closest to that of the actual origin firm.

Next, based on the sample of actual origin firms paired with all firms in the destination firm's industry, we model the decision of a firm manager to leave the origin firm and join a certain destination firm by running the following logistic regression:

Table 1
Descriptive statistics for origin firms and destination firms

	Origin firm (*Ori*)		Destination firm (*Dst*)		*p*-value for diff.	
	Mean	Median	Mean	Median	Mean	Median
FundShrP %	9.8	3.6	8.4	1.4	0.302	0.000
LogAsset	22.410	22.146	22.115	21.741	0.048	0.007
BM	0.457	0.420	0.408	0.360	0.061	0.051
HPR12M	−0.075	−0.120	−0.077	−0.119	0.949	0.802
AnaCov	16.937	10.000	15.816	7.000	0.540	0.096
AssetGrth	0.211	0.115	0.404	0.128	0.022	0.433
SaleGrth	0.152	0.107	0.205	0.135	0.393	0.865
SOE	0.704	1.000	0.628	1.000	0.088	0.088
IndDir	0.361	0.333	0.369	0.333	0.118	0.187
Boardsize	2.230	2.197	2.209	2.197	0.304	0.170

This table reports summary statistics of the firms involved in 223 corporate executive (manager) migration events, in which executives migrate from origin to destination firms listed in Chinese stock markets from 2006 to 2013. All continuous variables are winsorised at 1 and 99 percent, and all variables are defined as in the Appendix.

$$\begin{aligned}\text{Probability}(Migrate_{imt}=1) = f(&FundShrP\_Ori_{it-1}, FundShrP\_Dst_{it-1},\\ &LogAsset\_Ori_{it-1}, LogAsset\_Dst_{it-1},\\ &BM\_Ori_{it-1}, BM_{Dst_{it-1}}, HPR12M\_Ori_{it-1},\\ &HPR12M\_Dst_{it-1}, AnaCov\_Ori_{it-1},\\ &AnaCov\_Dst_{it-1}, AssetGrth\_Ori_{it-1},\\ &AssetGrth\_Dst_{it-1}, SaleGrth\_Ori_{it-1},\\ &SaleGrth\_Dst_{it-1}, SOE\_Ori_{it-1}, SOE\_Dst_{it-1},\\ &IndDir\_Ori_{it-1}, IndDir\_Dst_{it-1},\\ &Boardsize\_Ori_{it-1}, Boardize\_Dst_{it-1},\\ &\text{Industry and Year Effect})\end{aligned} \tag{2}$$

This time, the dependent variable *Migrate* equals 1 if the actual origin firm is paired with the actual destination firm, and 0 otherwise. Variable *i* refers to the pair of origin and (hypothetical) destination firms; *m* refers to the migrating manager; and *t* refers to the year when managerial turnover took place. We compute the propensity score of the managerial move from the actual origin firm to all potential destination firms, and then choose as the control firm the firm with the propensity score closest to that of the actual destination firm.

After the procedure mentioned above, we found a pair of hypothetical origin and destination firms for each pair of actual origin–destination firms involved in a particular managerial migration event. Table 2 presents summary statistics of the

origin and destination firms in the treatment and control groups, respectively. We directly compare the origin (and destination) firms from the two groups and do not find a significant difference in various perspectives. These statistics indicate that the hypothetical firms identified by propensity scores are economically comparable with the actual origin and destination firms. Therefore, the hypothetical firms serve as qualified control firm samples to be used in empirical analyses.

4. Empirical results and discussion

4.1. Test on H1

In this section, we compare mutual fund switching behaviour between the origin–destination firms and hypothetical origin–destination firms. Among the

Table 2
Firm characteristics of origin and destination firms compared to the matched samples

	Actual (N = 223)		Matched (N = 223)		p-value for diff.	
	Mean	Median	Mean	Median	Mean	Median
FundShrP_Ori	0.098	0.036	0.100	0.042	0.883	0.683
FundShrP_Dst	0.084	0.014	0.079	0.018	0.669	0.642
LogAsset_Ori	22.410	22.146	22.439	22.243	0.831	0.748
LogAsset_Dst	22.115	21.741	22.135	21.817	0.893	0.581
BM_Ori	0.457	0.420	0.476	0.418	0.455	0.426
BM_Dst	0.408	0.360	0.436	0.392	0.298	0.312
HPR12M_Ori	−0.075	−0.120	−0.101	−0.137	0.387	0.816
HPR12M_Dst	−0.077	−0.119	−0.106	−0.158	0.377	0.229
AnaCov_Ori	16.937	10.000	17.363	10.000	0.808	0.614
AnaCov_Dst	15.816	7.000	15.852	9.000	0.984	0.678
AssetGrth_Ori	0.211	0.115	0.167	0.124	0.217	0.488
AssetGrth_Dst	0.404	0.128	0.253	0.124	0.080	0.970
SaleGrth_Ori	0.152	0.107	0.170	0.157	0.560	0.094
SaleGrth_Dst	0.205	0.135	0.157	0.138	0.453	0.631
SOE_Ori	0.704	1.000	0.709	1.000	0.917	0.918
SOE_Dst	0.628	1.000	0.677	1.000	0.275	0.275
IndDir_Ori	0.361	0.333	0.356	0.333	0.354	0.543
IndDir_Dst	0.369	0.333	0.363	0.333	0.340	0.363
Boardsize_Ori	2.230	2.197	2.241	2.197	0.546	0.683
Boardsize_Dst	2.209	2.197	2.233	2.197	0.259	0.150

This table reports mean and median values for firm characteristic variables. The sample consists of 223 pairs of firms where a corporate executive migrates from the origin to the destination company, and 223 pairs of firms with no managerial turnover matched by propensity score obtained from the estimation of Equations 1 and 2. The sample period is from 2006 to 2013. All continuous variables are winsorised at 1 percent and 99 percent, and all variables are defined as in the Appendix.

Table 3
Mutual fund comigration compared to the matched samples (fund level)

	Actual	Matched	*p*-value for diff.
Panel A: Investment in the destination firm after comigration			
CoMigrate %	3.579	2.095	0.000
Holding_Dst %	1.247	0.897	0.006
Panel B: Investment in the origin firm after comigration			
If Holding_Ori %	21.951	32.524	0.006
Holding_Ori %	0.247	0.227	0.732

This table reports the results of univariate analysis on mutual fund holdings for the analysis of mutual fund comigration behaviour with top corporate manager relocations from origin firms to destination firms. The sample consists of 223 pairs of firms where a corporate executive migrates from the origin to the destination company, and 223 pairs of firms with no manager turnover matched by propensity score. The sample period is from 2006 to 2013. All variables are defined as in the Appendix.

223 incidents of managerial turnover (actual origin–destination pairs), 82 incidents were associated with at least one mutual fund initiating investments in the destination firm. For the control group (223 hypothetical origin–destination pairs), this number is significantly smaller, only 57. Further, for each managerial turnover, about 1.906 funds initiate investments in the actual destination firm, while only 0.991 funds initiate investments in the corresponding hypothetical destination firm.

For further analysis, we explore mutual fund holdings to examine funds' comigrating behaviour. In particular, we contrast two groups of mutual funds: the mutual funds that had exhibited holdings of the origin firm in two successive semi-annual reports prior to the migrating executive's departure, and the mutual funds that had invested in the hypothetical origin firm during the same investment periods.

Panel A of Table 3 presents the percentage of funds that comigrated and the comigration funds' average percentage of assets invested in destination firms, in contrast to those invested in hypothetical destination firms. The result indicates that, among mutual funds that had invested in origin firms, about 3.579 percent of the sample comigrated; this number is significantly higher than the 2.095 percent of those funds invested in the hypothetical origin firms. The *t*-test shows a 1 percent statistical significance for the difference. After comigration, funds have invested on average 1.247 percent of their assets in destination firms, compared to 0.897 percent in the hypothetical destination firms. The difference is statistically significant at the 1 percent level. Panel B of Table 3 demonstrates the percentage of comigration funds still holding stocks in the (hypothetical) origin firms and the proportion of assets invested. We note that

only 21.957 percent of the comigration funds in the treatment group still invest in origin firms, a number that is significantly less than the 32.524 percent of the funds that previously invested in the hypothetical origin firms. As per the percentage of assets invested in the origin firms, no statistically significant difference is observed between the two fund groups. These results support our

Table 4
Regression of mutual fund investment in destination firms

	Logistic (dep. = *CoMigrate*)	Tobit (dep. = *Holding_Dst*)	OLS (dep. = *Holding_Dst*)
Migrate	0.342***	0.477***	0.019***
	(3.06)	(4.01)	(3.04)
Fund LogAsset	0.120**	0.108**	−0.002
	(2.29)	(2.41)	(−1.23)
NVGrth	−0.265	−0.469*	−0.017**
	(−1.60)	(−1.88)	(−1.98)
Fund Mger Turnover	0.175	0.233	0.006
	(1.09)	(1.31)	(0.64)
Same School	−0.124	−0.264	−0.022**
	(−0.30)	(−0.53)	(−2.01)
Same City	0.126	0.190	0.008
	(0.68)	1.14)	(0.79)
FundShrP_Diff	−0.246	−0.547	−0.013
	(−0.80)	(−1.49)	(−0.60)
LogAsset_Diff	−0.120***	−0.172***	−0.008***
	(−3.47)	(−4.61)	(−3.92)
BM_Diff	0.183	0.247	0.021***
	(1.06)	(1.38)	(4.06)
HPR12M_Diff	0.078	0.102	0.008
	(0.54)	(0.62)	(1.02)
AnaCov_Diff	−0.462***	−0.577***	−0.009***
	(−8.57)	(−8.00)	(−4.95)
AssetGrth_Diff	−0.186***	−0.247***	0.000
	(−3.15)	(−3.45)	(−0.17)
SaleGrth_Diff	−0.184	−0.198	−0.005
	(−1.32)	(−1.14)	(−1.10)
AnaMigrate	0.494***	0.710***	0.018**
	(5.30)	(4.70)	(2.13)
HighRank_Diff	0.084	0.147	0.002
	(0.59)	(0.94)	(0.38)
SOE_Diff	0.340***	0.454***	0.013***
	(3.48)	(3.79)	(2.98)
IndDir_Diff	−0.330	−0.328	−0.018
	(−0.45)	(−0.41)	(−0.56)
Boardsize_Diff	0.032**	0.031*	−0.001
	(2.01)	(1.65)	(−1.22)
Intercept	−6.141***	−8.020***	0.085**
	(−4.37)	(−7.10)	(2.06)

(continued)

Table 4 (continued)

	Logistic (dep. = *CoMigrate*)	Tobit (dep. = *Holding_Dst*)	OLS (dep. = *Holding_Dst*)
Year and Fund Style effect	Yes	Yes	Yes
Cluster on fund family	Yes	Yes	Yes
Observations	21,123	21,123	21,123
Pseudo/Adj. R^2	0.097	0.075	0.014

This table reports logistic, Tobit and OLS regression results for the analysis of mutual fund comigration with 223 top corporate managers moving from origin firms to destination firms. The sample consists of mutual funds that had exhibited holdings of the origin firm in two successive semi-annual reports (where the migrating executive was still working in the origin firm) prior to the departure of the migrating executive, but not invested in the destination firm in the year prior to the turnover of executive and the mutual funds that had invested in the hypothetical origin firms during the same investment periods, but not invested in the destination firm in the year prior to the turnover of executive. The sample period is from 2006 to 2013. All variables are defined as in the Appendix. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 two-tailed levels, respectively.

first hypothesis that managerial turnover triggers certain mutual funds to follow, and comigrating funds tend to divest from origin firms.

Based on the holdings of funds invested in origin firms and hypothetical origin firms before managerial turnovers, we next employ multivariate analysis to re-examine the relation between managerial turnover and the mutual fund's comigration decision. The regression model is:

$$\begin{aligned} Y = f(&Migrate_{fi}, Fund\,LogAsset_{ft-1}, NVGrth_{ft-1}, Fund\,Mger\,Turnover_{ft-1}, \\ &Same\,School_{fit-1}, Same\,City_{fit-1}, FundShrP\_Diff_{it-1}, LogAsset\_Diff_{it-1}, \\ &BM\_Diff_{it-1}\ HPR12M\_Diff_{it-1}, AnaCov\_Diff_{it-1}, AssetGrth\_Diff_{it-1}, \\ &SaleGrth\_Diff_{it-1}, AnaMigrate_{it-1} HighRank\_Diff_{it-1}, SOE\_Diff_{it-1}, \\ &IndDir\_Diff_{it-1},\ Boardsize\_Diff_{it-1}, \text{Year and Fund InvType Effect}), \end{aligned} \tag{3}$$

where the dependent variable Y is Probability ($CoMigrate$ = 1) (in the logistic model) and *Holding_Dst* (in the Tobit and linear OLS models)[6] ; the subscript letter i refers to the pair of (hypothetical) origin and destination firms; f refers to the mutual fund; m refers to the migrating manager; t refers to the year when managerial turnover took place. Table 4 presents the regression results.

[6] For robustness we use the Tobit model (i.e., censored regression model) because mutual fund managers are prohibited from short selling and as a result, their stock holdings cannot be lower than zero. In this sense, the distribution of *Holding_Dst* is left-censored.

The coefficient of *Migrate* from the logistic model is 0.342 with the 1 percent significance level, indicating a positive relation between managerial turnover and fund comigration. This statistic implies an odds ratio of 1.41, which indicates that if a top manager with whom the fund had a prior equity

Table 5
Regression of mutual fund divestment in origin firms

	Logistic (dep. = *IfHolding_Ori*)	Tobit (dep. = *Holding_Ori*)	OLS (dep. = *Holding_Ori*)
Migrate	−0.105**	−0.134***	−0.004
	(−2.34)	(−3.22)	(−0.47)
Fund LogAsset	−0.024	−0.131***	−0.014***
	(−0.62)	(−8.48)	(−2.88)
NVGrth	−0.279*	−0.419***	−0.013
	(−1.79)	(−4.13)	(−0.37)
Fund Mger Turnover	−0.071	−0.167**	−0.017
	(−0.61)	(−2.10)	(−1.03)
Same School	−0.299	−0.429*	−0.057*
	(−1.08)	(−1.96)	(−1.95)
Same City	0.003	0.094	0.004
	(0.04)	(1.56)	(0.24)
FundShrP_Diff	1.720***	0.981***	0.256***
	(8.31)	(6.07)	(6.69)
LogAsset_Diff	0.086***	0.103***	0.010***
	(5.06)	(7.00)	(3.11)
BM_Diff	−0.638***	−0.322***	−0.031*
	(−6.60)	(−4.86)	(−1.92)
HPR12M_Diff	0.116	0.345***	0.069***
	(1.54)	(5.63)	(5.16)
AnaCov_Diff	0.003	−0.055**	−0.020***
	(0.12)	(−2.46)	(−4.24)
AssetGrth_Diff	−0.200***	−0.096***	−0.028***
	(−5.63)	(−3.14)	(−6.05)
SaleGrth_Diff	0.332***	0.267***	0.066***
	(4.06)	(4.13)	(3.35)
AnaMigrate	0.566***	0.570***	0.114***
	(8.26)	(10.85)	(7.83)
HighRank_Diff	−0.015	−0.058	0.022**
	(−0.24)	(−1.06)	(2.29)
SOE_Diff	0.024	−0.025	−0.013
	(0.50)	(−0.56)	(−1.11)
IndDir_Diff	1.335***	1.618***	0.180***
	(4.03)	(6.12)	(3.05)
Boardsize_Diff	0.045***	0.057***	0.010***
	(4.22)	(5.33)	(3.09)
Intercept	−3.264***	−0.171	0.231**

(continued)

Table 5 (continued)

	Logistic (dep. = *IfHolding_Ori*)	Tobit (dep. = *Holding_Ori*)	OLS (dep. = *Holding_Ori*)
	(−3.52)	(−0.46)	(2.21)
Year and Fund Style effect	Yes	Yes	Yes
Cluster on fund family	Yes	Yes	Yes
Observations	21,123	21,123	21,123
Pseudo/Adj. R^2	0.260	0.024	0.022

This table reports logistic, Tobit and OLS regression results for the analysis of mutual fund divestment in 223 origin firms after managerial turnover. The sample consists of mutual funds that had exhibited holdings of the origin firm in two successive semi-annual reports (where the migrating executive was still working in the origin firm) prior to the departure of the migrating executive and the mutual funds that had invested in the hypothetical origin firms during the same investment periods. The sample period is from 2006 to 2013. All variables are defined as in the Appendix. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 two-tailed levels, respectively.

relationship moves to a new firm, the probability of a fund initiating investment in that new firm is 1.41 times more than that of not investing. After exploring the Tobit and linear OLS regression models, we find similar qualitative results reported in Columns 2 and 3. These findings illustrate corporate managerial turnover triggering mutual fund comigration after controlling for other firm and fund characteristics.

In an unreported OLS regression, we test the influence of managerial moves on mutual fund managers' investment decisions for a separate sample of funds that had invested in both origin and destination firms before managerial turnovers. The regression observations consist of the holding changes of the mutual funds that had invested in both the (hypothetical) origin firm and the (hypothetical) destination firm in the year prior to the executive's departure. The regression results indicate that firm manager's move does not predict holding changes in destination firms. This finding is consistent with the assumption that mutual fund portfolios should be diversified and consequently have low exposure to any one stock. Since mutual fund managers had already invested in the destination firm before the executive switched, they may hesitate to put in more money due to their fiduciary duty. This evidence further supports our investigative focus on those comigrating funds that had disclosed stockholdings of the origin firm but not the destination firm prior to the departure of the migrating executive.

If a corporate executive moves from the origin firm to the destination firm, a closely connected fund manager may lose preferred access to information regarding the origin firm, and the manager may rationally decide to divest from the origin firm. To test this conjecture in a multivariate setting, we replace the dependent variable in Equation 3 with *IfHolding_Ori* in the logistic regression model and *Holding_Ori* for the Tobit and OLS models.

The results reported in Table 5 indicate that the coefficients of *Migrate* in both logistic and Tobit models are negative and statistically significant. The results are not, however, statistically significant in the OLS model. This indicates that after comigration, mutual funds tend to decrease their investments in origin firms, probably because the managers have lost their preferred access to corporate information. In sum, the results of both univariate and multivariate analyses demonstrate managerial turnover causing mutual funds to invest in destination firms but divest from origin firms, which is consistent with H1.

4.2. Test on H2

The information provided by a connected executive will be more valuable if the firm is less transparent or less familiar to fund managers. In this section, we investigate the influence of location proximity and the extent of transparency of destination firms on a mutual fund manager's comigration decision. Logically, given higher information asymmetry and less familiarity with the firm, a fund manager's demand for information provided by connected firm managers should be proportionately greater. As explained in Section 3, we use two variables as the instruments for the extent of familiarity and of firm transparency: the distance between the firm's and the mutual fund's headquarters and the R^2 of the regression of stock returns.

We perform tests on a mutual fund holding sample consisting of comigration funds' stockholding in the destination firm disclosed in the annual report after managerial turnover, and non-comigration funds' contemporaneous new stockholdings, assuming that the variation in demand for extra corporate information results in a number of fund managers comigrating with the moving executive and investing in the destination firm, while other fund managers instead invested in different companies. We estimate the following logistic regression model:

$$\begin{aligned}\text{Probability}(CoMigrate_{fit} = 1) = f(&Distance_{fit} or Rsqr_{fit}, Fund\,LogAsset_{ft-1},\\ &NVGrth_{ft-1}, Fund\,Mger\,Turnover_{ft-1},\\ &Same\,School_{fit-1}, Same\,City_{fit-1},\\ &FundShrP_{it-1}, LogAsset_{it-1}, BM_{it-1},\\ &HPR12M_{it-1}, AnaCov_{it-1}, AssetGrth_{it-1},\\ &SaleGrth_{it-1}, HighRank_{it-1}, SOE_{it-1},\\ &IndDir_{it-1}, Boardsize_{it-1},\\ &\text{Year and Fund InvType Effect}\end{aligned} \tag{4}$$

The dependent variable is *CoMigrate*, and both firm- and fund-level controls and year dummies are included in the model. Variable i refers to a particular stock (or firm) holding, f refers to a particular fund, and t refers to the year when fund comigration occurred.

The results reported in Table 6 are consistent with our second hypothesis concerning the relationship between fund comigration and location proximity and transparency of the destination firm. For example, in Column 1, the estimated coefficient of *Distance* is 0.832 and at the 1 percent significance level, indicating a positive relation between fund comigration and managers' unfamiliarity with the destination firm. This finding deviates from the prior research documenting portfolio managers' tendency to invest disproportionately in nearby companies (Coval and Moskowitz, 1999) and earn higher returns on their local holdings (Coval and Moskowitz, 2001). When we replace *Distance* by *Rsqr*, the regression results demonstrated in Column 2 are qualitatively the same.

Based on these findings, we claim that when the destination firm exhibits greater opacity or when fund managers are less familiar with the firm, the managers have a greater demand for preferred access to information, and are consequently more likely to follow the connected corporate executive.

4.3. Test on H3

If we observe that a given fund has in contrast with other funds consistently obtained abnormal returns around earnings announcement windows, we may intuit the probability that the fund manager is connected with an insider, and therefore he or she is more likely to comigrate with the insider. Using all mutual funds' holdings in the origin firm disclosed in the annual reports prior to the moving executives' departure, we estimate the following logistic model:

$$\begin{aligned}\text{Probability}(CoMigrate_{fit} = 1) = f(&CAR_{it-1}, Mean\ Holding\_Ori_{fit-1},\\ &CAR_{it-1} \times Mean\ Holding\_Ori_{fit-1},\\ &Fund\ LogAsset_{ft-1}, NVGrth_{ft-1},\\ &Fund\ Mger\ Turnover_{ft-1}, School\ Tie_{fit-1},\\ &Geography\ Tie_{fit-1}, Executive\ Tenure_{fit-1},\\ &FundShrP_{it-1}, LogAsset_{it-1}, BM_{it-1},\\ &HPR12M_{it-1}, AnaCov_{it-1}, AssetGrth_{it-1},\\ &SaleGrth_{it-1}, HighRank_{it-1}, SOE_{it-1},\\ &IndDir_{it-1}, Boardsize_{it-1},\\ &\text{Year and Fund InvType Effect}\end{aligned} \tag{5}$$

Variable i refers to a particular stockholding, f refers to a particular fund, and t refers to the year when a fund comigrated.

CAR is a stock's cumulative abnormal return over the 3-day window around earnings announcement dates divided by three and then multiplied by 365. We use the average CAR if there are two or more earnings announcement events in

Table 6
Regression of fund comigration on demand for insider information

	(1)	(2)
Distance	0.832***	
	(3.64)	
Rsqr		0.500***
		(3.21)
Fund LogAsset	0.097**	0.111**
	(2.09)	(2.40)
NVGrth	−0.408	−0.399
	(−1.50)	(−1.45)
Fund Mger Turnover	−0.077	−0.053
	(−0.40)	(−0.28)
Same School	−0.145	−0.053
	(−0.40)	(−0.28)
Same City	0.044	−0.080
	(0.27)	(−0.50)
FundShrP	2.007***	1.785***
	(3.66)	(3.19)
LogAsset	0.201***	0.218***
	(4.06)	(4.35)
BM	0.218	0.224
	(0.59)	(0.62)
HPR12M	−0.299	−0.704***
	(−1.38)	(−2.84)
AnaCov	0.524***	0.727***
	(4.36)	(6.03)
AssetGrth	0.123	0.100
	(1.45)	(1.17)
SaleGrth	0.122	0.115
	(0.85)	(0.80)
HighRank	−0.311	−0.435
	(−1.04)	(−1.47)
SOE	−0.341**	−0.362**
	(−2.38)	(−2.51)
IndDir	3.769***	4.618***
	(3.46)	(4.12)
Boardsize	−0.359	−0.511*
	(−1.14)	(−1.65)
Intercept	−5.246***	−4.592***
	(−3.35)	(−2.91)
Year and Fund Style effect	Yes	Yes
Cluster on fund family	Yes	Yes
Observations	11,379	11,379
Pseudo R^2	0.148	0.169

This table reports logistic regression results for the analysis of mutual fund comigration with top corporate managers moving from origin firms to destination firms. The sample is constructed with the comigration funds' stockholding in the destination firm disclosed in the annual report the year following the manager turnover and non-comigration funds' contemporaneous new stockholdings. All variables are defined as in the Appendix. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 two-tailed levels, respectively.

the same year. In order to better interpret the estimated coefficient of the interaction term, we add one to CAR to make its value non-negative. The main reason for using CAR rather than holding period return is that CAR around corporate news announcement events is a better measure for capturing the benefit from non-public information. *Mean Holding_Ori*, the average percentage of fund assets invested in the origin firm, is computed based on the stockholdings disclosed in semi-annual and annual reports. Our third hypothesis predicts that the coefficient of the interaction term (*CAR* × *Mean Holding_Ori*) is positive.

Column 1 of Table 7 shows that *CAR* and its interaction term with the percentage asset invested in original firms are positive but not statistically significant at the 10 percent level. In an alternative regression model, we replace *CAR* with *CAR_Dum*, which is defined as 1 if *CAR* is positive and 0 otherwise. The results presented in Column 2 of Table 7 show that the coefficient of *CAR_Dum* × *Mean Holding_Ori* is positive and statistically significant at the 10 percent level.[7] This is consistent with the third hypothesis that in contrast to its peers, a mutual fund that has benefited more from its investments in the origin firm is more likely to follow the moving corporate executive and invest in the destination firm.

4.4. Test on H4

If a fund manager comigrates with a connected executive, he or she is likely to have preferred access to value-relevant information regarding the destination firm and rebalance his or her portfolio accordingly before the information becomes public. However, we expect non-connected fund managers to be less likely to adjust their portfolio composition in a timely manner. This assumption implies that compared to non-comigration funds' asset changes, comigration funds' asset changes in destination firms should more accurately predict CARs around earnings announcement dates. We test this hypothesis with the following OLS regression specification:

$$\begin{aligned} CAR_{fit+1} = {} & \alpha + \gamma_0 CoMigrate_{fit-1} + \gamma_1 ChgOwn_{fit} + \gamma_2 CoMigrate_{fit-1} \\ & \times ChgOwn_{fit} + \gamma_3 LogAsset_{it} + \gamma_4 BM_{it} + \gamma_5 ROA_{it} + \gamma_6 Debt_{it} \\ & + \gamma_7 Dividend_{it} + \gamma_8 Price_{it} + \gamma_9 HPRP6M_{it} + \gamma_{10} StockTurnover_{it} \\ & + \gamma_{11} StdRet_{it} + \gamma_{12} AnaCov_{it} + \gamma_{13} FirmAge_{it} + \gamma_{14} IfCSI300_{it} \\ & + \gamma_{15} SchoolTie_{it} + \gamma_{16} GeographyTie_{it} + \gamma_{17} SOE_{it} + \gamma_{18} IndDir_{it} \\ & + \gamma_{19} Boardsize_{it} + \text{Year and Industry Effect} + \varepsilon_{fit+1} \end{aligned} \tag{6}$$

[7] In a robustness test, we replace the origin firm stock's CAR with the alpha obtained from the CAPM model using 6-month daily stock returns, and the results remain qualitatively the same.

Table 7
Regression of fund comigration on prior investment in origin firms

	(1)	(2)
CAR	−0.015	
	(−0.67)	
CAR_Dum		−0.086
		(−0.49)
Mean Holding_Ori	−0.024	−0.297*
	(−0.25)	(−1.71)
CAR × Mean Holding_Ori	0.011	
	(0.63)	
CAR_ Dum × Mean Holding_Ori		0.338*
		(1.90)
Fund LogAsset	0.068	0.061
	(1.06)	(0.97)
NVGrth	−0.575**	−0.588**
	(−2.02)	(−2.06)
Fund Mger Turnover	−0.072	−0.093
	(−0.35)	(−0.45)
Same School	−0.033	−0.055
	(−0.08)	(−0.14)
Same City	0.005	0.001
	(0.03)	(0.00)
Executive Tenure	−0.719***	−0.725***
	(−6.70)	(−6.68)
Intercept	−3.207**	−2.952*
	(−1.97)	(−1.84)
Year effect	Yes	Yes
Investment style effect	Yes	Yes
Cluster on fund family	Yes	Yes
Observations	9,906	9,906
Pseudo R^2	0.046	0.049

This table reports logistic regression results for the analysis of mutual fund comigration with 223 top corporate managers moving from origin firms to destination firms from 2006 to 2013. The sample is constructed with all mutual funds' holdings in the origin firm disclosed in the annual reports prior to the executives' departure. All variables are defined as in the Appendix. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 two-tailed levels, respectively.

Variable i refers to a particular stockholding, f refers to a particular fund, and t refers to the half-year period. The sample used in the regression consists of observations of comigration funds' holding changes in destination firms and non-comigration funds' holding changes in stocks bought after managerial turnover. Similar to the adjustment we made when estimating Equation 5, we annualise CAR and use the average if there are two earnings announcement events in a given time period. All other variables used in the regression are defined as in the Appendix.

The results presented in the first column of Table 8 are consistent with our prediction. The coefficient of *CoMigrate* × *ChgOwn* is positive at the 1 percent significance level. The finding that comigration funds' holding changes in destination firms more accurately predict the variation in subsequent CARs around firm earnings announcements indicates that comigration funds are able to adjust their holdings before the events.[8] Therefore, we posit a high probability for comigration funds having received certain types of information before earnings announcement dates, which enables managers to rebalance their portfolio compositions early.

We may argue that comigration managers have better skills than do other fund managers and therefore have the ability to forecast the earnings to be announced. To address concerns arising from this competing explanation, we re-estimate Equation 6 with a second data set consisting of all stocks held by comigration funds after managerial turnover. Under this research setup, the independent variable *CoMigrate* in Equation 6 identifying holdings of comigration funds is replaced by *Migrate*, which indicates whether the holding stock was issued by the destination firm or by other firms. If the comigration managers have the ability to forecast earnings beyond specific firms, then the coefficients of *Migrate* × *ChgOwn* should not be statistically different from zero. However, the regression results shown in Column 2 of Table 8 indicate that the estimate is positive and statistically significant at the 1 percent level.

We further perform univariate analysis to compare the one-factor and Fama and French (1993) three-factor adjusted returns between comigration funds and non-comigration funds. Table 9 reports average performance evaluated by the two measurements over the 1-, 2-, and 3-year windows after fund comigrations, for the sample of 230 comigration funds and 774 non-comigration funds. Results show no significant difference in risk-adjusted performance between the two fund groups. Together with the findings reported in Table 8, the empirical data do not support the argument that the managers of comigration funds have better investment skills than do the managers of non-comigration funds. Instead, these findings are consistent with the presence of close relationships between the moving executives and the comigrating fund managers, who seemed to receive exclusive information on the destination firm.

4.5. Chasing executive talent?

If certain mutual fund managers are better able than the market to identify skilled firm managers, then these fund managers may choose to follow those skilled executives to new firms. To exclude this alternative explanation, i.e.,

[8] In robustness tests, we also find that comigration funds' holding changes in destination firms are better able to explain the variation in subsequent earnings surprises and alpha obtained from the CAPM model using 6-month daily stock returns.

Table 8
Regression of subsequent CARs on fund comigration

	(1)	(2)
CoMigrate	−0.613**	
	(−1.98)	
ChgOwn	0.026	0.242***
	(0.88)	(2.73)
CoMigrate × ChgOwn	1.834***	
	(2.73)	
Migrate		−0.600**
		(−2.26)
Migrate × ChgOwn		1.745***
		(2.86)
LogAsset	−0.003	−0.040
	(−0.18)	(−0.87)
BM	−0.194**	−0.179*
	(−2.24)	(−1.72)
ROA	0.051***	0.011***
	(9.35)	(2.60)
Debt	0.543***	0.457*
	(5.43)	(1.88)
Dividend	23.486***	34.735***
	(11.13)	(12.25)
Price	0.003	0.006**
	(0.93)	(2.30)
HPR6M	0.844***	0.652***
	(9.33)	(6.23)
Stock Turnover	−0.018***	−0.027***
	(−10.05)	(−11.02)
StdRet	−0.528	0.607
	(−1.07)	(1.11)
AnaCov	0.005	0.020
	(0.47)	(1.16)
FirmAge	0.001***	0.002***
	(2.98)	(3.09)
IfCSI300	0.227***	0.336***
	(5.17)	(2.88)
Same School	2.340***	1.766***
	(6.95)	(6.04)
Same City	0.225***	0.098
	(2.84)	(0.97)
SOE	0.049	−0.136**
	(1.01)	(−2.08)
IndDir	0.053	0.293
	(0.15)	(0.57)
Boardsize	0.037***	0.012
	(4.62)	(0.61)
Intercept	−1.766***	−0.284

(continued)

Table 8 (continued)

	(1)	(2)
	(−5.16)	(−0.27)
Year effect	Yes	Yes
Industry effect	Yes	Yes
Cluster on fund family	Yes	Yes
Observations	322,392	30,658
Adj. R^2	0.045	0.044

This table reports OLS regression results for the analysis of mutual fund CAR performance after comigration with 223 top corporate managers moving from origin firms to destination firms from 2006 to 2013. The regression reported in Column 1 uses a sample that consists of the observations of comigration funds' changes of asset invested in destination firms and non-comigration funds' changes of asset invested in new stocks bought after managerial turnover. The regression reported in Column 2 uses a sample that consists of all stocks held by comigration funds after managerial turnover. All variables are defined as in the Appendix. *, ** and *** indicate significance at the 0.10, 0.05 and 0.01 two-tailed levels, respectively.

Table 9
Comparison of fund performance

	Comigration fund	Non-comigration fund	*p*-value (*t*-test on Diff.)
Panel A: *One-factor alpha*			
1 Year	−0.0034	0.0023	0.337
2 Year	−0.0064	−0.0018	0.535
3 Year	0.0131	−0.0032	0.097
Panel B: *Three-factor alpha*			
1 Year	−0.0308	−0.0314	0.895
2 Year	−0.0632	−0.0576	0.481
3 Year	−0.0830	−0.0787	0.709

This table reports the mean values of one-factor and three-factor adjusted returns of comigration funds and non-comigration funds after 223 corporate executives move from the origin to destination companies listed on the Chinese equity market from 2006 to 2013. For a given fund, one-factor alpha is the summation of the daily fund return adjusted by market factor; three-factor alpha is the summation of daily risk-adjusted returns computed from the regression of daily fund net return on the three risk factors constructed in the spirit of Fama and French (1993) three factors. The results in Panel A are based on the sample of 230 comigration funds and 774 non-comigrating funds, while the results in Panel B are based on the sample of 230 comigration funds and 230 non-comigration funds matched by fund size and expense ratios.

mutual fund managers comigrate to chase managerial talent rather than to secure the potential benefits from personal connections, we conduct additional tests by comparing the operating performance of the destination firms before

Table 10
Firm performance before and after hiring the moving executives

	Before		After		After − Before		*p*-value	
	Mean	Median	Mean	Median	Mean	Median	*t*-test	Wilcoxon test
Panel A: *ROA* (%)								
1 year	1.609	0.500	−0.508	0.005	−2.116	−0.495	0.005	0.024
2 years	1.185	0.078	0.340	0.100	−0.845	0.023	0.189	0.170
3 years	1.872	1.357	−0.041	0.251	−1.913	−1.106	0.012	0.008
Panel B: *ROE* (%)								
1 year	3.140	2.160	−2.505	−0.195	−5.644	−2.355	0.003	0.028
2 years	3.179	2.475	0.418	1.940	−2.762	−0.535	0.034	0.082
3 years	3.307	2.919	−0.445	1.093	−3.752	−1.827	0.094	0.012
Panel C: *Sale Growth* (%)								
1 year	43.511	4.732	1.272	1.913	−42.239	−2.818	0.011	0.010
2 years	29.492	2.370	1.947	2.080	−27.544	−0.003	0.019	0.166
3 years	30.510	3.670	1.371	1.998	−29.139	−1.672	0.039	0.061
Panel D: *MB*								
1 year	−0.138	−0.395	−0.156	−0.450	−0.018	−0.055	0.906	0.605
2 years	0.174	−0.610	−0.325	−0.435	−0.499	0.175	0.148	0.491
3 years	0.228	−0.475	−0.322	−0.597	−0.550	−0.122	0.222	0.532

This table reports the average operating performance of 223 destination firms before and after executive's moving in, as well as *p*-values of the *t*-tests and Wilcoxon signed rank tests for the difference in performance between the two periods. All variables are defined as in the Appendix.

and after managerial turnover. Industry-median adjusted return-on-asset (*ROA*), return-on-equity (*ROE*), sales growth (*SaleGrth*) and market-to-book (*MB*) ratio are used as the measures for the 1-, 2-, and 3-year operating performance of the destination firms. If the migrating executive has exceptional skills, then destination firm performance should improve after he or she joins the firm. As a result, the difference in these measures between the two time periods should be positive and statistically significant.

Table 10 reports the means and medians of firm performance variables for the time period before managerial moving in and for the period after (Before vs. After), as well as the differences between the two periods (After–Before). As indicated by the large discrepancy between the means and medians for all performance measures, the distributions of the performance variables are highly skewed, which suggests the necessity to employ both *t*-test and Wilcoxon

signed rank test when testing whether the differences are statistically significant from zero.

These statistics indicate that the operating performance of destination firms declined after managerial migration. For example, in Panel A of Table 10, the *ex-post ROA* over the 1- and 3-year windows are lower than the corresponding values for the periods before managerial turnover. The tests indicate that the differences in the means and medians are both statistically significant. The *ROE* reported in Panel B of Table 10 and sales growth reported in Panel C of Table 10 exhibit similar patterns: their values decline after the executive moved in. A larger market-to-book ratio (*MB*) indicates more growth opportunities. As shown in Panel D of Table 10, the changes in *MB* are not statistically significant from zero at the 10 percent level. In sum, firm performance declines after hiring the migrating manager, indicating low probability that a given manager's ability is the reason for the mutual funds' comigration activities.

5. Conclusion

In this paper, we investigate the determinants and consequences of mutual fund comigration behaviours to infer potential connections between fund managers and corporate executives. By exploring a manually collected data set of 223 managerial migrations between firms listed on Chinese stock markets during 2006–2013, we find that departing corporate executives are followed by certain fund managers who divest from origin firms while initiating investments in destination firms. The probability of fund comigration is significantly higher if a mutual fund has obtained greater benefit from its prior investments in the origin firm. A mutual fund's comigration decision is also influenced by its demand for extra sources of information regarding the destination firm, as the probability of comigration increases with the level of the destination firm's information asymmetry and the fund manager's unfamiliarity with the firm. Other evidence indicates that comigration funds had access to earnings information before this information had been disclosed to the public; as a result, these funds adjusted their holdings before the news announcements and earned superior returns. Finally, we find that the investment skills of comigrating managers are not superior to those of non-comigrating managers and that the destination firms see no improvement in operating performance after hiring the moving executives. In sum, our findings reveal investment patterns for a subset of mutual fund managers, which result from corporate executives' switching to other companies. These findings ultimately substantiate the existence of important and ongoing relationships between corporate executives and a small number of institutional investors.

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Appendix

Variable definition

Table A1
Definition of variables used in propensity score matching

Variable	Definition
Migrate	An indicator variable that equals 1 if the executive moves from the origin firm to the destination firm, and 0 otherwise
FundShrP_Ori(Dst)	The amount of an origin (or destination) firm's common shares held by all mutual funds divided by the total number of shares outstanding
LogAsset_Ori(Dst)	The natural logarithm of total assets of an origin (or destination) firm
BM_Ori(Dst)	The original (or destination) firm's book-to-market ratio, which is the total equity divided by market capitalisation
HPR12M_Ori(Dst)	The origin (or destination) firm's 12-month holding period return up to the managerial turnover month
AnaCov_Or(Dst)i	The natural logarithm of the number of financial analysts covering an origin (or destination) firm
AssetGrth_Ori(Dst)	The annual growth rate of total assets of an origin (or destination) firm
SaleGrth_Ori(Dst)	The annual growth rate of net sales of an origin (or destination) firm
SOE_Ori(Dst)	A dummy variable that equals 1 if an origin (or destination) firm is state-owned, and 0 otherwise
IndDir_Ori(Dst)	The origin (or destination) firm's number of independent directors divided by to the total number of board directors
Boardsize_Ori(Dst)	The origin (or destination) firm's total number of board directors

Table A2
Definition of other variables used in main analysis

Variable	Definition
CoMigrate	A dummy defined as 1 if a mutual fund had disclosed stockholdings of the origin firm by the destination firm in at least two successive semi-annual reports when the migrating executive was still working in the origin firm and prior to the managerial departure, and if it holds the destination firm's stock within a year after the turnover, and 0 otherwise
IfHolding_Ori	A fund-level indicator that equals 1 if a fund held stocks of the origin firm within a year before managerial turnover, and still held the stocks at the end of the year after turnover
Holding_Ori(Dst)	The percentage of fund assets invested in an origin (or destination) firm
Mean Holding_Ori	The average percentage of fund assets invested in the origin firm before executive turnover
ChgOwn	The changes in the number of common shares held by the fund scaled by the total number of shares outstanding
CAR	The cumulative abnormal return over a 3-day earnings announcement time window divided by three and multiplied by 365
CAR_Dum	An indicator variable that equals 1 if CAR > 0, and 0 otherwise.

(continued)

Table A2 (continued)

Variable	Definition
Distance	The distance between the headquarters of the mutual fund and that of the destination firm, scaled by the maximum distance value of the sample
Rsqr	The natural logarithm of $R^2/(1 - R^2)$, where R^2 is the R^2 of a regression of weekly stock return on the current and prior week's value-weighted returns of the equity market and the current and prior week's value-weighted industry returns
ROA	Net income divided by the average total assets based on year-begin and year-end value
ROE	Net income divided by the average total equity based on year-begin and year-end value
AdjRet_One	The summation of daily 1-factor adjusted returns computed from the regression of daily fund net return on market excess return
AdjRet_Thr	The summation of daily 3-factor adjusted returns computed from the regression of daily fund net return on three risk factors constructed similarly to the Fama and French (1993) three factors
MB	The firm's market-to-book ratio, which is the market value of the shares outstanding divided by the book value of total equity
Fund LogAsset	The natural logarithm of total assets under management
NVGrth	The growth rate of total assets under management
Fund Mger Turnover	An indicator variable that equals 1 if a fund manager turnover occurred at the same year as the executive turnover, and 0 otherwise
Same School	An indicator variable that equals 1 if both migrating executive and fund manager graduated from the same college or university, and 0 otherwise
Same City	An indicator variable that equals 1 if a mutual fund and company's headquarters are located in the same city, and 0 otherwise
AnaMigrate	An indicator variable that equals 1 if an analyst had followed the origin firm when the migrating executive was still working in the origin firm and prior to the managerial departure, and if he or she follows the destination firm within a year after the turnover, and 0 otherwise
HighRank	The percentage of analysts' reports that recommend 'outperform' and 'buy'
Debt	Total liability divided by total assets
Dividend	The amount of cash dividend divided by the closing price in June or December
Price	The closing price on the last trading day in June or December
HPR6M	Mutual fund's 6-month holding period return, and then annualised by times two
Stock Turnover	The average daily trading volume scaled by the same-day market capitalisation of the firm
Executive Tenure	The natural logarithm of number of years the executive is in office
StdRet	The standard deviation of daily stock return in the prior year
FirmAge	The number of months since the firm's stock was listed on the stock exchange
IfCSI300	An indicator variable that equals 1 if the stock is included in the CSI300 index of the Chinese stock market, and 0 otherwise
_Diff	The value of the origin firm minus the value of the destination firm

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Judging a book by its Cover: The influence of physical attractiveness on the promotion of regional leaders☆

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ABSTRACT

We investigate the determinants of the promotion of Chinese municipal leaders and find that leaders with greater perceived attractiveness have a higher probability of promotion. Further exploration shows no correlation between a leader's facial traits and local economic growth under his jurisdiction. Essentially, a senior government official's look significantly affects his chance of promotion but says very little about his ability to advance the local economy. Our findings suggest that appearance-based discrimination exists when Chinese political hierarchy screens political elites.

1. Introduction

Economists have debated the driving forces behind China's remarkable economic growth, which took hold in the 1980s. While some scholars attribute China's economic success to top-down factors such as national leadership (Shirk, 1993), de facto federalism (Montinola et al., 1995), and successful rural reforms (Lin, 1992), several researchers propose that the efforts of regional political leaders are equally important (Blanchard and Shleifer, 2001; Li, 1998; Li and Bachman, 1989). These studies argue that China's performance-based cadre evaluation system has provided strong incentives for local administrators to compete for promotions and contribute to the spectacular nationwide economic growth. The significant role played by regional officials in China's growth provokes the question, what are the central factors determining the career paths of government officials? The answers to this question can help us better understand both the role of political incentive in facilitating local economies and the mechanism used by the Communist Party of China (CPC) to screen elite members for future

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national leadership. This paper deviates from prior studies that focus on political and economic factors affecting a Chinese official's career mobility to investigate the influence of regional leaders' physical appearance on their chance of promotion. Does attractiveness affect political turnover? If a "beauty effect" exists, is it a signal of a public administrator's ability? Or is it a function of the appearance-based discrimination commonly seen in the labor market? Answering these research questions are important, since the possibility of suboptimal promotion decisions due to such discrimination may lead to the assignment of political leaders to jobs that are incompatible with their qualifications.

Considerable research demonstrates that both perception and subsequent decision making are subject to bias: i.e., our perceptions of external reality result in discriminatory decision making. A list of biases has been identified by researchers studying human decision making in the fields of social psychology and economics, with the conclusion that these biases can lead to irrational judgements, suboptimal decisions, and inefficiency in social activities. Racial discrimination, for example, has been proven to be widespread in the labor market (Bertrand and Mullainathan, 2004; Grodsky and Pager, 2001; Pager et al., 2009). Recently, appearance-based discrimination has attracted increasing attention from sociologists and economists. Our visual perception of an object's appearance plays a significant role in how we evaluate the object. Although we are educated from early childhood that we should not "judge a book by its cover," we tend to prejudge objects and other people by their appearance. Evidence exists to support a beauty effect—hiring decisions based on appearance bias—in the labor market. The literature shows that people who are more attractive not only have a better chance of employment (Heilman and Saruwatari, 1979; Marlowe et al., 1996; Morrow et al., 1990; Ruffle and Shtudiner, 2014), but are also likely to earn higher wages (Biddle and Hamermesh, 1998; Hamermesh and Biddle, 1994; Mobius and Rosenblat, 2006; Pfann et al., 2000).[1] The phenomenon of attractive people receiving preferential treatment has also been studied in political contexts. In countries that have adopted a democratic election system to select political leaders, voters are found to favor candidates who appear more attractive (Banducci et al., 2008; Berggren et al., 2010; Lenz and Lawson, 2011). These findings are consistent with psychological research into the mechanism of human judgment: people often evaluate unfamiliar individuals' traits such as trustworthiness, competence, and intelligence based on external appearance (Hassin and Trope, 2000; Todorov et al., 2005; Zebrowitz et al., 2002).

The CPC's internal labor market provides a unique setting in which to study the influence of facial appearance on an individual's career development. Berggren et al., (2017) find that beauty serves as a cue for ideology in Europe, the United States, and Australia, as a political candidate's ideology could significantly affect voters' lives. In contrast, the mobility of local political leaders in China is determined by a small group of leaders in the upper levels of government. The life quality of these decision makers should not be significantly influenced by their subordinates' ideology. Another significant difference in China is that in Chinese political hierarchy all local senior administrators are evaluated every one or two years by their supervisors and by the Organization Department, the human resources unit of the CPC. Thus, unlike the majority of voters in democratic countries who have limited work-related information about political candidates running for mayor, governor, or even president, the CPC's Organization Department maintains personnel files for all senior officials. In addition, politicians in western countries may advance without experience in politics or public administration, while most Chinese subnational leaders do not enter politics from other career paths but begin their political careers soon after graduation from college.

According to the extant literature, limited information is the main reason people often judge unfamiliar individuals' competence based on their appearance; appearance only affects those voters who know next to nothing about politicians (Lenz and Lawson, 2011); therefore, the CPC's access to extensive work-related information should significantly reduce the influence of appearance-based discrimination in the selection of Chinese subnational leaders. Surprisingly, our data analysis provides solid evidence of the beauty effect operating in Chinese cadre evaluation system, wherein voters are familiar with political candidates. Specifically, we find that government officials who were rated as more attractive enjoyed a higher probability of promotion when their ability to facilitate economic growth, as well as their personal characteristics such as age, gender, education, etc. are controlled for. These findings are robust to various sensitivity tests.[2]

Our study contributes to the strand of the literature that explores human behaviors as a result of cognition bias. Research shows that attractive people are perceived to be more intellectually competent than their less attractive peers (Eagly et al., 1991; Feingold, 1992; Jackson et al., 1995) and that better-looking applicants are perceived to be more qualified for employment (Cash et al., 1977; Dipboye et al., 1975; Raza and Carpenter, 1987). In addition, there is a significant correlation between attractiveness and perceived trustworthiness (Berggren et al., 2010; Eagly et al., 1991; Till and Busler, 2000). On the other hand, psychological studies find weak evidence (Jackson et al., 1995; Rule and Ambady, 2008), or no evidence (Graham et al., 2016; Mobius and Rosenblat, 2006), for a correlation between performance and physical attractiveness. Consistent with the extant literature, we find that more attractive government officials are perceived as more competent and trustworthy than others and that, like physical attractiveness, perceived competence and trustworthiness positively affect officials' career mobility. We find no evidence, however, that government officials who are rated as attractive, competent,

[1] For general research purposes, physical appearance may include facial characteristics, height, weight, appropriateness of dress, hair color, and physical disability. This paper examines only facial characteristics.

[2] The statistical theory and the taste-based theory compete to explain various types of discrimination in the labor market. According to the statistical theory, the employer who does not have access to a potential employee's past work performance tends to evaluate the applicant based on the attributes of an average worker belonging to the same group (Arrow, 1973; Bielby and Baron, 1986; Phelps, 1972). According to the taste-based theory, employers' biases against particular groups of people will cause unequal labor-market outcomes (Arrow, 1973; Becker, 1957).

or trustworthy exhibited better measurable skills in various aspects of administering and advancing a local economy. These findings indicate that a political leader's physical appearance does not predict his skills or abilities in public administrations.

Our findings also contribute to a growing body of research on the role of subnational leaders in economic growth. The argument for a promotion tournament among Chinese local political leaders is supported by empirical studies examining the relation between the promotion of provincial leaders and local GDP growth (Jia et al., 2015; Li and Zhou, 2005; Maskin et al., 2000; Xu, 2011).[3] Yao and Zhang (2015) study city leaders and document a positive relation between promotion probability and leaders' capability. The current study explores a much larger sample of city leaders and shows consistent evidence that government officials with higher economic skills are more likely to be promoted. More importantly, this paper extends the literature by providing novel evidence that, other things being equal, an official with an appealing face has a better chance to win in the tournament. To the best of our knowledge, we are the first to document the existence of cognition bias in the political selection process in China, and thus provide a new perspective when investigating the promotion of politicians in a nondemocratic country in general.

2. The data sources and variables

Our sample consists of 270 cities covering the period 1999–2013. The growth rates of local gross domestic products (GDP) were collected from the China City Statistical Yearbook (http://chinadataonline.org/member/yearbooknew/yearbook/Ayblist.aspx). Other economic data such as fiscal revenue, total bank loans, and foreign direct investments were downloaded from the China Stock Market and Accounting Research Database (http://www.gtadata.com/products/plist.aspx) and the database of the Development Research Center of the State Council of the People's Republic of China (http://en.drc.gov.cn/).

The Chinese government consists of a region-based multilevel hierarchy. Below the central government five levels of subnational administrative bureaucracies descend as follows: province, prefecture (city), county, township, and village. Each subnational government is led by the Communist Party secretary whose immediate subordinate is the local chief of government, the mayor, for example, at the city level. In this case, the party secretary is in charge of personnel and other political duties, while the mayor is in charge of the daily operation of the government. In practice, the mayor is usually the immediate successor after the party secretary position is vacated; it is noteworthy that promotions based on automatic succession are not the same as promotions based on personal ability, performance, and other determinants. Prior studies merging party secretaries and governors (or mayors) do not consider the cases of automatic successors, and, as a result, their empirical findings may be biased. In this study, we avoid this potential problem by limiting our focus to the set of top city leaders, the party secretaries.

For the 981 party secretaries of the municipal committee of the cities in our sample, we collected their biographical data and official portrait photographs through the Renmin Net (http://people.com.cn/), the Local Party and Government Leaders Database provided by China Economic Net (http://www.ce.cn/), and the Party and Government Leaders Database provided by the News of the Communist Party of China (http://cpc.people.com.cn). These databases and online resources contain information such as the career histories of senior political leaders. Our sample required at least four municipality party secretaries for a given province and a given year, including those whose age approaches the retirement age.

The turnover of party secretaries at the city level is usually jointly determined by the leaders of the provincial and central governments. We define *Mobility* as an indicator variable whose value may be 1, 0, and – 1. The value of 1 indicates the scenario wherein a party secretary was promoted to a provincial position with a higher bureaucratic rank such as the vice governor, a provincial position with equivalent bureaucratic rank but more power and prestige, leadership positions of the provincial legislative institutions, or leadership positions of a subprovincial city.[4] The value 0 represents the cases in which a secretary held the same position or relocated with the same title to another prefecture-level city. Finally, the value of – 1 refers to all other situations in which a city leader retired or moved to a position with lower bureaucratic rank or less power. The data indicates that political turnover can take place one, two, three and even ten years after a government official assumed office. The average length of a city leader's tenure is around 3.6 years.

2.1. Perceived attractiveness

The extant literature on physical appearance uses subjective beauty ratings given by survey respondents (typically students) for the aesthetic evaluation of faces (Cunningham et al., 1990; Cunningham et al., 1995; Rhodes et al., 1999; Rhodes and Tremewan, 1996). We followed these articles and used undergraduate students studying in a large-sized university in China to evaluate physical attractiveness of those government officials in our sample.[5] Since each participant evaluated 50 officials and each official was evaluated by five students, we had 99 participants in total in this process. Each official was

[3] Chen and Kung (2016) analyze the political selection of China's county leaders and find that both GDPGrowth and land revenue have a significant and positive effect on promotion.

[4] In a robustness test, we include a third scenario of promotion wherein an official was placed in a city with larger jurisdiction and population as the party secretary or mayor, and the empirical results are similar.

[5] This university locates in Guangdong province. It is possible that some respondents are from the same province and know well those government officials working in Guangdong. To control for the potential bias from recognition, we perform tests while excluding the observations of government officials who worked in Guangdong province. The results are robust and reported in an online appendix.

evaluated regarding its attractiveness (1 = very unattractive, 2 = unattractive, 3 = average, 4 = attractive, 5 = very attractive). Please see Appendix A for a detailed description of the survey questions. Based on the aesthetic scores from five students, we computed the average score, which is named *Attractiveness*, as the measure for viewers' perceived attractiveness for the official in the photograph.

In general, a small group of secretaries working in the same province (rather than nationwide) compete for an emerging promotion opportunity. Under such a setup, we preferred to use a relative measure for their facial attractiveness. Therefore, we adjusted *Attractiveness* by the median value of all those competing secretaries from the same province and of the same year to obtain a relative measure, *RelativeBeauty*, for use in the main empirical analyses.

2.2. Personal abilities

Labor economics literature has recognized that workers differ in skills along multiple dimensions (such as manual, cognitive, and interpersonal) and that occupations require different combinations of various types of skills (Abraham and Spletzer, 2009; Borghans et al., 2008; Heckman and Sedlacek, 1985; Lazear, 2009; Poletaev and Robinson, 2008; Sanders and Taber, 2012; Yamaguchi, 2012). Our samples contain senior political officials whose jobs rarely require manual skills. However, cognitive and interpersonal skills are critical for these leaders and significantly affect their work performance. Although government officials are generally evaluated based on a list of criteria and goals, the ability to facilitate economic growth is the dominant factor, because all subnational governments have been motivated to pursue economic development after China began its economic reforms in the early 1980s. Accordingly, based on the information on local GDP growth, we have constructed an economic performance measure, *Ability*, as the proxy for the officials' capability related to economic growth. Li and Zhou (2005) and Chen and Kung (2016) use the average GDP growth rate from the date the incumbent government official assumed office to measure the official's economic performance. We refine this measure as the average abnormal GDP growth since the incumbent government official assumed office, whereas abnormal GDP growth is the annual GDP growth rate subtracted by the median value of all competing officials' GDP growth rates in the same province and at the same year.[6] The reason for the median-adjustment is that, similar to tournaments in corporations (Main et al., 1993), the CPC promotes a tournament competition among local political leaders. Therefore, a relative performance measure is appropriate.

2.3. Other control variables

As shown by prior research, nepotism and loyalty may also affect Chinese officials' political careers (Opper and Brehm 2007; Jia et al., 2015). The Communist Youth League (CYL) is one of the most influential political organizations in China, and it traditionally constitutes a recruitment pool for the Communist Party and government leadership. A leading position in the CYL implies strong political credentials and connections to top Communist leaders who can influence promotion decisions. We constructed a dummy variable, *CYL*, to indicate if a secretary had formerly worked as the regional chief secretary/vice secretary in this organization. An indicator variable, *PartySchool*, is defined as 1 if a secretary graduated from Communist Party schools, and 0 otherwise. This variable is used as another proxy for the official's loyalty to the CPC. *Cen_pro* is a dummy variable that indicates whether a secretary formerly worked in the central or provincial governments; experience in upper-level bureaucracies may provide opportunities to cultivate personal relationships with top leaders. Other control variables include the official's age, gender, education, length of office tenure, and level of economic development, among others. The Appendix B presents the definitions of all main variables used in this research.

Table 1 presents the summary statistics of main variables used in our analysis. There are a total of 3552 secretary-year observations, which include 508 (14.3%) observations of promotion, 2761 (77.7%) of stay or relocation to equivalent positions, and 283 (8.0%) observations of demotion. The maximum value of *Attractiveness* is 4, while the minimum value is 1.2, with the mean (median) of 2.6 (3). The average age of these local leaders is about 51.796 years, varying from 43 to 59 years. 65.6% of them have a graduate degree. Male officials dominate upper-level political bureaucracies in China, so it is unsurprising that only about 2.7% of our sample observations are of female officials (38 unique female officials). We also observe a wide dispersion in annual GDP growth across cities and years.

3. Empirical results and discussion

3.1. Career mobility and beauty effects

We report in Table 2 Panel A the means of variables by the three categories of mobility: promotion ($mobility = 1$), non-promotion ($mobility = 0$), and demotion ($mobility = -1$). We notice that promoted officials have a higher average attractiveness score (2.683) than those not promoted (2.663) and demoted (2.542), and 21.9% of promoted officials advanced from the CYL, compared to 18.1% for non-promoted and 12% for demoted officials. A larger percentage (45.3%) of promoted officials

[6] Alternatively, we follow Shih et al. (2012) and adjust for each local GDP growth by subtracting the median value of all competing officials' GDP growth rates in the same province and at the same year, and then by subtracting the average GDP growth rate for the five-year period before the incumbent party secretary was appointed. Using this alternative economic performance measure does not change our main finding of a beauty effect on government officials' political mobility.

Table 1
Summary Statistics of 981 Chinese Communist Party Secretaries, 1999–2013. All variables are defined in Appendix B. All continuous variables are winsorized at the 1st and 99th percentiles.

variable	N	mean	s.d.	min	p25	p50	p75	max
Mobility	3552	0.063	0.468	−1	0	0	0	1
Attractiveness	3552	2.656	0.628	1.2	2.2	2.6	3	4
RelativeBeauty	3552	0.005	0.593	−1.4	−0.400	0	0.400	1.5
GDP growth	3552	0.158	0.076	−0.079	0.107	0.159	0.205	0.374
Ability	3552	0.001	0.037	−0.110	−0.017	0	0.017	0.129
CYL	3552	0.182	0.386	0	0	0	0	1
Cen_pro	3552	0.421	0.494	0	0	0	1	1
Female	3552	0.027	0.162	0	0	0	0	1
Tenure	3552	2.613	1.552	1	1	2	4	7
FirstYear	3552	0.299	0.458	0	0	0	1	1
LogPCGDP	3552	0.217	0.237	0.028	0.078	0.137	0.257	1.455
PartySchool	3552	0.127	0.333	0	0	0	0	1
Graduate	3552	0.656	0.475	0	0	1	1	1
Age	3552	51.796	3.811	43	49	52	55	59

Table 2
Summary Statistics by Category. This table reports the means of main variables used in the empirical analyses. All variables are defined in Appendix B. "*", "**", and "***" represent statistical significance at the 10%, 5%, and 1% level, respectively.

Panel A: by Categories of Mobility

	Mobility = −1 (1)	Mobility = 0 (2)	Mobility = 1 (3)	(1)−(3)
Observation	283	2761	508	
Attractiveness	2.542	2.663	2.683	−0.141***
RelativeBeauty	−0.108	0.011	0.031	−0.140***
GDP growth	0.152	0.158	0.161	−0.011
Ability	−0.002	0.001	0.004	−0.005**
CYL	0.120	0.181	0.219	−0.098***
Cen_pro	0.367	0.421	0.453	−0.085**
Female	0.011	0.026	0.041	−0.031**
Tenure	3.753	2.336	3.488	0.264**
FirstYear	0.088	0.359	0.094	−0.006
LogPCGDP	0.223	0.213	0.238	−0.015
PartySchool	0.081	0.131	0.132	−0.051**
Graduate	0.519	0.665	0.683	−0.164***
Age	55.078	51.388	52.187	2.891***

Panel B: by Categories of RelativeBeauty

RelativeBeauty percentile rank (in descending order)	<20% (1)	[20%, 80%] (2)	>80% (3)	Difference (1)−(3)
Mobility	0.033	0.057	0.096	−0.064**
Attractiveness	1.605	2.533	3.505	−1.899***
RelativeBeauty	−0.866	−0.11	0.744	−1.610***
GDP growth	0.157	0.157	0.160	−0.004
Ability	0.001	0.001	0.001	0.000
CYL	0.120	0.168	0.249	−0.129***
Cen_pro	0.435	0.41	0.446	−0.011
Female	0.000	0.012	0.081	−0.081***
Tenure	0.399	0.21	0.122	0.277***
FirstYear	0.275	0.296	0.321	−0.046*
LogPCGDP	0.176	0.221	0.226	−0.051***
PartySchool	0.108	0.124	0.146	−0.038*
Graduate	0.585	0.639	0.739	−0.154***
Age	52.493	51.847	51.316	1.176***

previously worked in the upper levels of the government, compared to 42.1% for the non-promotion group, and 36.7% for the demotion group. It seems that advanced age is a negative factor for career advancement, since demoted officials are on average much older than those in the other two groups.

In panel B, we divide government officials into three groups based on their attractiveness percentile rankings. It is noted that, for the group wherein the ranks of attractiveness scores are above the 80th percentile in ascending order, the mean of *Mobility* is 0.096, which is much higher than 0.033 for the low-attractiveness group wherein the ranks of attractiveness are below the 20th percentile. The *t*-test indicates that the difference is statistically significant at the 5% level. This finding suggests that better-looking officials are statistically more likely to be promoted. The table also shows that government officials

Table 3
Ordered Logit Regressions of Mobility on Beauty Measures. This table reports the results of ordered logit regressions of *Mobility* on various measures of facial attractiveness in column (1) through (5) and of the logit regression of *Promotion* in column (6). All variables are defined in Appendix B. Heteroskedasticity-consistent standard errors clustered at the city level are reported in parenthesis. "*", "**", and "***" represent statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3) Dep. = Mobility	(4)	(5)	(6) Dep. = Promotion
RelativeBeauty	0.254***	0.202**			0.253**	0.331**
	(0.086)	(0.090)			(0.113)	(0.137)
BeautyRank			0.073*			
			(0.042)			
Top20%Beauty				0.300**		
				(0.119)		
Bottom20%Beauty				−0.009		
				(0.175)		
Ability		2.779**	2.777**	2.752**	3.325*	3.778*
		(1.322)	(1.324)	(1.320)	(1.780)	(2.218)
CYL		0.074	0.080	0.083	0.165	0.375**
		(0.128)	(0.128)	(0.128)	(0.161)	(0.186)
Cen_pro		0.071	0.077	0.078	0.163	0.254
		(0.106)	(0.106)	(0.105)	(0.125)	(0.157)
Female		0.391	0.422	0.385	0.582*	0.633*
		(0.307)	(0.310)	(0.307)	(0.337)	(0.384)
Tenure		0.165***	0.162***	0.164***	0.343***	0.514***
		(0.048)	(0.048)	(0.048)	(0.043)	(0.056)
FirstYear		−0.275***	−0.279***	−0.280***	−0.764***	−1.253***
		(0.099)	(0.100)	(0.100)	(0.153)	(0.207)
LogPCGDP		−0.364	−0.349	−0.334	−0.286	−0.571
		(0.481)	(0.484)	(0.480)	(0.511)	(0.596)
PartySchool		0.315**	0.309**	0.301**	0.222	0.367**
		(0.136)	(0.137)	(0.134)	(0.177)	(0.183)
Graduate		0.070	0.068	0.059	0.085	0.121
		(0.128)	(0.129)	(0.129)	(0.142)	(0.189)
Age		1.565***	1.572***	1.550***	0.419	−0.415
		(0.339)	(0.339)	(0.342)	(0.354)	(0.419)
Age_Square		−0.016***	−0.016***	−0.016***	−0.004	0.004
		(0.003)	(0.003)	(0.003)	(0.003)	(0.004)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Position FE	Yes	Yes	Yes	Yes	Yes	Yes
Pseudo R-squared	0.053	0.091	0.091	0.092	0.197	0.322
Observations	3552	3552	3552	3552	3552	3552

from these two categories are statistically significant in age, office tenure, and other political and educational background, which suggests the necessity to control for these variables when investigating the relation between physical appearance and work promotion.

Next, we employ multivariate analysis to study the effect of facial attractiveness on the mobility of government officials. An ordered logistic regression model is defined as

$$\text{Mobility}^*_{\text{it}} = \beta RelativeBeauty_{it} + X'_{it}\Gamma + \varepsilon_{it} \ , \tag{1}$$

$$Mobility_{\text{it}} = k \ if \ \lambda_k \leq Mobility^*_{it} < \lambda_{k+1}, \tag{2}$$

where $k = -1$, 0 and 1, $\text{Mobility}^*_{\text{it}}$ is the latent variable, λ_k is the threshold of the latent variable that separates $Mobility_{it} = k$ and $Mobility_{it} = k+1$, and X is a vector of control variables including *Ability, CYL, Cen_pro, Age*, etc. We estimate the ordered logistic fixed effect model employed by Baetschmann et al. (2015) and Dickerson et al. (2014) (the so-called Blow-up and Cluster or BUC method), controlling both city fixed-effect and year fixed-effect. A set of dummies for different promotion positions is created to control for the possible endogeneity issue that facial attractiveness is one of the main requirements for specific promotion positions. Further, the standard errors of the estimated coefficients are adjusted by clustering at the city levels.

Table 3 shows the results of ordered logit regressions with various model specifications. In column (1), the main variable of interest is *RelativeBeauty*. Its estimated coefficient is 0.254 and is statistically significant at the 1% level, which suggests that an official's physical attractiveness has a positive effect on the probability of promotion. The results of column (2) are from a full model that includes all control variables. Although more control variables have been included, the estimated coefficient of *RelativeBeauty* changes slightly to 0.202 with a 5% significance level. The estimation results suggest that a one standard deviation increase in *RelativeBeauty* increases the log odds of promotion by 17%.

The officials' ability to facilitate economic growth has a positive impact on the probability of promotion, as the estimated coefficient of *Ability* in column (2) is 2.779, and is statistically significant at the 5% level. This evidence is consistent with the findings in prior literature; therefore, we provide additional evidence to suggest the CPC adopts a performance-based cadre management system to select capable regional leaders. Graduating from Communist Party schools also helps boost the probability of promotion, as suggested by the positive and statistically significant coefficient of *PartySchool*. Meanwhile, an official is more likely to be promoted if he or she is more experienced or relatively older; the probability of promotion declines, however, if the candidate is too old. This regression model does not support that argument that city leaders' promotion is affected by his prior experience in CYL and in the upper level governments. There is neither solid evidence that promotion is closely related to official's gender, probably because of the small sample size of female officials.

The *RelativeBeauty* used in the regressions for column (1) and (2) is a continuous variable. To exclude the possibility that our results may be sensitive to the way the perceived attractiveness is measured, we construct a rank variable based on the original attractiveness scores. We sort all party secretaries of the same provinces and of the same year by *Attractiveness* in ascending order and then assign a value one to the observations located in the first quintile, and two to the second quintile, and so on. Thus the newly constructed variable, *BeautyRank,* has a range of one to five. Then we rerun the regression with *BeautyRank*, and the results reported in Table 3 column (3) are consistent with those from the first two regressions. It is noticed that the coefficient of *BeautyRank* is 0.073 and statistically significant at the 10% level.

To improve our confidence in the robustness of the results reported in Table 3, column (1) through column (3), we create a dummy *Top20%Beauty* and *Bottom20%Beauty* based on the quintile rankings of attractiveness score and then reestimate the regression. *Top20%Beauty* equals one if a beauty observation is ranked to the fifth quintile, and zero otherwise. Meanwhile, *Bottom20%Beauty* is defined as one if the observation is ranked to the first quintile, and zero otherwise. We report the results in column (4) of Table 3. Consistent with the results of the prior three regressions, we find that the coefficient on *Top20%Beauty* is 0.3 and significant at the 5% level. In contrast, *Bottom20%Beauty*'s coefficient is – 0.009 but not statistically significant at the 10% level. For additional robustness, we follow the method proposed by Ferrer-i-Carbonell and Frijters (2004) to estimate the model and report the results in column (5). The estimated coefficient of *RelativeBeauty* is 0.253, which is very close to the 0.202 reported in column (2), but the coefficients of *PartySchool, Age*, and *Age_Square* are not statistically significant anymore.

In column (6), we report the results of a logistic regression wherein the dependent variable is *Promotion*, which is defined as one if the value of *Mobility* equals one, and zero otherwise. Consistent with the results of the five ordered logistic models, facial attractiveness shows a positive effect on the probability of promotion.[7]

Based on the results of regressions with various model specifications, we conclude that there is a causal relationship between physical attractiveness and work promotion in the CPC's internal job market. With the assumption that no unobservable variables that determine attractiveness also determine work promotion, we are careful in selecting covariates when running regressions. The control variables used in our regressions capture information on officials' age, gender, education background, office tenure, perceived ability, and their nepotism and loyalty to the Communist Party. We assume all other determinants of physical attractiveness are orthogonal to the selected control variables and are therefore left in the error term. In robustness tests, we add additional control variables to the regressions. For example, ethnicity could be an important control as upper government officials may prefer promoting minority ethnicity leaders for the purpose of national unity, and certain ethnic groups may be deemed more attractive. As shown in Section 4, the main results hold after we control for additional demographics of government officials, including their ethnicities, social skills, and alumni connections with senior government leaders.

3.2. Beauty or ability?

We have provided evidence that party secretaries with comparatively greater physical attractiveness have higher chances of promotion than their less attractive peers. This phenomenon may be driven by the appearance-based bias, i.e., individuals who make promotion decisions act on perceptual distortions and irrational correlations between a person's looks and his or her ability. Although the observed beauty premium might be the reward for unobserved beauty-related ability unaccounted for in our analysis, the psychology literature provides weak to no evidence for the relation of beauty to better performance (Jackson et al., 1995; Rule and Ambady, 2008). In this section, we investigate whether beauty is correlated to ability measured in different dimensions.

We use growth rates of GDP, unemployment rate, fiscal revenue, bank loans, and foreign direct investment (FDI) as various proxies for a party secretary's ability to advance economic development. In a fixed-effect panel setting, we run the following regression:

$$\text{Performance}_{\text{it}} = \beta \text{RelativeBeauty}_{\text{it}} + \text{X}_{\text{it}}^{'}\Gamma + \alpha_{\text{i}} + \tau_t + \varepsilon_{\text{it}}, \tag{3}$$

where i and t index city and year, respectively. α_{i} and τ_t denote, respectively, to city and year fixed effects. X is a set of control variables including lagged Log*PCGDP*, lagged fixed asset investment, lagged growth rate of employed labor, *Tenure, Age, Age_Square*. The dependent variables of performance are measured by GDP growth rate, unemployment rate, the growth rate of fiscal revenue, the growth rate of commercial loan, and the growth rate of foreign direct investments, respectively.

[7] After excluding 96 female observations, we perform tests again and obtain results similar to those reported in Table 3.

Table 4
OLS Regressions of Various Performance Measures on Beauty. This table reports the results of OLS regressions of various work performance on *RelativeBeauty*. The dependent variables are GDP growth rate; unemployment rate; growth rate of fiscal revenue; growth rate of bank loans; and the growth rate of foreign direct investment (FDI). *Fixed Asset Investment* is the amount of fixed asset investment scaled by GDP; *Employed Labor Growth* is the growth rate of labor force. All other variables are defined in Appendix B. Heteroskedasticity-consistent standard errors clustered at the city level are reported in parenthesis. "*", "**", and "***" represent statistical significance at the 10%, 5%, and 1% level, respectively.

	GDP Growth	Unemployment rate	Fiscal Revenue Growth	Bank Loan Growth	FDI Growth
RelativeBeauty	0.001	0.000	−0.001	−0.007	0.041
	(0.003)	(0.001)	(0.007)	(0.011)	(0.047)
$LogPCGDP_{t-1}$	−0.123***	0.001	−0.219***	−0.152**	−0.318
	(0.014)	(0.003)	(0.043)	(0.062)	(0.240)
Fixed Asset $Investment_{t-1}$	0.012***	0.000	0.022***	−0.003	−0.061***
	(0.001)	(0.000)	(0.005)	(0.004)	(0.018)
Employed Labor $Growth_{t-1}$	0.001	−0.001	0.022***	−0.005	−0.012
	(0.002)	(0.001)	(0.007)	(0.021)	(0.049)
Tenure	−0.000	−0.000	−0.002	−0.001	0.008
	(0.001)	(0.000)	(0.002)	(0.004)	(0.015)
Age	0.016**	0.004*	−0.005	−0.030	0.251*
	(0.006)	(0.002)	(0.021)	(0.032)	(0.134)
Age_Square	−0.000**	−0.000*	0.000	0.000	−0.003*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Year FE	Yes	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes	Yes
R-squared	0.271	0.000	0.164	0.107	0.018
Observations	2898	3071	2275	2046	2808

We find that the estimates of the coefficient of *RelativeBeauty* are not significant in all regression specifications presented in Table 4. Results are similar when we replace *RelativeBeauty* by *Attractiveness*, lagged one- and lagged two-period *RelativeBeauty*. These results are consistent with the research of Mobius and Rosenblat (2006): there is no relationship between the maze-solving skill and physical attractiveness. We conclude that the effect of the beauty premium on a regional leader's promotion is more likely driven by the appearance-based bias, rather than an unobserved relation between skills and a person's look.

4. Robustness tests

Ethnicity may be an important determinant for Chinese officials' political mobility, especially in minority autonomous regions. An official of minority ethnicity may have a higher likelihood of promotion in order to fulfill the purpose of national unity and stability. Another potential factor is the alumni connection. An official may win in the promotion competition because of a close alumni relationship with top leaders in the upper level of government. It is possible that an official's physical appearance is correlated with his ethnicity and his baccalaureate college or university. To rule out this possibility, we add two new variables, *Minority* and *Alumni*, as additional controls in the baseline regression Eq. (1). *Minority* is defined as one if the official belongs to any minority ethnicity and zero otherwise. *Alumni* is defined as one if the official went to the same college or university as the provincial secretary or governor and zero otherwise.

In Eq. (1) we already control for local leaders' ability related to economic growth. Since social skills are supposed to contribute to vocational success, we intend to control for officials' social skills in multivariate analysis. We use an official's undergraduate major as the variable to proxy for his extroversion personality trait and interpersonal skills. Several psychology researchers suggest that college students' choices of educational majors are indirectly influenced by their personalities (Larson et al., 2007; Larson et al., 2010; Lounsbury et al., 2009). Based on these findings, we assume that the personality traits of Chinese students with STEM majors (science, technology, engineering, and mathematics) generally differ from those of liberal arts majors and business and economics majors, especially with respect to extroversion and social closeness. Accordingly, we use undergraduate majors as a proxy for officials' social skills. Although an undergraduate major is not a perfect measurement for interpersonal skills, it is a suitable proxy for our purpose, since it is impossible for us to conduct a large-scale survey of Chinese senior government officers to determine their personality traits. We do not observe any government officer in our sample who graduated from college with an art major, and therefore we treat STEM majors as the reference group and create two major dummies, *Liberal* and *Business*. We are able to find undergraduate major information for 800 officials in the sample.

The results of the new regression reported in Table 5 indicate that, after controlling for undergraduate majors and minority ethnicity as well as alumni connections with provincial leaders, the estimated coefficient of *RelativeBeauty* is 0.288 and remains statistically significant at the 5% level; the coefficient of *BeautyRank* is 0.103 and significant at the 10% level.

In the second robustness test, we split the whole sample into two periods, 1999–2007 and 2008–2013, and then reestimate Eq. (1) with these two subsamples. The results reported in the online appendix are consistent and robust.

Table 5
Ordered Logit Regressions of Mobility on Beauty Measures with Additional Controls. This table reports the results of ordered logit regressions of *Mobility* on various measures of facial attractiveness, including four new control variables, *Minority, Alumni, Business, and Liberal. Minority* is defined as 1 if the official belongs to any minority ethnicity and 0 otherwise. *Alumni* is defined as 1 if the official went to the same college or university as the provincial secretary or governor and 0 otherwise. *Business* is defined as 1 if the official's undergraduate major is business or economics, and 0 otherwise. *Liberal* is defined as 1 if the official's undergraduate major is liberal arts, and 0 otherwise. All other variables are defined in Appendix B. Heteroskedasticity-consistent standard errors clustered at the city level are reported in parenthesis. "*", "**", and "***" represent statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)	(4)
RelativeBeauty	0.283**		0.288**	
	(0.113)		(0.124)	
BeautyRank		0.101*		0.103*
		(0.052)		(0.058)
Ability	1.845	1.844	2.193	2.161
	(1.432)	(1.447)	(1.656)	(1.671)
CCYL	0.083	0.084	−0.033	−0.025
	(0.148)	(0.147)	(0.175)	(0.175)
Cen_pro	−0.006	0.008	0.015	0.029
	(0.128)	(0.128)	(0.157)	(0.156)
Female	0.531*	0.574*	0.607	0.653*
	(0.301)	(0.302)	(0.382)	(0.377)
Tenure	0.219***	0.215***	0.261***	0.257***
	(0.057)	(0.056)	(0.062)	(0.062)
FirstYear	−0.248**	−0.255**	−0.253*	−0.260**
	(0.120)	(0.119)	(0.130)	(0.130)
LogPCGDP	−0.113	−0.097	0.084	0.106
	(0.614)	(0.618)	(0.726)	(0.732)
PartySchool	0.275	0.273	0.161	0.158
	(0.172)	(0.172)	(0.193)	(0.193)
Graduate	0.104	0.100	0.212	0.206
	(0.150)	(0.150)	(0.184)	(0.185)
Age	1.859***	1.862***	1.798***	1.800***
	(0.426)	(0.427)	(0.499)	(0.500)
Age_Square	−0.019***	−0.019***	−0.018***	−0.019***
	(0.004)	(0.004)	(0.005)	(0.005)
Minority	−0.151	−0.144	0.038	0.028
	(0.314)	(0.316)	(0.366)	(0.369)
Alumni	0.071	0.082	−0.006	0.007
	(0.122)	(0.122)	(0.140)	(0.141)
Business			0.270*	0.277*
			(0.162)	(0.164)
Liberal			−0.368**	−0.352*
			(0.184)	(0.185)
Year FE	Yes	Yes	Yes	Yes
City FE	Yes	Yes	Yes	Yes
Position FE	Yes	Yes	Yes	Yes
Pseudo R-squared	0.100	0.099	0.103	0.102
Observation	2706	2706	2296	2296

All prior tests have been conducted on an unbalanced panel dataset wherein each official in our sample has multiple observations, since his office tenure may cover several years. In the last robustness test, the estimation of Eq. (1) is conducted with only one observation for each person and each office post, that is, the observations of the last year in each office post. Although the observation number drops to 886, the beauty effect on promotion remains.

5. Perceived trustworthiness and competence

The extant literature documents that we tend to judge other people's competence, intelligence, and trustworthiness based on external appearance (Hassin and Trope, 2000; Todorov et al., 2005; Zebrowitz et al., 2002). Numerous studies have shown that attractive people are perceived as more trustworthy and competent than others (Berggren et al., 2010; Cash et al., 1977; Dipboye et al., 1975; Eagly et al., 1991; Feingold, 1992; Jackson et al., 1995; Raza and Carpenter, 1987; Till and Busler, 2000). To have a better understanding on the observed beauty effects in the promotion tournament among Chinese local political

Table 6
Correlation matrix of facial trait measures. This table reports Pearson correlation coefficients among measures of facial traits for 981 party secretaries of the municipal committees. Each government official in the photograph is rated by five undergraduate students regarding its perceived attractiveness (1 = very unattractive, 2 = unattractive, 3 = average, 4 = attractive, 5 = very attractive). We compute the average of these ratings and name it *Attractiveness*, which is adjusted by the median value of all competing secretaries from the same province and of the same year to obtain a relative measure, *RelativeBeauty. Competence* (*RelativeCompetence*) and *Trustworthiness* (*RelativeTrust*) are constructed in the same way.

Panel A			
	Mobility	RelativeBeauty	RelativeCompetence
RelativeBeauty	0.05		
RelativeCompetence	0.03	0.54	
RelativeTrust	0.02	0.60	0.62
Panel B			
	Mobility	Attractiveness	Competence
Attractiveness	0.04		
Competence	0.02	0.59	
Trustworthiness	0.02	0.63	0.66

leaders, we step further to investigate whether the perceived attractiveness of these government officials is related to other facial traits such as the perceived trustworthiness and competence.

In addition to rating perceived attractiveness, in the survey students also provided their ratings of perceived competence and trustworthiness for every government official in our sample. For example, each face in the photograph was rated by five students regarding the perception of competence (1 = very incompetent, 2 = incompetent, 3 = average, 4 = competent, 5 = very competent). The average of these five rating scores was named *Competence*, which was then adjusted by the median value of all competing secretaries from the same province and of the same year to obtain a relative measure, *RelativeCompetence. Trustworthiness* and *RelativeTrust* were constructed in the same way and used as the measures for perceived trustworthiness.

The analysis of Pearson correlation allows us to compare the relationship between political promotion and assessments of the three facial traits one at a time. As reported in Panel A of Table 6, *Mobility* has a higher correlation with facial attractiveness (0.05) than with the other two traits. Further, there are high correlations among the three facial traits. The Pearson correlation coefficient between *RelativeBeauty* and *RelativeCompetence* is 0.54; The correlation between *RelativeBeauty* and *RelativeTrust is* 0.60; We also notice a high correlation between perceived competence and trustworthiness: 0.62. It seems that these three cognition measures share information about certain facial characters perceived by survey participants, and this information is most likely related to the impression of attractiveness, as the literature has shown that physically attractive individuals are ascribed a multitude of additional positive traits. Panel B shows similar results with absolute assessment values. In sum, the correlation analyses suggest that attractive government officials are perceived as more competent and trustworthy than others.

Prior studies have shown that the look of competence and perceived trustworthiness have significant impacts on commercial and political activities. For example, Graham et al. (2016) document that large-firm CEOs look more competent than CEOs from smaller firms; Todorov et al. (2005) show that U.S. politicians with competent-looking faces have a greater chance of being elected; Pareek and Zuckerman (2013) find that hedge fund managers whose photographs are rated as more trustworthy attract greater fund flows. Along this line, we further investigate whether China's political selection process of regional leaders is affected by the perceptions of competence and trustworthiness. We expect that officials who look more competent and trustworthy are more likely to be promoted. Similar to Eq. (1), we firstly estimate ordered logistic regression of *Mobility* on *RelativeCompetence* and *RelativeTrust*, respectively. Then, in a revised regression model, we include all three assessment measures of facial trait, controlling for other personal attributes.

Table 7 reports the regression results, which are consistent with our propositions. In column (1), perceived competence is the only facial trait tested. The coefficient of *RelativeCompetence* is 0.290 with a 5% significance level. For the perceived trustworthiness measure, as reported in column (2), its coefficient is 0.227 with a 10% significance level. These results indicate that, like physical attractiveness, perceived competence and trustworthiness may positively affect officials' career mobility. Column (3) shows the regressions results when all three facial trait measures are included in the empirical model. Compared to those reported in Table 3, the coefficient of *RelativeBeauty* becomes marginally smaller, and its statistical significance vanishes. *RelativeCompetence* and *RelativeTrust* do not sustain their statistical significance, either. Since these three variables have very high correlations with each other, the observed disappearance of statistical significance of beauty and other two facial traits is likely driven by the potential multicollinearity issue. Next, we perform a joint significance test to determine whether these trait variables considered as a whole is statistically significant or not. We find that the Chi-

Table 7
Ordered Logit regressions of *Mobility* on other facial trait measures. This table reports the results of ordered logit regressions of *Mobility* on various facial trait measures. Each government official in the photograph is rated by five undergraduate students regarding its perceived attractiveness (1 = very unattractive, 2 = unattractive, 3 = average, 4 = attractive, 5 = very attractive). We compute the average of these ratings and name it *Attractiveness*, which is adjusted by the median value of all competing secretaries from the same province and of the same year to obtain a relative measure, *RelativeBeauty*. *RelativeCompetence* and *RelativeTrust* are constructed in the same way and used as the measures for perceived competence and trustworthiness. All other variables are defined in Appendix B. Heteroskedasticity-consistent standard errors clustered at the city level are reported in parenthesis. "*", "**", and "***" represent statistical significance at the 10%, 5%, and 1% level, respectively.

	(1)	(2)	(3)
RelativeBeauty			0.166
			(0.143)
RelativeCompetence	0.290**		0.154
	(0.141)		(0.178)
RelativeTrust		0.227*	0.045
		(0.127)	(0.165)
Ability	3.198*	3.303*	3.375*
	(1.781)	(1.776)	(0.161)
CYL	0.159	0.163	0.156
	(0.161)	(0.161)	(0.161)
Cen_pro	0.171	0.167	0.158
	(0.125)	(0.125)	(0.125)
Female	0.620*	0.660**	0.580*
	(0.335)	(0.332)	(0.338)
Tenure	0.339***	0.339***	0.343***
	(0.043)	(0.043)	(0.043)
FirstYear	−0.764***	−0.776***	−0.770***
	(0.153)	(0.153)	(0.153)
LogPCGDP	−0.280	−0.286	−0.273
	(0.508)	(0.511)	(0.512)
PartySchool	0.218	0.192	0.212
	(0.176)	(0.176)	(0.177)
Graduate	0.088	0.081	0.079
	(0.142)	(0.142)	(0.143)
Age	0.440	0.414	0.428
	(0.356)	(0.354)	(0.355)
Age_Square	−0.005	−0.004	−0.004
	(0.003)	(0.003)	(0.003)
Year FE	Yes	Yes	Yes
City FE	Yes	Yes	Yes
Position FE	Yes	Yes	Yes
Pseudo R-squared	0.196	0.196	0.197
Observations	3552	3552	3552

square statistics is 4.04 (p-value = 0.0445), which suggests that our three measures contain common information that significantly affects political leaders' career path. Our findings echo the evidence of halo effect found in the extant literature. Berggren et al. (2010) collect the same three measures as ours and study the role of these facial traits in electoral success of Finnish political candidates. They find high correlations among these measures, too. They also find that only attractiveness sustains its statistical significance (but with much smaller marginal effect) when all three measures are included in the same regression.

It is possible our perceived competence and trustworthiness measures are good proxy for the candidate's ability or competence and nothing to do with attractiveness. In unreported tests, we examine the association between the perceptions of competence and trustworthiness of an official and his economic performance. In particular, we reestimate Eq. (3) but replace *RelativeBeauty* with *RelativeTrust* or *RelativeCompetence* as the main independent variable in the regressions, and we do not find a significant relation between economic growth and perceived competence and trustworthiness. This evidence suggests that the measures for perceived competence and trustworthiness do not contain information about sample officials' true competence, and as a result, it is plausible that the perceived competence and trustworthiness are driven by a halo effect. This implication is also suggested by the result of joint significance test and high correlations among the three trait measures demonstrated in Table 6.

6. Conclusion

Drawing upon extensive literature on growth in transitional economies and literature on discrimination in the labor market, we use a hand-collected dataset of 981 Chinese government officers to estimate the beauty effect on their career advancement. Our findings indicate that more attractive and less attractive officials are not treated equally. When we control for personal ability, age, gender, education, and other individual characteristics, we find that attractive officials are more likely to be promoted than are their less attractive peers. Although economic performance is a chief determinant for promotion, a poorly performing official may still have a statistically significant chance of promotion if he or she is attractive. In addition, more attractive leaders are assigned higher scores for trustworthiness and competence, which help raise the chance of promotion.

We also conduct research to determine whether attractive subnational leaders perform better than other unattractive ones. Since we find no evidence of a positive relation between physical attractiveness (and perceived trustworthiness as well as perceived competence) and economic performance measured in various dimensions, we conclude that the observed beauty effects are more likely to be driven by a cognitive bias rather than a spurious relation between ability and attractiveness. While prior studies have offered evidence that Chinese political leaders assign promotions based on performance and personal ability, the unequal promotion outcome between more attractive and less attractive officials, as found in this paper, suggests that physical appearance matters in the tournament competition among CPC's officials. This appearance-based bias or discrimination may be inherited from historic Chinese culture.

The ancient Chinese believed that one's face reflects who one is, what one thinks, and why one behaves in particular ways, and "judging a book by its cover" was once very common. Abundant historical documentation records that the ruling bureaucracies in ancient China favored physical attractiveness in the selection of government officials. In the Han Dynasty, for example, one of the criteria for selecting male government officials was "masculine beauty." Physical requirements in the Tang, Ming, and Qing Dynasties were even more specific. Historical traditions of order, law, and culture may endure over time and significantly affect a country's development of new systems (Acemoglu et al., 2001). Thus, it is not unexpected that discrimination based on appearance is common in today's China. Research on the Chinese job market by China Labor Bulletin, a Hong Kong based non-governmental organization, shows that about 8% of job advertisements listed height requirements and/or other discriminatory standards for physical appearance.[8] Our study provides new evidence that the CPC's human capital management system inherited the appearance-based discrimination of historic Chinese bureaucratic culture.

Declarations of interest

none

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Supplementary material

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jebo.2019.01.005.

Appendix A. Survey questions

1. Do you think this person is attractive?
   1) Very unattractive
   2) Unattractive
   3) Average
   4) Attractive
   5) Very attractive
2. Do you think this person looks like a competent leader?
   1) Very incompetent
   2) Incompetent
   3) Average
   4) Competent
   5) Very competent
3. Do you think this person looks trustworthy?
   1) Very untrustworthy

[8] The information is from the website http://www.clb.org.hk/.

2) Untrustworthy
3) Average
4) Trustworthy
5) Very trustworthy

Appendix B. Variable definitions

Variable	Definition
Ability	The average abnormal GDP growth since the incumbent government official assumed office, whereas abnormal GDP growth is the annual GDP growth rate subtracted by the median value of all competing officials' GDP growth rates in the same province and at the same year.
Age	The age of the secretary.
Attractiveness	Each face in the photograph is evaluated by five students regarding its attractiveness (1 = very unattractive, 2 = unattractive, 3 = average, 4 = attractive, 5 = very attractive). Then the average of the five scores is computed.
BeautyRank	All secretaries of the same province and of the same year are sorted in ascending order by Attractiveness into quintile, and the observations located in a given quintile are assigned the number of that quintile. It has discrete values from 1 to 5.
Bottom20%Beauty	An indicator variable that equals 1 if BeautyRank = 1, and 0 otherwise.
CYL	An indicator variable that equals 1 if the party secretary once held a managerial position as the secretary or vice-secretary of the Communist Youth League at the prefecture or upper level and 0 otherwise.
Cen_pro	An indicator variable that equals 1 if the party secretary once worked in the central or provincial government, and 0 otherwise.
Graduate	An indicator variable that equals 1 if the secretary holds a master or higher degree, and 0 otherwise.
Female	An indicator variable that equals 1 if the party secretary is female, and 0 otherwise.
FirstYear	An indicator variable that equals 1 if the secretary is at the first year of the term, and 0 otherwise.
GDP growth	Annual growth rate of gross domestic product of a city.
LogPCGDP	The natural logarithm of per capita GDP (in 1000 China Yuan).
Mobility	An indicator variable that equals 1 (for promotion), 0, and − 1 (for demotion).
PartySchool	An indicator variable that equals 1 if the secretary received a degree from the communist party schools, and 0 otherwise.
Promotion	An indicator variable that equals 1 if the value of Mobility equals one, and 0 otherwise.
RelativeBeauty	The Attractiveness minus the median value of all competitors in the same province and at the same year.
Tenure	The number of year an officer has been in the incumbent position.
Top20%Beauty	It equals 1 if BeautyRank = 5, and 0 otherwise.

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Article

Corporate Financial Policies under Heterogeneous Beliefs

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Abstract: This study investigates a firm's financing, investment, and payout policies through a rational expectation equilibrium based on which managers and outside investors have heterogeneous prior beliefs. The proposed model demonstrates that managers tend to overinvest (underinvest) if the extent of heterogeneousness is above (below) a threshold, which differs under distinct circumstances. Moreover, a price bubble is positively related to overinvestment, and the model shows that a firm's optimal financing choices and payout policies vary with the assumption of heterogeneous beliefs.

Keywords: Heterogeneous beliefs; Corporate financing; Investment level; Cash dividend; Stock repurchase

1. Introduction

Considerable studies on behavioral finance (Surveyed in Shleifer, 2000; Xiong, 2013), suggest that market participants are not always rational and may have differing opinions on future payoffs of assets. Such heterogeneous beliefs are based on gradual information flow, limited attention, and having heterogeneous priors (Hong and Stein, 2007). Using a setup in which a firm's manager and outside investors have heterogeneous beliefs, we simultaneously investigated three important corporate finance-related topics: corporate financing decisions, investment at a firm level, and optimal payout policies.

There have been a number of theoretical models and empirical evidence for these subjects. Stein (2003) summarized the previous research on how the efficiency of corporate investments is influenced via asymmetric information and agency problems. DeAngelo et al. (2008) demonstrated a synthesis of academic research on corporate payout policies that were based on the pioneering contributions of Lintner (1956) and

Miller and Modigliani (1961). They demonstrated that a simple asymmetric information framework, which focuses on the requirement to distribute free cash flow and integrates agency costs (Jensen, 1986) and security valuation problems (Myers and Majluf, 1984), does a better job of explaining the primary features of the observed payout policies. The recent research on these topics can be mainly categorized to three classes.

One such class studies heterogeneous beliefs among investors. Differences in investors' belief could cause stock prices to deviate from fundamentals, which would lead to market inefficiency. In fact, a firm's manager would exploit such opportunities and make financial decisions for their own benefits. Related literature works include Shefrin and Statman (1984), Stein (1996), Baker and Wurgler (2002), Shleifer and Vishny (2003), Barberis and Thaler (2003), Baker and Wurgler (2004), Gilchrist et al. (2005), Li and Lie (2006), Chen and Liu (2007), Denis and Osobov (2008), Von Eije and Megginson (2008), Butler et al. (2011), Bayar et al. (2013), Frijns et al. (2013), Wang et al. (2013), Buisseret (2014), Jung and Subramanian (2014), Smith (2014), Baker et al. (2016), and Siganos et al. (2017), etc.

A second strand of literature examines the behavioral bias of managers, such as overconfidence, which has been repeatedly established in the literature. Roll (1986) was one of the first researchers to explicitly introduce overconfidence within the corporate finance context by explaining a particular form of overinvestment, that is, overpayment by acquiring other firms. Other related works include Myers and Majluf (1984), Heaton (2002), Fairchild (2005), Malmendier and Tate (2005), Ben-David et al. (2007), Bontempi and Golinelli (2012), Banerjee et al. (2013), Niu et al. (2017), and Garlappi et al. (2017), etc. Note that overconfident managers believe that they are acting benevolently toward shareholders. This leads to less disciplined activities such as overinvestment or costly external financing, which has a great influence on corporate policies, and is not limited to certain investments or payout channels.

Note that some researchers are more interested in disagreements between managers and outside investors. Because managers may have better information compared with outside investors about the firm (i.e., information asymmetry) and may invest excess cash in unprofitable projects rather than pay it back to shareholders (i.e., moral hazard), their disagreement will definitely have an effect on a firms' financial policies (see, for example, Bigus, 2003; Gugler, 2003; Dittmar and Thakor, 2007; Lee, 2009; Shibata and Nishihara, 2010; Thanatawee, 2011; Morellec and Schürhoff, 2011; Yang, 2013; Delaney and Thijssen, 2015, etc.).

Other related studies are as follows. Berkovitch and Kim (1990) investigated effects of seniority rules and restrictive dividend covenants on over- and under-investment incentives, which are associated with risky debt. Holt (2003) utilized a real options framework to explain how investment and payout decisions interacted over time when irreversibility and financial constraints were jointly bound. Childs et al. (2005) developed and analyzed a dynamic model of a firm's investment and financing decisions within a setting that had stockholder–bondholder conflicts over investment policy. Similarly, Richardson (2006) examined corporate overinvestment activities. Huang and Thakor (2013) proposed a novel explanation on why firms should conduct open-market and privately-negotiated stock repurchases, for which they identified supporting empirical evidence. Sloan and You (2015) quantified the magnitude of wealth transfers via equity issuance and analyzed their implications. They identified that, on average, such wealth transfers are ~40% of the net income, that these wealth transfers could be predicted using various characteristics of a firm, and that future wealth transfers are an important determinant for current stock prices. Munoz et al. (2016) proposed a novel two-phase bounding and decomposition approach for computing optimal and

near-optimal solutions for large-scale mixed-integer investment planning problems.

To our knowledge, there is very less amount of research that has focused on the effects of heterogeneous prior beliefs among managers and investors for corporate investment and payout policies. Our study contributes to the extant literature by considering both heterogeneous prior beliefs among investors as well as those between managers and investors. Moreover, we extend the existing model by including firms' financing, investment, and payout policies to establish a rational expectation equilibrium framework. In fact, our study provides several important implications. Unlike Bayar et al.'s (2013) results, we demonstrate that if heterogeneous beliefs exceed a certain level (i.e., higher information asymmetry or cognitive bias), managers will have a tendency to overinvest, whereas if such heterogeneous beliefs are lower than a threshold, managers will underinvest. Another interesting result is that there is a positive relation between price bubbles and level of overinvestment. Finally, we observe that optimal financing choices of firms and payout policies are different in various cases.

The rest of this paper proceeds as follows. Section 2 develops a theoretical framework for further analysis. Section 3 describes the investment and payout policies for heterogeneous prior beliefs without external financing. Section 4 discusses the investment and payout policies with debt or equity financing. The conclusion is presented in Section 5.

2. Basic assumptions

We assume that a firm's net cash flow realized at time t is X_t; the share price is P_t; and the new investment is Π_t. New investment has two components: (1) the required investment expenditure to maintain assets in place and the expected investment expenditure in new positive net present value projects, denoted by I_t. (2) The overinvestment or underinvestment level, denoted by δ_t, i.e., $\Pi_t = I_t + \delta_t$. Note that all the participants are risk neutral.

Similar to Miller and Rock (1985), we assume that the evolution of the firm's earnings stream X_t is described as $X_t = F(\Pi_{t-1}) + \varepsilon_t$, $X_{t+1} = F(\Pi_t) + \varepsilon_{t+1}$, where $E(\varepsilon_t) = 0$, $E(\varepsilon_{t+1} | \varepsilon_t) = \theta\varepsilon_t$, $F(\Pi_t) \geqslant 0$, $F(0) = 0$, $F'(\Pi_t) > 0$, $F''(\Pi_t) < 0$, and the rate of return is r_t.

If only heterogeneous beliefs exist between the manager and outside investors, we assume the firm's equity financing with total shares N_t at time t, among which the manager's shareholding is $\alpha_t N_t$, without any moral hazard, and the outside shareholders hold $(1-\alpha_t)N_t$. Both their heterogeneous beliefs are reflected in the form of investment functions, that is, $F^M(\Pi_t) = a\ln(\Pi_t + 1)$, $F^I(\Pi_t) = (a + d_t)\ln(\Pi_t + 1)$.

If heterogeneous beliefs exist between the manager and outside investors, and among outside investors, we assume the firm's equity financing with total shares N_t at time t, among which the manager's shareholding is $\alpha_t N_t$, without moral hazard; the outside optimistic shareholders hold $\beta_t N_t$ and the pessimistic investors hold $(1-\alpha_t-\beta_t)N_t$. Moreover, their heterogeneous beliefs are reflected in the form of investment functions, that is, $F^M(\Pi_t) = a\ln(\Pi_t + 1)$, $F^O(\Pi_t) = (a + d_t)\ln(\Pi_t + 1)$, and $F^P(\Pi_t) = (a - d_t)\ln(\Pi_t + 1)$, respectively.

Based on the settings provided by Fama and French (2012), we assume the firm determines to pay cash dividend to or repurchase stock from D_t (its shareholders) after satisfying the necessary investment. When

the net cash flow X_t is insufficient for the necessary investment I_t, the firm has to rely on external financing F_t, i.e., $X_t + F_t = \Pi_t + D_t$ when $X_t < I_t$. We will now discuss the following four types of situations: debt financing, equity financing, cash dividend, and stock repurchase.

3. Investment and payout policies without external financing

When there is no external financing, i.e., the net cash flow is sufficient for necessary investment, i.e., $X_t > I_t$, $F_t = 0$, $X_t = \Pi_t + D_t$, we provide solutions for investment and payout policies along with cash dividends and stock repurchase, respectively.

3.1. Firm's investment level with cash dividend

3.1.1. Heterogeneous beliefs between manager and outside investors

Manager's and outside investors' estimations of the value of the firm are $V_t^M = X_t - \Pi_t + \left[F^M(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$ and $V_t^I = X_t - \Pi_t + \left[F^I(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, respectively. Since managers have no moral hazard and their target is wealth maximization of shareholders, a simple social welfare function is appropriate for objective functions, i.e., attaching weights to each group's interests in proportion to the values of their holdings, which can be written as follows:

$$\max E(V_t) = \alpha_t E(V_t^M) + (1-\alpha_t) E(V_t^I) = X_t - \Pi_t + \frac{\left[\alpha_t a + (1-\alpha_t)(a+d_t)\right]}{(1+r_t)} \ln(\Pi_t + 1),$$

subject to $X_t = \Pi_t + D_t$.

The first-order condition for the abovementioned maximization problem with respect to Π_t for a given X_t is $\frac{\partial E(V_t)}{\partial \Pi_t} = -1 + \frac{\left[\alpha_t a + (1-\alpha_t)(a+d_t)\right]}{(\Pi_t+1)(1+r_t)} = 0$, i.e., $\frac{\left[\alpha_t a + (1-\alpha_t)(a+d_t)\right]}{(\Pi_t+1)(1+r_t)} = 1$. Thus, the over- or underinvestment level is obtained as $\delta_t^* = \frac{\left[a + (1-\alpha_t) d_t\right]}{(1+r_t)} - (I_t + 1)$. Then, we have the following results.

Proposition 1. (1) *If* $a + (1-\alpha_t) d_t > (I_t+1)(1+r_t)$, *i.e.,* $d_t > \frac{(I_t+1)(1+r_t) - a}{(1-\alpha_t)}$, *then* $\delta_t^* > 0$. *This indicates that if heterogeneous beliefs between managers and investors exceed a certain level, a firm will have a tendency toward overinvestment.* (2) *If* $a + (1-\alpha_t) d_t < (I_t+1)(1+r_t)$, *i.e.,* $d_t < \frac{(I_t+1)(1+r_t) - a}{(1-\alpha_t)}$, *then* $\delta_t^* < 0$. *This indicates that if heterogeneous beliefs between managers and investors are lower than that certain level, firms will have a tendency toward underinvestment.* (3) δ_t^* *has a positive relationship with* d_t, *which indicates that if participants are more optimistic, then the greater the dispersion of beliefs between managers and outside investors, the higher is the level of overinvestment.*

Furthermore, share prices estimated by two participants are $P_t^M = \frac{E(V_t^M)}{N_t}$ and $P_t^I = \frac{E(V_t^I)}{N_t}$ and a

price bubble can be written as $B_t = P_t^I - P_t^M = \frac{d_t \ln(\Pi_t + 1)}{N_t(1+r_t)}$. Therefore, $\frac{\partial B_t}{\partial \Pi_t} = \frac{\partial B_t}{\partial \delta_t} = \frac{d_t}{N_t(1+r_t)(I_t+\delta_t+1)}$. From this information, we can obtain Proposition 2.

Proposition 2. *If d_t is positive, i.e., outside investors are more optimistic, then the price bubble has a positive relationship with overinvestment and vice versa.*

Moreover, we can describe the expected value of the firm, i.e.,

$$E(V_t) = \alpha_t E(V_t^M) + (1-\alpha_t) E(V_t^I) = X_t + 1 + \frac{[a+(1-\alpha_t)d_t]}{(1+r_t)} \ln \frac{[a+(1-\alpha_t)d_t]}{e(1+r_t)} \tag{1}$$

Propositions 1 and 2 indicate that when investors' sentiments toward the security market are more optimistic, share prices are more likely to be overvalued; thus, managers tend to take advantage of such situations and promote investments.

3.1.2. Heterogeneous beliefs between manager and outside investors, and among outside investors

When heterogeneous beliefs exist between managers and outside investors and among outside investors, as shown in the calculation process in Appendix A, we obtain an over- or under-investment level which is $\delta_t^* = \frac{[a+(\alpha_t+2\beta_t-1)d_t]}{(1+r_t)} - (I_t+1)$. Thus, we get Proposition 3.

Proposition 3. (1) *If $a+(\alpha_t+2\beta_t-1)d_t > (I_t+1)(1+r_t)$, i.e., $d_t > \frac{(I_t+1)(1+r_t)-a}{(\alpha_t+2\beta_t-1)}$, then $\delta_t^* > 0$. This indicates that if heterogeneous beliefs between managers and investors exceed a certain level, firms will have a tendency toward overinvestment.* (2) *If $a+(\alpha_t+2\beta_t-1)d_t < (I_t+1)(1+r_t)$, i.e., $d_t < \frac{(I_t+1)(1+r_t)-a}{(\alpha_t+2\beta_t-1)}$, then $\delta_t^* < 0$. This indicates that if heterogeneous beliefs between managers and investors are lower than this level, firms will have a tendency toward underinvestment.* (3) *If $\alpha_t + 2\beta_t > 1$, δ_t^* has a positive relationship with d_t; while if $\alpha_t + 2\beta_t < 1$, δ_t^* has a negative relationship with d_t.*

Proposition 3 demonstrates that if more optimistic investors exist in the market, the possibility of overinvestment can increase.

For such cases, the expected value of a firm can be defined as follows:

$$E(V_t) = \alpha_t E(V_t^M) + \beta_t E(V_t^O) + (1-\alpha_t-\beta_t) E(V_t^P) = X_t + 1 + \frac{[a+(\alpha_t+2\beta_t-1)d_t]}{(1+r_t)} \ln \frac{[a+(\alpha_t+2\beta_t-1)d_t]}{e(1+r_t)} \tag{2}$$

3.2. Firm's investment level with stock repurchase

We assume that the firm decides to repurchase stocks from outside investors using an amount D_t after satisfying the necessary investment rather than paying cash-based dividend to its shareholders. Note that $X_t = \Pi_t + D_t$ still holds.

3.2.1. Heterogeneous beliefs between the manager and outside investors

Based on most recent research results, a firm will select to repurchase stocks if market prices of shares are lower than their fundamental value. Based on this assumption, if we assume here that firms decide to repurchase shares $b_t N_t$ with price P_t from outside investors, then $D_t = b_t N_t P_t$, i.e., the manager's shareholding is $(\alpha_t + b_t)N_t$, and outside shareholders hold $(1-\alpha_t - b_t)N_t$ and $1-\alpha_t > b_t$. Thus, the investment functions of managers and investors are $F^M(\Pi_t) = a\ln(\Pi_t + 1)$ and $F^I(\Pi_t) = (a + d_t)\ln(\Pi_t + 1)$, respectively. As shown in Appendix B, the over- or underinvestment level is $\delta_t^* = \frac{\left[a + (1-\alpha_t - b_t)d_t\right]}{(1+r_t)} - (I_t + 1)$. Then, we can get the following results.

Proposition 4. (1) *If* $a + (1-\alpha_t - b_t)d_t > (I_t + 1)(1+r_t)$, *i.e.,* $d_t > \frac{(I_t+1)(1+r_t) - a}{(1-\alpha_t - b_t)}$, *then* $\delta_t^* > 0$. *This indicates that if heterogeneous beliefs between managers and investors exceed a certain level, firms will have a tendency toward overinvestment.* (2) *If* $a + (1-\alpha_t - b_t)d_t < (I_t + 1)(1+r_t)$, *i.e.,* $d_t < \frac{(I_t+1)(1+r_t) - a}{(1-\alpha_t - b_t)}$, *then* $\delta_t^* < 0$. *This indicates that if heterogeneous beliefs between managers and investors are lower than a specific level, firms will have a tendency toward underinvestment.* (3) δ_t^* *has a positive relationship with* d_t, *which indicates that if participants are more optimistic, the greater the dispersion of beliefs between managers and outside investors, the higher is the level of overinvestment.*

Thus, the expected value of the firm is as follows:

$$E(V_t) = (\alpha_t + b_t)E(V_t^M) + (1-\alpha_t - b_t)E(V_t^I) = X_t + 1 + \frac{\left[a + (1-\alpha_t - b_t)d_t\right]}{(1+r_t)}\ln\frac{\left[a + (1-\alpha_t - b_t)d_t\right]}{e(1+r_t)} \tag{3}$$

When considering equations (3) and (1), we have

$$\Delta E(V_t) = \frac{\left[a + (1-\alpha_t - b_t)d_t\right]}{(1+r_t)}\ln\frac{\left[a + (1-\alpha_t - b_t)d_t\right]}{e(1+r_t)} - \frac{\left[a + (1-\alpha_t)d_t\right]}{(1+r_t)}\ln\frac{\left[a + (1-\alpha_t)d_t\right]}{e(1+r_t)}.$$

Thus, it is easy to get the following result.

Proposition 5. *If* $d_t > 0$, *then* $\Delta E(V_t) < 0$, *which indicates that a cash dividend is better than stock repurchase. However, if* $d_t < 0$, *then* $\Delta E(V_t) > 0$, *which indicates that stock repurchase is better than the cash dividend.*

Propositions 4 and 5 demonstrate that in a rising security market, which has more optimistic investors that disagree with each other, a firm's investment may not be efficient enough for excessive cash flow to be a viable payout method for investors.

3.2.2. Heterogeneous beliefs among outside investors, and between manager and outside investors

Share repurchase from optimistic outside investors: We assume that firms decide to repurchase shares $b_t N_t$ with price P_t from optimistic investors, which indicates that prices are lower than that estimated by optimistic investors and higher than that estimated by pessimistic investors.

Then, $D_t = b_t N_t P_t$, i.e., the manager's shareholding is $(\alpha_t + b_t)N_t$, and outside optimistic shareholders hold $(\beta_t - b_t)N_t$, $b_t < \beta_t$, while pessimistic investors hold $(1-\alpha_t-\beta_t)N_t$. Note that their heterogeneous beliefs are reflected in the form of investment functions, i.e., $F^M(\Pi_t) = a\ln(\Pi_t+1)$, $F^O(\Pi_t) = (a+d_t)\ln(\Pi_t+1)$, and $F^P(\Pi_t) = (a-d_t)\ln(\Pi_t+1)$, respectively. In that case, we obtain the over- or underinvestment level $\delta_t^* = \frac{\left[a+(\alpha_t+2\beta_t-b_t-1)d_t\right]}{(1+r_t)} - (I_t+1)$, the calculations of which can be seen in Appendix C. Thus, we have Proposition 6.

Proposition 6. (1) *If* $a+(\alpha_t+2\beta_t-b_t-1)d_t > (I_t+1)(1+r_t)$, *i.e.,* $d_t > \frac{(I_t+1)(1+r_t)-a}{(\alpha_t+2\beta_t-b_t-1)}$, *then* $\delta_t^* > 0$. *This indicates that if heterogeneous beliefs between managers and investors exceed a certain threshold, firms will have a tendency toward overinvestment.* (2) *If* $a+(\alpha_t+2\beta_t-b_t-1)d_t < (I_t+1)(1+r_t)$, *i.e.,* $d_t < \frac{(I_t+1)(1+r_t)-a}{(\alpha_t+2\beta_t-b_t-1)}$, *then* $\delta_t^* < 0$. *This indicates that if heterogeneous beliefs between managers and investors are lower than this threshold, firms will have a tendency towards underinvestment.* (3) *If* $\alpha_t+2\beta_t-b_t>1$, *then* δ_t^* *has a positive relationship with* d_t; *however, if* $\alpha_t+2\beta_t-b_t<1$, *then* δ_t^* *has a negative relationship with* d_t. (4) *If* d_t *is positive and outside optimistic investors are more optimistic, then the higher the proportion of share repurchases, the lower is the level of overinvestment, and vice versa.*

Thus, the expected value of the firm is as follows:

$$E(V_t) = X_t + 1 + \frac{\left[a+(\alpha_t+2\beta_t-b_t-1)d_t\right]}{(1+r_t)}\ln\frac{\left[a+(\alpha_t+2\beta_t-b_t-1)d_t\right]}{e(1+r_t)} \tag{4}$$

When considering equations (4) and (2), we have

$$\Delta E(V_t) = \frac{\left[a+(\alpha_t+2\beta_t-b_t-1)d_t\right]}{(1+r_t)}\ln\frac{\left[a+(\alpha_t+2\beta_t-b_t-1)d_t\right]}{e(1+r_t)} - \frac{\left[a+(\alpha_t+2\beta_t-1)d_t\right]}{(1+r_t)}\ln\frac{\left[a+(\alpha_t+2\beta_t-1)d_t\right]}{e(1+r_t)}$$

Therefore, we can obtain Proposition 7.

Proposition 7. *If* $d_t>0$, *then* $\Delta E(V_t)<0$, *which indicates that cash dividend is better than stock repurchase. However, if* $d_t<0$, *then* $\Delta E(V_t)>0$, *which indicates that stock repurchase is better than cash dividend.*

Share repurchase from pessimistic outside investors: We assume that a firm decides to repurchase shares $b_t N_t$ at price P_t from pessimistic investors, which indicates that the price is significantly lower than that estimated by pessimistic investors. For such cases, $D_t = b_t N_t P_t$, i.e., the manager's shareholding, is $(\alpha_t+b_t)N_t$; moreover, outside optimistic shareholders hold $\beta_t N_t$, while pessimistic investors hold $(1-\alpha_t-\beta_t-b_t)N_t$, where $1-\alpha_t-\beta_t>b_t$. The heterogeneous beliefs of optimistic and pessimistic investors are reflected in the form of investment functions, which are $F^M(\Pi_t) = a\ln(\Pi_t+1)$, $F^O(\Pi_t) = (a+d_t)\ln(\Pi_t+1)$, and $F^P(\Pi_t) = (a-d_t)\ln(\Pi_t+1)$, respectively. As shown in Appendix D, the over- or underinvestment level is $\delta_t^* = \frac{\left[a+(\alpha_t+2\beta_t+b_t-1)d_t\right]}{(1+r_t)} - (I_t+1)$. Following this, we have Proposition 8.

Proposition 8. (1) *If* $a+(\alpha_t+2\beta_t+b_t-1)d_t>(I_t+1)(1+r_t)$, *i.e.,* $d_t>\frac{(I_t+1)(1+r_t)-a}{(\alpha_t+2\beta_t+b_t-1)}$, *then* $\delta_t^*>0$. *This indicates that if heterogeneous beliefs between managers and investors exceed a certain threshold, a firm will have a tendency to overinvest.* (2) *If* $a+(\alpha_t+2\beta_t+b_t-1)d_t<(I_t+1)(1+r_t)$, *i.e.,* $d_t<\frac{(I_t+1)(1+r_t)-a}{(\alpha_t+2\beta_t+b_t-1)}$, *then* $\delta_t^*<0$. *This indicates that if heterogeneous beliefs between managers and investors are lower than this level, a firm will have a tendency to underinvest.* (3) *If* $\alpha_t+2\beta_t+b_t>1$, *then* δ_t^* *has a positive relationship with* d_t, *while if* $\alpha_t+2\beta_t+b_t<1$, *then* δ_t^* *has a negative relationship with* d_t. (4) *If* d_t *is positive and the outside optimistic investors are more optimistic, then the higher the proportion of share repurchases, the higher the level of overinvestment, and vice versa.*

Thus, the expected value of a firm can be calculated as follows:

$$E(V_t)=X_t+1+\frac{\left[a+(\alpha_t+2\beta_t+b_t-1)d_t\right]}{(1+r_t)}\ln\frac{\left[a+(\alpha_t+2\beta_t+b_t-1)d_t\right]}{e(1+r_t)} \tag{5}$$

When considering equations (5) and (2), we have

$$\Delta E(V_t)=\frac{\left[a+(\alpha_t+2\beta_t+b_t-1)d_t\right]}{(1+r_t)}\ln\frac{\left[a+(\alpha_t+2\beta_t+b_t-1)d_t\right]}{e(1+r_t)}-\frac{\left[a+(\alpha_t+2\beta_t-1)d_t\right]}{(1+r_t)}\ln\frac{\left[a+(\alpha_t+2\beta_t-1)d_t\right]}{e(1+r_t)}.$$

Thus, we can have Proposition 9.

Proposition 9. *If* $d_t>0$, *then* $\Delta E(V_t)>0$, *which implies that stock repurchase is better than cash dividend. In contrast, if* $d_t<0$, *then* $\Delta E(V_t)<0$, *which implies that cash dividend is better than stock repurchase.*

Note that Proposition 6 to Proposition 9 lead to certain additional implications, i.e., in a downward security market condition having additional pessimistic investors, managers could reduce the investment level and a cash dividend could be a better payout approach compared to stock repurchases.

If we combine the circumstances discussed in Section 3, it can be identified that without external financing (i.e., if a firm has enough cash flow), when there are higher heterogeneous beliefs and more optimistic investors, share prices will become higher, managers may prefer cash dividends, and they will also have a tendency to overinvest.

4. Investment and payout policies with external financing

Assume that the net cash flow X_t is not sufficient for the necessary investment I_t; therefore, the firm has to rely on external financing F_t, i.e., $X_t<I_t$ and $X_t+F_t=\Pi_t+D_t$. We will now discuss the following four types of situations: debt financing, equity financing, cash dividend, and stock repurchases.

4.1. Firm's investment level with debt financing and cash dividend

We assume that all the F_t is acquired via loans from banks or by issuing bonds, and that the principal

and interest will be returned to debtors at the end of a certain period.

4.1.1. Heterogeneous beliefs between the manager and outside investors

As shown in Appendix E, the over- or underinvestment level is $\delta_t^* = \frac{\left[a+(1-\alpha_t)d_t\right]}{(1+r_t)} - (I_t+1)$. This leads to Proposition 10.

Proposition 10. (1) *If* $a+(1-\alpha_t)d_t > (I_t+1)(1+r_t)$, *i.e.,* $d_t > \frac{(I_t+1)(1+r_t)-a}{(1-\alpha_t)}$, *then* $\delta_t^* > 0$. *This indicates that if heterogeneous beliefs between managers and investors exceed a certain level, firms will have a tendency to overinvest.* (2) *If* $a+(1-\alpha_t)d_t < (I_t+1)(1+r_t)$, *i.e.,* $d_t < \frac{(I_t+1)(1+r_t)-a}{(1-\alpha_t)}$, *then* $\delta_t^* < 0$. *This indicates that if heterogeneous beliefs between managers and investors are lower than a certain level, firms will have a tendency to underinvest.* (3) δ_t^* *has a positive relationship with* d_t, *which indicates that if participants are more optimistic, then the greater the dispersion of beliefs between managers and outside investors, the higher the level of overinvestment.*

Furthermore, the share prices estimated by two participants are $P_t^M = \frac{E(V_t^M)}{N_t}$ and $P_t^I = \frac{E(V_t^I)}{N_t}$. The price bubble is $B_t = P_t^I - P_t^M = \frac{d_t \ln(\Pi_t+1)}{N_t(1+r_t)}$. Thus, $\frac{\partial B_t}{\partial \Pi_t} = \frac{\partial B_t}{\partial \delta_t} = \frac{d_t}{N_t(1+r_t)(I_t+\delta_t+1)}$. From this information, we can obtain Proposition 11.

Proposition 11. *If* d_t *is positive, i.e., outside investors are more optimistic, then the price bubble has a positive relationship with the level of overinvestment, and vice versa.*

The implications of Proposition 10 and Proposition 11 are consistent with results obtained by Proposition 1 and Proposition 2 under conditions of debt financing and cash dividends.

The expected value of the firm is

$$E(V_t) = \alpha_t E(V_t^M) + (1-\alpha_t)E(V_t^I) = X_t + F_t + 1 + \frac{\left[a+(1-\alpha_t)d_t\right]}{(1+r_t)} \ln \frac{\left[a+(1-\alpha_t)d_t\right]}{e(1+r_t)} \tag{6}$$

4.1.2. Heterogeneous beliefs among outside investors, and between manager and outside investors

As shown in Appendix F, the over- or underinvestment level is $\delta_t^* = \frac{\left[a+(\alpha_t+2\beta_t-1)d_t\right]}{(1+r_t)} - (I_t+1)$. This leads to Proposition 12.

Proposition 12. (1) *If* $a+(\alpha_t+2\beta_t-1)d_t > (I_t+1)(1+r_t)$, *i.e.,* $d_t > \frac{(I_t+1)(1+r_t)-a}{(\alpha_t+2\beta_t-1)}$, *then* $\delta_t^* > 0$. *This indicates that if heterogeneous beliefs between managers and investors exceed a certain level, firms will have a tendency to overinvest.* (2) *If* $a+(\alpha_t+2\beta_t-1)d_t < (I_t+1)(1+r_t)$, *i.e.,* $d_t < \frac{(I_t+1)(1+r_t)-a}{(\alpha_t+2\beta_t-1)}$, *then* $\delta_t^* < 0$. *This indicates that if heterogeneous beliefs between managers and the investors are lower than a certain level, firms will have a tendency to underinvest.* (3) *If* $\alpha_t+2\beta_t > 1$, *then* δ_t^* *has positive relationship with* d_t. *In contrast, if* $\alpha_t+2\beta_t < 1$,

then δ_t^* *has a negative relationship with* d_t.

Interestingly, the results of Proposition 12 are similar to those obtained by Proposition 3 under conditions of debt financing and cash dividend.

The expected value of the firm is

$$E(V_t) = X_t + F_t + 1 + \frac{\left[a + (\alpha_t + 2\beta_t - 1)d_t\right]}{(1+r_t)} \ln \frac{\left[a + (\alpha_t + 2\beta_t - 1)d_t\right]}{e(1+r_t)} \tag{7}$$

4.2. Firm's investment level with debt financing and stock repurchase

We assume that the firm decides to repurchase stocks from outside investors using the amount D_t after satisfying necessary investment requirements rather than paying cash dividend to its shareholders, i.e., $X_t + F_t = \prod_t + D_t$.

4.2.1. Heterogeneous beliefs between manager and outside investors

Similar to the calculations in section 3.2.1 and as shown in Appendix G, the over- or underinvestment level is $\delta_t^* = \frac{\left[a + (1-\alpha_t - b_t)d_t\right]}{(1+r_t)} - (I_t + 1)$. This leads to Proposition 13.

Proposition 13. (1) *If* $a + (1-\alpha_t - b_t)d_t > (I_t + 1)(1+r_t)$, *i.e.,* $d_t > \frac{(I_t+1)(1+r_t) - a}{(1-\alpha_t - b_t)}$, *then* $\delta_t^* > 0$. *This indicates that if heterogeneous beliefs between managers and investors exceed a certain level, firms will have a tendency to overinvest.* (2) *If* $a + (1-\alpha_t - b_t)d_t < (I_t + 1)(1+r_t)$, *i.e.,* $d_t < \frac{(I_t+1)(1+r_t) - a}{(1-\alpha_t - b_t)}$, *then* $\delta_t^* < 0$.*This indicates that if heterogeneous beliefs between managers and investors are lower than a certain level, firms will have a tendency to underinvest.* (3) δ_t^* *has a positive relationship with* d_t, *which indicates that if participants are more optimistic, then the greater the dispersion of beliefs between managers and outside investors, the higher the level of overinvestment.* (4) *If* d_t *is positive and outside investors are more optimistic, then the higher the proportion of share repurchases, the lower the level of overinvestment, and vice versa.*

The expected value of the firm is

$$E(V_t) = X_t + F_t + 1 + \frac{\left[a + (1-\alpha_t - b_t)d_t\right]}{(1+r_t)} \ln \frac{\left[a + (1-\alpha_t - b_t)d_t\right]}{e(1+r_t)} \tag{8}$$

When considering equations (8) and (6), we obtain

$$\Delta E(V_t) = \frac{\left[a + (1-\alpha_t - b_t)d_t\right]}{(1+r_t)} \ln \frac{\left[a + (1-\alpha_t - b_t)d_t\right]}{e(1+r_t)} - \frac{\left[a + (1-\alpha_t)d_t\right]}{(1+r_t)} \ln \frac{\left[a + (1-\alpha_t)d_t\right]}{e(1+r_t)}.$$

Therefore, it is easy to get Proposition 14.

Proposition 14. *If* $d_t > 0$, *then* $\Delta E(V_t) < 0$, *which implies that cash dividend is better than stock repurchase.*

In contrast, if $d_t < 0$, *then* $\Delta E(V_t) > 0$, *which implies that stock repurchase is better than cash dividend.*

We can see that the results of Proposition 13 and Proposition 14 are similar to those obtained for Proposition 4 and Proposition 5 under conditions of debt financing and stock repurchases.

4.2.2. Heterogeneous beliefs among outside investors, and between the manager and outside investors

Share repurchase from optimistic outside investors: Similar to the description in section 3.2.2 and as shown in Appendix H, the over- or underinvestment level is $\delta_t^* = \frac{\left[a + (\alpha_t + 2\beta_t - b_t - 1)d_t\right]}{(1+r_t)} - (I_t + 1)$. This leads to Proposition 15.

Proposition 15. (1) *If* $a + (\alpha_t + 2\beta_t - b_t - 1)d_t > (I_t + 1)(1 + r_t)$, *i.e.,* $d_t > \frac{(I_t + 1)(1 + r_t) - a}{(\alpha_t + 2\beta_t - b_t - 1)}$, *then* $\delta_t^* > 0$. *This indicates that if heterogeneous beliefs between managers and investors exceed a certain level, firms will have a tendency to overinvest.* (2) *If* $a + (\alpha_t + 2\beta_t - b_t - 1)d_t < (I_t + 1)(1 + r_t)$, *i.e.,* $d_t < \frac{(I_t + 1)(1 + r_t) - a}{(\alpha_t + 2\beta_t - b_t - 1)}$, *then* $\delta_t^* < 0$. *This indicates that if heterogeneous beliefs between managers and investors are lower than a certain level, firms will have a tendency to underinvest.* (3) *If* $\alpha_t + 2\beta_t - b_t > 1$, *then* δ_t^* *has a positive relationship with* d_t, *while if* $\alpha_t + 2\beta_t - b_t < 1$, *then* δ_t^* *has a negative relationship with* d_t. (4) *If* d_t *is positive and outside optimistic investors are more optimistic, then the higher the proportion of share repurchases, the lower the level of overinvestment, and vice versa.*

The expected value of the firm is

$$E(V_t) = X_t + F_t + 1 + \frac{\left[a + (\alpha_t + 2\beta_t - b_t - 1)d_t\right]}{(1+r_t)} \ln \frac{\left[a + (\alpha_t + 2\beta_t - b_t - 1)d_t\right]}{e(1+r_t)} \tag{9}$$

When considering equations (9) and (7), we obtain

$$\Delta E(V_t) = \frac{\left[a + (\alpha_t + 2\beta_t - b_t - 1)d_t\right]}{(1+r_t)} \ln \frac{\left[a + (\alpha_t + 2\beta_t - b_t - 1)d_t\right]}{e(1+r_t)} - \frac{\left[a + (\alpha_t + 2\beta_t - 1)d_t\right]}{(1+r_t)} \ln \frac{\left[a + (\alpha_t + 2\beta_t - 1)d_t\right]}{e(1+r_t)}$$

Then, we have Proposition 16.

Proposition 16. *If* $d_t > 0$, *then* $\Delta E(V_t) < 0$, *which implies that cash dividend is better than stock repurchase. In contrast, if* $d_t < 0$, *then* $\Delta E(V_t) > 0$, *which implies that stock repurchase is better than cash dividend.*

We can see that the results of Proposition 15 and Proposition 16 are very close to those obtained for Proposition 6 and Proposition 7 under conditions of debt financing and stock repurchase from optimistic investors.

Share repurchase from pessimistic outside investors: Similar to the description in section 3.2.2 and as shown in Appendix I, the over- or underinvestment level is $\delta_t^* = \frac{\left[a + (\alpha_t + 2\beta_t + b_t - 1)d_t\right]}{(1+r_t)} - (I_t + 1)$. This leads to Proposition 17.

Proposition 17. (1) *If* $a + (\alpha_t + 2\beta_t + b_t - 1)d_t > (I_t + 1)(1 + r_t)$, *i.e.,* $d_t > \frac{(I_t + 1)(1 + r_t) - a}{(\alpha_t + 2\beta_t + b_t - 1)}$, *then* $\delta_t^* > 0$.

This indicates that if heterogeneous beliefs between managers and investors exceed a certain level, firms will have a tendency to overinvest. (2) *If* $a+(\alpha_t+2\beta_t+b_t-1)d_t<(I_t+1)(1+r_t)$, *i.e.,* $d_t<\frac{(I_t+1)(1+r_t)-a}{(\alpha_t+2\beta_t+b_t-1)}$, *then* $\delta_t^*<0$. *This indicates that if heterogeneous beliefs between managers and investors are lower than a certain level, firms will have a tendency to underinvest.* (3) *If* $\alpha_t+2\beta_t+b_t>1$, *then* δ_t^* *has a positive relationship with* d_t, *while if* $\alpha_t+2\beta_t+b_t<1$, *then* δ_t^* *has a negative relationship with* d_t. (4) *If* d_t *is positive and outside optimistic investors are more optimistic, then the higher the proportion of share repurchases, the higher the level of overinvestment, and vice versa.*

The expected value of the firm is

$$E(V_t)=X_t+F_t+1+\frac{\left[a+(\alpha_t+2\beta_t+b_t-1)d_t\right]}{(1+r_t)}\ln\frac{\left[a+(\alpha_t+2\beta_t+b_t-1)d_t\right]}{e(1+r_t)} \tag{10}$$

When considering equations (10) and (7), we obtain

$$\Delta E(V_t)=\frac{\left[a+(\alpha_t+2\beta_t+b_t-1)d_t\right]}{(1+r_t)}\ln\frac{\left[a+(\alpha_t+2\beta_t+b_t-1)d_t\right]}{e(1+r_t)}-\frac{\left[a+(\alpha_t+2\beta_t-1)d_t\right]}{(1+r_t)}\ln\frac{\left[a+(\alpha_t+2\beta_t-1)d_t\right]}{e(1+r_t)}$$

From this information, we can obtain Proposition 18.

Proposition 18. *If* $d_t>0$, *then* $\Delta E(V_t)>0$, *which implies that stock repurchase is better than cash dividend. In contrast, if* $d_t<0$, *then* $\Delta E(V_t)<0$, *which implies that cash dividend is better than stock repurchase.*

The results of Proposition 17 and Proposition 18 are consistent with those obtained for Proposition 8 and Proposition 9 under conditions of debt financing and stock repurchases from pessimistic investors.

4.3. Firm's investment level with equity financing and cash dividend

We assume that the firm decides to pay cash dividend D_t to its shareholders after satisfying the necessary investment requirements, i.e., $X_t+F_t=\Pi_t+D_t$.

4.3.1. Heterogeneous beliefs between manager and outside investors

Based on the most recent research results, a firm will select equity issuance if the market price of shares is higher than its fundamental value. Based on this assumption, we assume that the firm decides to issue new shares n_tN_t with price P_t to outside investors. In that case, $F_t=n_tN_tP_t$, the manager's shareholding is $\frac{\alpha_t}{1+n_t}N_t$, and outside shareholders hold $\frac{1-\alpha_t+n_t}{1+n_t}N_t$. The investment functions of the manager and the investors are $F^M(\Pi_t)=a\ln(\Pi_t+1)$ and $F^I(\Pi_t)=(a+d_t)\ln(\Pi_t+1)$, respectively. As shown in Appendix J, the over- or underinvestment level is $\delta_t^*=\frac{a}{(1+r_t)}+\frac{(1+n_t-\alpha_t)d_t}{(1+n_t)(1+r_t)}-(I_t+1)$. This leads to Proposition 19.

Proposition 19. (1) *If* $a(1+n_t)+(1+n_t-\alpha_t)d_t>(I_t+1)(1+n_t)(1+r_t)$, *i.e.,* $d_t>\frac{\left[(I_t+1)(1+r_t)-a\right](1+n_t)}{(1+n_t-\alpha_t)}$, *then* $\delta_t^*>0$. *This indicates that if heterogeneous beliefs between managers and investors exceed a certain level, firms will have*

a tendency to overinvest. (2) *If* $a(1+n_t)+(1+n_t-\alpha_t)d_t<(I_t+1)(1+n_t)(1+r_t)$, *i.e.,* $d_t<\frac{[(I_t+1)(1+r_t)-a](1+n_t)}{(1+n_t-\alpha_t)}$, *then* $\delta_t^*<0$. *This indicates that if heterogeneous beliefs between managers and investors are lower than a certain level, firms will have a tendency to underinvest.* (3) δ_t^* *has a positive relationship with* d_t, *which indicates that if participants are more optimistic, then the greater the dispersion of beliefs between managers and outside investors, the higher the level of overinvestment.* (4) *If* $d_t>0$, *then additional new shares are issued, and with additional financing amount* F_t, *the higher is the level of overinvestment.*

Besides, the share prices estimated by two participants are $P_t^M=\frac{E(V_t^M)}{(1+n_t)N_t}$ and $P_t^I=\frac{E(V_t^I)}{(1+n_t)N_t}$, so the price bubble is $B_t=P_t^I-P_t^M=\frac{d_t\ln(\Pi_t+1)}{(1+n_t)N_t(1+r_t)}$, and therefore $\frac{\partial B_t}{\partial \Pi_t}=\frac{\partial B_t}{\partial \delta_t}=\frac{d_t}{(1+n_t)N_t(1+r_t)(I_t+\delta_t+1)}$. This leads to Proposition 20.

Proposition 20. *If* d_t *is positive, i.e., outside investors are more optimistic, then the price bubble has a positive relationship with the level of overinvestment, and vice versa.*

The expected value of the firm is

$$E(V_t)=X_t+F_t+1+\left[\frac{(a+d_t)(1+n_t)-\alpha_t d_t}{(1+n_t)(1+r_t)}\right]\ln\left[\frac{(a+d_t)(1+n_t)-\alpha_t d_t}{e(1+n_t)(1+r_t)}\right] \tag{11}$$

When considering equations (11) and (6), we obtain $\Delta E(V_t)=\left[\frac{a}{(1+r_t)}+\frac{(1+n_t-\alpha_t)d_t}{(1+n_t)(1+r_t)}\right]\ln\left[\frac{a}{e(1+r_t)}+\frac{(1+n_t-\alpha_t)d_t}{e(1+n_t)(1+r_t)}\right]-\frac{[a+(1-\alpha_t)d_t]}{(1+r_t)}\ln\frac{[a+(1-\alpha_t)d_t]}{e(1+r_t)}$ Further, we obtain Proposition 21.

Proposition 21. *If* $d_t>0$, *then* $\Delta E(V_t)>0$, *which implies that equity financing is better than debt financing. In contrast, if* $d_t<0$, *then* $\Delta E(V_t)<0$, *which implies that debt financing is better than equity financing.*

Thus, Proposition 19, Proposition 20, and Proposition 21 predict that in a security market with more optimistic investors, managers prefer equity financing and invest more, which is identical with the present research results.

4.3.2. Heterogeneous beliefs among outside investors, and between manager and outside investors

New equity issuance to optimistic outside investors: We assume that the firm decides to issue new shares n_tN_t with price P_t to outside investors; however, only optimistic investors buy the new shares, which means the price is higher than that estimated by pessimistic investors. Then, $F_t=n_tN_tP_t$, the manager's shareholding is $\frac{\alpha_t}{1+n_t}N_t$, and outside optimistic shareholders hold $\frac{\beta_t+n_t}{1+n_t}N_t$, while pessimistic investors hold $\frac{1-\alpha_t-\beta_t}{1+n_t}N_t$. Their heterogeneous beliefs are reflected in the form of investment functions $F^M(\Pi_t)=a\ln(\Pi_t+1)$, $F^O(\Pi_t)=(a+d_t)\ln(\Pi_t+1)$, and $F^P(\Pi_t)=(a-d_t)\ln(\Pi_t+1)$, respectively. As

shown in Appendix K, the over- or underinvestment level is $\delta_t^* = \frac{a}{(1+r_t)} + \frac{(\alpha_t + 2\beta_t + n_t - 1)d_t}{(1+n_t)(1+r_t)} - (I_t + 1)$. Accordingly, we obtain Proposition 22.

Proposition 22. (1) *If* $a(1+n_t) + (\alpha_t + 2\beta_t + n_t - 1)d_t > (I_t + 1)(1+n_t)(1+r_t)$, *i.e.,* $d_t > \frac{[(I_t+1)(1+r_t) - a](1+n_t)}{(\alpha_t + 2\beta_t + n_t - 1)}$, *then* $\delta_t^* > 0$. *This indicates that if heterogeneous beliefs between managers and investors exceed a certain level, firms will have a tendency to overinvest.* (2) *If* $a(1+n_t) + (\alpha_t + 2\beta_t + n_t - 1)d_t < (I_t + 1)(1+n_t)(1+r_t)$, *i.e.,* $d_t < \frac{[(I_t+1)(1+r_t) - a](1+n_t)}{(\alpha_t + 2\beta_t + n_t - 1)}$, *then* $\delta_t^* < 0$. *This indicates that if heterogeneous beliefs between managers and investors are lower than that level, firms will have a tendency to underinvest.* (3) *If* $\alpha_t + 2\beta_t + n_t > 1$, *then* δ_t^* *has a positive relationship with, while if* $\alpha_t + 2\beta_t + n_t < 1$, *then* δ_t^* *has a negative relationship with* d_t. (4) *If* $d_t > 0$, *additional new shares are issued, and with additional financing amount* F_t, *the overinvestment level is higher.*

The expected value of the firm is

$$E(V_t) = X_t + F_t + 1 + \left[\frac{a}{(1+r_t)} + \frac{(\alpha_t + 2\beta_t + n_t - 1)d_t}{(1+n_t)(1+r_t)}\right] \ln\left[\frac{a}{e(1+r_t)} + \frac{(\alpha_t + 2\beta_t + n_t - 1)d_t}{e(1+n_t)(1+r_t)}\right] \tag{12}$$

When considering equations (12) and (7), we obtain

$$\Delta E(V_t) = \left[\frac{a}{(1+r_t)} + \frac{(\alpha_t + 2\beta_t + n_t - 1)d_t}{(1+n_t)(1+r_t)}\right] \ln\left[\frac{a}{e(1+r_t)} + \frac{(\alpha_t + 2\beta_t + n_t - 1)d_t}{e(1+n_t)(1+r_t)}\right] - \frac{[a + (\alpha_t + 2\beta_t - 1)d_t]}{(1+r_t)} \ln \frac{[a + (\alpha_t + 2\beta_t - 1)d_t]}{e(1+r_t)}$$

Thus, it is easy to obtain Proposition 23.

Proposition 23. *If* $d_t > 0$, *then* $\Delta E(V_t) > 0$, *which implies that equity financing is better than debt financing. In contrast, if* $d_t < 0$, *then* $\Delta E(V_t) < 0$, *which implies that debt financing is better than equity financing.*

New equity issuance to pessimistic outside investors: We assume that the firm decides to issue new shares $n_t N_t$ with price P_t to outside investors; however, only the pessimistic investors buy these new shares, which indicates that the price is lower than that estimated by pessimistic investors. Then, $F_t = n_t N_t P_t$, the manager's shareholding is $\frac{\alpha_t}{1+n_t} N_t$, and outside optimistic shareholders hold $\frac{\beta_t}{1+n_t} N_t$, while pessimistic investors hold $\frac{1 - \alpha_t - \beta_t + n_t}{1+n_t} N_t$. Their heterogeneous beliefs are reflected in the type of investment functions, which are $F^M(\Pi_t) = a\ln(\Pi_t + 1)$, $F^O(\Pi_t) = (a + d_t)\ln(\Pi_t + 1)$, and $F^P(\Pi_t) = (a - d_t)\ln(\Pi_t + 1)$, respectively. As shown in Appendix L, the over- or underinvestment level is $\delta_t^* = \frac{a}{(1+r_t)} + \frac{(\alpha_t + 2\beta_t - n_t - 1)d_t}{(1+n_t)(1+r_t)} - (I_t + 1)$. This leads us to Proposition 24.

Proposition 24. (1) *If* $a(1+n_t) + (\alpha_t + 2\beta_t - n_t - 1)d_t > (I_t + 1)(1+n_t)(1+r_t)$, *i.e.,* $d_t > \frac{[(I_t+1)(1+r_t) - a](1+n_t)}{(\alpha_t + 2\beta_t - n_t - 1)}$, *then* $\delta_t^* > 0$. *This indicates that if heterogeneous beliefs between managers and investors exceed a certain level, firms will have a tendency to overinvest.* (2) *If* $a(1+n_t) + (\alpha_t + 2\beta_t - n_t - 1)d_t < (I_t + 1)(1+n_t)(1+r_t)$, *i.e.,*

$d_t < \frac{\left[(I_t+1)(1+r_t)-a\right](1+n_t)}{(\alpha_t+2\beta_t-n_t-1)}$, *then* $\delta_t^* < 0$. *This indicates that if heterogeneous beliefs between managers and investors are lower than a certain level, firms will have a tendency to underinvest.* (3) *If* $\alpha_t+2\beta_t-n_t>1$, *then* δ_t^* *has a positive relationship with* d_t, *while if* $\alpha_t+2\beta_t-n_t<1$, *then* δ_t^* *has a negative relationship with* d_t. (4) *If* $d_t>0$, *additional new shares are issued, and with additional financing amount* F_t, *lower is the level of overinvestment.*

The expected value of the firm is

$$E(V_t)=X_t+F_t+1+\left[\frac{a}{(1+r_t)}+\frac{(\alpha_t+2\beta_t-n_t-1)d_t}{(1+n_t)(1+r_t)}\right]\ln\left[\frac{a}{e(1+r_t)}+\frac{(\alpha_t+2\beta_t-n_t-1)d_t}{e(1+n_t)(1+r_t)}\right] \tag{13}$$

When considering equations (13) and (7), we get

$$\Delta E(V_t)=\left[\frac{a}{(1+r_t)}+\frac{(\alpha_t+2\beta_t-n_t-1)d_t}{(1+n_t)(1+r_t)}\right]\ln\left[\frac{a}{e(1+r_t)}+\frac{(\alpha_t+2\beta_t-n_t-1)d_t}{e(1+n_t)(1+r_t)}\right]-\frac{\left[a+(\alpha_t+2\beta_t-1)d_t\right]}{(1+r_t)}\ln\frac{\left[a+(\alpha_t+2\beta_t-1)d_t\right]}{e(1+r_t)}$$

Then, it is easy to obtain Proposition 25.

Proposition 25. *If* $d_t>0$, *then* $\Delta E(V_t)<0$, *which implies that debt financing is better than equity financing. In contrast, if* $d_t<0$, *then* $\Delta E(V_t)>0$, *which implies that equity financing is better than debt financing.*

If we combine information from Proposition 22 to Proposition 25, it can be identified that for external financing, when there are higher heterogeneous beliefs and additional optimistic investors, share prices will be higher, managers may prefer cash dividend, firms may have a tendency to overinvest, and equity financing could represent a better option for the firm.

If we compare the discussion in Section 3 and Section 4, we can see that in the financial market, heterogeneous beliefs can have a significant impact on share prices (as well as price bubbles), a firm's financing decisions, investment levels, as well as dividend policies, which helps explain this financial phenomenon to some extent.

5. Conclusions

In this study, we have analyzed financing, investment, and payout policies through a rational-expectation equilibrium based on which managers and outside investors have heterogeneous prior beliefs. The primary conclusions are as follows.

(1) Investment and payout policies without external financing

When the firm chooses to pay cash dividend:

(a) Assuming that heterogeneous beliefs exist only between manager and outside investors as a group, the more optimistic the outside investors are, the more dispersion of beliefs between managers and outside investors, and more overinvestment could be made by the manager. Moreover, price bubbles are observed to have a positive relationship with the level of overinvestment.

(b) Assuming that heterogeneous beliefs exist among managers and outside investors, the more optimistic the outside investors are, more is the overinvestment that could be made by the manager. Moreover, when the proportion of shares held by managers and outside optimistic investors is relatively

large, the more dispersion of belief among investors and between managers and outside investors, the higher is the level of overinvestment, and vice versa.

When the firm chooses to repurchase shares:

(a) If heterogeneous beliefs exist only between managers and outside investors, then the more optimistic the outside investors are, the more dispersion of beliefs there is between managers and outside investors. Furthermore, if the proportion of repurchased shares is lower, the level of over investment is higher. In this condition, cash dividend is a better option compared to stock repurchases, and vice versa.

(b) If heterogeneous beliefs exist among outside investors and between managers and outside investors, and shares are repurchased from optimistic investors, then the more optimistic the outside investors are, the higher is the level of overinvestment. Moreover, when the proportion of shares held by managers and outside optimistic investors is relatively large, there is additional dispersion of beliefs among investors and between managers and outside investors; thus, the level of overinvestment is higher too. In fact, once again, cash dividend is better compared to stock repurchases, and vice versa.

(c) If new shares are repurchased from pessimistic investors, the more optimistic the outside investors are, the higher is the level of overinvestment. Moreover, when proportion of shares held by managers, outside optimistic investors, and repurchased shares is relatively large, with additional dispersion of beliefs among outside investors, and between manager and outside investors, the level of overinvestment is higher too. In fact, for such cases, stock repurchase is better compared to cash dividend, and vice versa.

(2) Investment and payout policies with external financing

Debt financing, cash dividend

When the firm chooses to pay cash dividend and raise finance by debt, the findings are similar to the situation of investment and cash dividend without external financing.

Debt financing, stock repurchase

When the firm chooses to repurchase shares and raise finance by debt, the findings are similar to the situation of an investment decision and stock repurchase without external financing.

Equity financing, cash dividend

When the firm chooses to pay cash dividend and raise finance by issuing new shares:

(a) If there are heterogeneous beliefs only among the manager and outside investors, the more optimistic the outside investors are, the more dispersion of beliefs there is between the manager and outside investors, and the more new shares are issued, the higher the level of overinvestment is. Equity financing is better than debt financing, and vice versa.

(b) If there are heterogeneous beliefs among outside investors and between the manager and outside investors, and new shares are issued to optimistic investors, the more optimistic the outside investors are, the higher the level of overinvestment is. Moreover, when the proportion of shares held by the manager and the outside optimistic investors as well as the proportion of newly issued shares is relatively large, the more dispersion of beliefs there is among investors and between the manager and outside investors, the higher the level of overinvestment is. Equity financing is better than debt financing, and vice versa.

(c) If new shares are issued to pessimistic investors, the more optimistic the outside investors are, the higher the level of overinvestment is. Moreover, when the proportion of shares held by the manager and by the outside optimistic investors is relatively large, the more the dispersion of beliefs among investors and between the manager and outside investors, the higher the level of overinvestment made by the manager.

Debt financing is better than equity financing, and vice versa.

However, our work focuses on a situation where there is no agency problem and the market is efficient. It can be extended to other circumstances, such as having a manager with overconfidence, having stock prices deviating from the fundamental value, and encountering financing friction. Besides this, the investors' belief update is another direction that is worth further study.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

The value of the firm is $V_t^M = X_t - \Pi_t + \left[F^M(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, $V_t^O = X_t - \Pi_t + \left[F^O(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, $V_t^P = X_t - \Pi_t + \left[F^P(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, and thus we have the following model:

$$\max E(V_t) = \alpha_t E(V_t^M) + \beta_t E(V_t^O) + (1-\alpha_t-\beta_t)E(V_t^P) = X_t - \Pi_t + \frac{\left[\alpha_t a + \beta_t(a+d_t) + (1-\alpha_t-\beta_t)(a-d_t)\right]}{(1+r_t)}\ln(\Pi_t+1),$$

subject to $X_t = \Pi_t + D_t$.

The first-order condition for the above maximization problem with respect to Π_t for a given X_t is $\frac{\partial E(V_t)}{\partial \Pi_t} = -1 + \frac{\left[\alpha_t a + \beta_t(a+d_t) + (1-\alpha_t-\beta_t)(a-d_t)\right]}{(\Pi_t+1)(1+r_t)} = 0$, i.e., $\frac{\left[\alpha_t a + \beta_t(a+d_t) + (1-\alpha_t-\beta_t)(a-d_t)\right]}{(\Pi_t+1)(1+r_t)} = 1$, and thus $\delta_t^* = \frac{\left[a + (\alpha_t + 2\beta_t - 1)d_t\right]}{(1+r_t)} - (I_t+1)$.

Appendix B

The value of the firm is $V_t^M = X_t - \Pi_t + \left[F^M(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, $V_t^I = X_t - \Pi_t + \left[F^I(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, and thus we have the following model:

$$\max E(V_t) = (\alpha_t + b_t)E(V_t^M) + (1-\alpha_t-b_t)E(V_t^I) = X_t - \Pi_t + \frac{\left[(\alpha_t+b_t)a + (1-\alpha_t-b_t)(a+d_t)\right]}{(1+r_t)}\ln(\Pi_t+1),$$

subject to $X_t = \Pi_t + D_t$.

The first-order condition for the above maximization problem with respect to Π_t for a given X_t is $\frac{\partial E(V_t)}{\partial \Pi_t} = -1 + \frac{\left[(\alpha_t+b_t)a + (1-\alpha_t-b_t)(a+d_t)\right]}{(\Pi_t+1)(1+r_t)} = 0$, i.e., $\frac{\left[(\alpha_t+b_t)a + (1-\alpha_t-b_t)(a+d_t)\right]}{(\Pi_t+1)(1+r_t)} = 1$, and thus $\delta_t^* = \frac{\left[a + (1-\alpha_t-b_t)d_t\right]}{(1+r_t)} - (I_t+1)$.

Appendix C

The value of the firm is $V_t^M = X_t - \Pi_t + \left[F^M(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, $V_t^O = X_t - \Pi_t + \left[F^O(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, $V_t^P = X_t - \Pi_t + \left[F^P(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, and thus we have the following model:

$$\begin{aligned}\max E(V_t) &= (\alpha_t + b_t)E(V_t^M) + (\beta_t - b_t)E(V_t^O) + (1-\alpha_t-\beta_t)E(V_t^P)\\ &= X_t - \Pi_t + \left[(\alpha_t + b_t)a + (\beta_t - b_t)(a+d_t) + (1-\alpha_t-\beta_t)(a-d_t)\right]\frac{\ln(\Pi_t+1)}{(1+r_t)}\end{aligned}$$

subject to $X_t = \Pi_t + D_t$.

The first-order condition for the above maximization problem with respect to Π_t for a given X_t is

$$\frac{\partial E(V_t)}{\partial \Pi_t} = -1 + \frac{\left[(\alpha_t + b_t)a + (\beta_t - b_t)(a+d_t) + (1-\alpha_t-\beta_t)(a-d_t)\right]}{(\Pi_t+1)(1+r_t)} = 0,$$

i.e., $\dfrac{\left[(\alpha_t + b_t)a + (\beta_t - b_t)(a+d_t) + (1-\alpha_t-\beta_t)(a-d_t)\right]}{(\Pi_t+1)(1+r_t)} = 1$, thus, $\delta_t^* = \dfrac{\left[a + (\alpha_t + 2\beta_t - b_t - 1)d_t\right]}{(1+r_t)} - (I_t+1)$.

Appendix D

The value of the firm is $V_t^M = X_t - \Pi_t + \left[F^M(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, $V_t^O = X_t - \Pi_t + \left[F^O(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, $V_t^P = X_t - \Pi_t + \left[F^P(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, and thus we have the following model:

$$\begin{aligned}\max E(V_t) &= (\alpha_t + b_t)E(V_t^M) + (\beta_t - b_t)E(V_t^O) + (1-\alpha_t-\beta_t)E(V_t^P)\\ &= X_t - \Pi_t + \left[(\alpha_t + b_t)a + \beta_t(a+d_t) + (1-\alpha_t-\beta_t-b_t)(a-d_t)\right]\frac{\ln(\Pi_t+1)}{(1+r_t)}\end{aligned}$$

subject to $X_t = \Pi_t + D_t$.

The first-order condition for the above maximization problem with respect to Π_t for a given X_t is

$$\frac{\partial E(V_t)}{\partial \Pi_t} = -1 + \frac{\left[(\alpha_t + b_t)a + \beta_t(a+d_t) + (1-\alpha_t-\beta_t-b_t)(a-d_t)\right]}{(\Pi_t+1)(1+r_t)} = 0,$$

i.e., $\dfrac{\left[(\alpha_t + b_t)a + \beta_t(a+d_t) + (1-\alpha_t-\beta_t-b_t)(a-d_t)\right]}{(\Pi_t+1)(1+r_t)} = 1$, then, $\delta_t^* = \dfrac{\left[a + (\alpha_t + 2\beta_t + b_t - 1)d_t\right]}{(1+r_t)} - (I_t+1)$.

Appendix E

The value of the firm is

$$V_t^M = D_t + \left[F^M(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t) = X_t + F_t - \Pi_t + \left[F^M(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t),$$

$$V_t^I = D_t + \left[F^I(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t) = X_t + F_t - \Pi_t + \left[F^I(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t).$$

Thus, we have the following model:

$$\max E(V_t) = \alpha_t E\left(V_t^M\right) + (1-\alpha_t)E\left(V_t^I\right) = X_t + F_t - \Pi_t + \frac{\left[\alpha_t a + (1-\alpha_t)(a+d_t)\right]}{(1+r_t)}\ln(\Pi_t + 1)$$

subject to $X_t + F_t = \Pi_t + D_t$.

The first-order condition for the above maximization problem with respect to Π_t for a given X_t is $\frac{\partial E(V_t)}{\partial \Pi_t} = -1 + \frac{\left[\alpha_t a + (1-\alpha_t)(a+d_t)\right]}{(\Pi_t+1)(1+r_t)} = 0$, i.e., $\frac{\left[\alpha_t a + (1-\alpha_t)(a+d_t)\right]}{(\Pi_t+1)(1+r_t)} = 1$, then, $\delta_t^* = \frac{\left[a + (1-\alpha_t)d_t\right]}{(1+r_t)} - (I_t + 1)$.

Appendix F

The value of the firm is $V_t^M = X_t + F_t - \Pi_t + \left[F^M(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, $V_t^O = X_t + F_t - \Pi_t + \left[F^O(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, $V_t^P = X_t + F_t - \Pi_t + \left[F^P(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, and thus we have the following model:

$$\max E(V_t) = \alpha_t E\left(V_t^M\right) + \beta_t E\left(V_t^O\right) + (1-\alpha_t-\beta_t)E\left(V_t^P\right) = X_t + F_t - \Pi_t + \frac{\left[\alpha_t a + \beta_t(a+d_t) + (1-\alpha_t-\beta_t)(a-d_t)\right]}{(1+r_t)}\ln(\Pi_t + 1)$$

subject to $X_t + F_t = \Pi_t + D_t$.

The first-order condition for the above maximization problem with respect to Π_t for a given X_t is $\frac{\partial E(V_t)}{\partial \Pi_t} = -1 + \frac{\left[\alpha_t a + \beta_t(a+d_t) + (1-\alpha_t-\beta_t)(a-d_t)\right]}{(\Pi_t+1)(1+r_t)} = 0$, i.e., $\frac{\left[\alpha_t a + \beta_t(a+d_t) + (1-\alpha_t-\beta_t)(a-d_t)\right]}{(\Pi_t+1)(1+r_t)} = 1$, and thus $\delta_t^* = \frac{\left[a + (\alpha_t + 2\beta_t - 1)d_t\right]}{(1+r_t)} - (I_t + 1)$.

Appendix G

The value of the firm is $V_t^M = D_t + \left[F^M(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t) = X_t + F_t - \Pi_t + \left[F^M(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, $V_t^I = D_t + \left[F^I(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t) = X_t + F_t - \Pi_t + \left[F^I(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, and thus we have the following model:

$$\max E(V_t) = (\alpha_t + b_t)E\left(V_t^M\right) + (1-\alpha_t-b_t)E\left(V_t^I\right) = X_t + F_t - \Pi_t + \frac{\left[(\alpha_t + b_t)a + (1-\alpha_t-b_t)(a+d_t)\right]}{(1+r_t)}\ln(\Pi_t + 1),$$

subject to $X_t + F_t = \Pi_t + D_t$.

The first-order condition for the above maximization problem with respect to Π_t for a given X_t is

$\frac{\partial E(V_t)}{\partial \Pi_t} = -1 + \frac{\left[(\alpha_t + b_t)a + (1-\alpha_t - b_t)(a+d_t)\right]}{(\Pi_t + 1)(1+r_t)} = 0$, i.e., $\frac{\left[(\alpha_t + b_t)a + (1-\alpha_t - b_t)(a+d_t)\right]}{(\Pi_t + 1)(1+r_t)} = 1$, and thus $\delta_t^* = \frac{\left[a + (1-\alpha_t - b_t)d_t\right]}{(1+r_t)} - (I_t + 1)$.

Appendix H

The value of the firm $V_t^M = X_t + F_t - \Pi_t + \left[F^M(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, $V_t^O = X_t + F_t - \Pi_t + \left[F^O(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, $V_t^P = X_t + F_t - \Pi_t + \left[F^P(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, and thus we have the following model

$$\begin{aligned}\max E(V_t) &= (\alpha_t + b_t)E(V_t^M) + (\beta_t - b_t)E(V_t^O) + (1-\alpha_t - \beta_t)E(V_t^P) \\ &= X_t + F_t - \Pi_t + \left[(\alpha_t + b_t)a + (\beta_t - b_t)(a+d_t) + (1-\alpha_t - \beta_t)(a-d_t)\right]\frac{\ln(\Pi_t + 1)}{(1+r_t)}\end{aligned}$$

subject to $X_t + F_t = \Pi_t + D_t$.

The first-order condition for the above maximization problem with respect to Π_t for a given X_t is $\frac{\partial E(V_t)}{\partial \Pi_t} = -1 + \frac{\left[(\alpha_t + b_t)a + (\beta_t - b_t)(a+d_t) + (1-\alpha_t - \beta_t)(a-d_t)\right]}{(\Pi_t + 1)(1+r_t)} = 0$, i.e., $\frac{\left[(\alpha_t + b_t)a + (\beta_t - b_t)(a+d_t) + (1-\alpha_t - \beta_t)(a-d_t)\right]}{(\Pi_t + 1)(1+r_t)} = 1$; then, $\delta_t^* = \frac{\left[a + (\alpha_t + 2\beta_t - b_t - 1)d_t\right]}{(1+r_t)} - (I_t + 1)$.

Appendix I

The value of the firm is $V_t^M = X_t + F_t - \Pi_t + \left[F^M(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, $V_t^O = X_t + F_t - \Pi_t + \left[F^O(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, $V_t^P = X_t + F_t - \Pi_t + \left[F^P(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, and thus we have the following model:

$$\begin{aligned}\max E(V_t) &= (\alpha_t + b_t)E(V_t^M) + (\beta_t - b_t)E(V_t^O) + (1-\alpha_t - \beta_t)E(V_t^P) \\ &= X_t + F_t - \Pi_t + \left[(\alpha_t + b_t)a + \beta_t(a+d_t) + (1-\alpha_t - \beta_t - b_t)(a-d_t)\right]\frac{\ln(\Pi_t + 1)}{(1+r_t)}\end{aligned}$$

subject to $X_t + F_t = \Pi_t + D_t$.

The first-order condition for the above maximization problem with respect to Π_t for a given X_t is $\frac{\partial E(V_t)}{\partial \Pi_t} = -1 + \frac{\left[(\alpha_t + b_t)a + \beta_t(a+d_t) + (1-\alpha_t - \beta_t - b_t)(a-d_t)\right]}{(\Pi_t + 1)(1+r_t)} = 0$, i.e., $\frac{\left[(\alpha_t + b_t)a + \beta_t(a+d_t) + (1-\alpha_t - \beta_t - b_t)(a-d_t)\right]}{(\Pi_t + 1)(1+r_t)} = 1$; then, $\delta_t^* = \frac{\left[a + (\alpha_t + 2\beta_t + b_t - 1)d_t\right]}{(1+r_t)} - (I_t + 1)$.

Appendix J

The value of the firm is $V_t^M = X_t + F_t - \Pi_t + \left[F^M(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, $V_t^I = X_t + F_t - \Pi_t + \left[F^I(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, and thus we have the following model:

$$\max E(V_t) = \frac{\alpha_t}{1+n_t}E\left(V_t^M\right) + \frac{1-\alpha_t+n_t}{1+n_t}E\left(V_t^I\right) = X_t + F_t - \Pi_t + \left[\frac{\alpha_t}{1+n_t}a + \frac{1-\alpha_t+n_t}{1+n_t}(a+d_t)\right]\frac{\ln(\Pi_t+1)}{(1+r_t)},$$

subject to $X_t + F_t = \Pi_t + D_t$.

The first-order condition for the above maximization problem with respect to Π_t for a given X_t is $\frac{\partial E(V_t)}{\partial \Pi_t} = -1 + \frac{\left[\alpha_t a + (1-\alpha_t)(a+d_t)\right]}{(1+n_t)(\Pi_t+1)(1+r_t)} = 0$, i.e., $\frac{\left[\alpha_t a + (1-\alpha_t)(a+d_t)\right]}{(1+n_t)(\Pi_t+1)(1+r_t)} = 1$, and thus $\delta_t^* = \frac{a}{(1+r_t)} + \frac{(1+n_t-\alpha_t)d_t}{(1+n_t)(1+r_t)} - (I_t+1)$.

Appendix K

The value of the firm is $V_t^M = X_t + F_t - \Pi_t + \left[F^M(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, $V_t^O = X_t + F_t - \Pi_t + \left[F^O(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, $V_t^P = X_t + F_t - \Pi_t + \left[F^P(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, and thus we have the following model:

$$\begin{aligned}\max E(V_t) &= \frac{\alpha_t}{1+n_t}E\left(V_t^M\right) + \frac{\beta_t+n_t}{1+n_t}E\left(V_t^O\right) + \frac{1-\alpha_t-\beta_t}{1+n_t}E\left(V_t^P\right)\\ &= X_t + F_t - \Pi_t + \left[\frac{\alpha_t}{1+n_t}a + \frac{\beta_t+n_t}{1+n_t}(a+d_t) + \frac{1-\alpha_t-\beta_t}{1+n_t}(a-d_t)\right]\frac{\ln(\Pi_t+1)}{(1+r_t)}\end{aligned}$$

subject to $X_t + F_t = \Pi_t + D_t$.

The first-order condition for the above maximization problem with respect to Π_t for a given X_t is $\frac{\partial E(V_t)}{\partial \Pi_t} = -1 + \frac{\left[\alpha_t a + (\beta_t+n_t)(a+d_t) + (1-\alpha_t-\beta_t)(a-d_t)\right]}{(1+n_t)(\Pi_t+1)(1+r_t)} = 0$, i.e., $\frac{\left[\alpha_t a + (\beta_t+n_t)(a+d_t) + (1-\alpha_t-\beta_t)(a-d_t)\right]}{(1+n_t)(\Pi_t+1)(1+r_t)} = 1$, and thus $\delta_t^* = \frac{a}{(1+r_t)} + \frac{(\alpha_t+2\beta_t+n_t-1)d_t}{(1+n_t)(1+r_t)} - (I_t+1)$.

Appendix L

The value of the firm is $V_t^M = X_t + F_t - \Pi_t + \left[F^M(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, $V_t^O = X_t + F_t - \Pi_t + \left[F^O(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, $V_t^P = X_t + F_t - \Pi_t + \left[F^P(\Pi_t) + \theta\varepsilon_t\right]/(1+r_t)$, and thus we have the following model:

$$\max E(V_t) = \frac{\alpha_t}{1+n_t} E\left(V_t^M\right) + \frac{\beta_t}{1+n_t} E\left(V_t^O\right) + \frac{1-\alpha_t-\beta_t+n_t}{1+n_t} E\left(V_t^P\right)$$
$$= X_t + F_t - \Pi_t + \left[\frac{\alpha_t}{1+n_t} a + \frac{\beta_t}{1+n_t}(a+d_t) + \frac{1-\alpha_t-\beta_t+n_t}{1+n_t}(a-d_t)\right] \frac{\ln(\Pi_t+1)}{(1+r_t)}$$

subject to $X_t + F_t = \Pi_t + D_t$.

The first-order condition for the above maximization problem with respect to Π_t for a given X_t is $\frac{\partial E(V_t)}{\partial \Pi_t} = -1 + \frac{\left[\alpha_t a + \beta_t(a+d_t) + (1-\alpha_t-\beta_t+n_t)(a-d_t)\right]}{(1+n_t)(\Pi_t+1)(1+r_t)} = 0$, i.e.,

$\frac{\left[\alpha_t a + \beta_t(a+d_t) + (1-\alpha_t-\beta_t+n_t)(a-d_t)\right]}{(1+n_t)(\Pi_t+1)(1+r_t)} = 1$; then, $\delta_t^* = \frac{a}{(1+r_t)} + \frac{(\alpha_t+2\beta_t-n_t-1)d_t}{(1+n_t)(1+r_t)} - (I_t+1)$.

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Dynamic autocorrelation of intraday stock returns

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ABSTRACT

We discover three significant periodicities in the autocorrelation of intraday stock returns. We demonstrate that (i) the autocorrelation is 64% more negative during afternoons than during mornings, (ii) the autocorrelation is more negative Tuesdays through Fridays than on Mondays, (iii) overall serial correlation becomes less negative when salient information events arrive, i.e., earnings months, but measures less negative during mornings and on Mondays. Our results support the hypothesis that informational demand is more critical following daily and weekly market closures when information accumulated cannot easily be traded on, while liquidity demand intensifies closer to the no-trading periods.

1. Introduction

Serial return correlation is a topic of significant interest in financial economics. Many studies have argued that informed trading and liquidity trading generate very different short-term serial return correlation patterns.[2] Informed trading due to private information tends to generate zero or positive return autocorrelation (Glosten and Milgrom, 1985; Glosten and Harris, 1988; Wang, 1994; Llorente, Michaely, Saar, and Wang, 2002; Boulatov, Hendershott, and Livdan, 2013; Dong, Feng, and Sadka, 2015; Dong and Massa, 2016), while liquidity trading tends to exhibit negative return autocorrelation (Grossman and Miller, 1988; Campbell, Grossman, and Wang, 1993; Llorente et al., 2002; Nagel, 2012; Dong 2012). In this paper we investigate the dynamics of high frequency, *intraday* stock return autocorrelation during different daytime periods as well as across different trading days of the week when the relative importance of information and liquidity are likely to differ. The relevant literature has not fully examined the behavior of intraday serial correlation: previous studies have mainly examined serial correlation ranging from yearly to daily levels, such as the 12-month momentum and the monthly reversal (French and Roll, 1986; Amihud and Mendelson, 1987; Stoll 1989; Lo and Mackinlay, 1988, 1990; Jegadeesh, 1990; Jegadeesh and Titman, 1993). However, the dynamics of intraday return autocorrelation have become particularly important due to critical

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[2] Liquidity trading in our paper generally refers to trading without new information about future payoff. Liquidity trading may be driven by hedging demand, risk sharing, noise, or any noninformation-based trading.

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implications for understanding high frequency trading, which has accounted for as much as 60–73% of the total US equity trading volume in recent years.[3]

We have built our hypotheses on the central premise of much of the empirical and theoretical microstructure literature: When investors sell (buy) a stock for the purpose of liquidity trading, the stock price must decline (increase) in order to attract other risk averse investors. Since such trades are "non-informational," the expected future payoff of the focal stock remains the same; hence the stock's reduced (increased) price results in a low (high) return for the current period and a high (low) expected return for the next period. The first-order return autocorrelation is therefore negative, i.e., a short-term reversal (Grossman and Miller, 1988; Campbell, Grossman, and Wang, 1993; Llorente et al., 2002; Nagel, 2012). In contrast, the price impacts of informed trades are less likely to reverse, either because the price impact of informational trades is permanent (Glosten and Milgrom, 1985; Glosten and Harris, 1988), or because the full private information is not revealed immediately due to various market frictions (Wang, 1994; Llorente et al., 2002; Boulatov, Hendershott, and Livdan, 2013).

Anand, Chakravarty and Martell (2005) use a unique dataset that enables them to distinguish between informed (institutional) and uninformed (individual) orders on NYSE stocks. They find that institutional informed trading is more likely to occur during the first half rather than the second half of the trading day. Anand et al. (2005) also find that uninformed (liquidity) trading tends to behave in a manner opposite to informed trading. This result is consistent with the finding in Bloomfield et al. (2005) that informed traders use market orders in the beginning of the trading period.[4]

From this premise we posit first that the intraday return autocorrelation will differ depending on whether trades occur in the morning or the afternoon, as the relative importance of informational and liquidity trading should differ significantly across these two periods. Contrasted with trades later in the day, comparatively more trades in the early hours directly after the opening of the stock market are likely to be motivated by speculation on information, because most information such as earnings becomes available when the market is closed. Therefore, much of the trading demand based on new information is likely to occur immediately after the market reopens the following day. As a result, the autocorrelation of intraday stock returns should be less negative early in the trading day when both liquidity and informational trading demands are significant. Conversely, fewer information-based trades should occur as market participants digest information through trading. Therefore, the volume of informed trades subsides as the day proceeds. Furthermore, because investors cannot trade shares easily when information arrives after the market closes, liquidity-based rebalancing needs are likely to be stronger as the market approaches the closing bell. These liquidity needs include hedging demands initiated by market makers, such as investment banks or hedge funds, who need to rebalance in order to keep their inventory at zero at market close. Hence the autocorrelation of intraday stock returns should be comparatively more negative during the second half of the trading day.

Foster and Viswanathan (1990) argue that since informed traders receive private information throughout the week, and public information is released only on weekdays, informed traders will therefore trade more intensely before the information is revealed. However, uninformed traders, who suffer from a larger information asymmetry on Mondays, will avoid trading in the early part of the week. Cross (1973) finds that price changes on Mondays are higher than price changes Tuesdays through Fridays. These findings motivate us to further posit that the same economic consideration will generate not only autocorrelation difference intraday but also generate a day-of-the-week effect at the daily level. Specifically, most information made available over weekends cannot be traded on until Monday. Conversely, to hedge the information risk over weekends, liquidity needs may grow especially stronger during Tuesdays through Fridays. Therefore, informational trading demands may be stronger on Mondays, while liquidity demand is stronger on subsequent weekdays. This implies less negative return autocorrelation on Mondays than on other weekdays.

Finally, the above mechanisms are also affected by other events that can generate informational trading demand. For example, during the periods when corporate earnings are announced, more trades motivated by earnings information are likely to occur. Therefore, the morning–afternoon and Monday–other weekdays autocorrelation difference should be more significant during earnings announcement months.

To test our hypotheses, we examine the transaction data of individual stocks traded on the New York Stock Exchange (NYSE), American Stock Exchange (AMEX) and NASDAQ during the period 2006–2010. Our first finding is that the first-order autocorrelation of 10-minute stock returns is −0.0928 in the morning versus −0.1521 in the afternoon. This represents a 64% increase in negative autocorrelation as information trading demand subsides while liquidity demand increases. These magnitudes are substantial, especially considering that autocorrelation should be zero in a random walk-based efficient market hypothesis (Fama, 1965).

We obtain this morning–afternoon autocorrelation difference on two types of weekdays — Monday and other weekdays. The results suggest a robust morning–afternoon difference in return autocorrelation that is consistent with the interpretation of more afternoon than morning trades motivated by liquidity.

[3] It is estimated that as of 2009, high frequency trading accounted for 60-73% of all US equity trading volume, with that number falling to approximately 50% in 2012. See "Times Topics: High-Frequency Trading", The New York Times, December 20, 2012. Similar results was also obtained in Brogaard, Hendershott, and Riordan (2014) that high-frequency traders participate in 68.5% of the dollar volume traded during 2008–2009.

[4] In the US markets, Foster and Viswanathan (1993) document the U-shaped intraday pattern of trading volume in NYSE. Barclay and Hendershott (2003) document a U-shaped pattern in price discovery over the trading day with a much larger spike at the beginning of the day. This suggests that there is more informed trading early in the day.

Table 1
Summary statistics.

Year	Stock	Market Cap.	Amihud	First-order
	Number	(million)	Illiquidity	Autocorrelation
2006	4548	5271	0.006	−0.097
2007	4685	5612	0.007	−0.085
2008	4182	5147	0.009	−0.074
2009	3771	4553	0.014	−0.066
2010	4030	5259	0.007	−0.076

Next, consistent with our hypothesis, we find that the return autocorrelation on other weekdays is more negative than on Mondays, and that the autocorrelation on Monday mornings is less negative than is found on subsequent weekday mornings. This finding indicates comparatively more informed trades occurring on Mondays than on other weekdays, particularly during morning hours.

Further analyses confirm that return autocorrelation is less negative during earnings announcement months. Both the morning–afternoon and the Monday–other weekdays autocorrelation difference become more positive (or less negative) during earnings announcement months. These findings indicate that more information-based trades occur in general, and during morning trading hours, as well as on Monday in particular, when there are more information events that can trigger the needs for trading on information.

Our paper has several implications. First, we reveal patterns in intraday serial return correlation. Most previous work in this field focuses on either longer horizon time-series return autocorrelation or on return continuation/reversal patterns in the cross-section (French and Roll, 1986; Lo and Mackinlay, 1988). We provide evidence for morning vs. afternoon and Mondays vs. other weekdays intraday return autocorrelation differences, as well as how salient information events such as earnings announcement periods affect intraday autocorrelation. Second, our findings provide evidence for understanding the relative importance of information vs. liquidity trades within the trading day as well as across different weekdays. This question is of particular importance for traders, market makers, exchange designers, and regulators. Our results suggest that, even given the proliferation of high frequency liquidity providers in recent years, the liquidity provided in the market can vary (i) throughout a regular trading day, (ii) across different trading days, and (iii) between days with and without informational events. Third, our findings provide high frequency traders or market makers a foundation to design better market making strategies which may not only provide lucrative trading profits but also facilitate market liquidity, which is essential for maintaining market efficiency.

2. Data and construction of variables

Our empirical analysis is based on the transaction data from the Trade and Quote (TAQ) database and the daily stock data provided by the Center for Research in Security Prices (CRSP). From TAQ we collect the trading time and price for each trade and each stock traded on NYSE, AMEX, and NASDAQ from January 2006 through December 2010. We eliminate stock-months with average daily closing prices less than $5, and then compute individual stock returns for every 10-minute interval from 9:30 a.m. to 4:00 p.m. For each time interval, the periodic return r is calculated as follows:

$$r_t = \frac{p_t - p_{t-1}}{p_{t-1}}, \tag{1}$$

where p_t is the last trade price in period t and p_{t-1} is the last trade price in period $t-1$. Each trading day consists of 39 such intervals. This procedure leaves us with a set of 10-minute return profiles for every stock and every trading day. From the CRSP database we collect the closing price and number of common shares outstanding for each stock in order to compute the corresponding firms' market capitalization—that is, the closing price multiplied by the number of outstanding common shares. We define the morning half-day as the trading period from 9:30 a.m. to 12:00 p.m. and the afternoon half-day as the period from 1:30 p.m. to 4:00 p.m. For each trading day, we estimate the following regression:

$$r_{i,t} = \lambda_{i,0} + \lambda_{i,1} r_{i,t-1} + \varepsilon_{i,t} \tag{2}$$

where $r_{i,t}$ is the return of stock i for the 10-minute time interval t and $\varepsilon_{i,t}$ is the error term.

Table 1 reports the yearly average of number of stocks, market capitalization, Amihud Illiquidity, and the first-order autocorrelation of intraday returns estimated from Eq. (2). We remark that although there is some variation across years, the first-order autocorrelation is negative and statistically significant at the 1% level for all 5 years of the sample. Another significant finding is that this autocorrelation becomes less negative over the sample period.

3. Results of the empirical analysis

3.1. First-order autocorrelation: morning vs. afternoon

Liquidity trading tends to exhibit negative return autocorrelation whereas informed trading tends to generate zero or positive return autocorrelation. Thus, the magnitude of negative autocorrelation observed in Table 1 should depend on the

Table 2
First-order autocorrelation and trading period morning vs. afternoon.

	Mean	Std. Dev.
Morning	−0.0928	0.2479
Afternoon	−0.1521	0.2932
difference	−0.0593	
p-value	< 0.01	

Table 3
Informed trading pattern over weekdays.

VARIABLES	Mon&Tue	Mon&Wed	Mon&Thu	Mon&Fri
Monday	0.0029***	0.0030***	0.0024***	0.0011***
	(0.00)	(0.00)	(0.00)	(0.00)
Amihud Illiquidity	50.9989**	129.9886**	131.8946***	10.2741
	(0.03)	(0.01)	(0.01)	(0.40)
Earmonth	0.0018***	0.0018***	0.0021***	0.0017***
	(0.00)	(0.00)	(0.00)	(0.00)
Firm fixed effect	Yes	Yes	Yes	Yes
Month dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
Adj. R-squared	0.300	0.349	0.425	0.422

Standard errors are adjusted by clustering at the stock level. The p-values (in parentheses) are given below the estimated coefficients.
*** denotes significance at the 1% level.
** denotes significance at the 5% level.

relative importance of these two types of trades. Presumably, the first-order autocorrelation should be less negative in the morning when stocks are more likely to be traded on information, and it should be more negative in the afternoon when liquidity trading is more likely to occur. Our purpose in the following section is to compare autocorrelation in terms of the two half-day trading periods.

We find that for the entire sample the first-order autocorrelation of stock returns is −0.0928 in the morning and −0.1521 in the afternoon. The difference is 0.0593 (morning minus afternoon), which is about 64% percent of the morning autocorrelation. As indicated by a *t*-test, the difference is statistically significant at the 1% level. Table 2 confirms that the afternoon autocorrelation is much more negative than the morning autocorrelation. This finding is consistent with our first hypothesis that *the first-order autocorrelation of intraday stock returns should be more negative in the afternoon than in the morning*—namely, there is more liquidity trading in the afternoon period. Our finding is also consistent with Anand, Chakravarty and Martell (2005), which finds that informed orders contribute a significantly higher proportion of the total price change in the first half of the day versus the second half of the trading day.

3.2. First-order autocorrelation: mondays versus tuesdays through fridays

We first test the Monday versus non-Monday informed trading pattern by using the probability of informed trading (PIN) measure. Easley, Kiefer, O'Hara, and Paperman (1996) present PIN as a reliable proxy of information asymmetry, based on the assumption that informed traders cause an important part of the observed order imbalance. Easley, Engle, O'Hara, and Wu (2008) propose a dynamic model allowing for the time-varying arrival of informed and uninformed trades. We estimate the PIN on Monday and the four other weekdays.[5] In Table 3 we estimate various regression models of stock PIN as a function of Monday dummy and control variables (Amihud illiquidity, earning's month dummy, year dummy, month dummy) using a sample subset that includes Monday and Tuesday, Monday and Wednesday, Monday and Thursday, and Monday and Friday. We also include the firm fixed effect. Standard errors are adjusted by clustering at the stock level. The results indicate that the probability of informed trading on Mondays is statistically different and higher than on other weekdays. These findings are consistent with Foster and Viswanathan (1990)'s idea that informed traders trade more intensely before the information is revealed; however, uninformed traders, who suffer from a larger information asymmetry on Mondays, will avoid trading in the early part of the week.

We next compare the intraday autocorrelation in trades occurring on Mondays with those on the other weekdays; these results are reported in Table 4. In line with our second hypothesis, the mean autocorrelation is more negative on Friday

[5] We focus on NYSE-listed stocks because the market microstructure of that venue most closely conforms to that of Easley, Engle, O'Hara, and Wu (2008)'s structural model. PIN is estimated in a stock-day basis as described in Easley et al. (2008). We chose stocks with an average daily trading value over US$10,000. We further restrict the sample to stocks traded in more than 90% of the trading days to be able to estimate the dynamic PIN model.

Table 4
First-order autocorrelation and weekdays.

	Monday	Tuesday	Wednesday	Thursday	Friday
Panel A: Full Sample					
	−0.1175	−0.1237	−0.1228	−0.1244	−0.1234
subtracted by Monday		−0.0062	−0.0053	−0.0069	−0.0059
p-value		< 0.01	< 0.01	< 0.01	< 0.01
Panel B: NYSE and AMEX					
	−0.1019	−0.1101	−0.1091	−0.1104	−0.1094
subtracted by Monday		−0.0083	−0.0073	−0.0086	−0.0075
p-value		< 0.01	< 0.01	< 0.01	< 0.01
Panel C: NASDAQ					
	−0.1265	−0.1327	−0.1324	−0.1337	−0.1333
subtracted by Monday		−0.0062	−0.0059	−0.0072	−0.0068
p-value		< 0.01	< 0.01	< 0.01	< 0.01

Table 5
First-order autocorrelation and trading period (morning and afternoon) and weekdays.

	Monday	Tuesday	Wednesday	Thursday	Friday
Panel A: Morning					
	−0.0857	−0.0922	−0.0979	−0.0941	−0.0933
subtracted by Monday		−0.0065	−0.0122	−0.0084	−0.0076
p-value		< 0.01	< 0.01	< 0.01	< 0.01
Panel B: Afternoon					
	−0.1494	−0.1552	−0.1476	−0.1546	−0.1536
subtracted by Monday		−0.0058	0.0018	−0.0052	−0.0042
p-value		< 0.01	< 0.01	< 0.01	< 0.01

(−0.1234), Tuesday (−0.1237), Wednesday (−0.1228), and Thursday (−0.1244), than on Monday (−0.1175). The differences (Tuesday to Friday minus Monday) are −0.0062, −0.0053, −0.0069 and −0.0059 and, as indicated by a *t*-test, are statistically significant at the 1% level. We also run a subsamples analysis in NYSE and Amex (Panel B) and NASDAQ (Panel C) as robustness check since these exchanges have different trading rules. This result suggests that the relative importance of liquidity trading and informational trading differs between Mondays and non-Mondays.[6] These findings are consistent with Foster and Viswanathan (1990), Cross (1973), and our hypothesis 2 that *the first-order autocorrelation of intraday stock returns is less negative on Monday than on other weekdays*.

3.3. First-order autocorrelation: trading period and weekdays

We study the relative importance of information-based vs. liquidity-based trades during the trading day as well as during the different days of the week. Investors have more time to obtain information during weekends than on weeknights; Monday is therefore more likely than other weekdays to exhibit informed trading. Such trades, which are motivated by speculating on information, can be expected to result in less negative intraday autocorrelation on Monday mornings than on other weekday mornings. In contrast, the liquidity trading investors have more incentive to sell their shares on other weekdays than on Mondays, because the market is closed for a longer period over weekends than over weeknights. Consequently, return autocorrelation is expected to be more negative Tuesday through Friday afternoons than it is on Monday afternoons. In order to study the difference, we first reexamine Tables 2 and 4 and then compare the first-order return autocorrelation—in both the morning and the afternoon periods—for these two types of days in Table 5.

The autocorrelation is −0.0857 (−0.1494) for Monday morning (afternoon) and −0.0933 (−0.1536) for Friday morning (afternoon). The morning (afternoon) difference between Friday and Monday is −0.0076 (−0.0042), which is statistically significant at the 1% level. We also obtain the morning–afternoon autocorrelation difference between Monday and Tuesday through Thursday, and this difference is also statistically significant at the 1% level. These findings are consistent with hypothesis 3, *the first-order autocorrelation of intraday stock returns is less negative on Monday mornings than on other weekday mornings.*

3.4. Multivariate analysis

The results reported in Tables 1 through 5 support our three hypotheses by showing that the first-order autocorrelation of intraday returns seems to be affected by investors' liquidity trading and informational trading, and by events that may

[6] This evidence suggests that trading time periods and weekdays are important factors to consider when researchers estimate volatility or intraday return models by incorporating intraday price information in addition to the daily high and low prices (Li and Hong, 2011).

Table 6
Determinants of first-order autocorrelation.

	Autocorrelation							
	Mon&Tue		Mon&Wed		Mon&Thu		Mon&Fri	
Monday	0.0072***	0.0072***	0.0052***	0.0052***	0.0076***	0.0076***	0.0055***	0.0055***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Morning	0.0618***	0.0617***	0.0534***	0.0534***	0.0613***	0.061***	0.0603***	0.0602***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Earmonth	0.0023***	0.0022***	0.0016**	0.0018**	0.0027***	0.0026***	0.0022***	0.0021***
	(0.002)	(0.003)	(0.029)	(0.017)	(0.000)	(0.000)	(0.004)	(0.006)
Nasdaq		0.0041		0.0081*		0.0083**		0.0077*
		(0.322)		(0.053)		(0.050)		(0.071)
Amihud Illiquidity		0.1692		4.2934		16.6169		-1.7642
		(0.976)		(0.629)		(0.159)		(0.703)
Monday x Earmonth	0.0009	0.0009	0.0027***	0.0027***	0.0003	0.0004	0.0036***	0.0036***
	(0.259)	(0.266)	(0.001)	(0.001)	(0.679)	(0.635)	(0.000)	(0.000)
Morning x Earmonth	0.0007	0.0007	0.0039***	0.0039***	0.0005	0.0005	0.0016*	0.0016**
	(0.359)	(0.360)	(0.000)	(0.000)	(0.532)	(0.524)	(0.052)	(0.049)
Firm fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R-squared	0.0215	0.0215	0.0193	0.0193	0.0209	0.0208	0.0206	0.0205

Standard errors are adjusted by clustering at the stock level. The p-values (in parentheses) are given below the estimated coefficients.
*** denotes significance at the 1% level.
** denotes significance at the 5% level.
* denotes significance at the 10% level.

particularly generate informational trading demand. To further verify whether these results hold in a multivariate setting, we estimate the following regression with a sample subset including all half-day autocorrelations for Mondays and other weekdays:

$$Auto_{i,t} = \gamma_0 + \gamma_1 Monday + \gamma_2 Morning + \gamma_3 Afternoon \times Mon_{i,t} + \gamma_4 Controls_{i,t} + \varepsilon_{i,t}. \quad (3)$$

Here $Auto_{i,t}$ is the first-order return autocorrelation for stock i during the half-day period t; *Monday* is a dummy variable set equal to 1 if $Auto_{i,t}$ is based on trades that occurred on Monday and set to 0 otherwise; *Morning* is a dummy variable set equal to 1 if $Auto_{i,t}$ is based on trades that occurred in the morning and set to 0 otherwise; $Controls_{i,t}$ is a vector of control variables for stock i in month t, and $\varepsilon_{i,t}$ is the error term. The control variables may include Amihud's illiquidity measure,[7] NASDAQ dummy variable that is set equal to 1 only if the stock is listed on the NASDAQ,[8] earnings announcement dummy variable (*Earmonth*) that is set equal to 1 only if there is an earnings announcement for a stock in a given month, month dummies for the calendar months February through December, and year dummies for calendar years. We also include the firm fixed effect. Standard errors are adjusted by clustering at the stock level.

Table 6 reports the regression results, which are consistent with those from our univariate analyses. Estimates of the coefficients for *Monday* and *Morning* are 0.0056 and 0.0620, respectively for the *Monday* and *Friday* subsample; both coefficients are statistically significant at the 1% level.

Since earnings announcements of fundamentally related firms, such as firms in the same industry, are often clustered in adjacent periods, multiple earnings announcement events in an earnings announcement month might be relevant for triggering information-based trading demands. We therefore test this proposition by examining the relation between return autocorrelation and an earnings announcement month. Estimates of the coefficients for *Monday* × *Earmonth* and *Morning* × *Earmonth* are 0.0036 and 0.0016 for the Monday and Friday subsample; both coefficients are statistically significant at the 1% level. Our results still hold after we eliminate the observations of the earnings announcement month, which has larger intraday price movements.[9] The outcome of this adjustment indicates our results are robust to different magnitudes of intraday returns.[10]

[7] The stock autocorrelation might be affected if a different liquidity level affects return autocorrelation through bid-ask bounce; we want to see whether return autocorrelation contains incremental information beyond a simple amihud liquidity measure. Nevertheless, the results show that the estimates of the coefficients are not significantly different from zero. Amihud illiquidity does not affect our results.

[8] The *NASDAQ* dummy is included because there are key microstructural differences between NYSE, AMEX and NASDAQ.

[9] Due to space limitations, the results are not reported in the paper.

[10] Holmberg, Lönnbark and Lundström (2013) propose a profitable momentum-based trading strategy that seeks to identify large intraday price movements and that trades in the direction of previous price changes only when the price moves beyond some predetermined thresholds, i.e., the change from the opening price. In contrast, the focus of this paper is not constrained within momentum based strategies. Our findings have implications for understanding both momentum and reversal based strategies. The results suggest that momentum is likely to be more profitable during the mornings or Mondays and reversal is likely to be more profitable during afternoon or other weekdays. This paper focuses on the time period differences (morning vs. afternoon and Mondays vs. other weekdays) of autocorrelation rather than return. Therefore, such differences need not be related to magnitude of returns in a particular way.

In sum, both univariate and multivariate analyses yield consistent results, indicating that (i) there is comparatively more liquidity trading before the market closes than after it opens, and (ii) return autocorrelation is less negative during earnings announcement months, when there are more information events that may trigger the informational trading demand.

4. Conclusion

In this paper, we investigate the dynamic patterns of intraday serial return correlation using a large sample of NYSE, AMEX, and NASDAQ transaction data for the period 2006–2010. We document three noteworthy findings. First, the first-order autocorrelation of intraday stock returns is more negative in the afternoon and less negative in the morning. Second, this autocorrelation is more negative Tuesdays through Fridays than it is on Mondays. Third and finally, we discover that during periods of salient information events the return autocorrelation is significantly less negative overall but particularly less negative on Monday mornings. In conclusion, these results reveal the consistent intraday patterns of price movement as a function of trading period and information events.

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