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Introduction

In essay one, we examine whether sex discrimination contributes to the underrepresentation of female executives in large corporations. China's strong cultural preference for sons has made newborn boys greatly outnumber newborn girls. Using the male-to-female sex ratio at birth as the proxy for discrimination against women, we find that firms headquartered in more discriminatory areas hire fewer female executives. Even conditional on a woman reaching an executive position, she faces a higher likelihood of dismissal and receives lower compensation than her male counterparts. Overall, our findings suggest that sex discrimination plays an important role in preventing women from climbing the corporate ladder.

In essay two, we use the abnormal white-black interracial marriage rate as the proxy for racial segmentation in the U.S. and examine whether racial segmentation contributes to the underrepresentation of minority directors in public firms. We find that firms headquartered in areas with stronger racial segmentation are less likely to have minority directors on the board. We further use the racial segmentation measure as an instrumental variable for the presence of minority directors and show that minority directors significantly increase firm's innovation and firm value. Overall, our study provides evidence that racial segmentation plays an important role in preventing minority people from joining the boardroom.

In essay three, we investigate whether some mutual funds actively trade on suppliers based on the earnings announcement return of their customers. It is well documented in the literature that the stock price of economically linked suppliers can be predictable because they do not reflect shocks to the related customers in a timely manner (Cohen and Frazzini, 2008; Menzly and Ozbas, 2010). We show that fund managers, which understand the

economic linkage and trade accordingly, benefit from the trade. Moreover, these managers exhibit overall investment skills and generate superior performance. This performance results remain robust after adjusting for risk and controlling for other fund characteristics.

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Essay One: Sex Discrimination and Female Top Managers:

Evidence from China

ABSTRACT

We examine whether sex discrimination contributes to the underrepresentation of female executives in large corporations. China's strong cultural preference for sons has made newborn boys greatly outnumber newborn girls. Using the male-to-female sex ratio at birth as the proxy for discrimination against women, we find that firms headquartered in more discriminatory areas hire fewer female executives. Even conditional on a woman reaching an executive position, she faces a higher likelihood of dismissal and receives lower compensation than her male counterparts. Overall, our findings suggest that sex discrimination plays an important role in preventing women from climbing the corporate ladder.

Keywords: Sex discrimination; Female; Gender; Sex ratio; Corporate executives; Executive compensation; Turnover; China

JEL classification: G30; J71

1. Introduction

Female executives are rare in large corporations around the world. For example, in 2012, although women comprise 47% of the U.S. labor force and 51% of management, professional and related occupation, only 14% of executive officers and 4% of CEOs in Fortune 500 firms are women.¹ This under-representation is striking, especially because female corporate executives are usually found to be better decision makers (or at least no worse) than their male counterparts (see, for example, Dezso and Ross (2012) and Huang and Kisgen (2013)). A large number of studies conjecture that sex discrimination plays a role in preventing females from reaching top management positions. Becker (1971) suggests that discrimination could be one important fact in the labor market. Bertrand and Hallock (2001) find that women represented only about 2.5% of a large number of U.S. firms for the year 1992-97 and earned about 45% less than men. They suggest it may to some extent caused by discrimination via gender segregation or unequal promotion. Adams and Kirchmaier (2012),² find that the supply of female in the labor market could be one of the reasons why there are less female executives. The lack of evidence on gender discrimination possibly because discrimination is usually illegal and thus companies have obvious incentives to keep discriminatory actions hidden.

In this paper, we examine whether sex discrimination prevents females from climbing the corporate ladder, using a large sample of Chinese public firms. China's data are particularly useful to this study for three reasons. First, unlike developed markets, such as the U.S. or Europe, discrimination against females is more severe and explicit in China due to social norms and weaker legal protection towards women (OECD (2012) and World Bank

¹ Bureau of Labor Statistics 2012 Current Population Survey, and 2012 Catalyst Census: Fortune 500 Women Executives Officers and Top Earners.

² Other possible reasons include the difference in human capital skills, social norm, family consideration, risk attitudes, and psychological attribute regarding competition between male and female (Altonji and Blank (1999), Niederle and Vesterlund (2007), Vesterlund (2007), and Bertrand (2010)).

(2013)). Second, compared to developed economies, there are greater variations in sex discrimination across different areas within China (Ebenstein (2011) and Wei and Zhang (2011a)), which allows us to implement within-country comparative studies. Third, as of 2013, China is the second largest economy in the world; thus, understanding how corporate managers are selected in China is economically meaningful.

Our primary measure of sex discrimination is the newborn male-to-female ratio (hereafter referred to as sex ratio at birth). While the sex ratio at birth (left to nature) is generally around 100 to 105 boys per 100 girls due to human biology compensating for a slightly higher mortality rate for infant boys than infant girls, China has a significantly higher sex ratio at birth. According to the 2011 World Factbook published by the Central Intelligence Agency (see Appendix 1 for a partial list), China's sex ratio at birth in 2011 is 1.13, which is the highest figure across 228 countries in the world, followed by Armenia (1.12) and India (1.12). In contrast, this number in the European Union and the U.S. is 1.06 and 1.05, respectively. Such a high sex ratio at birth in China is attributed to sex-selective abortion and infanticide due to a strong preference for sons (Scharping (2003) and Zhu, Wei, Lu and Hesketh (2009)).

We use the province-level sex ratio at birth in China as a proxy of local discrimination against females and relate it to the representation of female managers in the top management team of local public firms. The sex ratio at birth statistic in each province is collectively determined by the birth-giving decisions of all parents in the area; therefore, it can be largely regarded as an exogenous variable to an individual public firm.

We expect firms in the provinces exhibiting stronger sex discrimination to have fewer female top managers for the following reasons. First, from the demand side of the labor market for top managers, the firms' employees and middle managers are probably pulled

from local communities and thus are likely to resist hiring female top managers. Second, the firms' incumbent local top managers are also likely to be influenced by local gender preference and bias against female top managers. Third, even if the incumbent top managers are not local and have no discrimination against women, they may still avoid hiring female executives considering that having female executives may cause conflicts and resistance among employees, middle managers, and local top managers. Fourth, from the supply side of the labor market for top managers, qualified female candidates for top management positions may avoid working in areas with stronger gender discrimination, and in these areas, junior and middle-level female employees may have a lower chance for promotion, leading to an insufficient supply of female candidates for corporate executive positions. Fifth, in the presence of strong discrimination, local girls may possess less education and training (Coate and Loury (1993)). The lack of human capital investment in the pre-labor market stage may further disadvantage females in climbing the corporate ladder after entering the labor market. Lastly, anticipating the occupational exclusion caused by discrimination in the selection process of top managers, talented women may avoid working as a professional manager in the first place (Altonji and Blank (1999)). Overall, from both the demand and supply sides of the labor market for corporate executives, stronger discrimination against women should lead to fewer female top managers.

Consistent with the prediction above, we find that firms headquartered in the province with a higher sex ratio at birth (i.e., stronger discrimination against girls, or equivalently stronger preference towards boys) have a smaller proportion of female executives in the firms' top management teams. This relation is both statistically and economically significant and is robust across different subsamples. After controlling for various firm and province characteristics, including the contemporaneous supply of the female labor force, we find that a one percentage-point decrease in newborn girls among all newborn infants is associated

with a decrease in the percentage of female managers in local public firms by approximately 0.4 percentage points.

To further our understanding of how sex discrimination affects females in reaching top management positions, we examine new executive appointments and dismissals. We find that conditional on firms appointing a new executive, the firms headquartered in more discriminatory provinces are less likely to appoint a female executive but are more likely to appoint a male one. However, conditional on firms firing an executive, we find that firms headquartered in more discriminatory provinces are more likely to fire a female manager than a male one. This finding is noteworthy, because females who manage to overcome such discrimination and successfully achieve a top executive position should be especially capable and thus should face a lower likelihood of being fired. Overall, the lower likelihood of being appointed and the higher likelihood of being removed lead to a significantly negative relation between sex ratio at birth and the proportion of female executives in top management teams.

Moreover, conditional on a female reaching an executive position, sex discrimination also has an impact on her compensation. We find a significantly negative relation between sex ratio at birth and the gap in compensation between female executives and their male peers: female executives are paid significantly less than their male counterparts, especially in the provinces with more severe discrimination.

There could be a reverse causality issue: after observing successful women (i.e., women in top management positions of public firms), parents are less likely to abort girls, leading to a negative relation between sex ratio at birth and the prevalence of female top managers. We conduct two tests to investigate this possibility. First, given that we examine public firm data between 2000 and 2011, and that the earliest year with available province-level sex ratio figures is 1990, we use the sex ratio at birth figure in 1990 to replace the

contemporaneous sex ratio at birth and our inferences are unchanged. Second, large firms are usually more influential than small firms. Therefore, under this reverse causality explanation, one should expect the negative relation between sex ratio at birth and the prevalence of female top managers to be more pronounced in large firms than in small firms. Opposite to this prediction, we find that the relation between sex ratio at birth and the prevalence of female top managers is more pronounced actually in small firms than in large firms, which is consistent with the view that small firms generally are more reliant on local market and thus are more sensitive to local gender bias. Overall, the reverse causality concern is unlikely to drive our results.

We further extend our analysis of female representation in top management to firms' board of directors. We also find a negative association between sex ratio at birth and the prevalence of female directors on the board, indicating that sex discrimination prevents females not only from reaching top management positions, but also from joining the board.

In summary, our paper contributes to the literature by providing evidence that discrimination against women is an important factor leading to the underrepresentation of female top managers in large corporations. Even though we focus on China, this paper also provides some implications for other developed countries such as the US. The underrepresentation of female executives is not limited to developing markets and the reasons behind this phenomenon are still controversial. Our finding shows that female discrimination may be one of the reasons why female executives are rare in the public firms in the US. Since the underrepresentation would lead to underperformance, it would be interesting to examine whether there are some mechanisms in the US that could mitigate the effect of female discrimination and improve market efficiency. The rich data on corporate governance, large

shareholders, regulation of law and culture and religion difference for the US provides an opportunity to do these kinds of test in future research.

The paper is organized as follows. We review the literature in the following section. Section 3 describes the data and key variable construction. Section 4 presents the empirical results on the relation between sex discrimination and the representation of female top managers. Finally, we conclude the paper in Section 5 with a brief summary.

2. Related Literature

Our study is related to the research in three areas: the social and economic implications of sex ratio, gender discrimination in the labor market, and the difference in corporate decisions made by male and female executives.

First, there is an increasing interest in the implication of a high sex ratio imbalance on status goods and social norms among economists. Wei and Zhang (2011a) and Wei and Zhang (2011b) find that when there is a great surplus of men in the pre-marital age cohort, parents of a son, or sons themselves, are more eager to do something to improve their standing in the marriage market by raising their savings, inducting more entrepreneurship activities, supplying more labor, and becoming more willing to take unpleasant jobs for a higher expected pay. On the other side, Edlund, Li, Yi, and Zhang (2013) find a positive association between sex ratio of 15–25 year-olds and crime rates: when young men cannot find wives, they commit more crimes. Using the world tea price as an instrument, Qian (2008) shows that an improvement in the economic status of women tends to reduce the sex ratio imbalance. Our study contributes to this literature by showing the significant negative association between sex ratio at birth and the representation of female top managers.

Second, there is also substantial literature about sex discrimination in the labor market (see Bertrand (2010), Fryer (2010), and Charles and Guryan (2011) for excellent reviews). Due to a lack of explicit observations of discrimination, economists typically measure sex discrimination in the labor markets indirectly by estimating the male-female wage differentials that are not attributable to observable differences in the human capital of workers (see, for example, Blinder (1973), Oaxaca (1973), and Mincer and Polachek (1974)). As pointed out by Kuhn (1987), this method may be biased because it fails to account for the discrimination in selecting women into job positions. Complementing this literature, our paper shows that sex discrimination not only leads to the compensation difference between female and male corporate executives, but also prevents women from reaching top management positions in the first place.³

Lastly, our study is also related to the surging literature on how male and female executives differ in corporate decisions. Huang and Kisgen (2013) find that acquisitions made by female executives have a higher announcement return than those made by male executives, and they interpret this finding as female executives being less overconfident than their male counterparts. Faccio, Marchica and Mura (2012) find that firms run by female CEOs have a higher chance of survival than firms run by male CEOs. In the banking industry, Beck, Behr and Guettler (2013) show that loans handled by female loan officers have a lower likelihood to turn problematic than those handled by male loan officers. From the perspective of the board of directors, Adams and Ferreira (2009) document that having females on the board usually improves board effectiveness. Moreover, firms with greater female participation on their boards are found to exhibit higher earnings quality and have better informativeness of stock prices (Gul, Srinidhi, and Ng (2011) and Srinidhi, Gul, and Tsui

³Instead of examining the wage difference between males and females, Kuhn and Shen (2013) study explicit gender discrimination in a population of advertisements on a Chinese Internet job board and find that gender-targeted job advertisements are common.

(2011)). In the context of acquisitions, Levi, Li, and Zhang (2013) find that acquiring firms with female directors on the board are less likely to overpay the target firms. Although these studies enhance our understanding of gender difference in corporate decision-making, none of them investigates why so few women are in top management positions, even when their decision-making skills are no worse than their male peers’.

3. Sample

Our primary measure of discrimination is the province-level boy-to-girl sex ratio at birth statistic, obtained from population census surveys in 2000, 2005, and 2010, conducted by the Chinese National Statistics Bureau.⁴The total number of each gender born in the 12-month period around the survey dates were recorded for each province. Our sample firms are the ones listed in the Shanghai and Shenzhen stock exchanges from 2000 to 2011, obtained from the CSMAR database. We start in 2000 because the CSMAR database starts to record detailed executive information from 2000. Similar to the U.S., executive positions in China typically include CEO, CFO, COO, Vice President, etc. Given that the sex ratio data is available every five years, for each firm-year observation we obtain the province-level sex ratio at birth in the firm’s headquarters in the closest prior year. That is, we apply the 2000, 2005, and 2010 survey information to the 2000–2004, 2005–2009, and 2010–2011 sample period, respectively.⁵Our final sample consists of 13,624 firm-year observations over the 2000–2011 period. We winsorize all continuous variables at the 1st and 99th percentiles and

⁴ The Chinese National Statistics Bureau usually conducts the population census surveys every five years and thus there are three surveys in the 2000–2010 period. We use the province-level data on sex ratio at birth mainly because the finest granularity of this information is at the province level.

⁵ Sex ratio at birth shows few changes over time. For example, the correlation coefficient between sex ratio at birth in 2000 and sex ratio at birth in 2010 is 0.75. This fact is consistent with our argument that sex ratio at birth reflects parents’ preference for sons, which changes very slowly over time.

convert all Chinese Yuan values to 2011 U.S. dollars.⁶ Detailed definitions of the variables are presented in Appendix 2.

Panel A of Table 1 presents the summary statistics of sample firms. In the median firm, only 10% of top management positions are held by women (i.e., the ratio of male executives to female executives is close to 9), while the median ratio of male workers over female workers in the labor force is 1.216, and the median ratio of males with college education over females with college education is 1.325. Clearly, the underrepresentation of female top managers cannot be fully explained by the difference in participation in the labor market or the difference in education level in the overall population. Moreover, the median sample firm is eight years old and has total assets of \$287 million. Further, it performs well with an ROA of 3.42% and a market-to-book ratio of 1.325.

Panel B of Table 1 presents the correlation matrix among independent variables. It is worth pointing out that sex ratio at birth is negatively associated with sex ratio in labor force with a correlation coefficient of -0.29 , but is positively associated with sex ratio with college degree with a correlation coefficient of 0.37 . This finding suggests that in provinces with stronger sex discrimination, girls (as compared to boys) have poorer opportunities for college and tend to enter the labor market at a younger age. The fact that these coefficients are relatively small in magnitude is not surprising, given that there is around a 20-year lag for an infant to obtain a college degree and enter the labor market, and that families may move from one province to another during this 20-year period. Moreover, none of the correlations among firm characteristics are high enough to warrant multicollinearity concerns for our multivariate analyses.

⁶ Chinese Yuan is converted to U.S. dollars based on an exchange rate of one U.S. dollar to seven Chinese Yuan.

As shown in Table 2, the average sex ratio at birth is 1.163 in China, indicating that there is severe discrimination against females.⁷ More importantly, there is great variation in this ratio across different provinces in China. The top three provinces with the highest sex ratios at birth are Anhui (1.291), Hainan (1.280), and Hubei (1.270), while the three provinces with the lowest sex ratios at birth are Ningxia (1.098), Xinjiang (1.057), and Tibet (1.045). The most economically developed areas (such as Beijing, Shanghai, and Guangdong) are in the middle of the list.⁸ Column (4) of Table 2 presents the percentage of female executives in firms headquartered in the corresponding provinces. In the last column, to account for the difference in industry distribution across different provinces, we compute the industry average adjusted percentage of female executives and find a clear pattern that the industry-adjusted percentage of female executives is typically negative when the sex ratio at birth is high and becomes positive when the sex ratio at birth is low.

In Figure 1 Panel A, we split our sample based on the median sex ratio at birth and plot the time-series pattern of the percentage of female executives. In each year of our sample, firms in areas with a high sex ratio at birth have fewer female executives than the ones in areas with a low sex ratio at birth. This difference is quite stable over the entire sample period, while both types of firms experience a modest increasing trend in the percentage of female executives. In Panel B, we plot the industry-average-adjusted percentage of female executives (the difference between a firm's percentage of female executives and the industry average value) and see similar patterns.

⁷ Assuming that the global benchmark of sex ratio at birth is 1.05, a t -test of the null of the sex ratio at birth being 1.05 is rejected at the 1% level.

⁸ Although son preference is the fundamental driving force for the imbalanced sex ratio at birth, the regional variation in sex ratio at birth may also be partially driven by the enforcement of the one-child policy and the availability of sex-selective abortion technology (i.e. Ultrasound B) in different provinces. To the extent that an individual firm's choice of having female executives has little to do with the one-child policy or Ultrasound B technology, this possibility works against us finding any significant results between sex ratio at birth and female representation in the top management team.

Table 3 presents the distribution of percentage of female executives across industries based on the industry classification from the Chinese Securities Regulatory Commission. The top three industries with most female executives are wholesale and retail (20.62%), textile and apparel (20.48%), and pharmaceuticals (15.55%). As expected, construction, metals and non-metals, and mining are the three industries with the fewest female executives, with the percentage of female executives being 8.11%, 7.18%, and 5.56%, respectively. This finding is broadly consistent with prior literature, which shows that female executives are more prevalent in service-oriented or women's products industries than in mining and manufacturing industries (Harrigan (1981), Fryxell and Lerner (1989), and Bertrand and Hallock (2001)).

4. Empirical Results

4.1 Percentage of Female Executives

We estimate the following ordinary least squares (OLS) regression to examine whether discrimination against women is related to the proportion of female executives in firms' top management teams:

$$\begin{aligned} \text{Percentage of female executives} = & \alpha + \beta_1 \text{Sex ratio at birth} + \beta_2 \text{Ln}(\text{total assets}) + \\ & \beta_3 \text{Firm age} + \frac{\beta_4 M}{B} + \beta_5 \text{ROA} + \beta_6 \text{Stock volatility} + \beta_7 \text{Ln}(\text{GDP per capita}) + \\ & \beta_8 \text{Sex ratio with college degree} + \beta_9 \text{Sex ratio in labor force} + \\ & \beta_{10} \text{Unemployment rate} + \beta_{11} \text{Corruption} + \text{Industry FEs} + \text{Year FEs} + \varepsilon. \end{aligned} \quad (1)$$

In Column (1) of Table 4 Panel A, we only include *Sex ratio at birth* and industry and year fixed effects in the regression; the coefficient on *Sex ratio at birth* is -14.448 and is significant at the 1% level. Further controlling for firm size in Column (2), the coefficient on

Sex ratio at birth is -15.417 and is still significant at the 1% level. We then control for firm age, market-to-book (M/B) ratio, ROA, and stock return volatility in Column (3) and still obtain a significant and negative coefficient on *Sex ratio at birth*. In Column (4), we include a few province characteristics. In particular, we use GDP per capita to control for the economic development, and use the ratio of the number of men with college degree over the number of women with college degree (sex ratio with college degree) and the ratio of the number of men in the labor force over the number of women in the labor force (sex ratio in labor force) to account for the overall labor market supply of men and women. Cai, Fang, and Xu (2011) find that Chinese firms spend significantly building relational capital with suppliers, clients, and government bureaucrats, spanning a wide variety of entertainment activities including eating, drinking, gifts, karaoke, and sports club membership. If males are more suitable than female for these entertainment activities, then it is not surprising to see a lack of female executives, especially in areas with a high level of corruption. Therefore, corruption could be one reason for the underrepresentation of female executives. We use a proxy for the corruption at the province level: the number of persons charged for corruption per 10,000 civil servants. The coefficient on *Sex ratio at birth* is -10.971 and is still significant at the 1% level. The economic magnitude of this coefficient is also sizeable: a one standard deviation decrease in the sex ratio at birth is associated with a increase in the percentage of female executives by 0.77% ($=0.07 \times 10.971\%$). This is equal to 6.4% increase from average ($=0.77\%/12.03\%$). As for the coefficient on Corruption, it is negative and significant, suggesting that corruption is related to the low level of female executives in listed firms.

Moreover, consistent with the view that firms facing less product market competition are more likely to discriminate (Ashenfelter and Hannan (1986) and Kuhn and Shen (2013)), large firms have a lower percentage of female executives. Firms in more developed provinces (higher GDP per capita) are found to have more female executives, consistent with

Adams and Kirchmaier's (2012) finding that country-level income per capita is positively related to female director representation on the board. The coefficients on the ratio of men over women with a college education and the ratio of men over women in the labor force are not significantly different from zero, indicating that firms' candidate pool for top managers is different from the general labor force. It is also worth noting that the *Sex ratio at birth* variable measures the contemporaneous ratio of infant boys over infant girls, which has no direct effect on the contemporaneous labor market pool for corporate executives. Thus, after controlling for the contemporaneous male-to-female ratio in the labor force, the effect of *Sex ratio at birth* on the proportion of female executives is not because there are simply more men than women in the labor market.⁹

In Panel B, we conduct various subsample analyses to further our understanding of how local discrimination influences the prevalence of female executives in a firm. First, the selection of top management, especially CEOs, in Chinese state-owned enterprises (SOEs) is greatly influenced by the central government (Qian (1996) and Chang and Wong (2004)). For this reason, the association between local discrimination and percentage of female executives may be weaker in SOEs than in non-SOEs. On the other hand, Kuhn and Shen (2013) find that sex discrimination is more severe in Chinese SOEs than in non-SOEs, because SOEs typically face less product market competition. Thus, *a priori*, it is not clear whether the sex ratio at birth variable influences the presence of female top managers in a different way across these two types of firms. In Columns (1) and (2), we separately examine SOE and non-SOE public firms and find that the coefficients on *Sex ratio at birth* in both columns are negative and significant. The corresponding Chow test on the equality of these two

⁹Moreover, as reported in Panel B of Table 1, sex ratio at birth is negatively correlated with sex ratio in the labor force, which further mitigates the concern that our results are driven by the fact that there are more men than women in the labor force in the provinces with high sex ratio at birth.

coefficients indicates no significant difference, implying that local discrimination influences SOEs as much as non-SOEs.

Second, the construction, metals and nonmetals, and mining industries are typically regarded as men-dominated industries, in which the executive positions are held by the lowest percentage of women in our sample. To examine whether the effect of *Sex ratio at birth* on the proportion of female executives varies across different industries, we further divide our sample into men-dominated industry and non-men-dominated industry and re-estimate Equation (1) based on the two subsamples, respectively. As shown in Columns (3) and (4), the coefficient on *Sex ratio at birth* is around a significant -10 in both columns, indicating that the effect of local gender discrimination on female executive representation is as strong in men-dominated industries as in other industries.¹⁰

Third, Shanghai and Guangdong (where the Shanghai Stock Exchange and the Shenzhen Stock Exchange are located, respectively) have the largest number of firms in our sample. To investigate whether our results are driven by these two places, we exclude Shanghai and Guangdong and re-estimate Equation (1). As reported in Column (5), the coefficient on *Sex ratio at birth* is still negative and significant.

Lastly, although public firms seldom move their headquarters (Pirinsky and Wang (2006) and Deng and Gao (2013)), it may be less accurate to identify a firm's local gender preference if the firm frequently changes its headquarters. In our sample, 99 firms relocate their headquarters during our sample period.¹¹ As a robustness check, in Column (6), we

¹⁰The corresponding Chow test on the equality of *Sex ratio at birth* across Columns (3) and (4) indicates no significant difference.

¹¹ Among these firms, 46 relocated their headquarters to Beijing, Shanghai, and Guangdong. This seems to suggest that the motivation for firms' relocation decision is to get closer to the financial or political center. Nevertheless, we find no evidence that firms hire more (fewer) female top managers after relocating to provinces with less (more) discrimination, possibly because the size of this relocating sample is too small and/or it takes time for a firm to change its top management team.

exclude these firms from the sample and re-estimate Equation (1). The *Sex ratio at birth* variable still attracts a negative and significant coefficient.

In Panel C, we employ several alternative methods to capture the female executive representation in a firm. In Column (1), to further account for the industry effects on the prevalence of female executives, we employ the industry-average-adjusted percentage of female executives as the dependent variable and find that the coefficient on *Sex ratio at birth* is -11.042 and is significant at the 1% level.

So far, we have controlled for the sex ratio with college degree and sex ratio in the labor force in the regression to account for the sex ratio in the general labor market pool. This method may be problematic if the influence of sex ratio with college degree and sex ratio in the labor force on the percentage of female executives is in a non-linear form. To address this concern, in Column (2) of Panel C, the dependent variable is the education-adjusted percentage of female executives, defined as (the percentage of female executives – the number of women as a percentage of the total number of people with a college degree in that province). Similarly, in Column (3), the dependent variable is the labor-adjusted percentage of female executives, defined as (the percentage of female executives – the number of women as a percentage of the total number of people in the labor force in that province). The coefficients on *Sex ratio at birth* are still negative and significant at the 1% level.

In summary, Table 4 documents a significant and robust negative association between the percentage of female executives and the local ratio of infant boys to infant girls, indicating that firms in locations with stronger discrimination against women have fewer female top managers.

4.2 New Appointments and the Dismissal of Female Executives

A natural question arising from Table 4 is this: Is the negative association between the percentage of female top managers and the sex ratio at birth due to a lower likelihood for women to be appointed as executives or a higher likelihood for female executives to be dismissed? We further examine this issue in Tables 5 and 6. Table 5 presents the logit regression results based on all new executive appointment cases in our sample firms (1,618 unique cases of appointing female executives and 11,667 unique cases of appointing male executives). The dependent variable takes the value of 1 if the newly appointed executive is a female, and 0 if the newly appointed executive is a male. We also control for the executive positions (the job title fixed effects) in the regression to account for the heterogeneity in job responsibility across top management positions. The coefficient on *Sex ratio at birth* is negative and significant at the 1% level across all the specifications, indicating that the appointment of a female executive (relative to a male executive) is less likely to occur in a province with stronger gender discrimination.

Table 6 presents the logit regression results on executive dismissal. We start with all executive dismissal cases in our sample. To the extent that some executive departures may be due to voluntary retirement rather than forced dismissal and the typical retirement age for men (women) is 60 (55) in China, we exclude all the departing male (female) executives aged 60 (55) or above. Further, to account for the possibility that some executive departures are due to better outside job offers, we also exclude the cases in which the departing executives take executive positions in other firms within three years afterwards. Our final sample in Table 6 consists of 1,088 dismissal cases of female executives and 4,033 dismissal cases of male executives. The dependent variable takes the value 1 if the dismissed executive is a female, and 0 if the dismissed executive is a male. We also include the manager's tenure in the regression to control for his/her seniority in the firm. In Column (1), we focus on the

firms with at least one female executive. The coefficient on *Sex ratio at birth* is not significantly different from zero. This insignificant result is likely due to the fact that the number of female executives is particularly small in the provinces with strong gender discrimination, leading to few cases of female executive departure. In Columns (2) and (3), we analyze the firms with at least two and three female executives, respectively, and the coefficients on *Sex ratio at birth* are both positive and significant. These results indicate that conditional on executive dismissal, a female executive faces a higher likelihood of being fired than her male counterparts in provinces with stronger discrimination against women. These findings are striking because one would expect that after overcoming discrimination and reaching top management positions, these female executives are particularly capable and thus less likely to be dismissed. It is possible that the result in Column (3) is simply due to the fact that there are more female executives than male executives in the subsample of firms with at least three female executives. To examine this possibility, we further require that the percentage of female executives is no larger than 50% in Column (4) and we still find a positive and significant coefficient on *Sex ratio at birth*.

Taken together, Tables 5 and 6 show that firms in high discrimination areas are not only less likely to add a new female executive but also more likely to dismiss an existing female executive, leading to a lower percentage of female executives in the cross-section documented in Table 4.

4.3 Difference in Compensation between Female and Male Executives

The discrimination of female executives may also lead to a paygap in compensation between female executives and their male peers (Hoffman (1976), Barbezat (1987), Bertrand and Hallock (2001)). When female executives face discrimination in the labor market, their

compensation can be lower than that of their male counterparts because of limited job opportunities caused by discrimination.¹²In Table 7, we examine how sex ratio at birth is related to executive compensation.¹³For each female manager, we define *Pay gap* as the difference between her Ln(total compensation) and the average Ln(total compensation) of male managers who are in the same province and same industry and hold the same position. The sample mean (median) value of *Pay gap* is $-0.19(-0.15)$, which is significantly different from zero and indicates that female executives are paid, on average, 17% ($= 1 - e^{-0.19}$) less than their male counterparts.

We then regress *Pay gap* on *Sex ratio at birth* as well as various firm and province characteristics. We find that the coefficient on *Sex ratio at birth* is negative and significant across all specifications, indicating that the deficiency in compensation of female executives relative to their male counterparts is more severe when there is a stronger discrimination against women. Taking Column (4) for example, the coefficient on *Sex ratio at birth* is -0.970 and is significant at the 5% level: a one-standard-deviation increase in sex ratio at birth (0.07) is associated with a more severe pay gap by 0.068 ($= 0.970 \times 0.07$), or equivalently 6.6% ($= 1 - e^{-0.068}$) lower compensation of the female executives relative to their male counterparts. Finally, we also find that female executives in large and well-performing firms and female executives with long tenure have a narrower pay gap relative to their male counterparts.

Overall, Table 7 provides evidence that sex discrimination plays an important role in the gender pay gap between female and male top managers.

¹²A counterargument can be that conditional on reaching top management positions, female managers are more capable and thus paid more.

¹³Chinese public firms started to report executive compensation information from 2005. Thus, the sample period in Table 7 is from 2005 to 2011.

4.4 Address Reverse Causality

There is a concern of reverse causality: parents are more willing to deliver a baby girl after observing more successful women (i.e., the females who reach top executive positions in public firms), leading to a negative association between the sex ratio at birth and the prevalence of female executives in public firms. We conduct two tests to address this possibility. First, we use sex ratio at birth in 1990 (the earliest year for available province-level sex ratio information) as the key independent variable and re-estimate Equation (1).¹⁴ As reported in Table 8 Panel A, the coefficients on *Sex ratio at birth 1990* are all negative and significant at the 1% level, implying that firms are less likely to have female executives when there is a strong discrimination against females. This test helps mitigate the above reverse causality concern because it is impossible for parents in 1990 to base their reproduction decisions on the prevalence of female top managers in the 2000–2011 period.

As our second test to investigate the possibility of reverse causality, we examine whether the relation between sex ratio at birth and the prevalence of female executives is stronger in large firms or in small firms. Considering that large firms are usually more influential than small firms, one should expect the relation between sex ratio at birth and the prevalence of female executives to be stronger in large firms if the prevalence of female executives drives local gender bias. In contrast, small firms generally are more reliant on local market and thus are more easily influenced by local gender bias. For this reason, one should expect the relation between sex ratio at birth and the prevalence of female executives to be stronger in small firms if local gender bias drives the prevalence of female executives. In Panel B of Table 8, we define the *Big firm* indicator variable that takes the value of 1 if the firm's total assets are in the top quartile of the sample, and 0 otherwise. Then, we re-estimate

¹⁴Chongqing became a municipality in 1997. Prior to that, Chongqing is part of Sichuan Province and there is no sex ratio data available for Chongqing in 1990. Therefore, we apply the 1990 sex ratio of Sichuan to Chongqing.

Equation (1) by including the *Big firm* indicator and its interaction with the sex ratio at birth variable. In Column (1) of Panel B, we find that the coefficient on the interaction term, *Sex ratio at birth 1990* $\times$ *Big firm indicator*, is positive and significant at the 5% level, indicating that the effect of local gender bias is stronger in small firms than in large firms. In Column (2), we use the contemporaneous sex ratio at birth and continue to find a positive and significant coefficient on the interaction, *Sex ratio at birth* $\times$ *Big firm indicator*. These results are opposite to what the reverse causality explanation predicts, and indicate that gender bias drives the prevalence of female top managers and it is not the other way round.

4.5 Female Board of Directors

Women hold not only few corporate executive positions but also few board seats, relative to men. For example, women held only 16.6% of Fortune 500 board seats in 2012 (Catalyst (2012)).¹⁵ Despite few women on the board, Adams and Ferreira (2009) find that having female directors usually increases board effectiveness. Thus, it is an interesting question to ask: why are few women in the boardroom while they usually enhance board effectiveness? Does sex discrimination also play a role in director selection? To investigate this question, we extend our analysis from the top management team to the board of directors in Table 9.

The regression specification follows Equation (1). The dependent variable in Column (1) is the number of women as a percentage of the total number of executives and directors. The significant and negative coefficient on *Sex ratio at birth* indicates that firms in the provinces with a higher sex ratio at birth have fewer female corporate executives and directors, consistent with the findings in Table 4. We further examine the percentage of

¹⁵<http://www.catalyst.org/media/catalyst-2012-census-fortune-500-no-change-women-top-leadership>

female directors on the board in Column (2) and still find a significantly negative coefficient of -7.018 on *Sex ratio at birth*. The economic magnitude of this coefficient is also nontrivial: an increase in *Sex ratio at birth* by one standard deviation (0.07) is associated with a decrease in the percentage of female directors on the board by 0.5% ($= 0.07 \times 7.018\%$), considering that the sample average percentage of female directors on the board is 9.8% . Overall, our results suggest that sex discrimination prevents women not only from reaching top management positions but also from joining the boardroom.

5. Conclusions

Why are female executives underrepresented in large firms? Does sex discrimination play a role? Although it is widely suspected that women are discriminated from reaching the top management position, evidence is lacking. This absence of evidence is probably due to the difficulties of measuring sex discrimination.

In this paper, we use the sex ratio at birth as a measure of discrimination against women and find that firms headquartered in more discriminatory areas have a lower proportion of female executives in their top management team. This relation arises from the fact that those firms are less likely to add new female executives but are more likely to remove existing female ones. Even if females reach top management positions, they are paid significantly less than their male counterparts in areas exhibiting stronger discrimination. Overall, we provide evidence that discrimination is an important factor that prevents women from climbing the corporate ladder.

Our study suggests a few directions for future research. First, as we discussed in the Introduction section, the effect of sex discrimination on female executives can be through both the supply channel (i.e., sex discrimination reduces the supply of qualified female

candidates for executive positions) and the demand channel (i.e., sex discrimination reduces the demand of public firms for female executives). The relative importance of the two channels is worth further investigation in the future. Second, although our paper focuses on China, the basic mechanism could be applied to other countries with an imbalanced sex ratio at birth, including Singapore, India, South Korea, Taiwan, Vietnam, Hong Kong, etc. Studies of international data on this issue could be an interesting area for future research. Lastly, while the sex ratio at birth in the U.S. is fairly balanced on average, there is still noticeable variation across different races and birth orders within the country. As reported by Egan et al. (2011), in the U.S. from 1975 to 2002, the sex ratio at birth is 1.053 for Whites, 1.030 for Blacks, 1.074 for Chinese, 1.073 for Filipinos, 1.068 for Asian Indians, and 1.080 for Koreans. The highest sex ratios are seen for third+ births to Asian Indians (1.126), Chinese (1.111), and Koreans (1.109). Considering Asian Americans are a growing and sizeable part of the total population of the U.S., their gender preference could have important implications on the U.S. economy, which deserves more investigation in future research.

References

- Adams, Renee B., and Daniel Ferreira, 2009. Women in the Boardroom and Their Impact on Governance and Performance. *Journal of Financial Economics* 94, 291-309.
- Adams, Renee B., and Tom Kirchmaier, 2012. Making It to the Top: From Female Labor Force Participation to Boardroom Gender Diversity. University of New South Wales working paper.
- Adams, Renee B., and Patricia C. Funk, 2012. Beyond the Glass Ceiling: Does Gender Matter? *Management Science* 58, 219-235.
- Altonji, Joseph G., and Rebecca M. Blank, 1999. Race and Gender in the Labor Market. In: Ashenfelter, Orley C., Card, David (Eds.), *Handbook of Labor Economics*, vol. 3. Elsevier.
- Ashenfelter, Orley, and Timothy Hannan, 1986. Sex Discrimination and Product Market Competition: The Case of the Banking Industry. *Quarterly Journal of Economics* 101, 149-173.
- Barbezat, Debra, 1987. Salary Differentials by Sex in the Academic Labor Market. *Journal of Human Resources* 22, 422-28.
- Beck, Thorsten, Patrick Behr, and Andre Guettler, 2013. Gender and Banking: Are Women Better Loan Officers? *Review of Finance* 17, 1279-1321.
- Becker, Gary S., 1971. *The Economics of Discrimination* 2nd edition. The University of Chicago Press, Chicago, IL.
- Bertrand, Marianne, and Hallock, Kevin, 2001. The Gender Gap in Top Corporate Jobs. *Industrial and Labor Relations Review* 55, 3-21.
- Bertrand, Marianne, Claudia Goldin, and Lawrence F. Katz, 2010. Dynamics of the Gender Gap for Young Professionals in the Financial and Corporate Sectors. *American Economic Journal: Applied Economics* 2, 228-255.
- Blinder Alan S, 1973. Wage Discrimination: Reduced Form and Structural Estimates. *Journal of Human Resource* 8, 436-55
- Cai, Hongbin, Hanming Fang and Lixin xu, 2011. Eat, Drink, Firms and Government: An Investigation of Corruption from Entertainment and Travel Costs of Chinese Firms. *Journal of Law and Economics* 54, 55-78.
- Carter, David., Betty J. Simkins, and W. Gary Simpson, 2003. Corporate Governance, Board Diversity, and Firm Value. *Financial Review* 38, 33-53.

- Chang, Eric C., and Sonia M. L. Wong, 2004. Political Control and Performance in China's Listed Firms. *Journal of Comparative Economics* 32, 617–36.
- Charles, Kerwin Kofi, and Jonathan Guryan, 2011. Studying Discrimination: Fundamental Challenges and Recent Progress. *Annual Review of Economics* 3, 479-511.
- Coate, Stephen, and Glenn Laury, 1993. Will Affirmative-action Policies Eliminate Negative Stereotypes? *American Economic Review* 83, 1220-1240.
- Deng, Xin, and Huasheng Gao, 2013. Nonmonetary Benefits, Quality of Life, and Executive Compensation. *Journal of Financial and Quantitative Analysis* 48, 197-218.
- Dezso, Cristian, and David Gaddis Ross, 2012. Does Female Representation in Top Management Improve Firm Performance? A Panel Data Investigation. *Strategic Management Journal* 33, 1072-1089.
- Ebenstein, Avraham, 2011. Estimating a Dynamic Model of Sex Selection in China. *Demography* 48, 783-811.
- Edlund, Lena, Hongbin Li, Junjian Yi, and Junsen Zhang, 2013. Sex Ratios and Crime: Evidence from China. *The Review of Economics and Statistics* 95, 1520-1534.
- Egan, James, Winston Campbell, Audrey Chapman, Alireza Shamshirsaz, Padmalatha Gurram, and Peter Benn, 2011. Distortions of Sex Ratios at Birth in the United States: Evidence for Prenatal Gender Selection. *Prenatal Diagnosis* 31, 560-565.
- Faccio, Mara, Maria-Teresa Marchica, and Roberto Mura, 2012. CEO Gender, Corporate Risk Taking, and the Efficiency of Capital Allocation. Purdue University working paper.
- Foote, Christopher, Warren Whatley, and Gavin Wright, 2003. Arbitraging a Discriminatory Labor Market: Black Workers at the Ford Motor Company, 1918-1947. *Journal of Labor Economics* 21, 493-531.
- Fryer, Roland, 2011. Racial Inequality in the 21st Century: The Declining Significance of Discrimination, *Handbook of Labor Economics*, volume 4B, Orley Ashenfelter and David Card, eds., 855–971.
- Fryxell, Gerald E., and Linda D. Lerner, 1989. Contrasting Corporate Profiles: Women and Minority Representation in Top Management Positions. *Journal of Business Ethics* 8, 341– 352.
- Gul, Ferdinand, Bin Srinidhi, and Anthony Ng, 2011. Does Board Gender Diversity Improve the informativeness of Stock Prices? *Journal of Accounting and Economics* 51, 314-338.
- Harrigan, Kathryn Rudie, 1981. Numbers and Positions of Women Elected to Corporate Boards. *Academy of Management Journal* 24, 619– 625.

- Hoffman, Emily, 1976. Faculty Salaries: Is There Discrimination by Sex, Race, and Discipline? *American Economic Review* 66, 196-98.
- Huang, Jiekun, and Darren Kisgen, 2013. Gender and Corporate Finance: Are Male Executives Overconfident Relative to Female Executives? *Journal of Financial Economics* 108, 822-839.
- Knyazeva, Anzhela, Diana Knyazeva, and Ronald Masulis, 2013. The Supply of Corporate Directors and Board Independence, *Review of Financial Studies* 26, 1561-1605.
- Kuhn, Peter, 1987. Sex Discrimination in Labor Markets: The Role of Statistical Evidence. *American Economic Review* 77, 567-83.
- Kuhn, Peter, and Kailing Shen, 2013. Gender Discrimination in Job ADS: Evidence from China. *The Quarterly Journal of Economics* 128, 287-336.
- Lee, Peggy, and Erika Hayes James, 2007. She'-E-Os: Gender Effects and Investor Reactions to the Announcements of Top Executive Appointments. *Strategic Management Journal* 28, 227-241.
- Levi, Maurice, Kai Li, and Feng Zhang, 2013. Director Gender and Mergers and Acquisitions. *Journal of Corporate Finance* forthcoming.
- Milliken, Frances J. and Luis L. Martins, 1996. Searching for Common Threads: Understanding the Multiple Effects of Diversity in Organizational Groups. *Academy of Management Review* 21, 402-433.
- Mincer, Jacob and Solomon Polachek, 1974. Family Investments in Human Capital: Earnings of Women. *The Journal of Political Economy* 82, 76-108.
- Niederle, Muriel and Lise Vesterlund, 2007. Do Women Shy away from Competition? Do Men Compete too Much? *Quarterly Journal of Economics* 122, 1067-1101.
- Oaxaca, Ronald, 1973. Male-Female Wage Differentials in Urban Labor Markets. *International Economic Review* 14, 693-709.
- OECD, 2012. Social Institutions and Gender Index, OECD Development Centre, OECD Publishing, Paris.
- Pirinsky, Christo, and Qinghai Wang, 2006. Does Corporate Headquarters Location Matter for Stock Returns? *Journal of Finance* 61, 1991-2015.
- Qian, Nancy, 2008. Missing Women and the Price of Tea in China: The Effect of Sex-Specific Earnings on Sex Imbalance. *Quarterly Journal of Economics* 123, 1251-85.
- Qian, Yingyi, 1996. Enterprise Reform in China: Agency Problems and Political Control. *Economics of Transition* 4, 427-447.

- Scharping, Thomas. 2003. *Birth Control in China 1949-2000*. New York, NY: Routledge Curzon.
- Siegel, Jordan, Lynn Pyun, and B.Y. Cheon, 2013. Multinational Firms, Labor Market Discrimination, and the Capture of Competitive Advantage by Exploiting the Social Divide. Harvard University working paper.
- Srinidhi, Bin, Ferdinand A. Gul, and Judy Tsui, 2011. Female Directors and Earnings Quality. *Contemporary Accounting Research* 28, 1610-1644.
- Staiger, Douglas, and James H. Stock, 1997. Instrumental Variables Regression with Weak Instruments. *Econometrica* 65, 557-586.
- Wei, Shang-Jin, and Xiaobo Zhang, 2011a. The Competitive Saving Motive: Evidence from Rising Sex Ratios and Savings Rates in China. *Journal of Political Economy* 119, 511-564.
- Wei, Shang-Jin, and Xiaobo Zhang. 2011b. Sex Ratios, Entrepreneurship, and Economic Growth in the People's Republic of China. Columbia University working paper.
- World Bank. 2013. The Little Data Book on Gender 2013. Washington, DC. <https://openknowledge.worldbank.org/handle/10986/13206>
- Zhu, Wei Xing, Li Lu, and Therese Hesketh, 2009. China's Excess Males, Sex Selective Abortion, and One Child Policy: Analysis of Data from 2005 National Intercensus Survey. *British Medical Journal* 338, 920-923.

Table 1. Summary Statistics

The sample consists of 13,624 firm-year observations from 2000 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. All dollar value variables are measured in 2011 constant dollars and all continuous variables are winsorized at the 1st and 99th percentiles. In Panel B, p-values of the correlation coefficients are reported in parentheses. The variable definitions are provided in Appendix 2.

Panel A: Characteristics of Sample Firms

	Mean	Std	P25	Median	P75
Percentage of female executives	12.03%	14.17%	0.00%	10.00%	20.00%
Sex ratio at birth	1.163	0.070	1.118	1.148	1.213
Sex ratio in labor force	1.257	0.129	1.159	1.216	1.337
Sex ratio with college degree	1.382	0.300	1.185	1.325	1.533
GDP per capita	3237	2401	1527	2481	4100
Firm age	8.111	4.129	5.000	8.000	11.000
Total assets (\$ millions)	760	1854	157	287	600
ROA	3.12%	7.22%	1.09%	3.42%	6.30%
M/B	1.638	0.918	1.077	1.325	1.831
Stock volatility	13.90%	4.89%	9.94%	13.18%	17.23%

Panel B: Correlation Matrix

	1	2	3	4	5	6	7	8	9
1 Sex ratio at birth	1								
2 Sex ratio in labor force	-0.29 (0.00)	1							
3 Sex ratio with college degree	0.37 (0.00)	-0.44 (0.00)	1						
4 Ln (GDP per capita)	-0.21 (0.00)	0.46 (0.00)	-0.54 (0.00)	1					
5 Firm age	-0.02 (0.02)	0.09 (0.00)	-0.28 (0.00)	0.36 (0.00)	1				
6 Ln(total assets)	-0.05 (0.00)	0.13 (0.00)	-0.19 (0.00)	0.26 (0.00)	0.15 (0.00)	1			
7 ROA	-0.01 (0.35)	0.02 (0.01)	-0.03 (0.00)	0.09 (0.00)	-0.11 (0.00)	0.18 (0.00)	1		
8 M/B	-0.03 (0.00)	0.03 (0.00)	-0.09 (0.00)	0.12 (0.00)	0.13 (0.00)	-0.32 (0.00)	0.13 (0.00)	1	
9 Stock volatility	-0.01 (0.22)	0.05 (0.00)	-0.20 (0.00)	0.27 (0.00)	0.34 (0.00)	0.01 (0.16)	-0.01 (0.40)	0.36 (0.00)	1

Table 2. Sex Ratio at Birth and Percentage of Female Executives across Provinces

The sample consists of 13,624 firm-year observations from 2000 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. All continuous variables are winsorized at the 1st and 99th percentiles. The variable definitions are provided in Appendix 2. The Chinese names of the provinces are provided in parentheses.

Province	Sexratio at birth	# of firm-year observations	Percentage of female executives (mean)	Industry-average adjusted percentage of female executives (mean)
Anhui (安徽)	1.291	435	9.47%	−0.29%
Hainan (海南)	1.280	191	11.64%	0.32%
Hubei (湖北)	1.270	617	10.23%	−1.55%
Hunan (湖南)	1.236	420	9.17%	−1.31%
Shaanxi (陕西)	1.235	251	10.53%	0.05%
Guangdong (广东)	1.232	1,588	12.24%	0.23%
Guangxi (广西)	1.230	211	9.32%	−2.14%
Fujian (福建)	1.218	431	11.38%	−1.73%
Jiangxi (江西)	1.211	213	6.11%	−4.34%
Jiangsu (江苏)	1.190	878	11.08%	−1.39%
Guizhou (贵州)	1.179	141	10.93%	1.04%
Henan (河南)	1.172	327	7.56%	−1.94%
Hebei (河北)	1.161	327	8.48%	−1.76%
Gansu (甘肃)	1.157	290	13.40%	2.68%
Shandong (山东)	1.152	781	10.24%	−0.05%
Zhejiang (浙江)	1.152	884	13.24%	0.17%
Sichuan (四川)	1.142	638	9.85%	−0.94%
Tianjian (天津)	1.136	212	13.72%	1.09%
Chongqing (重庆)	1.133	278	14.75%	2.34%
Qinghai (青海)	1.130	94	13.07%	4.24%
Shanghai (上海)	1.130	1,465	14.68%	2.73%
Shanxi (山西)	1.130	226	6.34%	−1.77%
Neimenggu (内蒙古)	1.120	171	9.19%	0.98%
Liaoning (辽宁)	1.118	488	12.07%	0.36%
Jilin (吉林)	1.116	308	14.25%	1.27%
Beijing (北京)	1.112	917	13.31%	1.24%
Yunnan (云南)	1.109	231	10.71%	0.25%
Heilongjiang (黑龙江)	1.106	251	11.09%	0.22%
Ningxia (宁夏)	1.098	5	9.09%	1.73%
Xinjiang (新疆)	1.057	274	16.60%	5.83%
Tibet (西藏)	1.045	81	16.60%	7.76%
Full sample	1.163	13,624	11.68%	-

Table 3. Percentage of Female Executives across Industries

The sample consists of 13,624 firm-year observations from 2000 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. All continuous variables are winsorized at the 1st and 99th percentiles. The classification of industries is defined by China Securities Regulatory Commission. The variable definitions are provided in Appendix 2.

Industry	# of firm-year observations	Average percentage of female executives
Wholesale and retail trade	1,023	20.62%
Textiles and apparel	426	20.48%
Pharmaceuticals	882	15.55%
Real estate	1,107	15.36%
Comprehensive	525	14.41%
Information technology	711	13.10%
Other manufacturing	90	12.96%
Finance and insurance	165	12.80%
Agriculture, forestry, livestock farming, fishery	252	12.78%
Communication and cultural Industry	175	12.72%
Social services	437	11.89%
Paper and printing	236	11.30%
Food and beverage	621	11.06%
Timber and furnishings	25	11.03%
Utilities	642	10.55%
Electronic	522	10.34%
Transportation	544	9.75%
Petrochemicals	1,412	8.52%
Machinery	2,019	8.44%
Construction	246	8.11%
Metals and non-metals	1,179	7.18%
Mining	385	5.56%
Full Sample	13,624	11.68%

Table 4. Gender Discrimination and Percentage of Female Executives

The sample consists of 13,624 firm-year observations from 2000 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. In Panels A and B, the dependent variable is the percentage of female executives in the firm's top management team (measured in percentage points). In Panel C Column (1), the dependent variable is the industry-average-adjusted percentage of female executives, defined as the percentage of female executives –the industry average percentage of female executives (measured in percentage points). In Panel C Column (2), the dependent variable is the education-adjusted percentage of female executives, defined as the percentage of female executives –the number of women as a percentage of total number of people with college degree in that province (measured in percentage points). In Panel C Column (3), the dependent variable is the labor-adjusted percentage of female executives, defined as the percentage of female executives –the number of women as a percentage of the total number of people in the labor force in that province (measured in percentage points). Sex ratio at birth is the ratio of newborn boys over newborn girls. All dollar value variables are measured in 2011 constant dollars and all continuous variables are winsorized at the 1st and 99th percentiles. The variable definitions are provided in Appendix 2. The symbols ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively. P-values based on robust standard error clustered at the firm level are reported in parentheses.

Panel A: Full Sample Analysis

	(1)	(2)	(3)	(4)
Sex ratio at birth	-14.448*** (0.003)	-15.417*** (0.003)	-15.106*** (0.003)	-10.971** (0.012)
Ln(total assets)		-1.264*** (0.000)	-1.320*** (0.000)	-1.454*** (0.000)
Firm age			0.162** (0.024)	0.141* (0.086)
M/B			0.203 (0.320)	0.142 (0.477)
ROA			3.334 (0.285)	3.154 (0.287)
Stock volatility			-9.115 (0.122)	-9.702 (0.108)
Ln(GDP per capita)				0.926 (0.205)
Sex ratio with college degree				-1.018 (0.293)
Sex ratio in labor force				0.249 (0.907)
Unemployment rate				41.243* (0.094)
Corruption				-0.087*** (0.003)
Constant	30.137*** (0.000)	55.456*** (0.000)	55.997*** (0.000)	50.085*** (0.000)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Adjusted R2	8.5%	9.3%	9.4%	9.8%
No. of Observations	13,624	13,624	13,624	13,624

Panel B: Subsample Analysis

	(1) SOE	(2) Non-SOE	(3) Men- dominated Industry	(4) Non-men- dominated Industry	(5) Excluding Shanghai & Guangdong	(6) Excluding Firms that Changed Location
Sex ratio at birth	-10.950** (0.046)	-14.441** (0.032)	-10.117** (0.039)	-11.348* (0.054)	-14.667*** (0.003)	-10.470** (0.029)
Ln(total assets)	-1.083*** (0.001)	-1.576*** (0.000)	-1.317*** (0.000)	-1.513*** (0.000)	-1.342*** (0.000)	-1.420*** (0.000)
Firm age	0.205* (0.068)	0.143 (0.173)	0.078 (0.481)	0.164 (0.160)	0.181* (0.095)	0.144* (0.091)
M/B	0.341 (0.211)	-0.190 (0.666)	0.035 (0.950)	0.179 (0.582)	-0.014 (0.954)	0.183 (0.390)
ROA	5.704 (0.131)	-3.552 (0.395)	2.000 (0.569)	3.574 (0.321)	1.605 (0.630)	3.594 (0.286)
Stock volatility	-11.402* (0.089)	-14.455 (0.101)	-2.571 (0.828)	-12.557* (0.064)	-15.215*** (0.007)	-8.387 (0.168)
Ln(GDP per capita)	1.133 (0.225)	-0.603 (0.507)	1.720** (0.028)	0.595 (0.502)	-0.509 (0.428)	1.158* (0.095)
Sex ratio with college degree	-1.491 (0.275)	0.281 (0.888)	1.471 (0.376)	-2.019* (0.089)	-1.443 (0.144)	-1.032 (0.308)
Sex ratio in labor force	-1.609 (0.653)	5.918* (0.099)	0.162 (0.954)	0.379 (0.904)	-0.138 (0.949)	-0.622 (0.771)
Unemployment rate	29.161 (0.333)	54.949 (0.346)	97.635** (0.029)	22.787 (0.463)	0.626 (0.984)	49.498** (0.031)
Corruption	-0.082** (0.013)	-0.114* (0.054)	-0.065 (0.136)	-0.096** (0.018)	-0.079*** (0.004)	-0.081*** (0.010)
Constant	44.205*** (0.003)	61.473*** (0.000)	26.522** (0.045)	56.777*** (0.001)	66.479*** (0.000)	47.173*** (0.000)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R2	10.6%	7.8%	3.0 %	8.3%	11.6%	10.1%
No. of Observations	9,553	4,071	3,829	9,795	10,571	12,809

Panel C: Alternative Measure of Female Executives Representation

	(1) Adjust for industry	(2) Adjust for education	(3) Adjust for labor participation
Sex ratio at birth	-11.270*** (0.008)	-12.595*** (0.010)	-10.848*** (0.009)
Ln(total assets)	-1.108*** (0.000)	-1.450*** (0.000)	-1.455*** (0.000)
Firm age	0.100 (0.195)	0.140* (0.090)	0.142* (0.085)
M/B	0.173 (0.378)	0.141 (0.482)	0.142 (0.477)
ROA	2.763 (0.341)	3.102 (0.298)	3.162 (0.285)
Stock volatility	-7.464 (0.227)	-9.600 (0.112)	-9.707 (0.109)
Ln(GDP per capita)	0.716 (0.248)	0.977 (0.174)	0.893 (0.225)
Sex ratio with college degree	-0.978 (0.297)		-0.961 (0.294)
Sex ratio in labor force	0.212 (0.918)	1.053 (0.605)	
Unemployment rate	45.666* (0.071)	42.869* (0.075)	40.734* (0.090)
Corruption	-0.089*** (0.002)	-0.091*** (0.003)	-0.087*** (0.003)
Constant	32.518*** (0.003)	48.478*** (0.000)	51.257*** (0.000)
Year FE	Yes	Yes	Yes
Industry FE	No	Yes	Yes
Adjusted R2	1.5%	9.9%	9.8%
No. of Observations	13,624	13,624	13,624

Table 5. Gender Discrimination and New Appointments of Female Executives

This table presents the logit regression results on the new appointment of female executives relative to male executives. The sample consists of 1,618 new appointments of female executives and 11,667 new appointments of male executives from 2000 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. The dependent variable is an indicator variable that takes the value of 1 if the newly-appointed executive is a female and 0 if the newly-appointed executive is a male. All dollar value variables are measured in 2011 constant dollars and all continuous variables are winsorized at the 1st and 99th percentiles. The variable definitions are provided in Appendix 2. The symbols ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively. P-values based on robust standard error clustered at the firm level are reported in parentheses.

	(1)	(2)	(3)	(4)
Sex ratio at birth	-0.161*** (0.000)	-0.173*** (0.000)	-0.178*** (0.000)	-0.187*** (0.000)
Ln(total assets)		-0.017*** (0.000)	-0.013*** (0.001)	-0.013*** (0.001)
Firm age			0.002*** (0.004)	0.002*** (0.005)
M/B			0.002 (0.691)	0.001 (0.762)
ROA			-0.008 (0.791)	-0.007 (0.818)
Stock volatility			0.045* (0.073)	0.045* (0.081)
Ln(Manager age)			-0.098*** (0.000)	-0.097*** (0.000)
Ln(GDP per capita)				0.003 (0.519)
Sex ratio with college degree				-0.009 (0.552)
Sex ratio in labor force				-0.040** (0.035)
Unemployment rate				0.176 (0.428)
Corruption				-0.000 (0.204)
Constant	-0.081 (0.123)	0.249*** (0.000)	0.531*** (0.000)	0.589*** (0.000)
Job Title FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Pseudo R2	2.5%	3%	3.1%	3.2%
No. of Observations	13,285	13,285	13,285	13,285

Table 6. Gender Discrimination and Dismissal of Female Executives

This table presents the logit regression results on the dismissal of female executives relative to male executives. The sample consists of 1,088 female executive departure cases and 4,033 male executive departure cases from 2000 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. The dependent variable is an indicator variable that takes the value of 1 if the departing executive is a female, and 0 if the departing executive is a male. All dollar value variables are measured in 2011 constant dollars and all continuous variables are winsorized at the 1st and 99th percentiles. The variable definitions are provided in Appendix 2. The symbols ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively. P-values based on robust standard error clustered at the firm level are reported in parentheses.

	(1) Firms with at least one female executive	(2) Firms with at least two female executives	(3) Firms with at least three female executives	(4) Firms with at least three female executives and percentage of female executives $\leq 50\%$
Sex ratio at birth	-0.088 (0.264)	0.331** (0.011)	0.943*** (0.009)	1.001*** (0.009)
Ln(total assets)	-0.014*** (0.000)	-0.033*** (0.000)	-0.114*** (0.000)	-0.099*** (0.000)
Firm age	-0.001 (0.892)	0.021 (0.381)	0.049 (0.365)	0.016 (0.803)
M/B	0.001 (0.342)	-0.004 (0.281)	-0.015*** (0.005)	-0.021*** (0.003)
ROA	-0.017 (0.571)	0.008 (0.941)	0.188 (0.445)	0.026 (0.888)
Stock volatility	0.108* (0.093)	0.579* (0.090)	1.177** (0.016)	1.600** (0.017)
Ln(Tenure)	0.029*** (0.001)	0.073*** (0.000)	0.082** (0.044)	0.069 (0.104)
Ln(Manager age)	-0.195*** (0.000)	-0.379*** (0.000)	-0.380*** (0.000)	-0.207 (0.127)
Ln(GDP per capita)	0.019** (0.019)	0.025 (0.114)	0.073** (0.049)	0.072* (0.097)
Sex ratio with college degree	-0.013 (0.578)	-0.044 (0.340)	0.198 (0.106)	0.264*** (0.004)
Sex ratio in labor force	0.002 (0.963)	0.038 (0.627)	0.366** (0.020)	0.364* (0.082)
Unemployment rate	0.108 (0.834)	1.265 (0.115)	4.490** (0.038)	4.483** (0.033)
Corruption	0.001 (0.328)	0.001 (0.672)	-0.001 (0.835)	-0.004 (0.355)
Constant	0.532*** (0.000)	0.876*** (0.005)	0.424 (0.521)	-0.635 (0.366)
Job Title FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Pseudo R2	9.3%	8.8%	15.0%	13.9%
No. of Observations	5,118	1,797	534	432

Table 7. Gender Discrimination and Pay Gap between Female and Male Executives

The sample consists of 6,885 female executive-year observations from 2005 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. The dependent variable, *Pay gap*, is the difference between the Ln(total compensation) of each female executive and the average Ln(total compensation) of all male executives who are in the same province and same industry and hold the same position. All dollar value variables are measured in 2011 constant dollars and all continuous variables are winsorized at the 1st and 99th percentiles. The variable definitions are provided in Appendix 2. The symbols ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively. P-values based on robust standard error clustered at the firm level are reported in parentheses.

	(1)	(2)	(3)	(4)
Sex ratio at birth	-0.832*** (0.009)	-0.708* (0.067)	-0.694* (0.078)	-0.970*** (0.002)
Ln(total assets)		0.168*** (0.000)	0.155*** (0.000)	0.178*** (0.000)
Firm age			0.004 (0.596)	0.003 (0.486)
M/B			0.033** (0.042)	0.043** (0.011)
ROA			1.042*** (0.000)	1.141*** (0.000)
Stock volatility			0.226 (0.267)	0.179 (0.374)
Ln (Tenure)			0.171*** (0.000)	0.171*** (0.000)
Ln (Manager age)			0.193 (0.205)	0.250* (0.055)
Ln(GDP per capita)				-0.254*** (0.000)
Sex ratio with college degree				-0.032 (0.648)
Sex ratio in labor force				0.213* (0.063)
Unemployment rate				2.669 (0.277)
Corruption				-0.001 (0.797)
Constant	0.854** (0.020)	-2.545*** (0.000)	-3.580*** (0.000)	-2.153** (0.021)
Job Title FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Adjusted R2	17.5%	23.8%	28.3%	31.1%
No. of Observations	6,885	6,885	6,885	6,885

Table 8. Addressing Reverse Causality

The sample consists of 13,624 firm-year observations from 2000 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. The dependent variable is the percentage of female executives in the firm's top management team (measured in percentage points). Sex ratio at birth 1990 is the ratio of newborn boys over newborn girls in each province in year 1990. All dollar value variables are measured in 2011 constant dollars and all continuous variables are winsorized at the 1st and 99th percentiles. The variable definitions are provided in Appendix 2. The symbols ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively. P-values based on robust standard error clustered at the firm level are reported in parentheses.

Panel A: Using Sex Ratio at Birth in 1990

	(1)	(2)	(3)	(4)
Sex ratio at birth1990	-31.226*** (0.009)	-31.519** (0.017)	-30.856** (0.011)	-29.101*** (0.000)
Ln(total assets)		-1.223*** (0.000)	-1.279*** (0.000)	-1.450*** (0.000)
Firm age			0.157** (0.026)	0.144* (0.082)
M/B			0.213 (0.294)	0.141 (0.489)
ROA			3.349 (0.274)	2.963 (0.313)
Stock volatility			-9.929* (0.094)	-10.170* (0.095)
Ln(GDP per capita)				1.259* (0.061)
Sex ratio with college degree				-1.217 (0.238)
Sex ratio in labor force				-2.049 (0.290)
Unemployment rate				0.635 (0.979)
Corruption				-0.061** (0.023)
Constant	47.176*** (0.000)	70.912*** (0.000)	71.236*** (0.000)	70.149*** (0.000)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Adjusted R2	8.5%	9.3%	9.4%	9.9%
No. of Observations	13,624	13,624	13,624	13,624

Panel B: The Effect of Firm Size

	(1)	(2)
Sex ratio at birth1990	-39.755*** (0.000)	
Sex ratio at birth1990 × Big firm indicator	40.527*** (0.001)	
Sex ratio at birth		-15.105*** (0.000)
Sex ratio at birth × Big firm indicator		17.604** (0.014)
Big firm indicator	-46.175*** (0.001)	-22.661*** (0.008)
Firm age	0.110 (0.195)	0.108 (0.206)
M/B	0.714*** (0.003)	0.710*** (0.004)
ROA	0.237 (0.937)	0.413 (0.892)
Stock volatility	-8.543 (0.154)	-8.274 (0.172)
Ln(GDP per capita)	1.175* (0.085)	0.762 (0.300)
Sex ratio with college degree	-1.200 (0.242)	-0.998 (0.310)
Sex ratio in labor force	-2.297 (0.250)	0.149 (0.947)
Unemployment rate	6.677 (0.784)	46.660* (0.064)
Corruption	-0.060** (0.028)	-0.087*** (0.003)
Constant	54.487*** (0.000)	28.112** (0.016)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Adjusted R2	9.5%	9.5%
No. of Observations	13,624	13,624

Table 9. Gender Discrimination and Percentage of Female Directors

The sample consists of 13,624 firm-year observations from 2000 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. In Column (1), the dependent variable is the number of women as percentage of the total number of executives and directors (measured in percentage points). In Column (2), the dependent variable is the number of women as percentage of total number of directors (measured in percentage points). All dollar value variables are measured in 2011 constant dollars and all continuous variables are winsorized at the 1st and 99th percentiles. The variable definitions are provided in Appendix 2. The symbols ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively. P-values based on robust standard error clustered at the firm level are reported in parentheses.

	(1) female as percentage of total # of executives and directors	(2) female as percentage of total # of directors
Sex ratio at birth	-8.098** (0.011)	-7.018** (0.037)
Ln(total asset)	-1.384*** (0.000)	-1.406*** (0.000)
Firm Age	0.090 (0.134)	0.054 (0.311)
M/B	-0.222 (0.296)	-0.457* (0.075)
ROA	-0.015 (0.993)	-1.375 (0.476)
Stock volatility	-7.419 (0.100)	-8.884* (0.056)
Ln(GDP per capita)	0.870** (0.026)	0.737* (0.084)
Sex ratio with college degree	-0.497 (0.470)	-0.768 (0.263)
Sex ratio in labor force	-0.914 (0.567)	-1.337 (0.501)
Unemployment rate	12.430 (0.449)	-3.953 (0.883)
Corruption	-0.023 (0.203)	0.018 (0.441)
Constant	44.211*** (0.000)	43.445*** (0.000)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Adjusted R2	11.3%	6.6%
No. of Observations	13,624	13,624

Figure 1. Percentage of Female Executives over Time

The sample consists of 13,624 firm-year observations from 2000 to 2011. All the firms are listed in the Shanghai and Shenzhen stock exchanges. The high (low) sex ratio at birth provinces are categorized based on the sample median value of sex ratio at birth.

Panel A: Percentage of Female Executives (mean)

Panel B: Industry-average Adjusted Percentage of Female Executives (mean)

Appendix 1. Global Sex Ratio at Birth in 2011 (A Partial List)

This table reports a partial list of global sex ratio at birth in 2011, reported in World Factbook published by the Central Intelligence Agency (<https://www.cia.gov/library/publications/download/download-2011/>).

Country	Sex ratio at birth(male/female)	Global rank of sex ratio at birth
China	1.13	1
Armenia	1.12	2
India	1.12	3
Albania	1.12	4
Vietnam	1.12	5
Azerbaijan	1.12	6
Georgia	1.11	7
Grenada	1.10	8
San Marino	1.09	9
Kosovo	1.08	10
Taiwan	1.08	11
Isle of Man	1.08	12
Republic of Macedonia	1.08	13
Singapore	1.08	14
Hong Kong	1.07	15
Bosnia and Herzegovina	1.07	16
Montenegro	1.07	17
Faroe Islands	1.07	18
Gibraltar	1.07	19
Tunisia	1.07	20
South Korea	1.07	21
Malaysia	1.07	22
Suriname	1.07	23
Portugal	1.07	24
Luxembourg	1.07	25
Spain	1.06	28
Sweden	1.06	36
Russia	1.06	39
Italy	1.06	54
Canada	1.06	63
Japan	1.06	63
Australia	1.05	66
Denmark	1.05	66
Germany	1.05	66
Norway	1.05	71
Switzerland	1.05	71
Netherlands	1.05	76
United Kingdom	1.05	76
United States	1.05	147

Appendix 2. Variable Definitions

<i>Variable</i>	<i>Definition</i>
Big firm indicator	An indicator variable that takes the value of 1 if the firm's total assets are in the top quartile of the sample, and 0 otherwise.
Capex	Capital expenditures normalized by total assets.
Corruption	The number of persons charged for corruption per 10,000 civil servants.
Firm age	Number of years since the firm went public.
GDP per capita	Total GDP divided by the resident population in a province.
Leverage	Book value of debts normalized by total assets.
Manager age	Age of the manager.
M/B	Market value of equity to book value of equity.
Pay gap	Difference between a female manager's Ln(total compensation) and the average Ln(total compensation) of male managers who are in the same province and same industry and hold the same position.
Percentage of female directors	Number of female directors normalized by the total number of directors.
Percentage of female executives	Number of female executives normalized by the total number of executives.
Percentage of female executives and directors	Number of female executives and directors normalized by the total number of executives and directors.
ROA	Net income normalized by average total assets at the beginning and the end of the year.
Sex ratio at birth	Ratio of number of newborn boys over the number of newborn girl in a province.
Sex ratio in labor force	Ratio of the number of men in the labor force over the number of women in the labor force in a province.
Sex ratio with college degree	Ratio of number of men with college degree over the number of women with college degree in a province.
Stock volatility	Standard deviation of monthly stock return for the prior 60 months.
Tenure	Number of years the executive is in the position.
Total assets	Book value of total asset(US\$ millions).
Unemployment rate	The unemployment rate in a province.

Essay Two: Racial Segmentation and Minority Directors in the United States

ABSTRACT

We use the abnormal white-black interracial marriage rate as the proxy for racial segmentation in the U.S. and examine whether racial segmentation contributes to the underrepresentation of minority directors in public firms. We find that firms headquartered in areas with stronger racial segmentation are less likely to have minority directors on the board. We further use the racial segmentation measure as an instrumental variable for the presence of minority directors and show that minority directors significantly increase firm's innovation and firm value. Overall, our study provides evidence that racial segmentation plays an important role in preventing minority people from joining the boardroom.

Keywords: Racial discrimination; Board directors; Minority

JEL classification: G30; J71

1. Introduction

It is widely known that minority directors are rare in large corporations in the U.S. According to the US Census in 2010, minority people comprise about 36.4% of the labor force and 22.9% of management, professional and related occupation. However, a report conducted by the Alliance for Board Diversity shows that only 12.8% of board directors in Fortune 500 firms are minority people in 2010. Although a large number of studies conjecture that racial segmentation plays a role in preventing minority people from reaching the board room (Altonji and Blank (1999)), there lacks of evidence possibly because racial segmentation is usually illegal and thus companies have obvious incentives to keep discriminatory actions hidden.

In this paper, we examine whether racial segmentation contributes to the underrepresentation of minority directors and the impact of this underrepresentation on firm performance. Our primary measure of racial segmentation is the abnormal white-black interracial marriage rate across U.S. state. The intuition behind this measure is as follows: if a white only marries another white and black only marries black, it indicates a greater segmentation between the white and the black and thus a stronger racial segmentation. In contrast, if whites and black can freely marry each other (after accounting for the difference in education, age, and population distribution), it indicates that whites and black are less segmented.

We expect that firms headquartered in the areas with stronger racial segmentation are less likely to have minority directors for the following reasons. First, from the demand side of the labor market for corporate board, the firms' employees and middle managers are probably local people and thus they are likely to have resistance toward minority directors. Second, the firms' incumbent local top managers are also likely to be influenced by the local racial

preference and bias against minority directors. Third, even if the incumbent top managers are nonlocal and have no bias against minority, they may still avoid hiring minority directors considering that having minority directors on the board may cause conflicts and resistance among employees, middle managers, and local top managers. Fourth, from the supply side of the labor market for corporate boards, qualified minority candidates for director positions may avoid working in areas with stronger racial segmentation, and in these areas, junior and middle-level minority employees may have less chance of promotion, leading to an insufficient supply of minority candidates for corporate director positions. Fifth, in the presence of strong racial segmentation, local minority may have less education and training (Coate and Loury (1993)). The lack of human capital investment in the pre-labor market stage may further cause minority to be disadvantaged in climbing the corporate ladder after entering the labor market. Lastly, anticipating the occupational exclusion caused by discrimination in the selection process of top managers or corporate board of directors, talented minority people may avoid the career of working as a professional manager in the first place (Altonji and Blank (1999)). Overall, from both the demand and supply sides of the labor market for corporate directors, stronger discrimination against minority should lead to fewer minority directors.

Consistent with the prediction above, we find that firms headquartered in the state with higher level of racial segmentation have a smaller proportion of minority directors on the firms' board. This relation is both statistically and economically significant and is robust after controlling for various firm and state characteristics.

To further our understanding of how racial segmentation affects minority in reaching the boardroom, we employ the exogenous demand shock for outside directors following the passage of the Sarbanes-Oxley Act (SOX) in 2002. SOX requires that all U.S. public firms

have a majority of outside directors on the board, and for this reason the firms that fail to meet this requirement are forced to have more outside directors on the board. We find that, in response to this exogenous demand, firms headquartered in high racial segmentation areas are less likely to add on minority directors than the ones headquartered in low racial segmentation areas.

There could be a reverse causality issue: after observing successful minorities (for example, the first black president Barack Obama), white people are more likely to marry non-white people, leading to a positive relation between interracial marriage rate and the prevalence of minority directors. We re-estimate the abnormal interracial marriage rate by using the couples aged 40 or above. By doing so, the couple's marriage decision is likely to be decades before our sample period and thus the reverse causality concern is less likely. Our results are unchanged.

Lastly, does the underrepresentation of minority directors affect firm performance? Existing literature on the board diversity suggests that minority directors may provide diverse perspectives and new ideas, which in turn increase firm value by stimulating corporate innovations (Miller and Triana (2009)). We use the abnormal interracial marriage rate as an identification to perform a 2SLS regression analysis of the effects of minority directors on firm innovation (in terms of patents and patents citations) and firm value and provide evidence that the underrepresentation of minority in the boardroom has a significantly negative effect on firm innovativeness and market value.

This paper provides at least three major contributions to the literature. First, while the implication of racial segmentation on economic outcomes has long been an important question, most of the current studies focus on the wage disparity between white and nonwhite workers (see for example, Charles and Guryan (2008) and Levine et al. (2014)). We extend

this literature by focusing on the labor market for corporate directors and document evidence that racial segmentation is an important factor leading to the (inefficient) underrepresentation of minority directors on the board.

Second, this paper is also related to the literature on board diversity. There is increasing trend of emphasizing on board diversity. For example, Teachers Insurance and Annuity Association of America-College Retirement Equities Fund (TIAA-CREF) has been a longtime supporter of board diversity regarding to experience, gender, race and age. Adams and Ferreira (2009) finds that gender-diverse boards allocate more effect to monitoring. We extend the literature by examining racial-diverse boards. Besides, the influence of board diversity on firm value is mixed. For example, Cater, Simkins and Simpson (2003), Richard (2000) and Miller and Triana (2009) find a significant positive relationship between the fraction of minorities on the board and firm value, while Knight et al. (1999) argue that diversity may reduce performance. The exiting literature on this issue is likely to be biased due to the endogeneity issue. It is possible that some omitted variables drive both the board diversity decisions and firm performance (omitted variable problem). It is also possible that firms hire minority directors in response to their performance (reverse causality problem). Our paper sheds light into this issue by using abnormal interracial marriage rate as a novel instrumental variable and providing evidence on the casual positive relation between board racial diversity and firm valuation.

Lastly, the U.S., once “white-dominant,” is increasingly multi-hued, multi-lingual, and multi-ethnic. Over the last a few decades, immigrants from Latin America, Asia, and elsewhere have greatly expanded the population of minority resident. By 2050 people of color are projected to equal non-Hispanic whites in numbers (U.S. Census Bureau 2004). Understanding the frictions that may prevent minority people to be integrated into the

“mainstream” society becomes an important question (Altonji and Blank (1999)). We contribute to the strand of research by showing the prevalence of a racial segmentation in the labor market for corporate directors of large public firms.

The paper is organized as follows. We describe the data and key variable construction in the next section. Section 3 presents the empirical results on the relation between racial segmentation and the representation of female top managers. Finally, we conclude in Section 5 with a brief summary.

2. Sample

Our primary measure is a state-level index of racial segmentation. Following the method used by Levin, Rubinstein and Levkov (2014), we use the abnormal white-black interracial rate as a proxy for racial segmentation. The minorities include populations other than white race, such as black, American Indian, native Hawaiian, Alaska native, and Asian. However, because black population is the largest minority in the United States and historically the racial segmentation is most severe between white and black, we only use married couples of white and black people to calculate the rate of interracial marriage in each state. The rate of interracial marriage between white and other races such as American Indian and Asian could also be used as the indicator of racial segmentation. However, there are two main reasons preventing us from using it as the key indicator in this study. First, because the percentages of these races are lower in the US, the variation of the rate is much higher. Second, the information about married couples comes from the 2000 Census data, which is a 5% sample from the whole population. In some states, we do not have any interracial marriage couples between white and American Indian or Asian, which makes it impossible

for us to calculate the racial segmentation. Therefore, we only use the marriage between white and black to calculate our key variable.

The 2000 Census data is the most recent publicly available data that contain detailed marriage and demographic information for the United States. The primary sample contains married couples between the age of 18 and 65. Following the method used by Levin, Rubinstein and Levkov (2014), we use a logit model to calculate the *Racial segmentation index*:

$$\begin{aligned} \text{Racially mixed couple}_{is} = & \alpha + \beta_1 \text{Husband Age}_{is} + \beta_2 \text{Husband Education}_{is} + \\ & \beta_3 \text{Wife Age}_{is} + \beta_4 \text{Wife Education}_{is} + \\ & \beta_5 \text{Random Interracial Marriage Rate}_{is} + \\ & \beta_6 \text{Proportion of Blacks among Married Couples}_s + \varepsilon_{is} \end{aligned} \quad (1)$$

Where *Racially mixed couple*_{is} is an indicator equals to one if couple *i* in state *s* is between white and black and zero otherwise. Because interracial marriage depends on the personal characteristics and state level percentage of minorities, we control for the age and education of two spouses respectively. We also control for the random interracial marriage rate between white and black, which equals to $2P*(1-P)$, where *P* is the portion of black among the married population. ε_{is} is the residual of the regression. For each state, we then take an average ε_s of couples in the state, denoted as $\bar{\varepsilon}_s$. In order to make it easy to interpret the measure, we make some translations to this measure. Specially, we let the racial segmentation index equals to $100 \times \{ \bar{\varepsilon}_s - \min(\bar{\varepsilon}_s) \}$. Therefore, a larger index means higher level of racial segmentation and it equals zero for the state with the lowest racial segmentation.

The sample firms are the ones listed in the US from 1997 to 2011. We start from 1997 because we get the racial background about board directors from IRRC database and it starts from 1997. Our final sample consists of 19,724 firm-year observations over the 1997-2011

period. The accounting data for the firms in the sample were taken from Compustat database. All continuous variables are winsorized at the 1st and 99st percentiles. Detailed definitions of all variables are presented in the appendix.

Panel A of Table 1 presents the summary statistics of sample firms. The racial segmentation index has a median value of 0.303 and the standard deviation is 0.097. The mean percentage of minority directors is 4.53%, while the median value is zero. This means for many listed firms, there is not minority director on board at all. The percentage of minority in labor force is 15.73 on average, much higher than the percentage of minority directors. The results imply that the difference in participation in the labor force may not be the only reason of the underrepresentation of minority directors. Because IRRC covers large public companies, the median sample firm has a firm age of 22 years and total assets of 1981 millions. The median book leverage and ratio of tangible asset are 16.64% and 19.08% respectively. The sample firms perform well with a median ROA of 12.26% and market-to-book ratio of 1.42.

Panel B of Table 1 presents the correlation matrix among independent variables. GDP per capita and the percentage of minority in labor force are both negatively correlated with racial segmentation index. This finding suggests that states with higher GDP per capita are more friendly with minorities and for states with more minorities, the racial segmentation index is lower. As for other firm characteristics, firm age, total asset, book leverage, ratio of tangible asset, CAPEX and ROA are all positively related with racial segmentation index, while M/B ratio is negatively related with it. However, none is high enough to warrant multicollinearity concerns for our multivariate analyses.

We now turn from correlation matrix to the relation between racial segmentation index and percentage of minority directors across states. As shown in Table 2, the average

racial segmentation index is 0.263 and the racial segmentation index varies across states. The three states with the lowest racial segmentation index are Alaska (0), Washington (0.103) and Hawaii (0.113). Alaska has an index score equal to zero. This does not mean that there is not racial segmentation in this state but that the racial segmentation is the least severe according to our definition. Besides, the three states with the lowest percentage of white population in 2000 are Hawaii (40.8%), New Mexico (44.7%) and California (46.7%) (not reported in the table), all of them have a racial segmentation index below the average. California, mostly because of firms located in Silicon Valley, also contributes a large proportion of our sample. New York, where New York Stock Exchange locates, also has a low level of racial segmentation (0.113). For other states with large observations, Texas, Illinois, Ohio, and Pennsylvania, they lie in the middle of the ranking. The three states with the highest racial segmentation index are New Hampshire (0.463), Wyoming (0.460) and Maine (0.458). In last column, to account for the difference in industry distribution across different states, we compute the industry average adjusted percentage of minority directors. We find that the industry-adjusted percentage of minority directors is typically positive when the racial segmentation index is low and mostly negative when the index is high. Alaska and Hawaii have negative industry average adjusted percentage of minority directors, mostly because the number of observations is small and may not be representative.

Table 3 presents the distribution of percentage of minority directors across industries based on the Fama-French 48 industry classification. The top five industries with largest percentage of minority directors are tobacco products, candy and soda, restaurants, shipbuilding and personal services industries. The top five industries with the least percentage of minority directors are fabricated Products, precious metals, measuring and control equipment, coal and electronic equipment industry. These results are consistent with

the findings of Hertz, Tilly, and Massagli (2001) and Kmec (2003) that minorities are more likely to work in lower paying or lower skilled jobs than whites.

3. Empirical Results

3.1 Percentage of Minority directors

We estimate the following ordinary least squares (OLS) regression to examine whether racial segmentation is related to the proportion of minority of directors in the firm's board:

$$\begin{aligned} \text{Percentage of minority directors} = & \alpha + \beta_1 \text{Racial segmentation index} + \\ & \beta_2 \text{Ln}(\text{total assets}) + \beta_3 \text{Firm age} + \beta_4 \text{Book leverage} + \beta_5 \text{M/B} + \\ & \beta_6 \text{Ratio of tangible asset} + \beta_7 \text{CAPEX} + \beta_8 \text{ROA} + \beta_9 \text{Ln}(\text{GDP per capita}) + \\ & \beta_{10} \text{Percentage of minority in labor force} + \beta_{11} \text{Ln}(\text{Population}) + \beta_{12} \text{Ln}(\text{Colleges}) + \\ & \beta_{13} \text{Ln}(\text{Enrollment}) + \beta_{14} \text{Political balance} + \text{Industry FEs} + \text{Year FEs} + \varepsilon. \end{aligned} \quad (2)$$

In Column (1) of Table 4 Panel A, we only include *Racial segmentation index* and industry and year fixed effects in the regression; the coefficient on *Racial segmentation index* is -0.335 and is significant at the 5% level. Further controlling for firm size in Column (2), the coefficient on *Racial segmentation index* is -0.301 and is still significant at the 5% level. We then control for firm age, book leverage, market-to-book (M/B) ratio, ratio of tangible asset, CAPEX, and ROA in Column (3) and still obtain a significant and negative coefficient on *Racial segmentation index*.

In Column (4), we include state level characteristics. The challenge of identifying a causal effect in this study is that some unobserved or incorrectly measured characteristics of the economic, political, religious or labor market supply in a state could be correlated with the mixed racial marriage and drive the results. Therefore, we should control for other state

level characteristics to exclude the influence of other factors. In particular, we use GDP per capita to control for the economic development, and use the percentage of minority in labor force to account for the overall labor market supply of minorities. We additionally control the logarithm of annual state population. Investment in education is another factor that may have led to differences in patenting. Therefore, we also control for a state's intellectual resources via the number of degree-granting institutions of higher education in a given state, as well as via enrollment in institutions of higher education. We also control the political balance, which is the percentage of democrat representatives in the Lower House (House of Representatives) for a given state. Since state level religious may also affect people's attitude against minorities. We also control for the ratio of the number of religious adherents in the state over the total population in that state in 2000. A higher religion ratio indicates more religiosity. People in states with more religiosity may have different attitude towards minorities. The data on religiosity come from the Association of Religion Data Archive. Data on both state GDP and population is from the U.S. Bureau of Economic Analysis. The data on the number of colleges, college enrollment, and political balance is taken from the annual Statistical Abstracts from the U.S. Census Bureau.

The coefficient on *Racial segmentation index* is -0.321 and is still significant at the 1% level. The economic magnitude of this coefficient is also sizeable: a one-standard-deviation decrease in the *Racial segmentation index* will lead to an increase in the percentage of minority directors by 4% ($=0.097 \times 0.415$), relative to the sample mean value of 4.53%. Moreover, large firms and old firms have a higher percentage of minority directors, indicating that mature firms provide more opportunities to minority directors. One possible explanation is that large firms attract more attention from the public and are under high pressure to appoint minority directors on board. Besides, firm performance is positively related to the percentage of minority directors. Other firm characteristics, book leverage, market-to-

book ratio, ratio of tangible asset and CAPEX, do not play an significant role in determining the proportion of minority directors. As for state level variables, GDP per capita does not significant related to the minority director representative on board. The coefficient on the percentage of minority in labor force is significantly positive, indicating that director candidate pool is important for minority selection. Firms located in states with more minority population are more likely to have minority directors on boards. This is consistent with the finding in Knyazeva, and Knyazeva, and Masulis (2013), which shows that firms tend to select directors from local area. Finally, we find that the percentage of democrat representatives is positively related to the percentage of minority directors. The finding is not surprising since the Democratic Party is believed to be friendly with minorities.

We are using the racial segmentation of a firm's headquartering state to explain the racial-diversity of the board. This could be problematic if a firm's operation is geographically dispersed as the management team could be comprised by employees from different states. In order to address this concern, we exclude firms in certain sectors, retail, wholesale, transport, restaurants, hotels and motels. Column (5) of Table 4 Panel A reports the robust results. The coefficient on *Racial segmentation index* is still negative and significant.

In Table 4 Panel B we use two alternative measures of percentage of minority directors for robust check. As showed in Table 3, the percentage of minority directors varies across industries. To further account for the industry effects, we employ the industry-average-adjusted percentage of female executives as the dependent variable. The result is presented in column (1). The coefficient of *Racial segmentation index* is still negative and significant at the 1% level.

Even though we already include the percentage of minority in labor force as independent variable to control for effect of labor market pool on minority director

representation, it may be problematic if the influence is not linear. To mitigate this concern, in column (2) of Panel B, we use labor force adjusted percentage of minority directors as dependent variable, defined as the percentage of minority directors minus the percentage of minorities in labor force. The *Racial segmentation index* still attracts a negative and significant coefficient.

In summary, Table 4 documents a significant and robust negative association between the percentage of minority directors and the local *Racial segmentation index*, indicating that firms in locations with stronger racial segmentation have fewer minority directors.

3.2 New Appointments of minority directors after the passage of SOX

On July 30, 2002, the Sarbanes-Oxley Act (SOX) became law, which aimed to restrict corporate board structure and improve corporate governance after several high-profile corporate scandals. Because of this movement toward corporate governance changes, both the NYSE and the NASDAQ required the board of listed firms to have a majority of independent directors. Therefore, listed firms had to add independent directors if their boards were not considered as independent. We use the passage of SOX as an exogenous shock to the demand of minority directors. Specifically, we select the firms that do not qualified for the requirement of having a majority of independent directors in 2001 and look at the hiring of new directors after SOX for these firms. If racial segmentation plays a role in the hiring decision of public firms, we would expect a firm located in states with high racial segmentation is less likely to appoint minority directors on board when there are vacancies.

Table 5 presents the logit regression results based on all new appointment of independent directors between 2002 and 2003 in our sample firms (410 new appointments of

white independent directors and 41 unique cases of appointing minority independent directors). The dependent variable takes the value of 1 if the newly appointed director is a minority, and 0 if the newly appointed executive is a white director.

In column (1), the control variables are similar to the controls in Table 4. The coefficient on *Racial segmentation index* is negative and significant at the 5% level, indicating that the appointment of minority independent director is less likely to occur in a state with stronger racial segmentation. In column (2), we include director characteristics as control variables, a female dummy and the director age. The coefficient on female dummy is positive but not significant, while the coefficient on director age is significantly negative, meaning minorities with higher age are less likely to be appointed as independent directors. Furthermore, we also control for the local director candidate pools, as Knyazeva, and Knyazeva, and Masulis (2013) shows that local talents are potential candidates for public firms and the directors in other public firms nearby are possible to be select as new directors. Specifically, we control for the percentage of minority directors in the same state and in the same industry in previous year. If there were many qualified minority candidates in the same state or in the same industry, listed firms would have more choices when they are required to increase the number of independent directors on boards. Consistent with expectation, the coefficients on both variables are significantly positive, indicating that firms located in states with more minority directors or in industries with more minority directors are more likely to hire a minority independent director during the SOX period. In column (4), we present the marginal effects evaluated at the mean using the specification of column (3). We find that *Racial segmentation index* is negatively and significantly associated with minority director representativeness on board. The probability of appointing a minority independent director decrease by 18.4% ($=0.097 \times 1.896$) when the *Racial segmentation index* increases from its mean by one standard deviation. This effect is economically significant considering the

unconditional probability of appointing a minority director is close to 30%. In summary, the results shows that, when facing the choices of new directors, a firm located in high racial segmentation area is less likely to choose minority directors.

3.3 Address Reverse Causality

In the main test, we calculate the *Racial segmentation index* using married people with age between 18 and 65. However, this raises a concern of reverse causality: people are more willing to marry with minorities after observing more successful minorities climb up to the career ladder (i.e., the directors who reach top positions in public firms). To address this possibility, we calculate a new *Racial segmentation index* using married people with age between 50 and 65. For these people, they are more likely to have been married for a long time and less likely to carry this reverse causality issue. As reported in Table 6, the coefficients on *Racial segmentation index* are all negative and significant at the 1% level across all specifications. These results imply that firms are less likely to have minority directors on boards when there is a strong racial segmentation even after we account for the reverse causality issue.

3.4 Robustness check using KLD diversity score

Even though the percentage of minority directors is one important aspect to examine a firm's attitude towards minority, it does not reflect the whole picture of it. For example, a firm may hire minority executives or give minority employees equal opportunity. This kind of policies is not reflected in the percentage of minority directors. In order to gain more insight about the racial diversity of the public firms, we extract the diversity information from KLD database for our sample firms. This database covers about 80 indicators in seven areas

including community, corporate governance, diversity, employee relations, environment, human rights and product. For our research, we focus on the diversity dimension, which KLD provides the rating of 11 indicators, eight of which are positive rating (strengths) while the rest three are negative rating (concerns). For example, the first indicator measure whether the company's chief executive officer is a woman or a member of a minority group. If the company's chief executive officer is a woman or a member of minority group, then it gets one positive rating. Other indicators look at different aspect of firm policy about diversity. We calculate the final diversity index by taking away the total score of concerns from the total score of strengths. This diversity index has a broader measurement of a firm's attitude towards minorities. We match the index with our sample firms. The final sample has 14,772 firm-year observations.

Table 7 presents the results of regressions. The specifications of the four models are similar to the four models in Table 4, except that the dependent variable here is the diversity index from KLD. In column (1), we only control for the *Racial segmentation index*. The coefficient is significantly negative, indicating that firms located in states with high level of racial segmentation against minority are less likely to employ diversity policies. We further control for firm size and other firm characteristics in column (2) and column (3). The coefficient is still significant at 1% level. Firms with large size and became public long time ago are more likely to have high score in diversity index. Besides, both coefficients on market-to-book ratio and ROA are positive. This is consistent with the explanation that well perform firms have more resource to invest in diversity and promote the status of minorities. In last column, we further control for GDP per capita and the percentage of minority in labor force. In contrast to the results in table 4, the supply of minorities in the labor market does not have significant impact on public firms' diversity policy while the coefficient of GDP per capita is significantly positive.

Overall, our results show that firms headquartered in areas with strong racial segmentation are less friendly to minority people.

3.5 Minority Directors and Firm Performance

After showing the relation between racial segmentation and minority director on the board, the natural question is: does the underrepresentation of minority directors influence firm performance? Moreover, one of the possible channels for minority directors to influence firm valuation is through corporate innovation.

On the one hand, racial diversity on the board can increase the number of ideas, provide new perspectives, promote creativity, and thus lead to increased innovation (Miller and Triana (2009) and Cox (1996)). Empirically, Miller and Triana (2009) find a positive association between board diversity and R&D expenditure. Cater, Simkins and Simpson (2003) and Richard (2000) shows that having minority directors on the board is positively associated with firm performance. On the other hand, some researchers suggest that diversity in the management team can potentially be a disadvantage because of the additional time and effort needed to reach decisions in a heterogeneous team. For example, Knight et al. (1999) find that demographic diversity is negatively related to performance.

However, these studies are affected by the endogeneity problem. First, there could be omitted variable bias that some unobservable factors driving both board racial diversity and firm performance. For example, an open-minded CEO may be more likely to nominate minority directors on the board and the firm performance is also good because of the CEO's open-mindedness. Then the relation between board racial diversity and firm performance is spuriously determined by the CEO open-mindedness, which is unobservable in the empirical

tests. Moreover, there also could be reverse causality issue that good-performing firms can afford the expensive diversity program and appoint more minority directors. Then it is the firm performance driving the presence of minority directors, rather than the other way round. Thus, to overcome these endogeneity issues, one needs instrumental variables.

In this section, we apply 2SLS regression using *Racial segmentation index* as instrumental variable. A suitable instrumental variable has to meet the relevance and exogeneity condition. As shown in table 4, it is significantly associated with the percentage of minority directors. Therefore, it satisfies the relevance condition. Moreover, given that this variable is constructed based on individual household's marriage decision, there are no obvious reasons to believe that it directly affects a public firm's performance rather than through the effect of minority directors (satisfying the exogeneity condition).

We use the market-to-book (M/B) ratio as the measure of firm valuation. Firm innovation activities are measured by the R&D normalized by total asset next year. In the first stage, we regress percentage of minority directors on *Racial segmentation index* and other control variables used in the second stage. In the second stage, we regress firm performance and firm innovation on the predicted percentage of minority directors obtained from the first stage. Column (1) of Table 8 reports the first-stage regression. Consistent with the results in Table 4, the coefficient on *Racial segmentation index* is negative and significant at the 1% level. The *F*-test on the instrumental variable yields an *F*-statistic of 8.72, confirming the relevance of this variable.

The results of second stage regression are reported in Column (2) and (3) of table 7. The coefficients on the predicted percentage of minority directors are all positive and significant at the 1% level, indicating that having minority directors on board increases both firm performance and firm innovation. As a comparison, we also present the coefficients on

the percentage of minority directors from OLS regression at the end of the table. The coefficients is not significant for the M/B but positive and significant for the R&D regression. However, the magnitude of the coefficients is much smaller. The Hausman tests of the differences between OLS and 2SLS are significant at the 1% to 5% level, which indicates that endogeneity of minority director representation significantly underestimate the positive effect of minority directors on firm innovation and value.

Overall, our results provide evidence that minority directors on the board can significantly increase firm's innovation and stock market valuation. These results suggest that the racial segmentation in the director labor market is economically inefficient. Racial segmentation is one of the reasons that prevent firms from hiring more minority directors. Other reasons may also include the lack of competition from the product market. Besides, the lack of supply of qualified minority director may also make it difficult for firms to find the right person. The failure of corporate governance is another potential reason why the firms do not maximizing the firm value.

4. Conclusions

Why are there so few directors of color on the board of U.S. public firms? Does racial segmentation play a role in the labor market for corporate directors? In this paper, we examine these questions by using the abnormal white-black interracial marriage rate as a proxy for regional racial segmentation. We find that firms headquartered in the state with stronger racial segmentation have few minority directors on the board than the firms in the state with weaker racial segmentation. We further use the abnormal white-nonwhite interracial marriage rate as an instrumental variable to examine the effect of board racial diversity on firm performance. Consistent with the view that a diverse and inclusive boardroom provides a greater range of perspectives and ideas that spur innovation, we find a

positive effect of minority directors on firm's innovation and firm value. Overall, we provide evidence that racial segmentation plays an important role in preventing people of color joining the boardroom.

Due to data availability, our study focuses on board of directors. However, the basic mechanism can also be applied to corporate executives, given that people of color in the top management team are also underrepresented as well. For example, there are six black CEOs, nine Asian CEOs, and eight Latino CEOs of fortune 500 companies, accounting for 4.6 percent of all Fortune 500 CEOs¹⁶. Examining this issue can be an important area for future research.

¹⁶ <http://www.diversityinc.com/diversity-facts/wheres-the-diversity-in-fortune-500-ceos/>

References

- Adams, Renee B., and Daniel Ferreira, 2009. Women in the Boardroom and Their Impact on Governance and Performance. *Journal of Financial Economics* 94, 291-309.
- Adams, Renee B., and Tom Kirchmaier, 2012. Making It to the Top: From Female Labor Force Participation to Boardroom Gender Diversity. University of New South Wales working paper.
- Adams, Renee B., and Patricia C. Funk, 2012. Beyond the Glass Ceiling: Does Gender Matter? *Management Science* 58, 219-235.
- Altonji, Joseph G. and Rebecca M. Blank, 1999. Race and Gender in the Labor Market. In: Ashenfelter, Orley C., Card, David (Eds.), *Handbook of Labor Economics*, vol. 3. Elsevier.
- Becker, Gary S., 1971. *The Economics of Discrimination* 2nd edition. The University of Chicago Press, Chicago, IL.
- Carter, David A., Betty J. Simkins and W. Gary Simpson, 2003. Corporate Governance, Board Diversity, and Firm Value. *The Financial Review* 38, 33-53
- Charles, Kerwin Kofi., and Jonathan Guryan, 2008. Prejudice and Wages: An Empirical Assessment of Becker's The Economics of Discrimination. *Journal of Political Economy* 116, 773-809.
- Coate, Stephen, and Glenn Laury, 1993. Will Affirmative-action Policies Eliminate Negative Stereotypes?. *American Economic Review* 83, 1220-1240.
- Cox, Taylor, 1996. *Cultural Diversity in Organizations: Theory, Research, and Practice*. San Francisco: Berrett-Koehler.
- Hertz, Tom, Chris Tilly, and Michael Massagli, 2001. Linking the Multi-City Study's household and employer surveys to test for race and gender effects in hiring and wage setting. In *Urban Inequality: Evidence from Four Cities*, Alice O'Connor, Chris Tilly, and Lawrence Bobo, eds., 407-433. New York: Russell Sage
- Kmec, Julie A., 2003. Minority Job Concentration and Wages. *Social Problems* 50, 38-59
- Knight, Don, Craig Pearce, Ken G. Smith, Judy D. Olian, Henry P. Sims, Ken A. Smith and Patrick Flood, 1999. Top Management Team Diversity, Group Process, and Strategic Consensus, *Strategic Management Journal* 20, 445-465.
- Knyazeva, Anzhela., Diana Knyazeva, and Ronald Masulis, 2013. The Supply of Corporate Directors and Board Independence, *Review of Financial Studies* 26, 1561-1605.

- Levine, Ross., Yona Rubinstein, and Alexey Levkov, 2014. Bank Deregulation and Racial Inequality in America, *Critical Finance Review* 3, 1-48.
- Miller, Royah., and Maria del Carmen Triana, 2009. Demographic Diversity in the Boardroom: Mediators of the Board Diversity-Firm Performance Relationship, *Journal of Management Studies* 46, 754-786.
- Phelps, Edmund., 1972. The statistical Theory of Racism and Sexism, *American Economic Review* 62, 659-661.
- Richard, Orlando C., 2000. Racial Diversity, Business Strategy, and Firm Performance: A Resource-Based View, *Academy of Management Journal* 43, 164-177.
- Richard, Orlando C., Tim Barnett, Sean Dwyer and Ken Chadwick., 2004. Cultural Diversity in Management, Firm Performance, and The Moderating Role of Entrepreneurial Orientation Dimensions, *Academy of Management Journal* 47, 255-266.

Table 1. Summary Statistics

The sample consists of 19,724 firm-year observations from 1996 to 2011. All continuous variables are winsoried at the 1st and 99th percentiles. In Panel B, p-values of the correlation coefficients are reported in parentheses. The variable definitions are provided in the appendix.

Panel A: Characteristics of Sample Firms

	Mean	Std	P25	Median	P75
Percentage of minority directors	4.53%	7.75%	0.00%	0.00%	9.09%
Discrimination index	0.301	0.097	0.262	0.303	0.362
GDP per capita	41431	15614	34485	38576	43913
Percentage of minority in labor force	15.73%	9.50%	7.94%	13.62%	22.51%
Firm age	26.49	16.46	12.00	22.00	41.00
Total assets (\$ millions)	15473.7	83678.90	713.06	1981.78	6777.33
M/B	1.85	1.21	1.10	1.42	2.09
Book leverage	18.95%	16.44%	3.62%	16.64%	29.88%
Ratio of tangible asset	26.07%	23.45%	7.02%	19.08%	39.50%
CAPEX	4.81%	4.93%	1.53%	3.45%	6.42%
ROA	12.64%	9.21%	7.11%	12.26%	17.84%

Panel B: Correlation Matrix

	1	2	3	4	5	6	7	8	9	10
1 Racial segmentation index	1									
2 GDP per capita	-0.505 (0.000)	1								
3 Percentage of minority in labor force	-0.048 (0.000)	0.248 (0.000)	1							
4 Firm age	0.055 (0.000)	-0.013 (0.079)	-0.037 (0.000)	1						
5 Total assets (\$ millions)	0.009 (0.203)	0.089 (0.000)	0.096 (0.000)	0.331 (0.000)	1					
6 M/B	-0.085 (0.000)	0.040 (0.000)	0.008 (0.250)	-0.185 (0.000)	-0.218 (0.000)	1				
7 Book leverage	0.022 (0.002)	-0.053 (0.000)	-0.009 (0.180)	0.090 (0.000)	0.151 (0.000)	-0.225 (0.000)	1			
8 Ratio of tangible asset	0.148 (0.000)	-0.165 (0.000)	-0.112 (0.000)	0.174 (0.000)	-0.018 (0.014)	-0.107 (0.000)	0.305 (0.000)	1		
9 CAPEX	0.098 (0.000)	-0.116 (0.000)	-0.096 (0.000)	-0.037 (0.000)	-0.143 (0.000)	0.119 (0.000)	0.097 (0.000)	0.698 (0.000)	1	
10 ROA	0.039 (0.000)	-0.061 (0.000)	-0.055 (0.000)	0.029 (0.000)	-0.163 (0.000)	0.467 (0.000)	-0.095 (0.000)	0.240 (0.000)	0.345 (0.000)	1

Table 2. Discrimination Index and Percentage of Minority Directors across States

The sample consists of 19,724 firm-year observations from 1996 to 2011. All continuous variables are winsoried at the 1st and 99th percentiles. In Panel B, p-values of the correlation coefficients are reported in parentheses. The variable definitions are provided in the appendix.

State	Discrimination index	# of firm-year observations	Percentage of minority directors (mean)	Industry-average adjusted percentage of minority directors (mean)
Alaska	0.000	14	0.00%	-8.13%
Washington	0.103	357	5.33%	-0.22%
Hawaii	0.113	33	2.97%	-3.67%
New York	0.113	1565	6.70%	0.86%
Nevada	0.125	105	5.47%	0.33%
California	0.157	2940	3.63%	-0.86%
District of Columbia	0.187	77	14.08%	6.84%
Delaware	0.241	81	7.78%	1.38%
South Carolina	0.242	108	4.94%	-1.19%
Pennsylvania	0.257	930	4.93%	-0.49%
New Jersey	0.257	735	6.36%	0.56%
Kentucky	0.260	150	5.60%	-1.32%
Michigan	0.262	450	8.03%	2.45%
Illinois	0.269	1139	6.33%	0.64%
Rhode Island	0.270	66	7.95%	2.38%
New Mexico	0.275	19	6.73%	-1.31%
Maryland	0.276	294	9.58%	4.05%
Connecticut	0.276	541	6.71%	1.14%
Kansas	0.281	87	4.67%	-1.67%
Massachusetts	0.282	845	3.74%	-0.81%
Ohio	0.285	982	6.22%	0.27%
Missouri	0.289	446	5.89%	-0.10%
Arizona	0.301	252	4.85%	-0.38%
South Dakota	0.302	34	0.83%	-7.26%
Colorado	0.302	285	2.52%	-1.96%
Arkansas	0.303	158	6.55%	1.14%
Virginia	0.305	550	7.89%	1.76%
Florida	0.317	674	5.98%	0.11%
Texas	0.324	1765	4.61%	-0.57%
North Carolina	0.324	392	6.07%	-0.10%
Minnesota	0.326	654	5.88%	-0.44%
Nebraska	0.327	95	2.23%	-3.13%
Mississippi	0.336	63	6.98%	0.16%
Louisiana	0.342	189	3.42%	-2.52%
Georgia	0.348	565	7.27%	1.61%

Oregon	0.351	205	3.35%	-1.51%
Indiana	0.357	262	7.48%	1.90%
Wisconsin	0.358	416	6.27%	0.70%
Alabama	0.362	203	3.02%	-2.89%
Vermont	0.366	28	0.00%	-7.83%
Utah	0.368	107	0.45%	-4.90%
Oklahoma	0.383	148	4.63%	-1.31%
Idaho	0.390	60	1.10%	-5.01%
Tennessee	0.392	366	4.24%	-1.68%
Iowa	0.396	138	3.21%	-3.46%
Montana	0.402	12	0.00%	-5.52%
North Dakota	0.434	20	0.00%	-8.13%
West Virginia	0.448	18	0.00%	-6.77%
Maine	0.458	34	4.06%	-1.12%
Wyoming	0.460	1	0.00%	0.00%
New Hampshire	0.463	66	3.58%	-0.66%
Full sample	0.263	19724	4.53%	-

Table 3. Percentage of Minority Directors across Industries

The sample consists of 19,724 firm-year observations from 1996 to 2011. All continuous variables are winsoried at the 1st and 99th percentiles. In Panel B, p-values of the correlation coefficients are reported in parentheses. The variable definitions are provided in the appendix.

Industry	# of firm-year observations	Average percentage of minority directors
Fabricated Products	58	0.00%
Precious Metals	25	0.00%
Measuring and Control Equipment	383	1.59%
Coal	43	1.93%
Electronic Equipment	1,214	2.43%
Petroleum and Natural Gas	713	3.16%
Trading	729	3.23%
Electrical Equipment	258	3.40%
Textiles	93	3.41%
Business Services	1,816	3.55%
Entertainment	134	3.61%
Non-Metallic and Industrial Metal	73	3.72%
Recreation	102	3.77%
Medical Equipment	474	3.96%
Rubber and Plastic Products	125	4.02%
Automobiles and Trucks	326	4.13%
Construction Materials	406	4.13%
Transportation	515	4.39%
Machinery	779	4.51%
Pharmaceutical Products	687	4.52%
Computers	635	4.58%
Healthcare	306	4.63%
Steel Works Etc	366	4.75%
Construction	268	5.16%
Shipping Containers	90	5.48%
Defense	66	5.54%
Wholesale	706	5.56%
Others	144	5.88%
Apparel	270	5.90%
Aircraft	130	5.91%
Chemicals	560	6.01%
Banking	1,287	6.47%
Agriculture	40	6.59%
Business Supplies	379	6.66%
Insurance	900	6.96%
Retail	1,274	7.30%
Communication	358	7.81%
Food Products	401	7.85%
Utilities	1,195	8.18%
Printing and Publishing	222	8.42%
Consumer Goods	364	8.57%
Beer & Liquor	77	8.67%
Real Estate	26	8.77%
Personal Services	209	9.09%
Shipbuilding, Railroad Equipment	47	9.20%
Restaurants, Hotels, Motels	373	9.56%
Candy & Soda	34	13.48%
Tobacco Products	44	13.70%
Full Sample	19,724	4.53%

Table 4. Racial Segmentation and Percentage of minority directors

The sample consists of 19,724 firm-year observations from 1996 to 2011. In Panel A, the dependent variable is the percentage of minority directors. In Panel B, the dependent variable in column (1) is the industry-average-adjusted percentage of minority directors while in column (2) the dependent variable is labor-adjusted percentage of minority directors, defined as the percentage of minority directors minus the percentage of minority directors in labor force. All continuous variables are winsoried at the 1st and 99th percentiles. The variable definitions are provided in the appendix. The symbols ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively. P-values based on robust standard error clustered at the firm level are reported in parentheses.

Panel A: Full Sample Analysis

	(1)	(2)	(3)	(4)	(5)
Racial segmentation index	-0.335** (0.036)	-0.301** (0.047)	-0.312** (0.033)	-0.415*** (0.002)	-0.355*** (0.010)
Ln(total assets)		0.016*** (0.000)	0.015*** (0.000)	0.014*** (0.000)	0.013*** (0.000)
Firm age			0.008*** (0.001)	0.007*** (0.002)	0.007** (0.011)
Book leverage			0.013 (0.123)	0.012 (0.142)	0.010 (0.339)
M/B			0.001 (0.434)	0.002 (0.392)	0.001 (0.481)
Ratio of tangible asset			0.017 (0.191)	0.017 (0.153)	0.018* (0.095)
CAPEX			-0.054 (0.186)	-0.052 (0.199)	-0.069 (0.142)
ROA			0.027 (0.123)	0.027 (0.153)	0.029 (0.173)
Ln(GDP per capita)				-0.019 (0.343)	-0.013 (0.542)
Percentage of minority in labor force				0.093*** (0.005)	0.096*** (0.009)
Ln(Population)				0.005 (0.683)	-0.000 (0.986)
Ln(Colleges)				-0.009 (0.141)	-0.010 (0.139)
Ln(Enrollment)				-0.000 (0.976)	0.006 (0.645)
Political balance				0.011 (0.211)	0.010 (0.286)
Religious				0.032 (0.191)	0.040 (0.168)
Constant	0.100 (0.103)	-0.032 (0.532)	-0.048 (0.347)	0.101 (0.622)	0.043 (0.847)
Year FE	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Adjusted R2	5.1%	11.1%	11.5%	12.0%	11.3%
No. of Observations	19,724	19,724	19,724	19,724	16856

Panel B: Alternative measures

	(1) Adjusted for Industry	(2) Adjusted for Labor force participation
Racial segmentation index	-0.415*** (0.002)	-1.439* (0.068)
Ln(total assets)	0.014*** (0.000)	0.014*** (0.000)
Firm age	0.007*** (0.002)	0.006** (0.034)
Book leverage	0.012 (0.142)	0.011 (0.185)
M/B	0.002 (0.392)	0.001 (0.697)
Ratio of tangible asset	0.017 (0.153)	0.030** (0.020)
CAPEX	-0.052 (0.199)	-0.044 (0.316)
ROA	0.027 (0.153)	0.028 (0.169)
Ln(GDP per capita)	-0.019 (0.343)	-0.241*** (0.004)
Percentage of minority in labor force	0.093*** (0.005)	
Ln(Population)	0.005 (0.683)	-0.108*** (0.007)
Ln(Colleges)	-0.009 (0.141)	0.007 (0.817)
Ln(Enrollment)	-0.000 (0.976)	0.078* (0.074)
Political balance	0.011 (0.211)	0.053 (0.108)
	0.032	0.285**
Constant	0.101 (0.622)	2.964*** (0.001)
Year FE	Yes	Yes
Industry FE	Yes	Yes
Adjusted R2	7.9%	17.1%
No. of Observations	19,724	19,724

Table 5. New Appointments of Minority Directors after the Passage of SOX

This table presents the logit regression results on the new appointment of female executives relative to male executives. The sample consists of 410 new appointments of white independent directors and 41 new appointments of minority independent directors from 2002 to 2003. The dependent variable from column (1) to column (3) is an indicator variable that takes the value of 1 if the newly-appointed director is a minority and 0 if the newly-appointed director is not. Column (4) shows marginal effect estimates (evaluated at the sample mean) of column (4). All continuous variables are winsorized at the 1st and 99th percentiles. The variable definitions are provided in the appendix. The symbols ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively. P-values based on robust standard error clustered at the firm level are reported in parentheses.

	(1)	(2)	(3)	(4) Marginal Effects of Column (3)
Racial segmentation index	-21.597** (0.038)	-28.795** (0.015)	-34.370*** (0.005)	-1.896** (0.013)
Ln(total assets)	0.779*** (0.000)	0.734*** (0.000)	1.000*** (0.000)	0.056*** (0.000)
Firm age	-0.687** (0.024)	-0.637* (0.070)	-0.443 (0.347)	-0.037 (0.171)
Book leverage	0.871 (0.569)	1.317 (0.389)	0.844 (0.575)	0.050 (0.608)
M/B	-0.169 (0.583)	-0.142 (0.687)	-0.209 (0.575)	-0.010 (0.673)
Ratio of tangible asset	4.427** (0.047)	4.629** (0.047)	5.794** (0.021)	0.355** (0.027)
CAPEX	-18.575*** (0.001)	-19.602*** (0.001)	-20.860*** (0.001)	-1.342*** (0.002)
ROA	7.133 (0.159)	7.101 (0.178)	10.254* (0.078)	0.584* (0.095)
Ln(GDP per capita)	-3.998** (0.016)	-4.265** (0.021)	-7.639*** (0.001)	-0.452*** (0.001)
Percentage of minority in labor force	-0.539 (0.877)	-1.581 (0.683)	-4.963 (0.117)	-0.274 (0.199)
Ln(Population)	2.796 (0.173)	2.624 (0.208)	2.077 (0.291)	0.141 (0.250)
Ln(Colleges)	-0.986* (0.054)	-1.113** (0.035)	-2.076*** (0.000)	-0.135*** (0.000)
Ln(Enrollment)	-1.529 (0.441)	-1.210 (0.547)	0.663 (0.721)	0.030 (0.788)
Political balance	-1.285 (0.242)	-1.315 (0.250)	-1.294 (0.369)	-0.104 (0.253)
Religious	0.046 (0.988)	0.804 (0.803)	2.179 (0.544)	0.118 (0.608)
Female Dummy		0.499 (0.265)	0.621 (0.171)	0.039 (0.181)
Log(director age)		-2.726* (0.083)	-3.074* (0.054)	-0.172* (0.081)
Percentage of minority director in the same state			7.330*** (0.000)	0.402*** (0.000)
Percentage of minority director in the same industry			25.940** (0.024)	0.476 (0.136)

Constant	14.324 (0.451)	27.713 (0.248)	35.380 (0.160)	
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Adjusted R2	22.7% %	24.9% %	29.5%	29.5%
No. of Observations	451	451	451	451

Table 6. Using people at least 50 years old to calculate Racial Segmentation index

The sample consists of 19,724 firm-year observations from 1996 to 2011. The dependent variable is the percentage of minority directors. All continuous variables are winsoried at the 1st and 99th percentiles. The variable definitions are provided in the appendix. The symbols ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively. P-values based on robust standard error clustered at the firm level are reported in parentheses.

	(1)	(2)	(3)	(4)
Racial segmentation index	-0.542*** (0.005)	-0.438** (0.021)	-0.443** (0.014)	-0.578*** (0.003)
Ln(total assets)		0.016*** (0.000)	0.014*** (0.000)	0.014*** (0.000)
Firm age			0.007*** (0.001)	0.007*** (0.003)
Book leverage			0.014* (0.099)	0.013 (0.124)
M/B			0.001 (0.431)	0.001 (0.408)
Ratio of tangible asset			0.017 (0.192)	0.017 (0.168)
CAPEX			-0.052 (0.188)	-0.049 (0.218)
ROA			0.027 (0.121)	0.028 (0.151)
Ln(GDP per capita)				-0.022 (0.254)
Percentage of minority in labor force				0.091** (0.014)
Ln(Population)				-0.000 (0.986)
Ln(Colleges)				-0.005 (0.484)
Ln(Enrollment)				-0.000 (0.998)
Political balance				0.011 (0.240)
Religious				-0.008 (0.722)
Constant	0.123** (0.040)	-0.014 (0.776)	-0.031 (0.541)	0.227 (0.321)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Adjusted R2	5.3%	11.2%	11.6%	12.0%
No. of Observations	19,724	19,724	19,724	19,724

Table 7. Robustness Check of Using KLD Diversity Score

The sample consists of 14,772 firm-year observations from 1996 to 2011. The dependent variable is the score of firm diversity from KLD. All continuous variables are winsorized at the 1st and 99th percentiles. The variable definitions are provided in the appendix. The symbols ***, **, * denote significance at the 1%, 5%, and 10% levels, respectively. P-values based on robust standard error clustered at the firm level are reported in parentheses.

	(1)	(2)	(3)	(4)
Racial segmentation index	-6.787*** (0.002)	-4.931** (0.020)	-5.156** (0.012)	-1.39* (0.0941)
Ln(total assets)		0.481*** (0.000)	0.476*** (0.000)	0.470*** (0.000)
Firm age			0.153*** (0.007)	0.176*** (0.001)
Book leverage			-0.461*** (0.007)	-0.401** (0.012)
M/B			0.044** (0.021)	0.039** (0.025)
Ratio of tangible asset			0.003 (0.985)	0.072 (0.664)
CAPEX			0.356 (0.355)	0.208 (0.570)
ROA			0.844*** (0.001)	0.973*** (0.000)
Ln(GDP per capita)				0.555** (0.016)
Percentage of minority in labor force				-0.372 (0.341)
Ln(Population)				-0.243* (0.084)
Ln(Colleges)				-0.139 (0.139)
Ln(Enrollment)				0.409*** (0.001)
Political balance				0.400*** (0.000)
Religious				-0.878*** (0.009)
Constant	0.266 (0.180)	-4.260*** (0.000)	-2.605*** (0.000)	-9.434*** (0.001)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Adjusted R2	12.4%	34.2%	35.4%	36.1%
No. of Observations	14,772	14,772	14,772	14,772

Table 8. Racial Segmentation and Firm Performance and Innovation

The sample consists of 18,910 firm-year observations from 1996 to 2011. In Column (1), we report the first-stage regression from the two-stage least squares (2SLS) regression, using Discrimination index as instrumental variables. In Columns (2) and (3), we report the second-stage regression from the 2SLS regression. The dependent variable of Columns (2) and (3) are Market-to-Book ratio and ROA respectively. All continuous variables are winsorized at the 1st and 99th percentiles. The variable definitions are provided in the appendix. The symbols ***, **, * denote significance at the 1%, 5%, and 10%.

	1 st stage regression from 2SLS (1) Percentage of minority directors	2st stage regression from 2SLS	
		(2) M/B ratio	(3) R&D ratio
Racial segmentation index (a)	-0.382*** (0.000)		
Predicted percentage of minority directors		4.185** (0.033)	0.253*** (0.000)
Ln(total assets)	0.014*** (0.000)	-0.084*** (0.004)	-0.006*** (0.000)
Firm age	0.007*** (0.000)	-0.139*** (0.000)	-0.004*** (0.000)
Ratio of tangible asset	0.010* (0.051)	-0.634*** (0.000)	-0.021*** (0.000)
Book leverage	0.014** (0.020)	-0.975*** (0.000)	-0.005 (0.118)
CAPEX	-0.015 (0.510)	2.453*** (0.000)	0.073*** (0.000)
ROA	0.032*** (0.000)	5.294*** (0.000)	-0.072*** (0.000)
Log(GDP)	-0.018** (0.033)	0.269*** (0.001)	0.010*** (0.002)
Percentage of minority in labor force	0.093*** (0.000)	-0.034 (0.827)	-0.025*** (0.000)
Ln(Population)	-0.001 (0.928)	-0.216*** (0.000)	-0.018*** (0.000)
Ln(Colleges)	-0.007** (0.018)	0.132*** (0.000)	0.006*** (0.000)
Ln(Enrollment)	0.002 (0.649)	0.162*** (0.005)	0.017*** (0.000)
Political balance	0.010** (0.014)	0.120*** (0.006)	0.007*** (0.001)
Religious	0.034*** (0.000)	-0.389*** (0.001)	-0.022*** (0.000)
Constant	0.063 (0.494)	-1.656 (0.102)	0.023 (0.554)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes

Adjusted R2	12.9%	15.4%	1.4%
No. of Observations	18,910	18,910	18,910
Percentage of minority directors from OLS		0.245 (0.293)	0.026*** (0.003)
Hausman test		4.31**	33.7***
F-test of (a)=0:	8.72***		

Appendix. Variable Definitions

<i>Variable</i>	<i>Definition</i>
CAPEX	Capital expenditures normalized by total assets. Source: Compustat database.
Director age	Age of the director. Source: IRRC database.
Racial segmentation index	Calculated using the interracial marriage data. Source: Census 2000 data for the United states.
Female dummy	Equal to one if the director is female, else zero. Source: IRRC.
Firm age	Number of years since the firm went public. Source: Compustat database.
GDP per capita	Total GDP divided by the resident population. Source: US Bureau of Economic Analysis.
Leverage	Book value of total debts (Item DLTT + Item DLC) normalized by total assets (Item AT). Source: Compustat database.
Ln(Colleges)	Natural logarithm of enrollment in institutions of higher education in a given state. Source: U.S. Census Bureau.
Ln(Enrollment)	Natural logarithm of the number of degree-granting institutions of higher education in a given state. Source: U.S. Census Bureau.
Ln(Population)	Natural logarithm of a state's population. Source: U.S. Census Bureau.
M/B	Market value (as defined below) over total assets (Item AT). Source: Compustate database.
Market value	Liabilities (Item LT) minus balance sheet deferred taxes and investment tax credit (Item TXDITC) plus Preferred Stock (as defined below) plus Market Equity (Item CSHO multiply Item PRCCF). Source: Compustate database.
Percentage of minority directors	Number of minority directors normalized by the total number of directors. Source: IRRC database.
Percentage of minority in labor force	Ratio of the number of minority in the labor force over the number of people in the labor force. Source: The Bureau of Labor Statistics.
Percentage of minority directors in the same industry	Number of minority directors in an industry normalized by the number of total directors firms in the same industry. Source: IRRC database.
Percentage of minority directors in the same state	Number of minority directors in a province normalized by the number of total directors firms in the same province. Source: IRRC database.
Political balance	The percentage of democrat representatives in the Lower House (House of Representatives) for a given state. Source: U.S. Census Bureau.
Prefer stock	Preferred Stock is equal to liquidating value(Item PSTKL) if available, else redemption value(Item PSTKRV) if available, else carrying value (Item PSTK). Source: Compustate database.
Ratio of tangible asset	Net property, plant, and equipment (Item PPENT) over Total Assets (Item AT). Source: Compustat database.
Religious	The ratio of the number of religious adherents in the state over the total population in that state in 2000. A higher religion ratio indicates more religiosity. The data on religiosity come from the Association of Religion Data Archive.
ROA	Operating income before depreciation (Item OIBDP) over Total Assets (Item AT). Source: Compustat database.
Score of firm diversity	The total score of strength minus the total score of concerns in the firm's

diversity profile. Source: KLD database.

Total assets

The book value of assets (Item AT). Source: Compustat database.

Essay Three: Do Mutual Funds Trade on Economic Links?

ABSTRACT

It is well documented in the literature that the stock price of economically linked suppliers can be predictable because they do not reflect shocks to the related customers in a timely manner (Cohen and Frazzini, 2008; Menzly and Ozbas, 2010). This paper investigates whether some mutual funds actively trade on suppliers based on the earnings announcement returns of their customers. We show that fund managers, which understand the economic links and trade accordingly, benefit from the trade. Moreover, these managers exhibit overall investment skills and generate superior performance. This performance results remain robust after adjusting for risk and controlling for other fund characteristics.

Keywords: Mutual Funds; Supplier-Customer;

JEL classification: G23

1. Introduction

There have been many papers analyzing the financial implication of economic linkage between suppliers and customers. For example, Cohen and Frazzini (2008) find evidence of return predictability across economically linked firms. Specially, stock prices of supply firms do not promptly incorporate news about their major customer firms, generating strong return predictability. A long-short trading strategy based on customer firm past returns lead to significant and long-lasting profit, i.e. a cumulative abnormal return of 4.75% over the subsequent year. They argue this is due to investor inattention and lack of understanding of the underlying economic linkage. Pandit, Wasley, and Tzachi (2011) find information externalities along the supply chain. The stock returns of suppliers are positively related to the quarterly earnings announcement returns of their customers because they contain information related to market expectation about the level of suppliers' future performance as measured by changes in consensus analyst forecasts of suppliers' future earnings. At the industry level, Menzly and Ozbas (2010) find that industry profits along the supply chain are correlated and there is a strong cross-predictability effect among industries that are related along the supply chain. They attribute the results to the gradual diffusion of information from economically related industries.

An interesting question is whether institutional investors, such as mutual fund managers, have better understanding of economic links and trade on the links to make profits. Specifically, we ask the following questions: Do some mutual funds trade on economic links? Do these funds benefit from their trades? Do these fund managers have superior skills? That is, do they have outperformance in not only economically linked trades, but also other positions they take?

Understanding these questions has important implications. First, there is a long-held debate in mutual fund literature of whether mutual fund managers have skills. Even if on average, mutual fund managers do not outperform market benchmark, there may still be some skilful managers exist. How to identify them is an important yet difficult task. Second, if professional money managers can add value, we would like to know how they add value. Are they able to better understand economic fundamentals and therefore facilitate the information transmission through their trading activities?

In order to answer these questions, we investigate whether some mutual funds actively trade on suppliers based on the information of their customers. To measure the trading opportunities from the economic links, we focus on the earnings announcement surprises of the customers.

The quarter or annual earnings data is one of the most important information investors looking at when they make investment decisions. In the Appendix, we show that a long-short portfolio formed on the firm's (average) customer earnings announcement returns in the previous quarter earns a 3% abnormal return in the next 6 months and around 6% in the next 24 months. The results are consistent with the finding in Cohen and Frazzini (2008). Because of the information revelation along the supplier chain, the stock performance of suppliers can be predicted by the information from the customers. Cohen and Frazzini (2008) shows that the past stock return of customers can be used to predict supplier stock performance. The results in Appendix show that, the predictability is not limited to stock performance but also the earnings announcement returns of customers. Existing studies show that changes in sellside analysts' recommendations carry useful predictive information (Womack (1996); Kim, Lin, and Slovin (1997), and Jegadeesh et al. (2004)). Kacperczyk and Seru (2007) use the changes in analysts' past recommendations to capture changes in

information in the public and calculate RPI (Reliance on Public Information) of a particular fund as the R^2 of the regression of percentage changes in its portfolio holdings on changes in analysts' past recommendations. They find we find a strong inverse relationship between RPI and various existing measures of performance, and between RPI and fund flows. The earnings announcements are accompanied with significant market reactions (Beaver (1968) and Ball and Brown (1968)). Therefore, we expect mutual fund managers to pay attentions to the firms making earnings announcements, and by understanding the economic implications on economic linked firms, they can trade accordingly.

First, we expect these funds exhibit superior performance. By understanding economic links, these funds should earn positive return from the suppliers they trade because of the slow information diffusion and return predictability associated with it. Second, the ability to correctly trade on economic linked stocks may be a signal of an overall superior managerial skill. If this is true, these funds should also earn higher return from other holding stocks.

We follow the method suggested by Fee and Thomas (2004) to identify the supplier-customer links and create the economic links trade (*ELT*) measure, which measure the extent to which a mutual fund trades on supplier firms based on earnings announcement news on customers. Specifically, *ELT* equals sum of percentage of total trade used to purchase suppliers multiplied by corresponding customers' earnings surprises. The results show that there is a significant variation of this *ELT* measure among mutual funds.

Using various factors adjusted and holding adjusted performance measures, we document a positive relationship between the *ELT* measure and subsequent fund performance. We find that funds in the top group outperform funds in the bottom group by about 2% percent on an annualized basis using the Fama-French model. By decomposing the holdings return into two components, we find that funds generate positive returns from the economic

linked stocks and other stocks. The results indicate that funds that profit from the economic links trade do have investment skills. Furthermore, we use multivariate regression to control for other fund characteristics. This performance results remain robust after adjusting for risk and controlling for other fund characteristics.

We further decompose the *ELT* measure into buy-side and sell-side trades, we find that the performance result is stronger from the buy trades. This is consistent with the fact that mutual funds mostly cannot involve in short sells and therefore are limited on their engagements in the sell-side strategies. In addition, we find performance results on both good news and bad news of customers, with good-news side slightly stronger.

By examining previous holdings of mutual funds, we find that funds that hold more customer stocks prior to the news tend to benefit more from related *ELT* trades. Since these managers have prior exposure to the industry, they are likely to pay more attention to related firms and gain better understanding of their economic links and therefore benefit from it through their trades.

Furthermore, the results are not restricted to the setting of earnings announcement returns. When we use the buy-and-hold abnormal return or changes of analyst consensus recommendation as alternative measures of good news or bad news from customers and related the mutual funds' trade on suppliers with future fund performance, we find significant results.

This paper contributes to several research areas. First, this paper contributes to the performance literature. There has been a constant debate on whether mutual fund managers exhibit superior investment abilities since Jensen (1968). The literature analyzing the net returns documents that mutual funds, on average, underperform passive benchmarks. In contrast, studies based on the portfolio holdings, such as Grinblatt and Titman (1989, 1993),

Daniel, Grinblatt, Titman, and Wermers (1997), find that managers who follow active investment strategies have stock-picking abilities. Moreover, recent studies have linked various fund characteristics to performance and provided evidence that at least some managers possess stock-selection skills. This paper complements the performance literature by examining mutual fund trading activities directly, and provides evidence that supports the view that some mutual fund managers have the ability to identify profitable opportunities and that their trades add value.

Second, this paper also contributes to the literature on supplier and customer linkage. Previous literature (Cohen and Frazzini (2008), Menzly and Ozbas(2010)) shows that economic linkage and investors' general inattention and lack of understanding lead to strong return implications of linked stocks. We add to the literature by showing that at least some sophisticated investors such as some mutual fund managers fully understand the economic linkage and have the ability to trade successfully using their knowledge. They generate superior performance from trading on the linked stocks.

The remainder of this paper is organized as follows: in Section 2 we describe the economic links trade (ELT) measure. Section 3 explains the data sources and gives summary statistics. Section 4 provides the performance implications of the measure. Some robustness checks are discussed in section 5. Section 6 concludes.

2. Measuring Economic Links trade

In this section, we describe the main measure of economic links trade. In particular, we measure the amount of suppliers traded by each fund in a given quarter. The quarterly

holding data of mutual funds is used to compute the measure. The time line of our test is illustrated in Figure 1:

Figure 1: Time line of the test

For all the suppliers with effectively linked customers, we observe the earnings announcement returns of their customers in quarter $t-1$. The delay price response of suppliers to information shocks from their customers provides an opportunity for sophisticated investors to make profit. We expect that mutual funds which are aware of the economic links would act on the information they got from quarter $t-1$. We compare the holding at the end of quarter t with the holding at the beginning and use the holding change to calculate the key measure ELT . The measure calculated in quarter t is used to predict the fund returns in quarter $t+1$. We expect funds with higher ELT would have better future performance.

2.1 Identifying Supplier-Customer Linkage

We identify customer-supplier relationships following the method suggested by Fee and Thomas (2004). Under FASB No. 14 and No. 131 firms are required to report certain financial information for significant industry segments which comprised more than 10% of consolidated yearly sales, assets or profits. The information is available in the Compustat industry segment files. However, there is not identifier that can be used link the customers to the listed firms. We only do the matching for firms with financial information in CRSP/Compustat and excluding foreign firms, private firms and the U.S. government. We compare the customer names or the abbreviation of the names with the company names listed

on CRSP. Because the customer names showed in the segment file are not always identical to the names showed in CRSP or Compustat, more than one potential matched company may be found. We manually check the information and only keep the precise one. The reported customers that we could not identify unique matched listed firms are excluded from the sample. The final supplier-customer links are between 1980 and 2008. In order to make sure that the supplier-customer relationships are known to the public before mutual fund trade, we make assumption that there is a 6-month lag to the fiscal year-end date, similar to the gap imposed by Fama and French (1993).

2.2 Economic Links Trade

To measure mutual funds' ability to trade on economically linked firms, we define economic links trade (*ELT*) as the fraction of total trade value used to purchase suppliers with their customers made earnings announcements in the previous quarter:

$$ELT_{i,t} = \frac{\sum_{s \in \{linked_suppliers\}} \{\Delta Hold_{s,i,t} * \bar{P}_{s,t}\} * CAR_customer_{s,t-1}}{\sum_{j \in \{fund_portfolio\}} \{\max(0, \Delta Hold_{j,i,t} * \bar{P}_{j,t})\}}$$

where $\Delta Hold_{s,i,t}$ is the holding change adjusted for split for supplier s by mutual fund i during quarter t , and $\bar{P}_{s,t}$ is the average price of supplier s over the quarter. We use average price to avoid the impact of returns on trading weight during the quarter. The information about earnings announcements comes from IBES. We use the market model to calculate the 3-day cumulative abnormal returns, $CAR_customer_{s,t-1}$, for the customer of supplier s around the announcement day in the previous quarter. We calculate the equal weighted CAR for suppliers with more than one customer. The CRSP value-weighted market return is used as the proxy for the market return. It is worth pointing out that the measure indicates that when making the decision of trading on suppliers, mutual funds do not have to predict the market

reaction to the earnings announcements of their customers. Instead, the mutual funds only have to be aware of the supplier-customer relationships and pay attention to the earnings announcements of the customers. The mutual funds can then trade according to the information they collect from the supplier chain.

We also create several alternative measures. First, the buying and selling activities may contain different information about the trading skills of mutual funds. The buying decisions of mutual funds are more informative because they are more likely to be motivated by private information. In contrast, the selling decisions may come from liquidation concern or portfolio rebalancing, containing less information about the skill of mutual funds. In order to gain more insight about *ELT*, we separate the buying and selling by creating two similar measures base on the trade direction:

$$ELT_Buy_{i,t} = \frac{\sum_{s \in \{linked_suppliers\}} \{\Delta Buy_{s,i,t} * \bar{P}_{s,t}\} * CAR_customer_{s,t-1}}{\sum_{j \in \{fund_portfolio\}} \{\max(0, \Delta Hold_{j,i,t} * \bar{P}_{j,t})\}}$$

$$ELT_Sell_{i,t} = \frac{\sum_{s \in \{linked_suppliers\}} \{\Delta Sell_{s,i,t} * \bar{P}_{s,t}\} * CAR_customer_{s,t-1}}{\sum_{j \in \{fund_portfolio\}} \{\max(0, \Delta Hold_{j,i,t} * \bar{P}_{j,t})\}}$$

where $\Delta Buy_{s,i,t}$ and $\Delta Sell_{s,i,t}$ are the shares buys and sells for supplier s by mutual fund i during quarter t .

Besides, the impact of customers' information on suppliers depends on whether it is good news or bad news. We therefore create another two measures base on the sign of earnings announcement returns of customers:

$$ELT_Positive_{i,t} = \frac{\sum_{s \in \{linked_suppliers\}} \{\Delta Hold_{s,i,t} * \bar{P}_{s,t}\} * CAR_Positive_customer_{s,t-1}}{\sum_{j \in \{fund_portfolio\}} \{\max(0, \Delta Hold_{j,i,t} * \bar{P}_{j,t})\}}$$

$$ELT_Negative_{i,t} = \frac{\sum_{s \in \{linked_suppliers\}} \{\Delta Hold_{s,i,t} * \bar{P}_{s,t}\} * CAR_Negative_customer_{s,t-1}}{\sum_{j \in \{fund_portfolio\}} \{\max(0, \Delta Hold_{j,i,t} * \bar{P}_{j,t})\}}$$

where $CAR_Positive_customer_{s,t-1}$ and $CAR_Negative_customer_{s,t-1}$ represent positive and negative customer CARs respectively. The definitions of other components in the four alternative measures are the same as before.

3. Data Description and Summary Statistics

In this section, we explain the data used in the paper, present the summary statistics of the variables and investigate the characteristics of mutual funds that engage in the economic links trade.

3.1 Data Description

The data of mutual funds and stocks come from several databases. We collect the fund return, total assets under management, the management fee, investment objectives and other fund-level characteristics from the CRSP Survivorship Bias Free Mutual Fund Database. For funds with more than one share class, we compute the fund-level characteristics by aggregating across different classes. The holding position of mutual funds is extracted from the Thomson Financial database. Since we need the mutual funds' quarterly stock holding change of stocks to calculate the economic links trade measure, we only keep funds with adjacent quarterly holding information from Thomson. We merge these two databases using the MFlinks file based on Wermers (2000), which is available through the Wharton Research data Services. The stock price, shares outstanding and other firm-level characteristics comes from CRSP stock database. Because we focus on the trading skills of actively-managed

domestic equity mutual funds, the index, sector, balanced, bond, money market and international funds are excluded from the sample. Small funds that have less than 20 million total assets under management in the previous month are also eliminated. Because the data of fund holdings are available only after 1980, our sample period is from 1980 to 2008.

3.2 Summary Statistics

In table 1 we report the summary statistics of fund-level characteristics. The mean total net asset under management is \$1,040 million. Age is the number of years since a fund's inception to the current date. For funds without information about the inception date, we use the date it first appeared in the CRSP database. The average age of a fund is about 15 years with a standard deviation of 15 years. The Expense Ratio, about 0.1% per month, is the percentage of operating expenses fee paid by shareholders. Turnover ratio is the minimum of aggregated purchases or sales divided by the average 12-month TNA of the mutual fund. In our sample the turnover ratio is about 88% per year. On average, a typical mutual fund holds 6.54% of their asset in cash. The quarterly fund flow is defined as the growth rate of TNA after adjusting for the appreciation of the assets. The mutual funds in our sample experience an inflow of around 3% per quarter. The number of stocks hold by mutual funds is 107 on average. The last row of the table 1 reports our key measure, *ELT*. During our sample period, the *ELT* is close to -0.007% with a standard deviation of 0.592%.

3.3 Fund Characteristics by Economic Links Trade (ELT)

To investigate the characteristics of funds involved in economic links trade, we sort mutual funds into five groups in each month according to their most recent *ELT* measure. Funds with the lowest *ELT* are put into the first group while funds with the highest *ELT* are put into fifth group. For those funds that do not trade any supplier with earnings announcement CAR of its customers, *ELT* equals to zero, we put them into third group.

Table 2 summarizes the characteristics of mutual funds sorted according to their *ELT* measure. We observe that mutual funds vary in their *ELT* measures. The bottom group of mutual funds have a *ELT* close to -0.75% while the top group have a *ELT* close to 0.72%. The spread in *ELT* between the top and the bottom groups is close to 1.5% and the difference is significant at the 1% level. Funds with the highest *ELT* tend to be smaller and younger, with an age of 14.8 years and TNA of 900 million. The mutual funds in top group also have a higher expense ratio than mutual funds in other groups. However, we do not find significant difference between top and bottom groups in the turnover ratio, cash holding proportion and the number of stocks held by mutual funds. The fund flow for the top group is higher than the fund flow in the bottom group; however, the magnitude is not larger than the average value of the sample.

4. The performance Implications of Economic Links Trade

To examine the performance implication of the *ELT* measure, we compare the performance of mutual funds with higher *ELT* with the performance of mutual funds in other groups. To avoid any potential issues of reverse causality, we only analyze the future performance of funds after computing the *ELT* measure. The fund return was measured by different factor models suggested in the literature.

4.1 Portfolio Performance

Table 3 reports the calendar-time abnormal return of the mutual fund portfolios sorted by their economic links trade activities. At the end of each month, mutual funds are sorted into one of five quintile portfolios according to their most recent *ELT* measure. We then compute the abnormal return of the corresponding portfolios over the next month. The

abnormal return is the intercept on a regression of monthly excess return from the rolling strategy. The explanatory variables include the market excess return, the Fama and French (1993) factor, the Carhart (1997) momentum factor, and the Pastor and Stambaugh (2003) liquidity factor. The abnormal return of a zero-cost portfolio is showed on the rightmost column. This long-short portfolio holds the equal-weighted top mutual fund portfolio and sells short the bottom mutual fund portfolio. We focus on before-expense fund returns, because raw return are more appropriate in determining whether fund managers have stock selecting abilities before subtracting operating fees.

As shown in Table3, mutual funds with higher $ELT_{i,t}$ exhibit higher subsequent performance. Mutual funds in the top portfolio exhibit a positive abnormal return ranging from 0.09% to 0.12% per month depending on which factor model we are using. Moreover, funds with the highest $ELT_{i,t}$ outperform the funds with the lowest $ELT_{i,t}$ by 0.16% per month (t-statistic = 3.88), or approximately 1.94% per year, when we are using market model. The Fama and French (1993) abnormal return still remains significant at 0.17% per month. We go on to adjust the returns by augmenting the factor model with Carhart's (1997) momentum factor. The abnormal return only slightly decreases to 0.13% per month and is still significant at 1% level. In the last two rows we adjust the returns using a five-factor model by including the liquidity factor of Pastor and Stambaugh (2003). This adjustment has little effect on the abnormal results. The results show that after controlling for the common factors, mutual funds that have higher $ELT_{i,t}$ earn higher subsequent returns. A zero-investment strategy that longs the funds with higher and shorts the funds with lower generate significant positive returns.

Cohen and Frazzini (2008) shows that the abnormal return from the potential arbitrage return in economic linked stocks is around 5% 12 months after formation. Here we find that

the abnormal return fund managers generate from economic linked stocks is around 2%. To our understanding, there are two main reasons for the return gap. First, our *ELT* measure is not precise as we calculate the holding change from quarterly-end holding data instead of really trading data. Therefore, the *ELT* measure does not capture the true investment ability of fund managers. Second, the trading behavior of institutional investors will move the stock price to the intrinsic value, narrowing the return opportunity they can exploit. Therefore, the abnormal return documented here is lower than the abnormal return showed in Cohen and Frazzini (2008).

In order to gain deeper insight about the sources of the outperformance of funds with higher level of *ELT* measure, we also report the sorting results base on four alternative measures in Table 4. In Panel A and Panel B, we sorted the mutual funds by $ELT_Buy_{i,t}$ and $ELT_Sell_{i,t}$ respectively. As shown in Pane A, the long-short strategy still generates a significant abnormal return when we form portfolios base on the purchasing behaviour of mutual funds. The magnitude of abnormal return is between 0.10% and 0.14% per month. However, the abnormal return becomes insignificant when we sort portfolios according to $ELT_Sell_{i,t}$. The results in Panel B show that there is not outperformance when we compare the top portfolio with the bottom portfolio. Panel A and Panel B together show that the measure calculated based on the purchasing decisions is a better predictor of fund skills compared to the measure calculated based on the selling decisions. This is consistent with our understanding that the buying decisions of mutual funds are more informative.

In Panel C and Panel D of Table 4 we report the portfolio performance of mutual funds sorted by $ELT_Positive_{i,t}$ and $ELT_Negative_{i,t}$. The positive and negative earnings announcement returns from customers should influence suppliers differently. Whether it is

easier for mutual funds to take the trading opportunities of suppliers from the good news or bad news released by their customers is an empirical question. The results in Panel C and Panel D suggest that the long-short portfolios sorted by the two measures calculated based on positive and negative earnings announcement returns from customers both exhibit significant abnormal returns.

4.2 Return decomposition

To gain a better understanding about the sources of the superior performance of the funds involved in economic links trade, we decompose the funds' holding returns into returns from the suppliers bought in the previous quarter and the rest of the positions that the funds hold at the start of the quarter. If the superior performance come from the economic linked stocks is due to the working or education experience of the fund managers and the managers does not have information advantage in other non-linked stocks, we should not observe any outperformance from other positions. However, if the superior performance is due to managerial skills, and the fund managers not only pay attention to the economic linked stocks but also try to explore other investment opportunities, we expect the funds to exhibit superior return not only in the suppliers they bought but also in other positions they hold.

The second column of Table 5 reports the gross holding returns of portfolios sorted by $ELT_{i,t}$. The next two columns show the holdings returns of the suppliers bought and the return of other holdings positions. First, we find that funds are better at selecting suppliers with higher future return. The suppliers bought by the top ELT group have higher return than the suppliers bought by the bottom portfolio by 0.17% per month. However, the difference is not significant. This may due to the fact that the number of suppliers with customers' earnings announcements each quarter is limited and mutual funds can only take advantage of some suppliers which they are more familiar with, most likely the ones whose customers they

already hold in the previous quarter. In our sample period, the number of *ELT* stocks a typical mutual fund buys each quarter is close to six and the standard deviation is above three, meaning mutual funds' trade on *ELT* stocks vary across time. Second, excluding the supplier stocks, the mutual funds in the top *ELT* group still hold a winning portfolio, which outperforms the bottom group by 0.10% per month.

Table 5 also reports the benchmark adjusted performance and factor adjusted performance. We calculate the size, book-to-market and momentum adjusted stock return following the method suggested by Daniel, Grinblatt, Titman, and Wermers (1997). We aggregate the stock returns as benchmark adjusted fund return. In the last four columns we report the Carhart-adjusted fund return. Both adjusted performance yield similar results to the holding returns. Funds that profit from the suppliers with higher return also show superior investment ability other holdings. This support the argument that mutual funds in the top group not only because they are able to identify suppliers with better future performance from the information down the supplier chain but also because they possess overall superior skills, which contribute to their substantial outperformance.

4.3 Multivariate Regression

In this section, we use multivariate regression analysis to investigate the relationship between economic links trade and the subsequent fund performance. We control for several fund-level characteristics that may be related to fund performance. We run the following Fama-MacBeth specifications:

$$return_{i,t} = \beta_0 + \beta_1 ELT_{i,t-1} + \beta_2 LogTNA + \beta_3 RF_{f,t-1} + \beta_4 Flow_{f,t-1} + \beta_5 LogAge_{f,t-1} + \beta_6 Exp_{f,t-1} + \beta_7 TO_{f,t-1} + \varepsilon_{i,t}$$

where the dependent variable in each cross-section is either the raw return of an individual mutual fund in a particular month, the Fama-French-Carhart model adjusted abnormal return,

or the characteristic adjusted fund return. The key independent variable is the most recent *ELT* measure. The coefficient β_1 captures the relationship between the fund trade on supplier-customer links and the subsequent fund returns. The other control variables include the logarithm of the total asset under management, the average fund flow in the previous year, the age of the fund defined as the logarithm of (1+age), the expense ratio of the fund, and the turnover ratio. In the first step, we run a cross-section regression in each month; in the second step, we calculate the means of the cross-sectional coefficients we get from the first step.

Panel A of table 6 shows the results of Fama-MacBeth regressions. The first column use raw fund return as dependent variable. The coefficient is significantly positive, indicating a positive relationship between economic links trade and subsequent fund performance. The lag fund return is also positively correlated with future return. It is significant at below 5% level across different models, suggesting that current fund performance is strongly related to past performance. The fund size is negatively related to fund return. This result is consistent with the argument of dis-economy of scale in fund management by Berk and Green (2004). The expense ratio is related to four-factor adjusted return as well, which is consistent with Carhart(1997), who finds that net fund returns are negatively correlate to expense levels. We do not find significant effects on other control variables.

To measure risk adjusted performance, we use the Fama-French-Carhart four factor model. Specifically, we estimate the factor loadings for each fund using the past 60 months fund returns. The abnormal returns for each fund equals to the difference between the actual fund return and the expected fund return based on the estimated factor loadings. The result is reported on Column 2 of Panel A. The coefficient on *ELT* is still positive and significant.

We also calculate a holding based performance measure, characteristic selectivity measure, following the method suggested by Daniel, Grinblatt, Titman, and Wermers (1997).

It measures how well fund managers select stocks that beat stocks with the same characteristics at the beginning of each month. It is defined as follows:

$$CS_{f,t} = \sum_{i=1}^N w_{f,t}^i [R_{i,t} - BR_{i(t-1),t}]$$

where $R_{i,t}$ denotes the return of stock i during period t . The benchmark return, $BR_{i(t-1),t}$, is the portfolio during period t to which stock i was allocated during month $t-1$, according to its size, value, and momentum characteristics. The proportion of assets invested in stock i at the beginning of month t by fund f is denoted as $w_{f,t}^i$. As shown in Column 3 of Panel A, the relationship between *ELT* measure and fund return still holds when the fund return is measured by four-factor adjusted return or DGTW-adjusted return.

The argument of this study is that, skilled mutual funds are aware of the supplier-customer links and they actively purchase suppliers with customers that have positive information and sell suppliers with customers that have negative information. The measure of *ELT* captures the trading behaviour of mutual funds, therefore, mutual funds with higher *ELT* exhibit superior performance. However, it is possible that mutual funds employ a trading strategy that purchasing stocks with positive earnings announcement returns and selling stocks with negative earnings announcement returns. Literature in accounting shows that post-earnings announcement drift (PEAD) is one of the most robust anomalies in asset pricing. PEAD refers to the continuance of abnormal returns after earnings announcements in the direction of quarterly earnings surprises. The drift may last for as long as three months. Ke and Ramalingegowda (2005) find that some institutional investors trade to exploit the PEAD anomaly and generate abnormal return from the trading. If a mutual fund exploits the post earnings announcement drift, it may also generate superior performance in the following months. In order to examine this possibility, we add another control variable to the regression.

Specifically, we create a new measure to capture the behavior of trading stocks with earnings announcements in the previous quarter using the following method:

$$TradeCAR_{i,t} = \frac{\sum_{j \in \{stocks_with_CAR\}} \{\Delta Hold_{j,i,t} * \bar{P}_{s,t}\} * CAR_{j,t-1}}{\sum_{j \in \{fund_portfolio\}} \{\max(0, \Delta Hold_{j,i,t} * \bar{P}_{j,t})\}}$$

where $CAR_{j,t-1}$ is the earnings announcement return in the previous quarter. Since the earnings announcement returns of suppliers may be correlated with the earnings announcement returns of customers, we exclude the suppliers with customer earnings announcement returns in the previous quarter from the calculation. However, the inclusion of suppliers does change the results.

Panel B of Table 6 reports the regression results after controlling for the potential of trading on earnings announcement returns activities by mutual funds. The coefficient on $TradeCAR_{i,t}$ is significant at 10% level when we use the raw fund return as dependent variable, suggesting that a strategy that chasing stocks with positive earnings announcement return does contribute to the future fund performance. However, controlling $TradeCAR_{i,t}$ has little impact on ELT . The coefficient is still significant and positively correlated with future fund performance. This relationship holds when we use four-factor adjusted return and DGTW-adjusted return as dependent variable. The results suggest that trade on supplier-customer links is different from the arbitrage trade of PEAD anomaly. Controlling for this possibility does not change our conclusion that economic links trade predict fund performance.

Even though the supplier-customer linkage is public information, the ability to trade on economic linkage should vary among mutual funds due to limited-information. Stocks that

belong to the holding portfolio are more likely to catch the attention of fund managers. When a customer firm in the holding portfolio make earnings announcement, the fund managers should have better understanding of the economic implications on suppliers and more likely to trade the supplier stocks accordingly. For funds with little or no investment in the customer firms, they are less likely to be aware of the investment opportunity comes from the gradual diffusion of information along the supplier chain. Therefore, we expect that, mutual funds with higher holding value of customers at the beginning of the quarter are more likely to trade on economic linkage and benefit from the trading. Panel C of Table 6 reports the regression results of two subsamples. We divide the sample into two groups by the mutual funds' holding value of customers that made earnings announcements in the previous quarter. For the observations that funds have high level of holding value of customers at the beginning of the quarter, the coefficient on *ELT* is still significant across different models. In contrast, the coefficient on *ELT* becomes insignificant in the subsample with low holding value of customers. The positive relationship between economic linkage trade and future fund performance mainly come from the funds hold higher value of customer stocks at the beginning. This is consistent with the limited-information explanation.

Over all, the results in this section confirm the portfolio results reported in Table 3 that mutual funds that perform well in selecting economic linked suppliers have superior performance, even after controlling for other fund-level characteristics and after controlling for risk and style.

5. Robustness Check

In this section, we discuss several issues related to our results and do additional robustness tests.

5.1 Sub-period tests

Are the results we document driven by some specific period? In order to answer this question, we split the sample into two periods, 1980-1993 and 1994-2008, and report the results of portfolio returns in Table 7. The last column in Panel A and Panel B shows the return of long-short strategy respectively. The returns are significant positive using different risk adjusted models, suggesting that our results exist in the two sub-periods. We observe significant outperformance for mutual funds in top group during the early period. The magnitude of the abnormal return is higher during the early period.

Column 5 in Panel A of Table 7 shows the abnormal return during this period is between 0.09% and 0.24% per month depending on which model we are using to adjust the raw return. However, the portfolio returns of top group are not significant different from zero during the later period. Column 5 in Panel B of Table 7 reports an insignificant abnormal return between 0.03% and 0.08% per month. The inconsistency may come from the fact that from 1994 to 2008, the crash of dot-com bubble after 2000 and the subprime mortgage crisis since 2007 seriously bring down the fund return.

5.2 Alternative measures

The main measure in our study uses the earnings announcement returns for calculation. It is possible that some extremely high or low returns drive the results. We employ two alternative measures to directly address this concern:

$$ELT_Dummy_{i,t} = \frac{\sum_{s \in \{linked_suppliers\}} \{\Delta Hold_{s,i,t} * \bar{P}_{s,t}\} * CAR_Dummy_customer_{s,t-1}}{\sum_{j \in \{fund_portfolio\}} \{\max(0, \Delta Hold_{j,i,t} * \bar{P}_{j,t})\}}$$

$$ELT_Top_{i,t} = \frac{\sum_{s \in \{linked_suppliers\}} \{\Delta Hold_{s,i,t} * \bar{P}_{s,t}\} * Top_CAR_customer_{s,t-1}}{\sum_{j \in \{fund_portfolio\}} \{\max(0, \Delta Hold_{j,i,t} * \bar{P}_{j,t})\}}$$

where $CAR_Dummy_customer_{s,t-1}$ represents a dummy that equals to 1 if the earnings announcement returns of the customers is positive and equals to 0 if the return is negative or zero, and $Top_CAR_customer_{s,t-1}$ represents a dummy that equals to 1 if the earnings announcement returns of the customers belongs to the top 5% among all customers released earnings in the previous quarter. All other components are as previously defined. We sort the mutual funds according to these two alternative measures and examine the future fund returns.

The results are reported in Table 8. As shown in the last column of Panel A, the zero-investment portfolio generates significant positive return. The performance results of $ELT_Dummy_{i,t}$ are quite consistent with the results found using the original ELT measure. The last column in Panel A of Table 8 reports abnormal return from 0.09% to 0.13% per month. Funds that successfully trade on suppliers with customer earnings announcement perform better than funds that failed to make the right economic links trade. The results are stronger using $ELT_Top_{i,t}$. The magnitude of long-short strategy return is around 0.18% per month when we use multi-factor models, as reported in the last column of Panel B. Again, the results using alternative measures confirm the previous findings that funds with better economic links trade tend to have better performance and these results are not due to some extreme high or low return.

5.3 Contemporaneous Measure

Our main results show that mutual funds that correctly trade on economic linked stocks earn superior performance. There are two potential explanations for the results. One is the fund managers have better understanding of the economic links and buy/sell the suppliers when observing the good/bad news from customers. The main measure we employ in this study aims to capture the ability of mutual fund on capitalizing the performance drift caused by price response delay along the supplier chain. The gradual diffusion of information among economically linked stocks gives skilful investors to take advantage of the public information, namely the earnings announcement returns of customers in the previous quarter. The superior performance comes from the arbitrage trade from the performance drift.

Another explanation of the results we documented above is that, skilled fund managers are able to predict the earnings announcement returns of customers and trade the suppliers accordingly. Their predict ability may come from their personal expertise experience, connection with the firm managers or other insiders. In other words, fund managers have information advantage about the stock performance of suppliers even without knowing the earnings announcement return of their customers. To examine this possibility, we create a contemporaneous measure as follows:

$$ELT_Con_{i,t} = \frac{\sum_{s \in \{linked_suppliers\}} \{\Delta Hold_{s,i,t} * \bar{P}_{s,t}\} * CAR_customer_{s,t}}{\sum_{j \in \{fund_portfolio\}} \{\max(0, \Delta Hold_{j,i,t} * \bar{P}_{j,t})\}}$$

where $CAR_customer_{s,t}$ is the earnings announcement returns of the customers of supplier s in quarter t , suggesting that, the trade of mutual funds and the earnings announcement happen at the same quarter. Other components of the formula stay the same.

If mutual funds have information advantage and can predict the earnings announcement returns of customers and trade on suppliers accordingly, we expect the contemporaneous measure to be positively related to future fund return. Table 9 reports the portfolio returns calculated using the contemporaneous measure. The results of long-short strategy showed in the last column, around 0.05% per month, are not significant different from zero across different models, suggesting that the predicting ability of mutual funds is not the reason of superior performance.

5.4 Other economic information settings

In the previous test, we use earnings announcement as a proxy of economic information from customers to suppliers. To check whether the economic links trade strategy still works under other economic information settings, we use two alternative methods to identify winners and losers.

First, other than earnings announcements, fund managers should also pay attention to the past performance of customers. Here we calculate the *ELT* measure based on the buy-and-hold abnormal returns (BHARs) of customers using the following formula:

$$ELT_BHAR_{i,t} = \frac{\sum_{s \in \{linked_suppliers\}} \{\Delta Hold_{s,i,t} * \bar{P}_{s,t}\} * BHAR_customer_{s,t}}{\sum_{j \in \{fund_portfolio\}} \{\max(0, \Delta Hold_{j,i,t} * \bar{P}_{j,t})\}}$$

where $ELT_BHAR_{i,t}$ is buy-and-hold abnormal returns of customers in the last 12-month. We take equal-weighted BHARs for suppliers with more than one customer.

The results of portfolio returns of mutual funds sorted by $ELT_BHAR_{i,t}$ are reported in Panel A of Table 10. The last column presents the long-short strategy return around 0.07% per month. The magnitude is smaller compared to the results sorted by *ELT* based on earnings

announcement returns, which is between 0.13% and 0.17% per month; however, the returns are still significant at 10% level.

Second, we use the analyst consensus recommendation as an alternative proxy of economic information from customers. If analysts upgrade (downgrade) the recommendation of customers, we regard the supplier as winner (loser). We calculate the new measure base on analyst consensus recommendation as follows:

$$ELT_Recom_{i,t} = \frac{\sum_{s \in \{linked_suppliers\}} \{\Delta Hold_{s,i,t} * \bar{P}_{s,t}\} * \Delta Recommendation_customer_{s,t-1}}{\sum_{j \in \{fund_portfolio\}} \{\max(0, \Delta Hold_{j,i,t} * \bar{P}_{j,t})\}}$$

where $\Delta Recommendation_customer_{s,t-1}$ is the consensus recommendation change of customers in quarter $t-1$. This data comes from IBES and is only available only after 1994. The rating of consensus recommendation ranges from one to five. In order to make the interpretation easier, we take the strong buy recommendation as five and sell recommendation as one. For the suppliers with more than one customer, we take an average of consensus recommendation change across customers. Other components of the formula are the same as before. A fund that buy suppliers which their customers were upgraded in the previous quarter or sell suppliers which their customers were downgraded in the previous quarter will have a higher value of $ELT_Recom_{i,t}$.

Panel B of Table 10 reports the future risk-adjusted performance of mutual funds sorted by the new measure. The results show that, the long-short strategy still works when we use analyst consensus recommendation as alternative proxy of economic information. The zero-investment return is around 0.09% per month. However, we do not find superior return for funds in the top group. This is probably because the mutual fund industry as a whole does not do well during this sample period, as evidenced by Panel B of table 6.

5.5 Simulation results

Another concern of our study is that, mutual funds trade economic linked stocks randomly instead of purposely. It is the unique characteristics of the stocks mutual funds hold that contribute to the superior performance. In other words, the winning funds purchase stocks with better future performance and sell stocks with worse future performance, and these kinds of stocks happened to be the suppliers with better and worse customer earnings announcement returns respectively. In order to address this concern and check whether a strategy that trade on stocks with similar characteristics could generate the same superior performance, we do a simulation test in this part.

First, in each quarter, we sort suppliers with available customer earnings announcement returns in the previous quarter into nine groups according to their market size and book-to-market value. For a supplier traded by a given fund, we randomly draw one from the portfolio which the supplier belongs to. We use the earnings announcement returns of the customer of the simulated supplier, $CAR_simulated_{s,t-1}$, to calculate the simulated measure using the following formula:

$$ELT_Simulated_{i,t} = \frac{\sum_{s \in \{linked_suppliers\}} \{\Delta Hold_{s,i,t} * \bar{P}_{s,t}\} * CAR_simulated_{s,t-1}}{\sum_{j \in \{fund_portfolio\}} \{\max(0, \Delta Hold_{j,i,t} * \bar{P}_{j,t})\}}$$

Second, we rank mutual funds into five groups according to the simulated measure and calculate the risk adjusted portfolio return following the method used in Table 3.

Panel A of Table 11 reports the 500 simulated results. The returns of long short strategy are around 0.02% per month across different risk adjusted models. In contract, the real returns of the long short strategy range from 0.13% to 0.17% per month. On average, the simulated strategy does not generate a superior performance, suggesting that the results we

documented are unlikely to come from a random trading strategy. In Panel B, we compare the simulated returns with the real returns from Panel A of table 3 taking the four factor model as an example. The last two rows show the difference of returns and the t-statistic of the difference. The long-short return difference between real alpha and the simulated alpha is 0.12% per month and it is significant at 1% level.

6. Conclusions

Whether managers of money management companies have skills is of great importance and interest. It is well documented in the literature that the stock price of economically linked suppliers can be predictable because they do not reflect shocks to the related customers in a timely manner (Cohen and Frazzini, 2008; Menzly and Ozbas, 2010). This paper investigates whether some mutual funds are aware of the economic linkage and trade on it to make profits. We measure the economic links trade (*ELT*) as the fraction of total trade value used to purchase suppliers with their customers made earnings announcement in the previous quarter. The results show that, fund managers which understand the economic links and trade accordingly benefit from the trade. Moreover, these managers exhibit overall investment skills and generate superior performance. Controlling other well-known fund-level characteristics that may be related to fund performance has little impact on the relationship between *ELT* and fund returns.

Cohen and Frazzini (2008) show that there are return predictability across economically linked firms. Their explanation for the existence of abnormal return is that investors lack attention or do not understand the meaning of economic links. Hirshleifer, Lim and Teoh (2011) find that investor neglect of earnings induces post-earnings announcement drift and the profit anomaly, suggesting that investor inattention could be one of the reasons for the return opportunity. Here we find that fund managers identify the opportunity and

make a profit from the trading. The question is, if mutual funds are sophisticated investors and do not suffer from inattention, the trading of mutual funds should incorporate the information from customers and the return opportunity should disappear because the prices of suppliers are adjusted immediately. However, in our study period, the return opportunity based on economic links still persists. The evidences combined suggest that some mutual funds trade on the economic links, affect the prices and reduce the return, but do not bring the abnormal return down to zero. Why mutual funds do not fully exploit the information? Our understanding is that, only some smart fund managers are aware of the economic links and their trading is not enough to make the abnormal return disappear.

The results of sub-periods in Table 7 also suggest that, the abnormal return is higher during the early period and smaller during the late period. As sophisticated investors play a more important role in the market and participate in the arbitrage, the return opportunity is reduced. Besides, the data about supplier-customer relationship come from Compustat industry segment files, which are not available before 2001. Therefore, it takes effect for fund managers to collect the information and apply a strategy based on economic links. McLean and Pontiff (2012) find that after the publication of academic research papers on the predictability of cross-sectional stock returns, the average post-publication decay of abnormal return is about 30% percent. The trading activity, variance, turnover, dollar volume and short interest all increase significantly post-publication. They argue that the findings are consistent with the idea that academic research draws attention to anomaly strategies, which results in more trading. Since the anomaly documented by Cohen and Frazzini (2008) was found not long ago, we expect that fund managers and other sophisticated investors just begin to exploit the anomaly and the abnormal return be reduced but persistent in the near future.

References

- Ball, Ray., and Brown, Philip., 1968. An empirical evaluation of accounting income numbers, *Journal of Accounting Research* 6, 159–178.
- Berk, Jonathan B., and Richard C. Green, 2004, Mutual fund flows and performance in rational markets, *The Journal of Political Economy* 112, 1269-1295.
- Beaver, William H., 1968, The information content of annual earnings announcements. *Journal of Accounting Research* 6, 67–92.
- Bollen, Nicolas. P. B., and Jeffrey. A. Busse, 2001, On the Timing Ability of Mutual Fund Managers. *The Journal of Finance* 56, 1075-1094.
- Carhart, Mark, 1997, On persistence in mutual fund performance, *Journal of Finance* 52, 57–82.
- Chen, J., S. Hanson, H. G. Hong, and J. C. Stein, 2008. Do hedge funds profit from mutual-fund distress? NBER Working Paper No. W13786.
- Cohen, Lauren, and Andrea Frazzini, 2008. *Economic Links and Predictable Returns*, *Journal of Finance* 63, 1977-2011.
- Cohen, Randolph B., Joshua D. Coval, and Lubos. Pastor, 2005, Judging Fund Managers by the Company They Keep. *The Journal of Finance* 60, 1057-1096.
- Coval, Joshua, and Erik Stafford, 2007. Asset Fire Sales (and Purchases) in Equity Markets. *The Journal of Financial Economics* 86, Issue 2, 479-512.
- Cremers, Martijn, and Antti Petajisto, 2009, How Active is Your Fund Manager? A New Measure that Predicts Performance, *Review of Financial Studies* 22, 3329-3365.
- Daniel, Kent, Mark Grinblatt, Sheridan Titman, and Russ Wermers, 1997, Measuring mutual fund performance with characteristic - based benchmarks, *The Journal of Finance* 52, 1035-1058.
- Daniel, Kent, and Sheridan Titman, 1997, Evidence on the characteristics of cross sectional variation in stock returns, *Journal of Finance* 52, 1–33.
- Fama, Eugene, and Kenneth French, 1993, Common risk factors in the returns on stocks and bonds, *Journal of Financial Economics* 33, 3–56.
- Fama, Eugene, and James MacBeth, 1973, Risk, return and equilibrium: Empirical tests, *Journal of Political Economy* 81, 607–636.

- Fee, Edward, and Shawn Thomas, 2004, Sources of Gains in Horizontal Mergers: Evidence from Customer, Supplier, and Rival Firms, *Journal of Financial Economics* 74, 423–460.
- Hirshleifer, David, and Siew Hong Teoh, 2003, Limited attention, information disclosure, and financial reporting, *Journal of Accounting and Economics* 36, 337–386.
- Hirshleifer, David, Sonya Lim, and Siew Hong Teoh, 2011. *Limited Investor Attention and Stock Market Misreactions to Accounting Information*. Review of Asset Pricing Studies 1, 35-73.
- Huang, Lixin, and Jayant R. Kale, 2013, Product Market Linkages, Manager Quality, and Mutual Fund Performance, *Review of Finance* 17, 1895-1946
- Frazzini, Andrea, and Owen A. Lamont, 2008, Dumb Money: Mutual Fund Flows and the Cross-section of Stock Returns. *Journal of Financial Economics* 88, Issue 2, 299-322.
- Grinblatt, Mark, and Sheridan Titman, 1992, The Persistence of Mutual Fund Performance, *The Journal of Finance* 47, 1977-1984.
- Hertzel, Michael G., Zhi Li, Micah S. Officer, and Kimberly J. Rodgers, 2008, Inter-firm Linkages and the Wealth Effects of Financial Distress along the Supply Chain, *Journal of Financial Economics* 87, 374-387.
- Hou, Kewei, 2007, Industry Information Diffusion and the Lead-lag Effect in Stock Returns, *Review of Financial Studies* 20, 1113–1138.
- Jegadeesh, Narasimhan, Joonghyuk Kim, Susan D. Krische, and Charles M.C. Lee, 2004, Analyzing the analysts: When do recommendations add value? *Journal of Finance* 59, 1083–1124.
- Jegadeesh, Narasimhan, and Sheridan Titman, 1993, Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency. *The Journal of Finance* 48, Issue 1, 65-91.
- Jensen, Michael, 1968. The Performance of Mutual Funds in the Period 1945-1964. *The Journal of Finance* 23, 389-416.
- Kacperczyk, Marcin, and Amit Seru, 2007, Fund Manager Use of Public Information: New Evidence on Managerial Skills, *The Journal of Finance* 62, 485-528.
- Kacperczyk, Marcin, Clemens Sialm, and Lu Zheng, 2005, On the industry concentration of actively managed equity mutual funds, *The Journal of Finance* 60, 1983-2011.
- Kacperczyk, Marcin, Clemens Sialm, and Lu Zheng, 2008, Unobserved actions of mutual funds, *Review of Financial Studies* 21, 2379-2416.

- Ke, Bin, and Santhosh Ramalingegowda, 2005, Do Institutional Investors Exploit the Post-Earnings Announcement Drift?, *Journal of Accounting and Economics* 39, 25-53.
- Kim, Sok Tae, Ji-Chai Lin, and Myron B. Slovin, 1997, Market structure, informed trading, and analysts' recommendations, *Journal of Financial and Quantitative Analysis* 32, 507–524.
- McLean R. David, Jeffrey Pontiff, 2012, *Does Academic Research Destroy Stock Return Predictability*. Working paper.
- Menzly, Liro. and Oguzhan Ozbas, 2010, Market Segmentation and Cross-Predictability of Returns, *Journal of Finance* 65, 1555–1580.
- Pandit, Shail, Charles E. Wasley, and Tzachi Zach, 2011, Information Externalities along the Supply Chain: The Economic Determinants of Suppliers' Stock Price Reaction to Their Customers' Earnings Announcements, *Contemporary Accounting Research* 28, 1304–1343
- Pastor, Lubos, and Robert F. Stambaugh, 2003, Liquidity risk and expected stock returns. *The Journal of Political Economy* 111, 642-685.
- Wermers, Russ, 2000, Mutual fund performance: An empirical decomposition into stock - picking talent, style, transactions costs, and expenses, *The Journal of Finance* 55, 1655-1703.
- Womack, Kent L., 1996, Do brokerage analysts' recommendations have investment value? *Journal of Finance* 51, 137–167.
- Zheng, Lu. (1999). Is money smart? a study of mutual fund investors' fund selection ability. *The Journal of Finance* 54, 901-933.

Appendix: The abnormal return of suppliers after customer earnings announcements

This figure shows the average cumulative return in month $t+k$ on a long-short portfolio formed on the firm's (average) customer earnings announcement returns in the previous quarter. At the beginning of every calendar quarter, stocks are ranked in ascending order based on the customer earnings announcement returns at the end of previous quarter. Stocks are assigned to one of ten decile portfolios. The figure shows the average cumulative returns over time of a zero-cost portfolio that buys the top 10% higher customer earnings announcement returns stocks and sells short the bottom 10% low customer returns stocks.

Table 1: Summary statistics

This table summarizes the characteristics for the mutual funds over the sample period between 1981 and 2008. Economic-Link trade (*ELT*) is measured as the dollar value of supplier stocks purchased by a mutual fund at the end of the quarter multiply by the average earnings announcement CAR of their customers in the previous quarter, divided by the maximum buy or sell of the fund at the end of the quarter.

Var	Mean	Std	Median
Total Net Assets (millions)	1040.3	4204.8	219.7
Age (years)	15.44	15.03	10.17
Expense Ratio	0.10%	0.04%	0.10%
Turnover Ratio	87.65%	109.70%	62.00%
Cash Proportion	6.54%	9.56%	3.60%
Flow	3.11%	20.25%	-0.74%
Net Return	0.32%	5.58%	0.82%
Number of Stocks	107.31	158.31	72.00
ELT	-0.007%	0.592%	0.000%

Table 2: Characteristics of funds

This table summarizes the average characteristics of portfolios of mutual funds sorted according to their most recent Economic-Link trade (*ELT*). All returns are expressed in percent per month. The significance levels are abbreviated with asterisks: One, two, and three asterisks denote significance at the 10, 5, and 1 percent level, respectively.

Rank	ELT	Total Net Assets	Age	Expense Ratio	Turnover Ratio	Flow	Cash Proportion	Number of Stocks
1	-0.753%	950.57	15.35	0.104%	87.63%	1.51%	6.11%	93.83
2	-0.181%	1180.95	14.95	0.103%	94.00%	3.60%	6.26%	124.13
3	-0.003%	1031.52	16.77	0.099%	76.79%	3.47%	7.81%	101.44
4	0.171%	1139.00	15.10	0.103%	92.57%	4.71%	6.16%	122.91
5	0.717%	900.43	14.82	0.106%	88.74%	2.19%	6.07%	95.00
(5-1)	1.470%***	-50.14*	-0.53***	0.001%***	1.12%	0.67%***	-0.04%	1.17

Table 3: Future Risk-Adjusted Performance of ELT Portfolios

This table reports the risk-adjusted monthly returns of portfolios of mutual funds sorted according to the most recent Economic-Link trade (*ELT*) measure. We use alphas from factor regressions based on the CAPM, Fama-French three-factor, Carhart four-factor, and five-factor models. In Panel A, we sort the funds by *ELT*; In Panel B, we sort funds by the buy side *ELT*; in Panel C, we sort funds by the sell side *ELT*. All returns are expressed in percent per month. The significance levels are abbreviated with asterisks: One, two, and three asterisks denote significance at the 10, 5, and 1 percent level, respectively.

Model	G1	G2	G3	G4	G5	LS
Excess returns	-0.07%	-0.02%	0.09% **	0.03%	0.09%	0.16% ***
	-1.27	-0.41	2.11	0.58	1.31	3.88
Three-factor alpha	-0.05%	-0.03%	0.05%	0.02%	0.12% ***	0.17% ***
	-1.13	-0.72	1.24	0.51	2.63	4.34
Four-factor alpha	-0.05%	-0.03%	0.06%	0.00%	0.08% *	0.13% ***
	-1.17	-0.77	1.35	-0.07	1.81	3.46
Five-factor alpha	-0.03%	-0.02%	0.06%	0.01%	0.09% **	0.13% ***
	-0.72	-0.36	1.53	0.21	2.02	3.18

Table 4: Future Risk-Adjusted Performance using alternative ELT measures

This table reports the risk-adjusted monthly returns of portfolios of mutual funds sorted according to the most recent alternative ELT measures. We use alphas from factor regressions based on the CAPM, Fama-French three-factor, Carhart four-factor, and five-factor models. In Panel A, we sort the funds by ELT ; In Panel B, we sort funds by the buy side ELT ; in Panel C, we sort funds by the sell side ELT . All returns are expressed in percent per month. The significance levels are abbreviated with asterisks: One, two, and three asterisks denote significance at the 10, 5, and 1 percent level, respectively.

Panel A: Sorted by buy side of $ELT_Buy_{i,t}$

Model	G1	G2	G3	G4	G5	LS
Excess returns	-0.05%	0.00%	0.07%	0.05%	0.07%	0.12%**
	-0.78	0.01	1.59	0.88	1.04	2.21
Three-factor alpha	-0.03%	-0.01%	0.03%	0.04%	0.11%**	0.14%**
	-0.67	-0.16	0.74	0.91	1.96	2.50
Four-factor alpha	-0.03%	0.00%	0.03%	0.01%	0.07%	0.10%*
	-0.72	0.02	0.82	0.27	1.25	1.84
Five-factor alpha	-0.02%	0.01%	0.05%	0.02%	0.09%	0.11%*
	-0.47	0.29	1.28	0.54	1.55	1.92

Panel B: Sorted by sell side of $ELT_Sell_{i,t}$

Model	G1	G2	G3	G4	G5	LS
Excess returns	-0.03%	-0.01%	0.05%	0.03%	0.06%	0.09%
	-0.41	-0.18	1.40	0.54	0.88	1.53
Three-factor alpha	0.00%	-0.01%	0.03%	0.02%	0.08%	0.08%
	0.02	-0.24	0.79	0.39	1.58	1.32
Four-factor alpha	-0.01%	-0.03%	0.03%	0.01%	0.05%	0.06%
	-0.13	-0.61	0.75	0.27	1.01	0.98
Five-factor alpha	0.03%	-0.01%	0.04%	0.02%	0.06%	0.03%
	0.46	-0.28	1.01	0.51	1.20	0.58

Panel C: Sorted by $ELT_Positive_{i,t}$

Model	G1	G2	G3	G4	G5	LS
Excess returns	-0.05%	-0.01%	0.06%	0.05%	0.09%	0.13%***
	-0.74	-0.10	1.35	0.90	1.30	2.88
Three-factor alpha	-0.02%	-0.02%	0.02%	0.04%	0.13%***	0.15%***
	-0.47	-0.36	0.40	0.93	2.61	3.30
Four-factor alpha	-0.02%	-0.03%	0.03%	0.01%	0.09%*	0.11%**
	-0.47	-0.54	0.80	0.26	1.72	2.36
Five-factor alpha	0.01%	-0.02%	0.04%	0.02%	0.10%**	0.09%*
	0.20	-0.32	1.13	0.51	1.98	1.93

Panel D: Sorted by $ELT_Negative_{i,t}$

Model	G1	G2	G3	G4	G5	LS
Excess returns	-0.07%	0.03%	0.08%*	-0.01%	0.02%	0.09%**
	-1.10	0.68	1.80	-0.11	0.32	2.06
Three-factor alpha	-0.04%	0.03%	0.04%	-0.02%	0.05%	0.09%*
	-0.91	0.64	1.01	-0.37	1.01	1.95
Four-factor alpha	-0.06%	0.02%	0.05%	-0.01%	0.02%	0.08%*
	-1.36	0.34	1.05	-0.15	0.38	1.71
Five-factor alpha	-0.05%	0.03%	0.06%	0.01%	0.03%	0.09%*
	-1.15	0.62	1.41	0.26	0.68	1.81

Table 5: Return Decomposition

This table reports holdings returns with and without economic links trade for portfolios sorted according to the most recent *ELT* measure. All returns are expressed in percent per month. The significance levels are abbreviated with asterisks: One, two, and three asterisks denote significance at the 10, 5, and 1 percent level, respectively.

Rank	Raw Fund Return			DGTW-Adjusted Return			Carhart-Adjusted Return		
	All	ELT stocks	Other Stocks	All	ELT stocks	Other Stocks	All	ELT stocks	Other Stocks
1	0.83%***	0.79%**	0.77%***	0.00%	0.04%	0.01%	-0.05%	0.07%	-0.07%
	2.87	2.13	2.97	0.11	0.26	0.17	(0.96)	0.41	(1.30)
2	0.88%***	0.62%*	0.82%***	0.02%	-0.14%	0.02%	-0.02%	-0.11%	-0.04%
	3.14	1.84	3.25	0.66	(1.14)	0.76	(0.47)	(0.77)	(0.70)
3	0.95%***	0.78%**	0.90%***	0.05%	0.12%	0.04%	0.06%	0.20%	0.04%
	3.60	2.02	3.69	1.49	0.91	1.44	1.16	1.35	0.70
4	0.94%***	0.78%**	0.87%***	0.05%	-0.07%	0.05%	0.02%	-0.03%	-0.01%
	3.34	2.23	3.41	1.35	(0.51)	1.39	0.33	(0.17)	(0.19)
5	0.96%***	0.96%***	0.86%***	0.08%	0.21%	0.06%	0.05%	0.15%	0.00%
	3.26	2.55	3.33	1.58	1.35	1.43	0.99	0.96	0.05
(5-1)	0.13%***	0.17%	0.10%***	0.07%***	0.17%	0.05%**	0.10%**	0.08%	0.08%**
	3.02	0.92	2.86	2.67	1.03	2.23	2.46	0.42	2.28

Table 6: Multi-Variate Performance Regression

The dependent variable from column 1 to 3 is raw monthly return, four-factor adjusted monthly return and Carhart-adjusted monthly return of an individual mutual fund in the subsequent quarter respectively. Economic-Link trade (*ELT*) is measured as the dollar value of supplier stocks purchased by a mutual fund at the end of the quarter multiply by the average earnings announcement CAR of their customers in the previous quarter, divided by the maximum buy or sell of the fund at the end of the quarter. The additional control variables are the prior-year fund return, the prior-year fund flows, the age of the fund defined as the logarithm of (1+AGE), the logarithm of the assets under management, the expense ratio of the fund, the turnover ratio. In Panel B, we also control for *Trade CAR*. The significance levels are abbreviated with asterisks: One, two, and three asterisks denote significance at the 10, 5, and 1 percent level, respectively. The sample period is from 1981 to 2009.

Panel A:

Name	Raw Return	Four-Factor Adjusted Return	DGTW-Adjusted Return
ELT	0.111** (2.51)	0.092** (2.06)	0.099** (2.24)
Lagged Return	0.017*** (3.25)	0.008** (2.56)	0.012*** (3.93)
Lagged Flow	-0.001 (-1.18)	-0.001 (-0.88)	-0.001 (-1.16)
Size	-0.000 (-1.14)	-0.000 (-0.96)	-0.000* (-1.85)
Age	-0.000 (-0.55)	-0.000 (-1.04)	0.000 (0.02)
Expense Ratio	-0.094 (-0.19)	-1.143*** (-2.94)	-0.239 (-0.57)
Turnover	0.000 (1.49)	-0.000 (-0.30)	-0.000 (-0.03)
Intercept	0.007*** (2.95)	0.000 (0.51)	-0.000 (-0.10)
Adjusted R2	0.167	0.078	0.076

Panel B:

Name	Raw Return	Four-Factor Adjusted Return	DGTW-Adjusted Return
ELT	0.111** (2.47)	0.093** (2.13)	0.094** (2.14)
Lagged Return	0.017*** (3.30)	0.008*** (2.60)	0.012*** (4.01)
Lagged Flow	-0.001 (-1.10)	-0.001 (-0.66)	-0.001 (-1.21)
Size	-0.000 (-1.08)	-0.000 (-1.09)	-0.000* (-1.88)
Age	-0.000 (-0.50)	-0.000 (-1.00)	-0.000 (-0.00)
Expense Ratio	-0.074 (-0.15)	-1.135*** (-2.99)	-0.217 (-0.51)
Turnover	0.000 (1.48)	-0.000 (-0.36)	-0.000 (-0.06)
Trade CAR	0.017* (1.70)	-0.001 (-0.10)	0.009 (0.97)
Intercept	0.007*** (2.95)	0.000 (0.52)	-0.000 (-0.08)
Adjusted R2	0.174	0.082	0.082

Panel C:

High holding value of customers at the beginning of the quarter				Low holding value of customers at the beginning of the quarter		
Name	Raw Return	Four-Factor Adjusted Return	DGTW-Adjusted Return	Raw Return	Four-Factor Adjusted Return	DGTW-Adjusted Return
ELT	0.153** (2.54)	0.110* (1.95)	0.115* (1.78)	0.015 (0.22)	0.001 (0.02)	-0.006 (-0.07)
Lagged Return	0.015*** (2.81)	0.003 (1.15)	0.009*** (2.90)	0.020*** (3.75)	0.014*** (3.44)	0.016*** (4.50)
Lagged Flow	0.000 (0.08)	-0.000 (-0.07)	-0.000 (-0.21)	-0.003* (-1.76)	-0.002 (-0.91)	-0.002 (-1.05)
Size	-0.000 (-0.18)	-0.000 (-0.51)	-0.000 (-0.07)	-0.000 (-1.59)	-0.000 (-0.66)	-0.000 (-1.23)
Age	-0.000 (-0.41)	-0.000** (-2.01)	-0.000 (-0.19)	-0.000 (-0.53)	-0.000 (-0.12)	0.000 (0.01)
Expense Ratio	-0.207 (-0.55)	-1.278*** (-4.11)	-0.220 (-0.58)	-0.374 (-0.44)	-0.917 (-1.36)	-0.209 (-0.22)
Turnover	0.000 (1.65)	0.000 (0.11)	0.000 (0.31)	0.001 (1.25)	-0.000 (-0.13)	0.000 (0.39)
Trade CAR	0.025** (2.15)	0.008 (0.81)	0.020* (1.83)	0.005 (0.40)	-0.010 (-0.90)	-0.006 (-0.49)
Intercept	0.008*** (3.06)	0.002 (1.59)	0.000 (0.07)	0.008*** (2.89)	-0.000 (-0.24)	-0.000 (-0.25)
Adjusted R2	0.173	0.084	0.079	0.187	0.108	0.104

Table 7: Sub-period tests

This table reports the risk-adjusted monthly returns of portfolios of mutual funds sorted according to the most recent Economic-Link trade (*ELT*) measure. We use alphas from factor regressions based on the CAPM, Fama-French three-factor, Carhart four-factor, and five-factor models. Panel A reports results using data between 1980 and 1993, while Panel B reports results using data between 1994 and 2008. The significance levels are abbreviated with asterisks: One, two, and three asterisks denote significance at the 10, 5, and 1 percent level, respectively.

Panel A: 1980-1993

Model	G1	G2	G3	G4	G5	LS
Excess returns	-0.09%	0.03%	0.10%	0.02%	0.09%	0.18%***
	-1.06	0.38	1.53	0.25	0.96	2.95
Three-factor alpha	0.07%	0.16%***	0.19%***	0.14%***	0.24%***	0.17%***
	1.16	3.00	3.27	2.67	3.81	2.67
Four-factor alpha	0.03%	0.10%**	0.15%**	0.09%*	0.17%***	0.14%**
	0.45	2.03	2.58	1.68	2.72	2.14
Five-factor alpha	0.05%	0.12%**	0.17%***	0.10%*	0.18%***	0.13%**
	0.86	2.35	2.97	1.90	3.03	2.02

Panel B: 1994-2008

Model	G1	G2	G3	G4	G5	LS
Excess returns	-0.05%	-0.06%	0.08%	0.03%	0.08%	0.14%**
	-0.75	-0.96	1.43	0.47	0.90	2.56
Three-factor alpha	-0.07%	-0.10%**	0.03%	-0.01%	0.07%	0.14%***
	-1.46	-2.01	0.58	-0.24	1.12	3.01
Four-factor alpha	-0.07%	-0.09%*	0.04%	-0.02%	0.04%	0.11%**
	-1.32	-1.81	0.90	-0.49	0.68	2.37
Five-factor alpha	-0.07%	-0.09%*	0.02%	-0.03%	0.03%	0.11%**
	-1.37	-1.76	0.43	-0.67	0.54	2.23

Table 8: Alternative Measures

This table reports the risk-adjusted monthly returns of portfolios of mutual funds sorted according to alternative measures. We use alphas from factor regressions based on the CAPM, Fama-French three-factor, Carhart four-factor, and five-factor models. In Panel A, we sort the funds by $ELT_Dummy_{i,t}$; in Panel B, we sort funds by $ELT_Top_{i,t}$. All returns are expressed in percent per month. The significance levels are abbreviated with asterisks: One, two, and three asterisks denote significance at the 10, 5, and 1 percent level, respectively.

Panel A: Sorted by $ELT_Dummy_{i,t}$ measure

Model	G1	G2	G3	G4	G5	LS
Excess returns	-0.06%	0.02%	0.08%*	0.03%	0.06%	0.13%***
	-1.23	0.30	1.81	0.60	1.04	3.15
Three-factor alpha	-0.05%	0.01%	0.05%	0.03%	0.08%*	0.13%***
	-1.25	0.31	1.25	0.69	1.86	3.46
Four-factor alpha	-0.04%	0.00%	0.04%	0.01%	0.05%	0.09%**
	-0.97	-0.08	1.04	0.28	1.13	2.39
Five-factor alpha	-0.03%	0.01%	0.05%	0.02%	0.07%	0.09%**
	-0.62	0.28	1.32	0.53	1.45	2.36

Panel B: Sorted by $ELT_Top_{i,t}$ measure

Model	G1	G2	G3	G4	G5	LS
Excess returns	0.02%	-0.03%	0.04%	0.06%	0.11%	0.11%
	0.55	-0.40	0.41	0.55	0.96	1.08
Three-factor alpha	0.01%	-0.02%	0.07%	0.11%	0.18%*	0.19%**
	0.23	-0.43	0.99	1.39	1.86	2.01
Four-factor alpha	0.00%	-0.04%	0.04%	0.05%	0.17%*	0.18%*
	0.13	-0.66	0.57	0.66	1.73	1.84
Five-factor alpha	0.02%	-0.02%	0.07%	0.07%	0.20%**	0.19%**
	0.53	-0.42	0.91	0.86	2.00	1.99

Table 9: Contemporaneous ELT measure

This table reports the risk-adjusted monthly returns of portfolios of mutual funds sorted according to contemporaneous measure $ELT_Con_{i,t}$. It is measured as the dollar value of supplier stocks purchased by a mutual fund at the end of the quarter multiply by the average earnings announcement CAR of their customers in the same quarter, divided by the maximum buy or sell of the fund at the end of the quarter. We use alphas from factor regressions based on the CAPM, Fama-French three-factor, Carhart four-factor, and five-factor models. All returns are expressed in percent per month. The significance levels are abbreviated with asterisks: One, two, and three asterisks denote significance at the 10, 5, and 1 percent level, respectively.

Model	G1	G2	G3	G4	G5	LS
Excess returns	-0.11%	-0.06%	-0.03%	-0.08%	-0.05%	0.06%
	-1.71	-1.31	-0.82	-1.59	-0.79	1.51
Three-factor alpha	-0.07%	-0.08%	-0.08%	-0.10%	-0.03%	0.04%
	-1.54	-1.97	-1.92	-2.15	-0.72	0.98
Four-factor alpha	-0.09%	-0.10%	-0.07%	-0.12%	-0.05%	0.04%
	-1.98	-2.33	-1.74	-2.55	-1.03	1.13
Five-factor alpha	-0.07%	-0.08%	-0.07%	-0.10%	-0.03%	0.05%
	-1.53	-1.89	-1.58	-2.22	-0.56	1.17

Table 10: Other economic information settings

Panel A reports the risk-adjusted monthly returns of portfolios of mutual funds sorted according to the most recent Economic-Link trade (*ELT*) measure using the buy-and-hold abnormal return of customers during the last 12-month. The sample period is between 1980 and 2008. Panel B reports the risk-adjusted monthly returns of portfolios of mutual funds sorted according to the most recent Economic-Link trade (*ELT*) measure using analyst consensus recommendation changes of customers. The sample period is between 1994 and 2008 as the IBES analyst consensus recommendation starts from November 1993. We use alphas from factor regressions based on the CAPM, Fama-French three-factor, Carhart four-factor, and five-factor models. All returns are expressed in percent per month. The significance levels are abbreviated with asterisks: One, two, and three asterisks denote significance at the 10, 5, and 1 percent level, respectively.

Panel A: Sorted by customer abnormal return

Model	G1	G2	G3	G4	G5	LS
Excess returns	-0.02%	0.03%	0.08%	0.03%	0.04%	0.06%
	-0.32	0.56	2.01	0.49	0.59	1.39
Three-factor alpha	-0.01%	0.02%	0.05%	0.02%	0.07%	0.07%
	-0.15	0.43	1.23	0.34	1.28	1.70*
Four-factor alpha	-0.02%	0.00%	0.05%	0.00%	0.05%	0.07%
	-0.54	0.04	1.24	0.00	0.90	1.64*
Five-factor alpha	-0.01%	0.02%	0.06%	0.02%	0.07%	0.08%
	-0.28	0.51	1.48	0.38	1.35	1.90*

Panel B: Sorted by changes of analyst consensus recommendation

Model	G1	G2	G3	G4	G5	LS
Excess returns	-0.03%	0.01%	0.08%	0.02%	0.06%	0.09%**
	-0.40	0.18	1.53	0.30	0.67	2.07
Three-factor alpha	-0.07%	-0.03%	0.03%	-0.01%	0.02%	0.09%**
	-1.25	-0.58	0.69	-0.21	0.41	2.14
Four-factor alpha	-0.07%	-0.03%	0.05%	-0.02%	0.01%	0.08%*
	-1.19	-0.58	1.27	-0.43	0.23	1.82
Five-factor alpha	-0.08%	-0.03%	0.04%	-0.03%	0.00%	0.08%*
	-1.40	-0.67	1.00	-0.45	0.07	1.87

Table 11: Simulation test

This table reports the results of 500 simulation tests for Table 3 Panel A. We use alphas from factor regressions based on the CAPM, Fama-French three-factor, Carhart four-factor, and five-factor models. All returns are expressed in percent per month. The significance levels are abbreviated with asterisks: One, two, and three asterisks denote significance at the 10, 5, and 1 percent level, respectively.

Panel A: 500 Simulation results of Table 3 Panel A

Model	G1	G2	G3	G4	G5	LS
Excess returns	-0.01%	0.02%	0.08% *	0.02%	0.01%	0.02%
	-0.16	0.51	1.88	0.42	0.17	0.59
Three-factor alpha	0.01%	0.02%	0.04%	0.01%	0.03%	0.02%
	0.21	0.41	1.08	0.35	0.71	0.66
Four-factor alpha	0.00%	0.00%	0.05%	0.00%	0.01%	0.02%
	-0.10	0.09	1.13	-0.06	0.31	0.53
Five-factor alpha	0.01%	0.02%	0.06%	0.01%	0.03%	0.02%
	0.27	0.44	1.43	0.26	0.62	0.46

Panel B: Comparison of real four-factor alpha and simulated four-factor alpha

Name	G1	G2	G3	G4	G5	LS
Real alpha	-0.05%	-0.03%	0.06%	0.00%	0.08%	0.13%
	-1.17	-0.77	1.35	-0.07	1.81	3.46
Simulated alpha	0.00%	0.00%	0.05%	0.00%	0.01%	0.02%
	-0.10	0.09	1.13	-0.06	0.31	0.53
Difference	-0.05%	-0.04%	0.01%	0.00%	0.07%	0.12%
	-55.17	-45.31	21.39	-0.75	79.08	80.68