

Real Effects of Stock Underpricing

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Abstract

This paper provides evidence for a causal effect of equity prices on corporate investment and employment. We use fire sales by distressed equity funds during the 2007-2009 financial crisis to identify substantial exogenous underpricing. Firms whose stocks are most underpriced have considerably lower investment and employment than industry peers not subject to any fire sale discount. The causal effect of underpricing on investment is found to be largely concentrated on the most financially constrained firms.

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1 Introduction

Do stock listings and the subsequent information aggregation in equity prices constitute a stock-price-based monitoring channel and contribute to better investment quality? The economic literature has extensively discussed governance benefits of stock listings (and cross-listings) in terms of their impact on corporate legal and shareholder environment.¹ Yet the very role of the stock price itself in determining corporate investment remains elusive. Do managers base capital budgeting decisions on private information and ignore stock prices so that the latter become a “sideshow”?² Or do stock prices play an important role in coordinating investment decisions across firms and sectors by channeling capital to its most profitable use after adjusting for risk?

The 2007-2009 financial crisis provides a natural experiment to study this issue. Using global fund ownership data, we find a large sample of U.S. stocks exposed to fire sales by distressed equity funds. These distressed funds were identified as having large investment losses in bank stocks and therefore experienced high fund redemptions. Non-financial stocks with high ownership by distressed equity funds were substantially underpriced relative to industry peers with non-distressed fund owners. In the absence of systematic investment bias by distressed funds in their portfolio of non-financial stocks, funds’ fire sale behavior represents an exogenous treatment effect and therefore provides a robust way to test for the causal effect of stock prices on the allocation of real resources.

We find that stock underpricing indeed had a powerful causal effect on both investment and employment in the 2007-2009 crisis. On average, stocks subject to fire sales were underpriced by 37% relative to stocks not subject to fire sales and simultaneously reduced quarterly investment in 2008/4 and 2009/1 by an additional 20% compared with industry peers; their employment incrementally decreased by 4.8% in 2009 relative to industry peers. Our further analysis focuses on the role of external finance in the dependence of real investments on stock valuation. Using the Hadlock and Pierce index of financial constraints (the ‘AS index’), we divide those firms

¹For a recent discussion of how cross-listings can constrain the private consumption of control benefits, see Doidge *et al.* (2009). Ferreira and Matos (2008) provide evidence that institutional owners in particular limit corporate overinvestment by large firms and improve their operating performance.

²See Blanchard, Rhee and Summers (1993), who refer to the stock market as a “sideshow”. See also Morck, Schleifer, and Vishny (1990).

subject to fire sale exposure into the 30% most likely to face external financing constraints and the rest. We find that the former group accounts for most of the strong decline in the investment share among underpriced stocks. By contrast, the 70% of firms least likely to be subject to external financing constraints do not reduce their own investment relative to industry peers even given severe stock underpricing. This finding suggests that external financial constraints play a key role in the causal effect of stock prices on investment. A direct stock-price-based monitoring channel operates through the availability of external finance—mostly affecting small and financially constrained firms.

Any welfare interpretation of the above finding on the stock-price-based monitoring depends on the degree of market efficiency and the pervasiveness of agency problems in corporate investment.³ Any direct allocation role of stock prices implies distortion of the investment process whenever stock prices are inefficient. Such a distortion in investment concerns not only stock underpricing (as in our natural experiment), but also stock overpricing. For example, Polk and Sapienza (2009) provide evidence that managers actively “cater” to market sentiment by investing more at inefficiently high stock prices.⁴ However, if corporate agency problems matter for corporate investment, then even a less than fully efficient stock price can be beneficial—external monitoring based on stock price information can restrain value destroying investments. In this latter case, stock market development contributes positively to economic efficiency (Holmström and Tirole, 1993).⁵

The previous literature has documented a positive correlation between stock market returns and subsequent corporate investment in both the time series and the cross section (Fama, 1981; Barro, 1990; and Morck, Shleifer, and Vishny, 1990). But this is uninformative about causality. Stock prices may just passively reflect changing investment opportunities and the respective investment decisions—suggesting that corporate investment efficiency does not depend on stock prices. On the other hand, an opposing “market centric view” of capital allocation sees stock prices as crucial for the external monitoring of the investment process. The latter view is predicated on a causal stock price effect on investment.⁶

³See Stein (2003) for a review of the effect of agency conflicts on corporate investment.

⁴See also Gilchrist *et al.* (2005).

⁵See Dow and Gorton (1997) for a discussion about the relationship of financial market efficiency and economic efficiency.

⁶For a theoretical analysis of the role of stock listings (and market liquidity) see for example Holmström and

In order to explore causality, previous work focused on the effect of asset mispricing on investment. The extant literature employs firm-level mispricing proxies to show the sensitivity of investment to stock mispricing varies in the cross-section according to certain firm characteristics. Small equity-dependent firms reveal much stronger investment sensitivity to mispricing measures such as Tobin's q (Baker, Stein, and Wurgler, 2003); opaque firms with high R&D intensity show a higher investment sensitivity with respect to a mispricing measure based on discretionary accruals (Polk and Sapienza, 2009). But these mispricing measures are noisy proxies and their measurement errors correlate with the correct valuation. Hence, one should expect to find different investment sensitivities based solely on cross-sectional differences in the agency problem even given no causal effect of stock mispricing on investment. In other words, convincing evidence for a causal link between stock valuation and investment depends on truly exogenous identification of mispricing such that measurement errors are uncorrelated with firm-level investment inefficiencies. This paper provides such an identification by using fund-level investment information sufficiently exogenous to the corporate investment process and its agency problems.

Another research strategy consists in directly confronting the measurement problem with respect to Tobin's q . Goyal and Yamada (2004) decompose Tobin's q into a firm specific and a non-fundamental component during the 1987-1990 Japanese stock market boom and find that the latter strongly correlates with investment.⁷ Bakke and Whited (2010) develop an errors-in-variables model which allows investment sensitivity to depend on a 'true' q observable only to managers. Here, the authors find no evidence that investment responds to the non-fundamental error component in q . But even their generalized framework must assume that the error in the measurable q is independent of other unobservable firm characteristics which might also influence a firm's investment share.

The identification strategy in our paper is related to Gao and Lou (2011), who use price pressure resulting from mutual fund flow-induced trading to identify equity mispricing. They show that equity overvaluations lead to more investment (as well as equity and debt issuance), particularly for the financially most constrained firms. Important for the authors' identification

Tirole (1993).

⁷See also Chirinko and Schaller (1996, 2001).

is that investor mutual fund inflows are exogenous and not determined by investor expectations regarding return prospects of the fund portfolio. By contrast, our identification strategy is not based on (possibly endogenous) fund flows, but on a negative return shock to a particular component of the fund portfolio. This constitutes an even more solid identification strategy.

The 2007-2009 crisis provide a new research opportunity to reach at a better understanding of the transmission channels from financial to real activities. Using survey-based data, Campello, Graham, and Harvey (2010) and Campello et al. (2011a and 2011b) document that financially constrained firms, especially those without access to credit lines, planned more cut in their capital spending and employment than other firms. Duchin, Ozbas, and Sensoy (2010) document that corporate investment declined significantly following the crisis for firms with low internal and external capitals. Almeida, Campello, Laranjeira, and Weisbenner (2011) identify firms whose long-term debt was mostly maturing right after the third quarter of 2007 and show that these firms reduced their investment substantially afterwards. The contribution of our paper is to show that a stock market crash itself has a causal effect on the real investment. Firms with a relatively more depressed stock prices due to fund fire sales during the crisis are particularly negatively impacted in their investment and employment.

The following section discusses our identification strategy for equity mispricing during the financial crisis. Section 3 presents evidence for the real effects of such mispricing. Section 4 discusses the role of firms' external financial constraints for the effect of stock prices on investment, followed by concluding remarks in Section 5.

2 Stock Price Effects of Fund Fire Sales

The stock market's tendency towards efficiency implies that cases of economically large stock mispricing tend to be rather exceptional. In this paper, we identify such an exceptional event based on fire sales by distressed equity funds over the 2007-2008 financial crisis. For individual stocks, fire sales by equity funds have been shown to imply relatively large transitory price effects (Coval and Stafford, 2007). Hau and Lai (2011) in particular show that fire sales by distressed equity funds in the recent crisis generated extremely large stock underpricing: Roughly one quarter of all U.S. stocks were subject to fire sales by equity funds and these stocks were

underpriced relative to industry peers by 37 percent on average. Transitory underpricing relative to industry peers is particularly pronounced for stocks with above-median performance during the crisis because distressed funds tended to sell their best performing stocks. The 2007-2009 financial crisis therefore serves as an event study in which a large scale of relative stock underpricing can be clearly identified.

2.1 Measuring Fire Sales Exposure

Following Hau and Lai (2011), we use the Thomson Reuters mutual fund database. It accounts for both pure equity funds as well as the equity holdings of balanced funds which also hold other assets like bonds. In the latter case only the equity proportion of the fund holdings is reported. Most funds report only at six month intervals — hence our analysis is carried out at a semi-annual frequency. For funds with multiple reporting dates within a semester, we retain only the last reporting date.

Our analysis discards highly concentrated fund holdings with less than five stock positions in a semester. Based on this filter, we obtain a sample of 27,274 mutual funds with equity investments in 25 developed and 54 emerging markets over 2007-2009. A total of 6,327 funds are domiciled in the U.S., 16,667 are located in other developed markets, and 4,280 are from emerging markets. The number of funds reporting in each semester is uneven. In June 2007, the data cover a total of 20,477 funds reporting stock positions with a combined total net equity value of 9.7 trillion dollars.⁸

In the first step, we calculate the return shortfall — called “fund exposure” (Exp^f) — for all equity funds worldwide due to ownership in financial stocks from July 2007 to July 2008. A “fund exposure” of -15% implies that a fund suffered a decrease of 15% in its total equity return over the 12 month period due to portfolio positions in bank stocks. The fund exposure measure identifies funds most likely to face strong investor redemptions because of overinvestment in underperforming financial stocks. The one-year period prior to the Lehman

⁸Our data coverage is therefore comparable to the Lionshares database used by Cremers *et al.* (2011), who reported total net equity assets of 7.97 trillion dollars for December 2007. Less than half of the reported equity holdings in our sample concern U.S. domiciled funds. We also highlight that 16,710 (or 82%) of all mutual funds hold at least one foreign stock and can therefore be classified as international funds. At 73%, this figure is somewhat smaller for U.S. domiciled funds. See also Ferreira *et al.* (2010).

collapse coincides with the a dramatic decline of many bank stock because of their exposure to the subprime market. In the second step, fund exposure is aggregated to a stock-specific measure of “stock exposure” (Exp^s) for all non-financial U.S. stocks.⁹ Formally, stock exposure for stock s is defined as

$$Exp^s = Fsh^s \sum_f \omega^s(f) Exp^f,$$

where $\omega^s(f)$ denotes the holdings of fund f in stock s relative to the aggregate holdings of all funds in the stock; and Fsh^s denotes the “fund share”, defined as the aggregate fund holdings in stock s relative to its shares outstanding. Both the holding weights $\omega^s(f)$ and the fund share Fsh^s are measured at the end of June 2007. A high stock exposure Exp^s implies that a relatively large proportion of a stock’s capitalization is owned by equity funds with high fund exposure to banking stocks. Such stocks therefore face the largest selling pressure if fund exposure captures the need for fire sales by individual funds.

Summary statistics on stock exposure of U.S. non-financial stocks are reported in Table 1. The mean (median) stock exposure is -0.249% (-0.181%), with large negative skewness of -2.0 . The 25%, 10%, and 5% most negative stock exposure quantiles are -0.35% , -0.46% , and -0.56% , respectively. For example, a stock exposure of -0.35% is obtained if 10% of a stock’s capitalization is owned by funds that on average lost 3.5% in their portfolio returns due to financial stock investments. The non-normality of the stock exposure variable makes it convenient to define a dummy $DExp^s$ which marks the 25% of U.S. stocks with the highest stock exposure. Quantifying the stock exposure effect in linear regressions is thus straightforward.

An alternative definition of fund distress could use fund outflows directly as an identifying measure. But in this case the fund outflows are likely to reflect the fund’s entire portfolio choice and may therefore become endogenous. For example, a high beta fund is likely to underperform during a financial crisis, experience larger fund outflows, and sell predominantly high beta stocks so that the fire sales price effect becomes entangled with a possible increase in stock risk premia.

But even if we do not use fund outflows as a direct measure of fund distress, fund ex-

⁹The focus on U.S. stocks is justified because our stock holding data are most complete for U.S. stocks and fund fire sales are most powerful here due to the large share of fund ownership. For a clean identification of non-financial stocks, we use the Compustat industry segment file and exclude from the sample all conglomerates that have finance divisions accounting for more than one percent of total sales.

posure to financial stocks (as defined above) should be highly correlated with fund outflows. To document this, we define as “exposed funds” the 15% of funds that had the largest losses from holding financial stocks. The rest of the funds are defined as “non-exposed.” For 8,250 funds we are able to match the fund identity in the Thomson database to the Lipper database, which provides complementary data on the exact fund returns and fund size in order to estimate monthly investor redemption. We excluded the 1% of funds with extreme monthly net flows because of concerns about reporting errors. Figure 1 shows the average cumulative net subscription/redemption from July 2007 through December 2009 separately for exposed and non-exposed funds. Exposed funds experience net investor outflows after September 2007, which accumulated to a sizeable average fund outflow of more than 7% in April 2009. By contrast, for non-exposed funds the average net cumulative inflow remains positive over the full 30 month period and climbs to 15% at the end of 2009.

2.2 Fire Sale Effects by Return Quantiles

Stock returns are measured as cumulative excess returns $r_s^{Ex}(k)$ from July 1, 2007, over k consecutive weeks. Risk adjustment of returns is based on the international version of the four-factor Carhart model, estimated on pre-crisis data from July 2002 to June 2007. The four domestic factors and four international factors each consist of the market, size, book-to-market, and momentum factors. More detailed description is provided in the Appendix. Alternative risk adjustment based, for example, on domestic risk factors produces qualitatively similar results.

First, we use quantile regressions to infer the fire sales effect. Risk-adjusted cumulative returns $r_s^{Ex}(k)$ over k weeks since June 29, 2007 of all non-financial stocks are regressed on the dummy $DExp^s$, which marks the 25% of U.S. stocks with the highest ownership share by distressed equity funds;

$$r_s^{Ex}(k) = \alpha_0^k + \alpha_1^k DExp^s + \alpha_2^k Fsh^s + \mu_s.$$

The regression controls for a stock’s fund share Fsh^s (aggregate fund ownership relative to stock capitalization) and also includes industry fixed effects. Controlling for fund share captures the holding bias of equity funds towards larger and more liquid stocks. Moreover, fund share is (strongly) negatively correlated with a stock’s retail investor ownership and therefore controls

for panic sales by retail investors over the 2007-2009 crisis (Hau and Lai, 2011). The coefficient α_1^k captures the fire sales effect for the 25% most exposed stocks relative to non-exposed stocks in the same industry.

Figure 2, graph A plots the evolution of the coefficient α_1^k for each week of the financial crisis at the 50% quantile of risk-adjusted cumulative returns, graph B plots the same evolution at the 75% quantile, graph C at the 90% quantile, and graph D at the 95% quantile. Vertical bars around the main line indicate a confidence interval of one standard deviation around the point estimate. Exposed stocks with median return performance (graph A) show no discernible evidence for a discount relative to non-exposed stocks. At the 75% quantile of better performing stocks, the exposure discount is economically and statistically significant and peaks at -29% in February 2009. At the 90% and 95% quantile of the best performing stocks, the fire sale discount reaches a large -74% and -145% , respectively, before reverting in the spring of 2009. No statistically significant effects are found for lower performance quantiles. As argued by Hau and Lai (2011), distressed equity funds avoided loss realization implicit in selling underperforming stocks and instead liquidated the best performing stocks in order to finance investor redemptions.

Second, we use cross-sectional OLS regressions to characterize the discount for cumulative returns measured at the quarterly frequency. As fire sales discounts are concentrated on the 50% best performing stocks, we focus on this stock group and define a high return dummy variable $DHighR(t)$ marking the 50% of stocks with the highest (risk-adjusted) return from the beginning of 2007/3 to the end of quarter $t-1$. The high return dummy for quarters 2007/1, 2007/2, and 2007/3 is set equal to that for quarter 2007/4. The high return dummy is then interacted with the exposure dummy $DExp^s$ to produce a proxy $DExp^s \times DHighR(t)$ of fire sales intensity and stock underpricing. Formally, the regression is of the form

$$r_s^{Ex}(t) = \beta_0 + \beta_1^t[DExp^s \times DHighR(t)] + \beta_2 X_s + \mu_s,$$

where $r_s^{Ex}(t)$ represents cumulative excess returns from the beginning of 2007/3 to the end of quarter t , and the coefficient β_1^t measures cumulative stock price discounts from fire sales. As a robustness check, we add cross-sectional regressions for the two quarters 2007/1 and 2007/2 prior to the crisis, where $r_s^{Ex}(t)$ measures excess returns for the respective quarter. The control

variables X_s include the fund share Fsh^s as well as the exposure dummy $DExp^s$ and the high return dummy $DHighR(t)$ as separate terms (not reported). In addition, we use industry fixed effects based on four-digit SIC codes so that the influence of macroeconomic crisis at the industry level is purged from the return regression.

Table 2 shows that the interaction dummy $DExp^s \times DHighR(t)$ captures price discounts over the entire period from 2007/3 to 2009/4. The discounts peak in 2008/4 and 2009/1 with a -43.1% and -44.6% cumulative return, respectively, before declining again. The OLS coefficient β_1^t therefore shows a time pattern for stock underpricing similar to the coefficients (for the high performance quantiles) plotted in Figure 2. We also note that the fund share control variable is frequently significantly positive. A change of two standard deviations ($= 0.306$) in the fund share (towards more equity fund and less retail ownership) at the end of 2008/3 implies an increase in crisis performance of 8.1% ($= 0.306 \times 26.4\%$). A higher share of (institutional) fund ownership in a stock generally correlates with lower crisis discounts. Section 3 uses the dummy $DExp^s \times DHighR(t)$ as a measure of stock underpricing in panel regressions of investment and employment.

2.3 Identification Issues

For a clear discussion of potential problems with our identification strategy, it is useful to highlight three dimensions in which a fund's portfolio choice may be endogenous. First, all funds exhibit common investment biases towards larger and more liquid stocks. Second, exposed funds (with large investments in underperforming bank stocks) may differ from non-exposed funds in their selection of non-financial stocks. Third, exposed funds pick high return stocks for their fire sales (which we mark by the dummy $DHighR(t)$), and they may furthermore choose particular high return stocks for sales.

Only the second possible endogeneity poses a serious identification challenge. A general investment bias of all funds toward particular stock types only means that the causal effect should also be concentrated in stocks with higher fund ownership. Given the observability of the fund share in all stocks, we are able to control for general fund investment biases.¹⁰ By contrast, it is important for our identification procedure that exposed and non-exposed funds

¹⁰The respective robustness test is provided in Table 5.

differ only randomly in their selection (of high return) non-financial stocks. We can test for independence in stock selection by comparing the portfolio similarity between two exposed funds to the average portfolio similarity between an exposed and a non-exposed fund. Finally, any endogeneity in the stock selection among the high return stocks by exposed funds is benign for the implicit random treatment assumption. The aggregation of fund exposure to stock exposure gives all non-financial stocks of distressed funds an equal weight. Hence we only capture an average effect for all stocks in the “fire sale choice set” of the distressed fund, which may attenuate the magnitude of the fire sale channel.

Do exposed and non-exposed funds systematically differ in their stock selection of (high-return) non-financial stocks? Or may one consider such holding differences as (largely) random, thereby justifying the random treatment assumption? The fund holding data allows us to examine independence in stock selection by comparing the portfolio similarity for pairs of exposed funds to that for pairs of one exposed and one non-exposed fund. Formally, for any pair of funds (f_1, f_2) , we define their portfolio overlap in the non-financial sector as the sum of the common weights in all stock groups g as

$$Overlap(f_1, f_2) = \sum_{g \in \text{Set of Stock-Groups}} \min[\hat{w}^{f_1.g}, \hat{w}^{f_2.g}],$$

where $\hat{w}^{f_1.g}$ and $\hat{w}^{f_2.g}$ represent the portfolio weights of high return stocks (relative to all non-financial stocks holdings) in stock group g by funds f_1 and f_2 , respectively. We use all exposed funds (defined as those with the 15% highest fund exposure) and a matching set of non-exposed funds with the same fund size distribution and define 48 distinct stock groups based on the 12 Fama-French industry groups, two stock size categories and two leverage categories.

Table 3 reports the portfolio similarity in these 48 stock groups between all pairs of any two exposed funds (column (1)) and between all pairs of exposed and non-exposed funds (column (2)). The distribution of the overlap statistics is extremely similar. For example, the median stock group overlap between two exposed stocks is 9.7% between two exposed funds compared to 8.4% for an exposed and a non-exposed fund. Given the large number of fund pairs, we reject the hypothesis that the two distributions are identical (in a statistical sense). But economically, both distributions are so similar and dispersed as to justify our random treatment assumption that the portfolio allocation of exposed funds in non-financial stocks is randomly (and not

systematically) different from that of non-exposed stocks.

3 Stock Underpricing and its Real Effects

The financial crisis was characterized by a general decline in firm investment. We measure the investment share as the capital expenditure reported in period t relative to the net capital stock in period $t-1$. This share declined for U.S. companies from a mean of 33.9% in 2007 to 29.4% in 2008 and to 19% in 2009. Median employment growth was 3.7%, 0.0%, and -4.1% in the years 2007, 2008, and 2009, respectively. The analysis of the investment share in section 3.1 is based on quarterly data, since capital expenditure is typically reported at that frequency, whereas firm level employment data used in section 3.2 are available only at the annual frequency.

3.1 Quarterly Investment Outcomes

In order to quantify the effect of stock undervaluation on investment, we first use panel regressions with the quarterly investment share as the dependent variable and the undervaluation proxy $DExp \times DHighR(t)$ as the explanatory variable:

$$Inv_{st} = \gamma_0 + \gamma_1[DExp^s \times DHighR(t)] + \gamma_2 X_s + \mu_{st}.$$

The coefficient γ_1 measures the investment shortfall due to exogenous stock underpricing.

In the first specification in Table 4, column (1), we use industry fixed effects interacted with time fixed effects to control for all macroeconomic effects at the industry level. As additional control variables X_s , we include the exposure dummy $DExp^s$ and the high return dummy $DHighR(t)$ as separate terms, and pre-crisis measures of *Stock Size* (log of assets at the end of 2006), *Tobin's Q* (in 2006), *Cash Flow* (for 2006), and risk-adjusted *Stock Return* (for 2006). We discard the 2% highest and lowest outliers for all accounting variables. Summary statistics for these variables are reported in Table 1. The undervaluation proxy $DExp \times DHighR(t)$ is (individually) statistically insignificant from 2007/1 to 2008/3. Around the peak of the underpricing of exposed stocks in 2008/4 and 2009/1, the coefficient becomes negative with a significance level of 1% before turning statistically insignificant in the second part of 2009. The F-test rejects the hypothesis that all four coefficients for the quarters 2008/3 to 2009/2 are jointly zero with an F-value of 11.39. We can therefore assert a negative investment effect from

stock underpricing for these four quarters at a very high level of statistical significance. The point estimate of -1.22% for 2008/4 represents an economically significant investment shortfall of -20% relative to an already depressed quarterly average investment share of 6.21% in 2008/4. The corresponding investment short-fall is -22% ($= -1.02\%/4.60\%$) in 2009/1. The control variables have the expected signs: Large firms feature a lower investment share, while the 2006 observations on Tobin's q , cash flow, and stock return correlate with higher firm investment. All standard errors are adjusted for clustering at the stock level. As a robustness check, we also allow for serial correlation in the error structure with similar results for statistical significance. The results are also robust to the exclusion of the 1% highest and lowest stock return outliers.

A second specification in Table 4, column (2), is based on stock fixed effects and separate time fixed effects. The stock fixed effects replace the four control variables; they provide a much better regression fit with an adjusted R^2 of 0.454 compared with 0.162 using industry fixed effects. The point estimates for the undervaluation effect on investment are (individually) statistically significant at the 4% level for each of the five quarters 2008/2 to 2009/2. The hypothesis of joint statistical insignificance for all four quarters 2008/3-2009/2 can be rejected, with an F-value of 13.12. The reported standard errors are adjusted for clustering at the stock level. The economic significance of the investment shortfall is very similar to the first specification; for 2008/4 (2009/1) the point estimate of -0.98% (-0.91%) is slightly smaller and represents a relative investment decrease of -16% (-20%). Overall, the regressions based on quarterly investment data provide strong evidence that the undervaluation of stocks subject to equity fund fire sales had a large adverse effect on own firms' behavior.

As an additional robustness test, we check that general investment biases of funds (for example towards larger and more liquid stocks) are of only minor influence on these results. In Table 5, column (2) we add interaction terms of the fund share in each stock (Fsh) and quarterly time fixed effects as control variables. The results for the investment shortfall for 2008/3 to 2009/2 remain very strong.

3.2 Annual Investment and Employment Outcomes

For a large cross-section of companies, employment data are reported at the end of the year. We therefore repeat the above regression using jointly the annual investment and employment

data. The dependent variable in the employment equation is given by the percentage change in the number of employees relative to the previous year.

Table 6, column (1), presents the OLS regression results where the investment share and employment change equations are estimated separately. We use the same pre-crisis controls as in Table 4, column (1), and include (as before) industry fixed effects interacted with time fixed effects. Both the investment and the employment equations yield a statistically significant negative coefficient for the undervaluation effect in 2009, as shown in $DExp \times DHighR(2009)$. The point estimate for the investment shortfall is -4.37% , which implies a relative change of -23% relative to a mean investment share of 19.20% for all firms in 2009. The yearly investment data therefore produce quantitatively similar results compared with the quarterly regressions in Table 4. The point estimate for the employment change in firms with depressed stock prices is -4.82% . The mean (median) employment change for all firms in 2009 is -4.10% (-4.06%); hence firms with depressed stock prices reduced employment by 118% (119%) more than the average (median) firm in the sample.

We also estimate both equations simultaneously as Seemingly Unrelated Regressions (SUR); the regression coefficients are reported in Table 6, column (2). The point estimate for the relative investment effect in 2009 is -3.81% , slightly smaller than the corresponding OLS estimate (-4.37%); the estimate for the employment effect is -4.80% , also somewhat smaller than the OLS coefficient (-4.82%). However, the simultaneous equation approach does not yield any significant reduction in the standard errors of the coefficients. But under the SUR approach, we can test the cross-equation restriction that both coefficients for the undervaluation effect are jointly zero. Such an hypothesis is again strongly rejected at the 1% level of significance. Overall, the annual data show that the investment shortfall in 2009 for firms with depressed stock prices is matched by a simultaneous employment reduction above the reduction experienced by industry peers.

4 Financial Constraints as a Transmission Channel

External financing constraints might play a particular role in the causal link between stock price underpricing and the incremental reduction in investment and employment documented above.

Equity may play an important role as collateral, particularly for small and young firms. In the presence of asymmetric information, a large stock price decline may deter external investors in general and banks in particular from providing new capital.

The finance literature has developed a variety of measures to evaluate firm financing constraints, including investment-cash flow sensitivities (Fazzari, Hubbard, and Petersen, 1988), the Kaplan and Zingales index of constraints (Lamont, Polk, and Saa-Requejo, 2001), the Whited and Wu index (Whited and Wu, 2006), and a variety of different sorting criteria based on firm characteristics. Using detailed qualitative information from financial filings, Hadlock and Pierce (2010) have subjected these measures to a rigorous test and found that only firm size and age are robust (and sufficiently exogenous) measures of financial constraints. We therefore focus here on the Hadlock and Pierce AS index, which is based on both firm asset size and age. Stocks are marked as financially constrained by dummy $DFinC$ if they are among the 30% of stocks with the highest AS index value; we also test our results at the 50% cutoff.

Figure 3 provides three scatter plots each pairing two of the three dimensions for the new triple exposure dummy ($DExp^s \times DHighR(t) \times DFinC$). The 106 stocks that are simultaneously (i) in the 25% quantile of high “Fire Sale Exposure”, (ii) feature a high “Log Cumulative Return” (above the median from 01/07/2007 to 31/12/2008), and (iii) are in the 50% quantile of the “Financial Constraint Index” are marked by a black cross, whereas all other firms are represented by a red circle. The vertical and horizontal cutoffs for the respective dummies are drawn by a black solid line. In each of the three dimension, the first quadrant shows a mix of black crosses and red circles, which implies that a sizeable sample of comparable firms in each dimension allow a triple difference in differences approach.

The panel regression for the quarterly investment share in column (2) of Table 4 is now expanded to capture the triple interaction between the fire sale exposure dummy ($DExp^s$), the high return dummy ($DHighR$), and the new financial constraint dummy ($DFinC$). Formally:

$$Inv_{st} = \gamma_0 + \gamma_1[DExp^s \times DHighR(t) \times DFinC] + \gamma_2 X_s + \mu_{st},$$

where the control variables X_s include the three double interaction terms ($DExp^s \times DHighR(t)$, $DExp^s \times DFinC$, and $DHighR(t) \times DFinC$) as well as the individual control terms ($DExp^s$, $DHighR(t)$, and $DFinC$). Similar to Table 3, column (2), we again allow for stock fixed effects and time fixed effects.

In Table 7, columns (1) and (2) report the regression results for the 30% and 50% cutoffs of the Hadlock-Pierce index. The first 12 regressors ($DExp^s \times DHighR(t)$) represent the quarterly investment shortfall captured by the interaction of stock exposure and high returns, while the following 12 regressors ($DExp^s \times DHighR(t) \times DFinC$) state the incremental investment shortfall due to financial constraints in each quarter. For the 30% financially most constrained firms (column (1)), the incremental effect peaks in 2009/1 with an economically large investment shortfall of -4.29% . For the four peak crisis quarters between 2008/3 and 2009/2 we obtain an aggregate investment decrease of 11.4% captured by the triple interaction term. Relative to an average investment share of 22.07% of all exposed, high return and unconstrained firms in these four quarters, this represents a 52% incremental investment decrease for the 30% most constrained firms. An F-test easily rejects the null hypothesis that the four coefficients for 2008/3, 2008/4, 2009/1, and 2009/2 are jointly equal to zero.

For the 50% financially most constrained firms (column (2)), the interaction of fire sale exposure and high stock returns produces a more modest investment shortfall of -1.69% for 2009/1. But this is still an economically large reduction relative to a mean quarterly investment share of 6.2% for the entire sample period. We also highlight that the investment shortfall of financially unconstrained firms at both cutoff points and captured by the regressor $DExp^s \times DHighR(t)$ is economically much smaller and statistically insignificant. Severe stock underpricing only mattered for investment if the company was among the 50% most financially constrained firms. As a robustness test, we also mark the 30% smallest firms as financially constrained. Unlike for the Hadlock-Pierce index, firm age no longer enters into the dummy construction. The corresponding results reported in Table 7, column (3), are slightly weaker than for the Hadlock-Pierce index with the same 30% cutoff. But qualitatively, such a simple size-based dummy of financial constraints produces very similar results.

Figure 4 provides a graphical illustration of the significant investment reduction by the subsample of fire sale exposed, high return, and financially constrained firms. Their quarterly investment share is plotted (based on the fixed effect obtained in Table 7, column (1)) as the solid black line marked by crosses and drops to as low as 2.56% in 2009/1. For comparison, the red dotted line represents the investment share of the exposed high return stocks which are financially unconstrained, the red long-dashed line draws the investment share of constrained

high return stocks without fire sale exposure, and the red short-dashed line for all high return firms. These three comparison groups all show a substantial reduction in their investment share, but not by nearly as much as the stocks marked by the triple interaction. Fire sale related stock underpricing reduced the investment of the 30% financially most constrained firms, but not for the majority of stocks.

5 Conclusions

Judgments on the role of financial market development for economic efficiency and growth hinge on evidence that these markets play a role in the capital allocation process. Previous work has used stock mispricing as a way to infer such a capital allocation role. If the stock market matters in equilibrium, then it should also matter “out of equilibrium” when stock prices do not (fully) reflect future investment opportunities. Instances of market inefficiency are therefore informative about the capital allocation role of the market.

But the endogeneity of investment and its entanglement with both agency problems and measurement errors for mispricing proxies make inference methodologically problematic. Ideally, the identification strategy for mispricing should rely on data unrelated to the investment problem of a firm—a standard not met by any work we know of. Our paper makes an important contribution by using fund fire sales as a truly exogenous source of identification: The treatment effect for stock underpricing is based on the fire sale pressure of a firm’s distressed mutual fund owners and is therefore removed from the firm’s investment problem.

We find evidence that (fire sale based) stock underpricing negatively affects investment and employment. The effects are statistically and economically significant; we can deduce an important capital allocation role for the stock price. Relative to industry peers, the most underpriced stocks experience an investment shortfall of roughly 20% prior to their stock price recovery and a relative annual employment decrease of 4.8% in 2009. We further investigate the transmission channel through which stock underpricing matters. Using the Hadlock-Pierce index of financial constraints, we identify that most of the investment shortfall caused by stock underpricing is concentrated in the 30% financially most constrained firms, for which investment is cut roughly by half.

The role of stock market development for economic efficiency and growth remains an unresolved issue because of the econometric challenges of causal inference (Beck, 2009). The evidence in this paper shows that stock prices co-determine corporate investment and most strongly so for firms dependent on external finance. For these firms stock price information must represent an important input into the external monitoring process.

Appendix: Risk Adjustment

Our analysis of the fire sales effects on stock prices first removes risk premia from the return analysis. For this risk adjustment, we use the international version of the Carhart (1997) four-factor model. For each country, we construct a domestic and an international version of the four factors: the market factor (MKT), the size factor (SML), the book-to-market factor (HML), and the momentum factor (MOM). The factor construction is based on monthly stock returns in U.S. dollars from Datastream over the five-year period from July 2002 to June 2007.

A country's international factors are calculated in the second step as the weighted average of the respective domestic factors of all other countries, where the weights are given by the relative stock market capitalization of each foreign country at the beginning of the year. The stock market capitalization date is obtained from World Development Indicator. We estimate the factor loadings of each stock on the four domestic and four international risk factors ($j = Dom, Int$) using a regression over 60 months from July 2002 to June 2007,

$$r_{s,t} = \alpha + \sum_{j=Dom,Int} \beta_{1,j}MKT_t^j + \beta_{2,j}SML_t^j + \beta_{3,j}HML_t^j + \beta_{4,j}MOM_t^j + \epsilon_{s,t},$$

where $r_{s,t}$ denotes a stock's monthly (cum dividend) return in U.S. dollars net of the one-month treasury bill rate. For the pre-crisis period, July 2002 to June 2007, the average factor loadings on the market, size, and value factors are positive. A negative average loading is found only for the momentum factor. All eight factors have explanatory power for the cross-section of returns. The observation that both domestic and international risk factors play an important role in the pricing of stocks corroborates the recent evidence advanced by Eun *et al.* (2010) on the risk-return trade-off of investment by global investors.

With the estimated factor loadings $\hat{\beta}_{i,j}$ for monthly returns, the monthly expected return during the crisis period from July 2007 to December 2009 is defined as

$$er_{s,t} = \sum_{j=Dom,Int} \hat{\beta}_{1,j}MKT_t^j + \hat{\beta}_{2,j}SML_t^j + \hat{\beta}_{3,j}HML_t^j + \hat{\beta}_{4,j}MOM_t^j.$$

The cumulative expected return over k weeks (since month t) follows as

$$1 + er_{s,t}(k) = (1 + er_{s,m+1})^{n/4} \prod_{i=1}^m (1 + er_{s,t+i}),$$

where m denotes the number of full months and n the number of weeks falling into the last month $m + 1$. The cumulative risk-adjusted (or excess) return of stock s over k weeks can be calculated from the weekly stock return (wr) and the estimated expected return as

$$r_s^{Ex}(k) = \prod_{i=1}^k (1 + wr_{s,t+i}) - (1 + er_{s,t}(k)).$$

The cumulative risk adjusted return of stock s over q quarters can be calculated in a similar manner as

$$r_s^{Ex}(q) = \prod_{i=1}^{3 \times q} (1 + r_{s,t+i}) - \prod_{i=1}^{3 \times q} (1 + er_{s,t+i}).$$

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Table 1: Summary Statistics

Reported are summary statistics for all non-financial and non-utility stocks. Fund exposure, Exp^f , is measured by the return loss of a fund due to ownership in financial stocks over the one-year period from July 1, 2007 to June 30, 2008. Stock exposure, Exp^s , measures the average fund exposure of all funds owning a stock, where the weights are given by the ownership share of a fund relative to the stock's market capitalization. The dummy variable $DExp^s$ marks the 25% of stocks with fund owners most exposed to financial stocks. Fund share Fsh^s measures the aggregate holdings of all funds in a stock as a percentage of the stock's market capitalization. The percentage investment share $Inv(t)$ in year or quarter t is defined as the capital expenditure in period t relative to the net capital stock in period $t - 1$, multiplied by 100. The percentage employment change $\Delta Emp(t)$ measure the percentage change in the number of employees relative to the number at the end of period $t - 1$. The dummy $DExp^s \times DHighR(2007)$ is the product of the exposure $DExp^s$ and the high return dummy $DHighR(t)$. The high return dummy $DHighR(t)$ marks all stock with above median (risk-adjusted) returns from the beginning of quarter 2007/3 to the end of quarter $t - 1$. As control variables, we use *Stock Size* measured by (log of) the asset size in 2006, *Tobin's Q* calculated for 2006, *Cash Flow* defined as income in 2006 (before extraordinary items but with depreciation and amortization) relative to net capital stock at the end of 2005 and the (risk-adjusted) *Stock Return* in 2006.

Variable	Obs.	Mean	Median	STD	Min	Max
Fund Exposure Measures						
Exp^f	13,369	-0.019	-0.012	0.026	-0.363	0.000
Stock Exposure Measures						
$Exp^s \times 100$	3,084	-0.249	-0.181	0.253	-2.261	0.000
$DExp^s$	3,084	0.250	0.000	0.433	0.000	1.000
Fund Ownership Share						
Fsh^s	3,084	0.219	0.222	0.153	0.000	0.781
Percentage Investment Share						
$Inv(2007)$	2,736	33.917	25.004	29.488	2.634	194.611
$Inv(2008)$	2,575	29.352	22.643	23.911	2.107	157.602
$Inv(2009)$	2,427	19.197	14.770	15.549	0.812	86.827
Percentage Employment Change						
$\Delta Emp(2007)$	2,690	6.193	3.726	18.816	-44.324	92.818
$\Delta Emp(2008)$	2,531	0.805	0.000	16.526	-48.268	73.077
$\Delta Emp(2009)$	2,381	-4.101	-4.057	14.120	-47.534	51.402
Stock Undervaluation Dummy						
$DExp^s \times DHighR(2007)$	2,879	0.195	0.000	0.396	0.000	1.000
$DExp^s \times DHighR(2008)$	2,705	0.200	0.000	0.400	0.000	1.000
$DExp^s \times DHighR(2009)$	2,545	0.235	0.000	0.424	0.000	1.000
Control Variables						
<i>Stock Size (log of assets)</i>	2,924	5.937	5.878	1.847	2.210	10.712
<i>Tobin's Q</i>	2,886	2.175	1.782	1.200	0.888	7.677
<i>Cash Flow</i>	2,393	-0.076	0.365	3.188	-22.760	7.857
<i>Stock Return(2006)</i>	3,084	0.033	-0.076	1.011	-0.998	35.589

Table 2: Cumulative Return Effect of Stock Fire-Sales

Reported are separate (cross-sectional) OLS regressions for the cumulative return measured from the beginning of quarter 2007/3 to the end of quarter $t = 2007/3, \dots, 2009/4$. For the two pre-crisis quarters 2007/1 and 2007/2, the dependent variable is given by the respective quarterly return. The exposure dummy $DExp^s$ marks the 25% U.S. stocks with the highest ownership exposure to distressed equity funds. The latter is interacted with a high return dummy $DHighR(t)$ marking (with one) all observations in a quarter $t = 2007/4, \dots, 2009/4$ if and only if the stock is among the 50% of stocks with the highest cumulative return from the beginning of 2007/3 to the end of quarter $t - 1$. For quarters 2007/1, 2007/2, and 2007/3, $DHighR(t)$ is set to equal to that in 2007/4. We include as a control variable the fund share (Fsh) measuring the ownership share of all reporting equity funds relative to stock capitalization. Included as additional controls (but not reported) are the exposure dummy $DExp^s$ and the high return dummy $DHighR(t)$, separately. Also included are fixed effects for each industry.

Dep. Variable: Cumulative Return	Indep. Variables				Obs.	Adj. R^2
	$DExp^s \times DHighR(t)$		$Fund\ Share\ (Fsh)$			
	Coefficient	T-value	Coefficient	T-value		
2007/1 (pre-crisis)	-0.014	-0.99	0.141	4.65	2,810	0.042
2007/2 (pre-crisis)	-0.008	-0.56	0.102	3.29	2,806	0.103
2007/3	-0.156	-10.32	0.030	0.84	2,841	0.568
2007/4	-0.238	-7.35	0.029	0.36	2,832	0.365
2008/1	-0.197	-6.04	0.166	2.21	2,655	0.399
2008/2	-0.363	-7.62	0.173	1.54	2,656	0.401
2008/3	-0.215	-4.73	0.264	2.50	2,642	0.263
2008/4	-0.431	-6.20	0.220	1.36	2,630	0.336
2009/1	-0.446	-5.99	0.155	0.86	2,489	0.342
2009/2	-0.229	-3.66	0.150	1.08	2,489	0.334
2009/3	-0.222	-3.82	0.310	2.34	2,467	0.369
2009/4	-0.247	-4.73	0.161	1.35	2,478	0.438

Table 3: Distribution of Portfolio Similarity in Non-Financials by Fund Pairs

We match the 15% most exposed funds with the same number of non-exposed funds based on the size of their total asset holdings in non-financial stock and examine for all high return stocks (with above median return from July 2007 to June 2008) if the portfolio allocation in groups of non-financial stocks is independent across the fund exposure criterium. For any pair of funds (f_1, f_2) , we define portfolio overlap in stock groups as

$$Overlap(f_1, f_2) = \sum_{g \in \text{Set of Stock-Groups}} \min[w^{f_1,g}, w^{f_2,g}],$$

where $\hat{w}^{f_1,g}$ and $\hat{w}^{f_2,g}$ represent the (non-financial) portfolio share in stock group g of funds f_1 and f_2 , respectively. We sort stocks into 12 industries (based on the Fama and French industry classification), 2 size categories (based on capitalization in 2006), and 2 leverage categories (based on data in 2006) or 48 stock groups in total. Column (1) reports the distribution of portfolio overlap for all pairs of any two (different) exposed funds and column (2) for all pairs of exposed and non-exposed funds, with one from each type of funds. We test of equality of the distribution using the median test and the Wilcoxon-Mann-Whitney ranksum test.

	(1) <i>Overlap</i> (f_1, f_2) Between all Pairs of Two Exposed Funds	(2) <i>Overlap</i> (f_1, f_2) Between all Pairs of Exp. and Non-Exp. Funds
Percentiles		
1%	0.000	0.000
5%	0.000	0.000
10%	0.000	0.000
25%	0.000	0.004
50%	0.097	0.084
75%	0.170	0.153
90%	0.230	0.208
95%	0.261	0.240
99%	0.307	0.299
Obs.	216, 153	432, 964
Mean	0.101	0.092
STD	0.091	0.083
Skewdness	0.438	0.574
Kurtosis	2.107	2.454
Percentage zeros	25.2%	21.4%
Median Test	$\chi^2(1) = 1049.92$	
	$p = 0.00$	
Wilcoxon Test	$z = 25.31$	
	$p = 0.00$	

Table 4: Investment Effect of Fund Ownership Exposure

Reported are Ordinary Least Square (OLS) regressions for the quarterly percentage investment share (capital expenditure in quarter t relative to the net capital stock in quarter $t - 1$) over the 3 year period from 2007/1 to 2009/4. The exposure dummy $DExp^s$ marks the 25% U.S. stocks with the highest ownership exposure to distressed equity funds. The latter is interacted with a high return dummy $DHighR(t)$ marking (with one) all observations in a quarter $t = 2007/4, \dots, 2009/4$ if and only if the stock is among the 50% of stocks with the highest cumulative return from the beginning of 2007/3 to the end of quarter $t - 1$. For quarters 2007/1, 2007/2, and 2007/3, $DHighR(t)$ is set to equal to that in 2007/4. Included as controls (but not reported) are the interaction terms between the exposure dummy $DExp^s$ and time fixed effects and also the interaction terms between the high return dummy $DHighR(t)$ and time fixed effects. Specification (1) uses industry fixed effects (given by four-digit SEC codes), time fixed effects, and their interactions, as well as the (pre-crisis) control variables *Stock Size*, *Tobin's Q*, *Cash Flow*, and *Stock Return* as defined in Table 1. Specification (2) uses stock fixed effects and separate time fixed effects. We report robust t-values adjusted for clustering at the stock level.

Dep. Variable: Quarterly Investment Share	(1)		(2)	
	Coefficient	T-value	Coefficient	T-value
$DExp^s \times DHighR(2007/1)$	0.231	0.42	-0.230	-0.47
$DExp^s \times DHighR(2007/2)$	0.116	0.21	-0.129	-0.27
$DExp^s \times DHighR(2007/3)$	0.226	0.42	-0.102	-0.22
$DExp^s \times DHighR(2007/4)$	0.154	0.26	-0.013	-0.03
$DExp^s \times DHighR(2008/1)$	-0.402	-0.77	-0.681	-1.73
$DExp^s \times DHighR(2008/2)$	-0.778	-1.45	-0.842	-2.13
$DExp^s \times DHighR(2008/3)$	-0.682	-1.26	-0.837	-2.06
$DExp^s \times DHighR(2008/4)$	-1.217	-2.58	-0.981	-2.48
$DExp^s \times DHighR(2009/1)$	-1.020	-2.68	-0.906	-2.61
$DExp^s \times DHighR(2009/2)$	-0.935	-2.43	-0.823	-2.36
$DExp^s \times DHighR(2009/3)$	-0.149	-0.40	-0.661	-1.80
$DExp^s \times DHighR(2009/4)$	0.003	0.01	-0.387	-0.98
<i>Stock Size (log of assets)</i>	-0.220	-4.36		
<i>Tobin's Q</i>	0.642	7.38		
<i>Cash Flow</i>	0.058	1.34		
<i>Return(2006)</i>	0.673	3.82		
Industry Fixed Effects	yes		no	
Industry Time Fixed Effects	yes		no	
Stock Fixed Effects	no		yes	
Time Fixed Effects	yes		yes	
<i>Obs.</i>	23,561		24,136	
<i>Adj.R</i> ²	0.162		0.454	
F-tests (F-statistics)				
H_0 : No effect 2008/1 to 2009/4		7.530		15.250
H_0 : No effect 2008/3 to 2009/2		11.393		13.122

Table 5: Robustness to Fund Share Controls

The regressions in Table 3, column (2) is repeated by controlling for fund share (Fsh) interacted with time fixed effects for each quarter. The exposure dummy $DExp^s$ marks the 25% U.S. stocks with the highest ownership exposure to distressed equity funds. The latter is interacted with a high return dummy $DHighR(t)$ marking (with one) all observations in a quarter $t = 2007/4, \dots, 2009/4$ if and only if the stock is among the 50% of stocks with the highest cumulative return from the beginning of 2007/3 to the end of quarter $t - 1$. For quarters 2007/1, 2007/2, and 2007/3, $DHighR(t)$ is set to equal to that in 2007/4. Included as controls (but not reported) are the interaction terms between the exposure dummy $DExp^s$ and time fixed effects and also the interaction terms between the high return dummy $DHighR(t)$ and time fixed effects. Specification (1) uses stock fixed effects and time fixed effects as in Table 3, column (2), whereas specification (2) adds the fund share interacted with time fixed effects as additional controls. We report robust t-values adjusted for clustering at the stock level.

Dep. Variable: Quarterly Investment Share	(1)		(2)	
	Coefficient	T-value	Coefficient	T-value
$DExp^s \times DHighR(2007/1)$	-0.230	-0.47	-0.211	-0.43
$DExp^s \times DHighR(2007/2)$	-0.129	-0.27	-0.048	-0.10
$DExp^s \times DHighR(2007/3)$	-0.102	-0.22	-0.084	-0.18
$DExp^s \times DHighR(2007/4)$	-0.013	-0.03	-0.022	-0.05
$DExp^s \times DHighR(2008/1)$	-0.681	-1.73	-0.640	-1.63
$DExp^s \times DHighR(2008/2)$	-0.842	-2.13	-0.862	-2.18
$DExp^s \times DHighR(2008/3)$	-0.837	-2.06	-0.886	-2.17
$DExp^s \times DHighR(2008/4)$	-0.981	-2.48	-1.073	-2.69
$DExp^s \times DHighR(2009/1)$	-0.906	-2.61	-0.991	-2.81
$DExp^s \times DHighR(2009/2)$	-0.823	-2.36	-0.926	-2.65
$DExp^s \times DHighR(2009/3)$	-0.661	-1.80	-0.757	-2.05
$DExp^s \times DHighR(2009/4)$	-0.387	-0.98	-0.467	-1.17
Stock Fixed Effects	yes		yes	
Time Fixed Effects	yes		yes	
Time Fixed Effects $\times Fsh$	no		yes	
<i>Obs.</i>	24, 136		23, 833	
<i>Adj.R</i> ²	0.454		0.455	
F-tests (F-statistics)				
H_0 : No effect 2008/1 to 2009/4		15.250		17.423
H_0 : No effect 2008/3 to 2009/2		13.122		15.514

Table 6: Investment and Employment Effect of Fund Ownership Exposure

Reported are Ordinary Least Square (OLS) regressions and Seemingly Unrelated Regressions (SUR) for the (percentage) investment share (capital expenditure in year t relative to the net capital stock in year $t - 1$) and the annual (percentage) employment change over the 3 year period from 2007 to 2009. The exposure dummy $DExp^s$ marks the 25% U.S. stocks with the highest ownership exposure to distressed equity funds. The latter is interacted with a high return dummy $DHighR(t)$ marking (with one) all observations in year $t = 2007, 2008, 2009$ if and only if the stock is among the 50% of stocks with the highest cumulative return from the July 2007 to the end of year $t - 1$. The $DHighR(t)$ dummy for 2007 is set to equal to that for 2008. We include (pre-crisis) control variables defined in Table 1. Included as additional controls (but not reported) are interaction terms between the exposure dummy $DExp^s$ and year fixed effects. Both equations include fixed time effects for each year, fixed effects for each industry (based on four-digit SEC industry codes) and the interaction of industry and fixed time effects. We report robust t-values adjusted for clustering at the stock level.

	(1) OLS		(2) SUR	
	Coefficient	T-value	Coefficient	T-value
Equation 1: Annual Investment Share				
<i>DHighR</i> (2007)	-0.244	-0.13	-0.645	-0.53
<i>DHighR</i> (2008)	1.612	0.95	1.409	1.10
<i>DHighR</i> (2009)	5.334	4.64	5.041	3.74
<i>DExp</i> ^s × <i>DHighR</i> (2007)	2.445	0.97	2.603	1.39
<i>DExp</i> ^s × <i>DHighR</i> (2008)	1.200	0.55	1.095	0.56
<i>DExp</i> ^s × <i>DHighR</i> (2009)	-4.368	-3.03	-3.806	-1.89
<i>Stock Size</i> (log of assets)	-1.382	-5.32	-1.379	-7.04
<i>Tobin's Q</i>	3.724	7.73	3.644	13.93
<i>Cash Flow</i>	0.349	1.63	0.336	3.15
<i>Return</i> (2006)	4.793	2.06	5.113	3.39
<i>Obs.</i>	5,919		5,632	
<i>Adj.R</i> ²	0.200		0.345	
Equation 2: Annual Employment Change				
<i>DHighR</i> (2007)	2.697	2.15	2.451	2.77
<i>DHighR</i> (2008)	4.889	4.37	4.641	5.00
<i>DHighR</i> (2009)	5.945	5.59	5.835	5.99
<i>DExp</i> ^s × <i>DHighR</i> (2007)	-0.395	-0.22	-0.365	-0.27
<i>DExp</i> ^s × <i>DHighR</i> (2008)	-0.109	-0.07	0.034	0.02
<i>DExp</i> ^s × <i>DHighR</i> (2009)	-4.815	-3.65	-4.797	-3.29
<i>Stock Size</i> (log of assets)	0.321	1.87	0.296	2.09
<i>Tobin's Q</i>	1.888	7.12	1.916	10.14
<i>Cash Flow</i>	0.380	2.69	0.382	4.96
<i>Return</i> (2006)	3.635	2.04	3.126	2.87
<i>Obs.</i>	5,762		5,632	
<i>Adj.R</i> ²	0.153		0.305	
F-test (F-statistic)				
H_0 : No real effect in 2009		—		5.890

Table 7: Financial Constraints as Transmission Channel

The stock fixed effect regression in Table 4 is extended to allow for interaction between the fire sale dummy $DExp^s \times DHighR(t)$ and a dummy ($DFinC$) marking firms with financial constraints. Three different proxies of financing constraints are considered: Column (1) uses as dummy for financially constrained firms the Hadlock-Priest AS index (based on firm Age and Size) at the 30% cutoff; in column (2) we mark as financially constrained a larger group of firms with greater than median Hadlock-Priest AS index; and column (3) uses a dummy for the 30% smallest firms based on book asset value (Size). Included in the regressions (but not reported) are stock fixed effects and separate time fixed effects and all remaining subcomponents of the triple interaction term: $DHighR \times DFinC$, $DExp^s \times DFinC$, $DExp^s$, $DHighR$, and $DFinC$, each interacted with all time dummies. We report robust t-values adjusted for clustering at the stock level.

Dep. Variable: Quarterly Investment Share	Type of Financial Constraint Dummy ($DFinC$)					
	(1)		(2)		(3)	
	Hadlock-Priest 30% cutoff		Hadlock-Priest 50% cutoff		Size 30% cutoff	
	Coefficient	T-value	Coefficient	T-value	Coefficient	T-value
$DExp^s \times DHighR(2007/1)$	0.556	1.01	0.706	1.28	0.522	0.95
$DExp^s \times DHighR(2007/2)$	-0.031	-0.06	-0.028	-0.05	-0.038	-0.07
$DExp^s \times DHighR(2007/3)$	-0.439	-0.91	-0.678	-1.32	-0.429	-0.89
$DExp^s \times DHighR(2007/4)$	0.783	1.43	0.604	1.01	0.840	1.53
$DExp^s \times DHighR(2008/1)$	-0.615	-1.49	-0.442	-0.97	-0.607	-1.46
$DExp^s \times DHighR(2008/2)$	-0.625	-1.44	-0.597	-1.34	-0.664	-1.53
$DExp^s \times DHighR(2008/3)$	-0.328	-0.75	-0.013	-0.03	-0.348	-0.79
$DExp^s \times DHighR(2008/4)$	-0.523	-1.16	-0.601	-1.20	-0.606	-1.35
$DExp^s \times DHighR(2009/1)$	-0.344	-0.86	-0.273	-0.63	-0.385	-0.97
$DExp^s \times DHighR(2009/2)$	-0.512	-1.35	-0.636	-1.59	-0.493	-1.30
$DExp^s \times DHighR(2009/3)$	-0.378	-0.87	-0.235	-0.48	-0.389	-0.90
$DExp^s \times DHighR(2009/4)$	-0.125	-0.28	-0.320	-0.67	-0.125	-0.28
$DExp^s \times DHighR(2007/1) \times DFinC$	-1.756	-0.66	-1.765	-1.45	-1.697	-0.65
$DExp^s \times DHighR(2007/2) \times DFinC$	-1.065	-0.46	-0.303	-0.25	-1.076	-0.48
$DExp^s \times DHighR(2007/3) \times DFinC$	0.781	0.31	0.917	0.86	0.661	0.26
$DExp^s \times DHighR(2007/4) \times DFinC$	-0.496	-0.19	-0.472	-0.37	-0.917	-0.35
$DExp^s \times DHighR(2008/1) \times DFinC$	-0.432	-0.22	-0.120	-0.13	-0.630	-0.32
$DExp^s \times DHighR(2008/2) \times DFinC$	-1.944	-1.10	-0.492	-0.53	-1.864	-1.07
$DExp^s \times DHighR(2008/3) \times DFinC$	-2.164	-0.79	-1.804	-1.73	-2.171	-0.80
$DExp^s \times DHighR(2008/4) \times DFinC$	-2.398	-1.67	-0.983	-1.01	-2.074	-1.45
$DExp^s \times DHighR(2009/1) \times DFinC$	-4.294	-2.77	-1.688	-2.01	-4.047	-2.66
$DExp^s \times DHighR(2009/2) \times DFinC$	-2.563	-1.51	-0.449	-0.52	-2.488	-1.50
$DExp^s \times DHighR(2009/3) \times DFinC$	-1.802	-1.00	-0.193	-0.22	-1.647	-0.94
$DExp^s \times DHighR(2009/4) \times DFinC$	-2.327	-1.16	-0.560	-0.61	-2.136	-1.09
<i>Obs.</i>	23, 889		23, 889		23, 889	
<i>Adj.R</i> ²	0.457		0.457		0.457	
F-tests for triple interaction terms (F-statistics):						
H_0 : No effect 2008/1 to 2009/4			4.490		2.650	
H_0 : No effect 2008/3 to 2009/2			4.880		4.210	
					4.140	
					4.480	

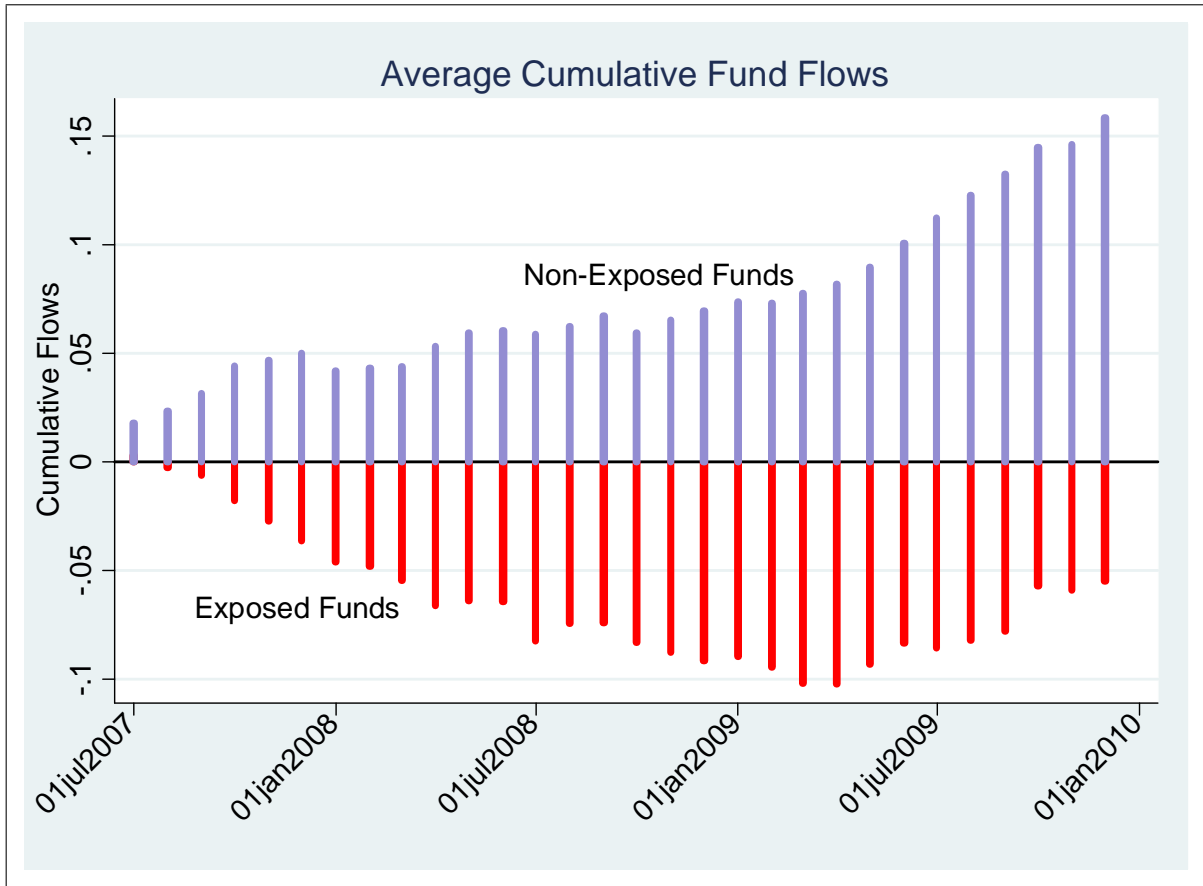


Figure 1: Plotted are the average cumulative fund flows (in percentage of total assets under management relative to holding in June 2007) for the 15% of funds with the highest investment losses in financial sector stocks (exposed funds) and the remaining 85% of funds (non-exposed funds).

Fire Sales Discount by Stock Return Quantile

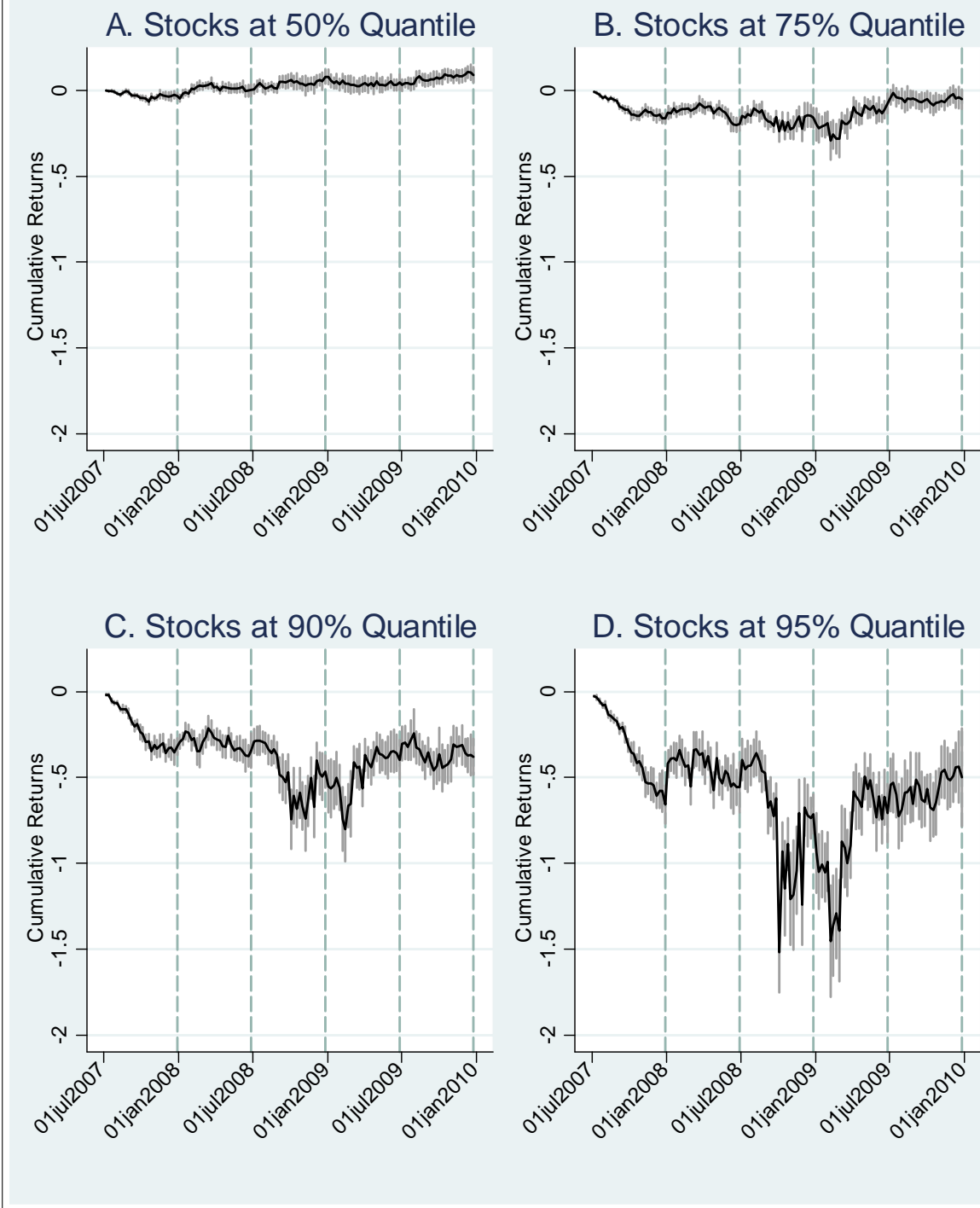


Figure 2: The graphs show the fire sales discounts (measured by the coefficient α_1^k) for exposed stocks in different performance quantiles measured over the period June 29, 2007 to December 25, 2009. Graph A shows fire sales discounts for stocks at the 50% (median) stock return quantile and graph B for the better performing stocks at the 75% stock return quantile. In graphs C and D, we plot the fire sales discount for exposed stocks at the highest 90% and 95% performance quantiles, respectively. Stock exposure is measured by ownership share of distressed equity funds in a particular stock. The vertical bars provide a 1 S.D. confidence interval around the point estimate.

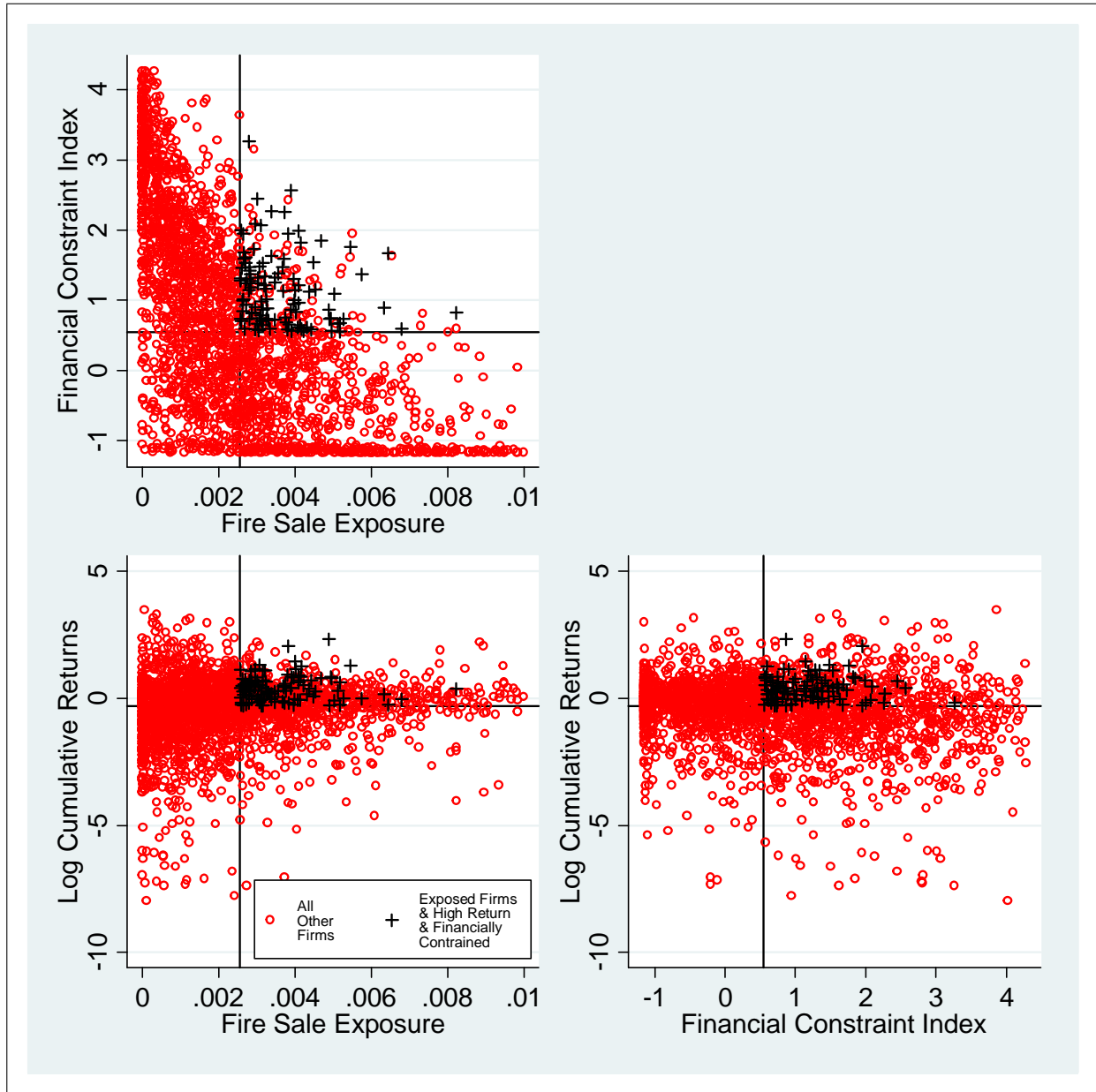


Figure 3: Plotted are all stocks in the three dimensions of (i) the Fire Sale Exposure, (ii) the Log Cumulative Return over the crisis period from July 2007 to December 2008 and (iii) the Financial Constraint Index (AS) by Hadlock and Pierce. The black vertical and horizontal lines mark the cut-off values for the three dummy variables, which are the 25% quantile for Fire Sale Exposure, the 50% quantile for Log Cumulative Returns, and the 50% quantile for Financial Constraint Index. Financially constrained stocks with high crisis returns and high fire sale exposures (triple dummy) are marked by a black cross and all other stocks with a red circle.

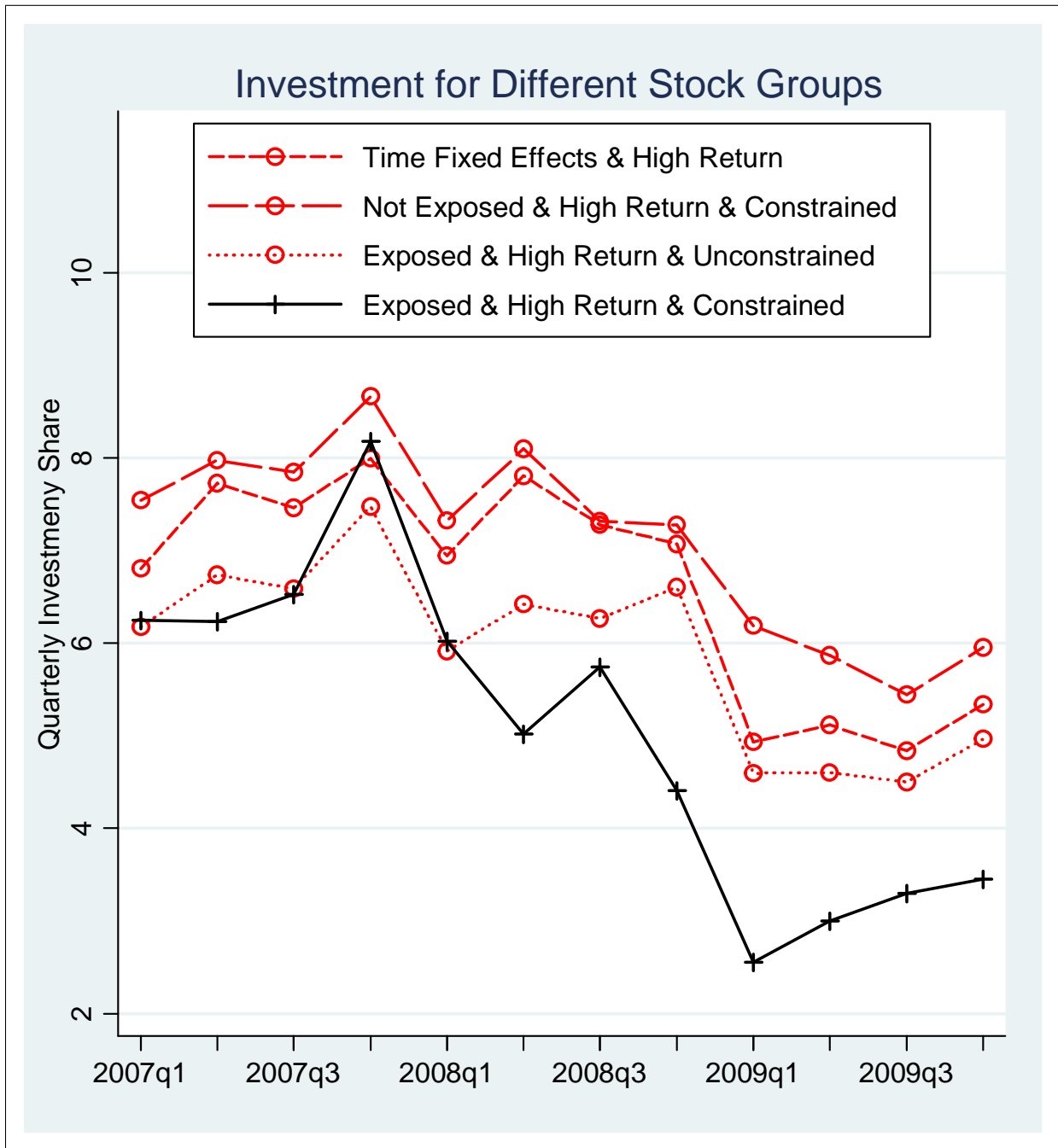


Figure 4: Plotted is the quarterly investment share (capital expenditure relative to net capital stock) for different groups of stocks based on the fixed effect obtained in Table 7, column (1). The evolution of the investment share for stocks with fire sale exposure (Exposed), above median return (High Return), and financial constraints (Constrained) is given by the black solid line.