# The Role of Equity Funds in the Financial Crisis Propagation

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**Abstract**

The early stage of the 2007/08 financial crisis was marked by large value losses for bank stocks. This paper identifies the equity funds most affected by this valuation shock and examines its consequences for the nonfinancial stocks owned by the respective funds. We find that ownership links to these "distressed equity funds" led to large transitory underperformance of the most exposed nonfinancial stocks, and in aggregate this contributed an additional 10% to the overall stock market downturn. We also find that distressed fire sales and the associated price discounts were concentrated among those exposed stocks that performed relatively well during the crisis.

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# 1 Introduction

Financial sector stocks accounted for only 20% of the total U.S. stock market value in 2007. Their widespread exposure to the subprime market not only hurt their own stock prices, but eventually led to a near 50% value decrease for nonfinancial stocks as well.[1] Is the price dop in nonfinancial stocks fully justified by their fundamentals or is there a price contagion from financial to nonfinancial stocks that accounts for part of the stock price effect? Using fund ownership data at the stock and fund/investor level, this paper identifies the common fund owners between financial and nonfinancial stocks as an important channel for price contagion during the crisis. Our analysis suggests that some 10% of the 53% crisis-related decline for the U.S. stock market is attributable to price contagion via such common fund ownership. By examining the 2007/08 crisis development in the stock market from this new angle of joint equity fund ownership between crisis and noncrisis stocks, our study identifies a sharp macroeconomic picture of crisis-induced transitory equity price dynamics, which to the best of our knowledge has not been documented in the existing literature.

A large empirical literature documents 'price contagion' across countries and asset classes.[2] Yet, as Forbes and Rigobon (2002) argue, it is often difficult to separate contagion from ordinary asset interdependence. This paper uses a new comprehensive sample on the equity positions of 22,621 equity funds around the world for a clear identification of a contagion channel. For each fund, we calculate *fund exposure* to financial stocks as the fund's return losses induced by financial sector positions in the initial phase of the financial crisis. Distressed equity funds with large losses faced larger investor redemptions and, therefore, had to engage in asset fire sales of their financial and/or nonfinancial stocks. To capture the selling pressure of a nonfinancial stock owned by distressed funds, we define its *stock exposure* as the ownership-weighted average *fund exposure* of all mutual funds owning the stock. Thus, nonfinancial stocks held by funds with heavy loadings on underperforming financial stocks would be considered highly exposed stocks, which have high exposure to the financial sector via their fund owners.

Separation of the stock universe into financial and nonfinancial stocks allows for a better identification of causal effects. We do not condition our analysis directly on fund outflows because of concerns

[1] As of June 2007, financial stocks (SIC code between 6000 and 6799) has a total market capitalization value of about US$3,771 billion, compared to US$13,624 billion for nonfinancial stocks. By February 2009, their respective values have dropped to US$1,010 billion and US$7,176 billion, which represent a value decline of 73% for financial stocks and 47% for nonfinancial stocks. The overall U.S. stock market value decreased by about 53% during this period.

[2] See Kindleberger (1978); Dornbusch, Park, and Claessens (2000); and Kaminsky, Reinhart, and Vegh (2003) for excellent surveys.

about outflow endogeneity in the context of the crisis. Funds with poor overall performance are likely to experience larger outflows so that conditioning the analysis on fund outflows would generate a sample bias toward funds holding underperforming (financial and nonfinancial) stocks. To avoid such a selection bias, we capture fund distress as (ex post) poor asset allocations in financial sector stocks only, while measuring fire sale effects exclusively for nonfinancial stocks.[3]

Our empirical analysis focuses on the relative return of *exposed stocks*, i.e., the 30% of nonfinancial stocks with the highest stock exposure. We show that nonfinancial stocks with high exposure to distressed funds considerably underperformed during the financial crisis. The stock price for the exposed U.S. stocks underperformed relative to nonexposed industry peers by 40.9% at the peak of the stock market downturn. This highlights the role of funding constraints for mutual funds and their importance for stock market "contagion."

In our research design, we carefully exclude stocks in banking-related industries (e.g., banking, insurance, real estate, and financial trading industries) from our sample of nonfinancial stocks. In addition, we exclude conglomerates that have more than 1% of total sales in these banking-related industries. Our findings are also robust to the control of various firm characteristics, including the Amihud illiquidity measure, receivables-to-sales ratio, price-to-book ratio, leverage ratio, short-term debt-to-asset ratio, and dividend yield. Importantly, our results cannot be explained by any omitted characteristics that are common between financial stocks and exposed, nonfinancial stocks—such an explanation implies the greatest price discount among the worst performing exposed, nonfinancial stocks (due to their shared firm characteristics with financial stocks). Contrary to the omitted variable hypothesis, we find that the fire sale discount is most pronounced for those exposed stocks that perform relatively well during the crisis.

The pronounced concentration of fire sale discounts for the best performing stocks shows that distressed funds preferred to liquidate stock positions for which selling did not imply realizing large capital losses. As a paradoxical consequence, large transitory stock underpricing afflicted primarily those stocks that have no real crisis exposure other than being owned by the distressed equity funds with large exposure to the financial sector. This has further implications for macroeconomic research on the real effects of a financial crisis. Such research might easily arrive at biased results for the real transmission mechanism unless it properly controls for fund ownership linkages.

A few other papers have also used portfolio data at the fund level to identify channels of asset

[3] Fund outflows also may be driven by a few investors' foresight about the future performance of a fund. In this case, outflows correlate with future stock underperformance, and the fire sale effect becomes entangled with a confounding selection effect.

contagions. In particular, Broner, Gelos, and Reinhart (2006) find that rebalancing toward the index ('retrenchment') by global equity funds during the previous emerging market crises (i.e., Thailand in 1997, Russia in 1998, and Brazil in 1999) had a pronounced effect on the cross-section of international equity index returns. Manconi, Massa, and Yasuda (2012) find that during the 2007/08 crisis, fixed income mutual funds transmitted the crisis from the securitized bond market to the corporate bond market. These papers point to a more general role of mutual funds as vehicles of asset price contagions.

Other works have taken a broader approach to characterize contagion channels. Calomiris, Love, and Martinez Peria (2012) examine how the collapse of global demand, the contraction of credit supply, and the selling pressure of firm equity jointly depressed non-U.S. stock prices in the 2007/08 crisis. They use a stock's free float and stock turnover as measures of asset liquidity and proxies for equity selling pressure—a weaker identification scheme than the stock exposure measure we propose in this paper. Longstaff (2010) provides complementary evidence on contagion from the ABX subprime indices to the bond market and financial stocks. Bekaert *et al.* (2012) focus on the international transmission of financial crisis and identify crisis-related risk factor changes. By contrast, the price effects we document are based on ownership characteristics of individual stocks instead of relying on the more simplified factor structure representation. Similar to Bartram, Griffin, and Ng (2012), we argue that ownership linkages are a highly important driver of stock returns, especially during a financial crisis.

Section 2 discusses the data. Section 3 describes this paper's research design and method. Section 4.1 presents evidence for the fire sale discounts along the time line of the crisis. Section 4.2 uses quantile regressions to document the asymmetric effect of fire sale discounts by stock performance quantiles. Section 4.3 presents evidence of distressed fund selling that matches the return evidence. The robustness issues related to stock selection biases and the international propagation of the crisis are examined in Section 5. Section 6 concludes.

## 2 Data

Our analysis focuses mostly on the crisis related underpricing of U.S. nonfinancial stocks (except for an extension to non-U.S. stocks in Section 5.2). Our measure of stock exposure is based on the worldwide fund holdings data from the Thomson Reuters International Mutual Fund database. The use of worldwide fund holdings is warranted because foreign funds hold a nonnegligible share of U.S. stocks. A detailed description of this database is provided in Hau and Rey (2008). They examine the fund-level home bias for years from 1997 to 2002, whereas we examine the transmission of crisis from financial stocks to nonfinancial stocks during 2007–2009. The Thomson Reuters data account for both pure equity funds and the equity holdings of balanced funds, which also hold other assets such as bonds. In the latter case, only the equity portion of the fund holdings is reported. Most international funds report only at six-month intervals—hence, the analysis related to fund holdings is carried out at a semi-annual frequency. For funds with multiple reporting dates within a semester, we retain only the last reporting date.[4]

Based on fund holdings data, we remove funds that had more than 75% of their asset holdings in financial stocks because these funds are likely to be financial sector funds. For those funds, the investment on banking stocks might be nondiscretionary, so investors might not attribute underperformance to a poor fund allocation. We therefore exclude such funds from the sample and focus on those with discretionary investment in financial stocks. We also exclude index funds and ETFs from our sample.[5] A general index selling by institutions is not likely to affect exposed stocks and nonexposed stocks differently because presumably index selling does not distinguish between these two types of nonfinancial stocks. Our final sample includes a total of $22,621$ funds reporting stock positions with a combined total net equity value of 9.7 trillion dollars as of June 2007.

We obtain the weekly and monthly global stock return data from Datastream. All return calculations are based on the total return index to account for dividend payments and capital measures. Global banking stocks are defined based on Datastream industry code 102. In order to have a cleaner measure of the crisis transmission effect from financial stocks to nonfinancial stocks, we remove banking-related industries from the sample of nonfinancial stocks. Based on the Fama and French 48 industry classification, we identify banking, insurance, real estate, and financial trading industries as banking-related industries. We use SIC codes to identify U.S. stocks in these industries. For international stocks, we use Datastream industry codes 36, 42, 46, 77, 85, 102, 106, 108, 111–113, 133, 141, 152, 160–167, and 184 to identify them. In addition, using the Compustat industry segment file we further exclude conglomerates that have more than 1% of total sales in those banking-related industries.

To account for the difference in firm characteristics among stocks, we obtain the market capitaliza-

[4] We can compare the Thomson Reuters aggregate country holding data to the ICI international fund statistics. The correlation between the holdings reported by Thomson Reuters and those reported by ICI (in logs of million dollars of equity fund assets) is 87.6% across countries. For the U.S. and Canada, the aggregate equity positions reported by Thomson Reuters differ from ICI by only -0.26% and 0.82%, respectively. To conserve space, the detailed comparison between the two databases is not tabulated but is available upon request from the authors.

[5] Because there is no index fund indicator in our fund database, we screen the names of all funds. If the word "index" or "ETF" appears in a fund's name, the fund is removed from our sample. We concede that such a keyword search may not fully purge index funds from our sample, but a general index fund selling is unlikely to explain our empirical findings.

tion and the price-to-book ratio from Datastream based on the latest data available as of June 2007. The receivables-to-sales ratio, leverage (total debt-to-asset) ratio, short-term (ST) debt-to-asset ratio, and dividend yield are obtained from the Compustat database based on the latest fiscal year-end data prior to July 2007. In addition, we calculate the Amihud illiquidity measure (Illiquidity) as the ratio of the daily absolute stock return to the dollar trading volume, averaged over July 2006 to June 2007. Panel A of Table 2 shows that the 30% most exposed, U.S. nonfinancial stocks tend to be larger and more liquid than the rest of U.S. nonfinancial stocks (i.e., nonexposed stocks). This corresponds to the general finding that fund ownership is biased toward larger and more liquid stocks; such stock characteristics should attenuate any return effect fund sales may have on exposed stocks. On average, the exposed stocks also have higher leverage but lower receivables-to-sales, price-to-book, and short-term debt-to-asset ratios than nonexposed stocks.

# 3 Research Design and Method

## 3.1 Hypotheses

The first fallout of the subprime crisis in 2007 was a substantial value loss for bank stocks. The mean return for U.S. financial stocks in the second semester of 2007 and the first semester of 2008 was a catastrophic −27.4% and −32.5%, respectively.[6] As a consequence, equity funds with large shares of ownership in financial stocks suffered a substantial negative shock to their fund performance. Such funds are likely to face stronger fund outflows after large value losses—the so-called "fund flow-performance relationship," which has been extensively documented in the literature (see, e.g., Chevalier and Ellison (1997) and Sirri and Tufano (1998)). To meet redemption requirements from investors, such equity funds might have to liquidate part of their portfolio, which in turn depreciates the equity values of the stocks they sell.[7]

We first explore whether the common fund ownership between financial stocks and nonfinancial stocks during the 2007 financial crisis represents a channel of price contagion from the former to the latter. We call this hypothesis the *Simple Fire Sale Hypothesis*. If this hypothesis holds, we expect that the subset of nonfinancial stocks linked by common fund ownership to poor performing financial

[6] See Gorton (2008) for a detailed discussion of the crisis chronology. An important public signal at the beginning of the crisis was the downgrading of mortgage backed securities by S&P and Moody's on July 10, 2007. The returns of −27.4% and −32.5% for U.S. financial stocks are calculated based on the S&P1500 Banking index from June 29, 2007 to December 28, 2007 and June 27, 2008.

[7] See also Pulvino (1998) and Coval and Stafford (2007) for related evidence that fire sales by distressed firms or equity funds produce lower asset values.

stocks would underperform during the financial crisis. Furthermore, such price contagion should lead to only temporary mispricing, so we expect the mispricing to fully revert in the long run.

Empirically, we can test this hypothesis by defining a stock exposure dummy, which marks those nonfinancial stocks that have distressed equity funds as the principal owners. Fund distress itself can be measured by the return loss experienced by a fund due to investments in financial stocks in the initial stage (the second semester of 2007 and the first semester of 2008) of the crisis. The simple fire sale hypothesis also predicts that given the initial holdings position at the onset of the crisis, the aggregate fund holdings should decrease more strongly for exposed, nonfinancial stocks than for nonexposed, nonfinancial stocks. We will subject this hypothesis to rigorous tests in Section 4.

The above hypothesis does not discriminate between the types of stocks a distressed equity fund may choose to sell. There are reasons suggesting that funds may choose to first sell better performing stocks than poorly performing stocks: First, if stock prices generally feature more pronounced deviations from fundamental values during a crisis, then a simple heuristic decision rule suggests that a fund first sells stocks with the highest realized crisis returns because other (relatively poor performing) stocks provide hope for a later price reversal. This implies that stocks in the higher performance quantiles are more likely to suffer from temporary underpricing. Second, U.S. tax law encourages mutual funds to pass on capital gains from asset sales to investors because the marginal tax rate for funds is typically higher than the rate for investors. To further minimize investors' capital gains taxes, fund managers may have an incentive to realize capital gains during the market downturn, when fund investors might have more capital losses from elsewhere to offset these gains.[8]

By contrast, the fund window dressing literature (see, e.g., O'Neal (2001), Meier and Schaumburg (2006), and Sias (2006)) argues that poor performing funds are particularly prone to conceal their poor stock picks by replacing underperforming stocks with overperforming stocks right before they report their asset holdings, suggesting that stocks in the lower performance quantiles are more likely to be sold by distressed funds. Ultimately, whether funds condition their equity sales on the crisis performance of a stock is an empirical question. Therefore, we also examine the *Stock Performance Dependent Fire Sale Hypothesis* in Section 4.

A straightforward procedure to explore this hypothesis is to measure the fire sale effect for different stock performance quantiles. We can also directly compare the decrease in fund holdings for the exposed stocks that performed relatively well and those that performed relatively poorly during the

[8] If equity fund managers suffer from a behavioral bias commonly referred to as the "disposition effect," they will also be more likely to liquidate better performing stocks than underperforming stocks. Frazzini (2006) show that such a behavioral bias exists among equity funds, particularly distressed funds.

crisis. Stock liquidity consideration also may matter for the choice of stocks for fire sales, but a fire sale preference for more liquid stocks needs not translate into a fire sale discount for more liquid stocks because those stocks are generally more price resilient. Nevertheless, we control for stock liquidity in our empirical tests.

### 3.2 Fund Exposure and Stock Exposure

We measure stock exposure in two steps. In the first step, we identify the exposure of a fund to financial stocks. Global banking stocks are defined based on Datastream industry code 102. Without loss of clarity, we use the term 'financial stocks' and 'banking stocks' interchangeably in the following discussion. Let $h^{f,s}(t)$ denote the number of shares held by fund $f$ in stock $s$ at time $t$ and $P_s(t)$ the corresponding stock price. The portfolio share of fund $f$ (for the equity components of its investments) in stock $s$ is as follows

$$w^{f,s}(t) = \frac{h^{f,s}(t)P_s(t)}{\sum_s h^{f,s}(t)P_s(t)}.$$

We calculate the financial stock-related return of fund $f$ as its value loss over a semester attributable to financial stock positions; hence

$$\overline{r}_{f,t}^{Financials} = \sum_{s \in Financials} \frac{1}{2}\left[w^{f,s}(t) + w^{f,s}(t-1)\right] r_{s,t} \quad ,$$

where $r_{s,t}$ denotes the semester stock return, and the summation involves all financial sector stocks worldwide. The average return is measured for the arithmetic midpoint between the beginning and the end of semester weights. *Fund exposure* for $f$ is defined as its return loss due to financial stock investments, and funds without any return loss are deemed to have a zero *fund exposure*. That is,

$$Exp^f(t) = \min(\overline{r}_{f,t}^{Financials}, 0).$$

Highly negative fund exposure can result from large portfolio weights for bank stocks in general and/or portfolio holdings in banks with particularly low returns. The identification of the valuation shock focuses on two semesters from July 2007 to June 2008, before the subprime crisis turned into a general financial crisis with the collapse of Lehman Brothers on September 15, 2008. The fund exposure for the second semester of 2007 is denoted by $Exp^f(2007/2)$ and for the first semester of 2008 by $Exp^f(2008/1)$. The total fund exposure, $Exp^f$, is measured by the combined return losses over the two semesters

$$Exp^f = Exp^f(2007/2) + Exp^f(2008/1).$$

The mean (median) fund exposure is $-2.64\%$ ($-2.17\%$) with a skewness of $-2.3$. The 25%, 15%, and 10% lowest fund exposure quantiles are given by $-3.94\%$, $-4.97\%$, and $-5.80\%$, respectively.

In the second step, for each nonfinancial stock $s$, we aggregate the exposure $Exp^f$ of their fund owners to an ownership-weighted measure of stock exposure. Let

$$\omega^s(f) = \frac{h^{f,s}}{\sum_f h^{f,s}}$$

denote the ownership share of fund $f$ relative to the aggregate ownership of all funds in stock $s$ in June 2007, and $Fsh^s$ denote the aggregate ownership of all funds in stock $s$ relative to the stock's market capitalization in June 2007. The exposure of a nonfinancial stock $s$ to the financial sector (via equity fund ownership) can then be defined as

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

A high *stock exposure* ($Exp^s$) implies that a relatively large proportion of a stock's capitalization is owned by equity funds with high exposure to financial stocks. Such high-exposure stocks should, therefore, face the largest selling pressure if fund exposure captures the need for fire sales by individual funds.

Summary statistics on U.S. stock exposure are reported in Table 1. The mean (median) stock exposure is $-0.27\%$ ($-0.18\%$) with a skewness of $-1.5$. The 25%, 15%, and 10% most negative stock exposure quantiles are $-0.43\%$, $-0.56\%$, and $-0.65\%$, respectively. For example, a stock exposure of $-0.43\%$ will be obtained if 10% of a stock's capitalization is owned by funds that on average lost 4.3% of their portfolio returns from financial stock investments.

The distribution of stock exposure is highly skewed and its effect on return and holding change might be nonlinear. It is therefore useful to define a dummy variable $DExp^s$ that marks all stock exposures below a certain quantile $Q(Exp^s)$, where

$$DExp^s = \begin{cases} 1 & \text{for} \quad Exp^s < Q(Exp^s) \\ 0 & \text{otherwise} \end{cases}.$$

Our empirical analysis focuses on the 30% quantile.[9] We define the 30% U.S. stocks with most negative $Exp^s$ as *exposed stocks* and the remaining 70% of stocks as *nonexposed stocks*. For expositional purpose, we can also define *exposed funds* and *nonexposed funds* analogously but based on $Exp^f$. Panel B of

[9]Using a continuous stock exposure variable in place of the exposure dummy also gives qualitatively similar results.

Table 2 shows considerable dispersion in the number of funds investing in the two types of stocks. For the subsample of exposed (nonexposed) stocks, the average number of exposed and nonexposed fund owners are, respectively, 109 and 131 (15 and 37) funds in June 2007. Such coarseness of fund ownership across stocks translates into a large dispersion of stock exposure.

### 3.3 Fund Holding Change and Aggregate Holding Change

The fund ownership data allow us to directly observe holding changes. Let $F(s)$ denote the set of funds with positive holdings in stock $s$ in June 2007. The percentage fund holding change $\Delta h$ of $f \in F(s)$ in stock $s$ over $k$ semesters (from $t$ to $t+k$) can be expressed as

$$\Delta h^{f,s}(k) = \frac{h^{f,s}(t+k) - h^{f,s}(t)}{h^{f,s}(t)} \times 100.$$

The aggregate ownership-weighted average (percentage) fund holding change for stock $s$, over $k$ semester, can then be calculated as

$$\Delta H^s(k) = \frac{\sum_{f \in F(s)} h^{f,s}(t+k) - \sum_{f \in F(s)} h^{f,s}(t)}{\sum_{f \in F(s)} h^{f,s}(t)} \times 100 = \sum_{f \in F(s)} \omega^s(f)\, \Delta h^{f,s}(k).$$

We can further define the stock capitalization scaled aggregate (percentage) holding change as

$$\Delta \widetilde{H}^s(k) = Fsh^s\, \Delta H^s(k) = Fsh^s \sum_{f \in F(s)} \omega^s(f)\, \Delta h^f(s,k),$$

where the product $Fsh^s \times \omega^s(f)$ denotes the ownership share of fund $f$ in stock $s$ relative to the total capitalization of the stock.

The aggregate fund holdings decrease over consecutive semesters for U.S. nonfinancial stocks is shown in Table 1. The average aggregate holding change for $k = 1, 2, 3, 4, 5$ is given by $-2.6\%$, $-4.8\%$, $-6.4\%$, $-7.4\%$, and $-8.8\%$, respectively. Section 4.3 explores whether this aggregate fund holding decrease is more pronounced for stocks with distressed fund owners.

### 3.4 Risk Adjustment of Returns

Our analysis of the fire sale 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 ($SMB$), the book-to-market factor ($HML$), and the momentum factor ($MOM$). The factor construction is based on monthly stock returns in U.S. dollars over the five-year period from July 2002 to June 2007 and is discussed in detail in the appendix.

We calculate the international factors of a country as the weighted-average domestic factors of all other countries, and the weights are given by the relative stock market capitalization of each country at the beginning of the year. We estimate the loadings of each stock $s$ on the domestic and international risk factors ($j = Dom, Int$) using a regression over 60 months, from July 2002 to June 2007, as follows

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

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. Untabulated results show that all eight factors have nonnegligible explanatory power for the cross-section of returns. This is consistent with the recent evidence by Eun et al. (2010), Hou, Karolyi, and Kho (2011), and Karolyi and Wu (2012) on the importance of both local and global factors in stock returns.

With the estimated factor loadings $\widehat{\beta}_{i,j,s}$, the expected return for stock $s$ in month $t$ during the crisis period, July 2007–December 2009, can be calculated as

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

We can then calculate the cumulative expected return over $q$ weeks (since month $t$) as follows

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

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

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

The cumulative risk-adjusted excess return of stock $s$ over $k$ semesters (or $6 \times k$ months) can be calculated in a similar manner as

$$r_s^{Ex}(k) = \prod_{i=1}^{6\times k} (1 + r_{s,t+i}) - \prod_{i=1}^{6\times k} (1 + er_{s,t+i}).$$

The summary statistics for cumulative risk-adjusted returns of all U.S. nonfinancial stocks are stated in Table 1. The standard deviation of cumulative excess returns increases from 0.607 to 1.483 as the return horizon under consideration increases from one semester (December 2007) to three semesters (December 2008). The cumulative excess return dispersion decreases thereafter to 1.112 and 1.065, respectively, as we consider returns extending until June 2009 and December 2009. This reveals some degree of excess return reversal for nonfinancial stocks in 2009.

# 4 Evidence

## 4.1 Stock Exposure Effects on the Crisis Time Line

Did losses in financial stock investment by a fund affect the performance of other stocks (or nonfinancial stocks) held by the same fund? A simple OLS regression of the risk-adjusted returns $r_s^{Ex}(k)$ over $k$ semesters of all nonfinancial stocks on the dummy variable $DExp^s$ can reveal the role of distressed fund owners in the crisis performance of a stock:

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

The dummy variable $DExp^s$ denotes the 30% U.S. nonfinancial stocks with the highest distressed fund ownership. Similarly, we define a dummy $DFsh^s$ for the 30% U.S. nonfinancial stocks with the highest overall fund ownership relative to the stock capitalization in June 2007. If common fund owners facilitate the transmission of crisis from financial stocks to nonfinancial stocks, we should observe $\alpha_1^k < 0$. The variable $DFsh^s$ serves as a control variable because higher overall fund ownership allows for more exposure to distressed funds. The regression discards the 1% highest and lowest return outliers. We include industry fixed effects in the regression. The coefficient $\alpha_1^k$ therefore captures risk-adjusted fire sale discounts over $k$ semesters for the 30% most exposed, nonfinancial stocks relative to other nonfinancial stocks in the same industry.

Table 3 reports the regression results for U.S. stocks. Column 1 is for the return period from July 1, 2007 to December 31, 2007, in which the stock exposure dummy $DExp^s(2007/2)$ is based on contemporaneous fund return losses in the second semester of 2007. The exposure dummy reveals an underperformance of −11.6% after one semester in December 2007, −15.3% after two semesters in June 2008, and −20.6% after three semesters in December 2008. For June 2009 (after four semesters) we find a reversal of the discount to −9.6%, and by December 2009 (after five semesters) the discount is no longer significantly different from zero. The high fund-ownership dummy $DFsh^s$ shows a significantly positive coefficient, suggesting that stocks with high overall fund ownership experience better crisis performance.[10]

[10] Suppose retail investors who manage their own investment capital directly have a higher propensity for panic sales during the crisis than institutional investors or investors who delegate investment decisions to portfolio managers. Then,

Figure 1 plot the coefficient for the exposure dummy $DExp^s$ and a confidence interval (of $\pm 1$ standard deviation) using cumulative risk-adjusted returns with weekly return increments. The regressions after 26, 52, 78, 104, 156 weeks coincide with regressions after $k = 1, 2, 3, 4, 5$ semesters. The corresponding dates for the five end-of-semester regressions are highlighted by dashed vertical lines. The fire sale effect shows negative twin peaks around November 7, 2008, and February 27, 2009, with an average return shortfall of $-31.5\%$ and $-40.9\%$, respectively, for exposed stocks. The estimation results for the twin peaks are reported in the last two columns of Table 3.

Could the differences in firm characteristics between exposed and nonexposed stocks explain our findings? Firms with a higher receivables-to-sales ratio can be more adversely affected by the liquidity crunch experienced by the commercial paper market during the crisis. A high price-to-book, leverage, or short-term debt-to-asset ratio can indicate the vulnerability of a firm during the crisis due to a higher default risk. Firms with a higher dividend yield may experience a higher before-tax stock return. A higher stock illiquidity can amplify the fund sale effect. We therefore include these stock characteristics as additional controls. The results, reported in Table 4, suggest that the receivables-to-sales ratio, price-to-book ratio, leverage, and dividend yield show no reliable evidence of explanatory power for the cross-section of cumulative stock returns. Not surprisingly, higher stock illiquidity and short-term debt-to-asset ratios are associated with more negative crisis returns. However, controlling for these firm characteristics has no qualitative effect on the results reported in Table 3. Therefore, stock liquidity and corporate liquidity problems do not account for the fire sale effect measured by the stock exposure dummy.[11]

Could any omitted firm characteristics that are common between financial stocks and exposed, nonfinancial stocks explain our findings? As discussed in the data section, we try to eliminate such a possibility by removing banking-related industries from our sample of nonfinancial stocks. We also exclude conglomerates that have more than 1% of total sales in those banking-related industries. In addition, we provide further evidence against such an explanation in the next subsection. Specifically, any common omitted firm characteristics between financial and nonfinancial stocks would imply the greatest price discounts among the worst-performing nonfinancial stocks (due to their shared firm characteristics with financial stocks), inconsistent with the evidence we present in the next subsection.

Overall, our results highlight that crisis propagation through fund exposure played a quantitatively

stocks with a higher overall fund ownership will perform relatively better than other stocks. However, this remains a conjecture, and more research is needed on this intriguing issue.

[11] We also test whether time-changing risk premia and factor loadings can explain our findings. Specifically, we include stock betas as additional control variables in the cumulative return regressions of Table 3. We find that such a more extended specification does not qualitatively alter our regression results.

important role for the overall index decline during 2007/09. An incremental return shortfall of 40.9% for the 30% exposed stocks implies an aggregate effect of 10% (= 40.9% × 30% × 80%) value decline for an equally weighted U.S. stock index.[12] Considering the fact that exposed stocks are on average larger than nonexposed stocks, the contribution of this effect to the decline of the overall U.S. stock market index (which is value-weighted) is likely to be at least as large. It is therefore not surprising that the maximum fire sale effects identified above are close to the two weekly U.S. stock index minima on November 7, 2008 and March 6, 2009.

## 4.2 Stock Exposure Effects by Stock Performance Quantile

Discretionary liquidation of stock positions by distressed funds implies a *Stock Performance Dependent Fire Sale Hypothesis*. We therefore estimate regressions for the 25%, 50%, 75%, and 90% quantiles of the cumulative excess return distribution as a linear function of the stock exposure dummy $DExp^s$. We use November 7, 2008 and February 27, 2009 as the reference dates for the cumulative returns because they represent the twin peaks of the fire sale discounts as shown in Figure 1. The regressions controls for the fund ownership dummy $DFsh^s$ and industry fixed effects as before. In addition, we control for stock liquidity proxied by either $DLiq^s$ (a dummy for the 30% most liquid U.S. stocks based on the Amihud illiquidity measure) or $LnSize^s$ (the natural logarithm of firm size). Table 5 reports the regression results. When controlling for both liquidity proxies in February 2009, the coefficient of the stock exposure dummy decreases from −3.8% and −7.7% for the 25% and 50% quantiles to −32.5% and −80.8% for the 75% and 90% quantiles, respectively. A similar pattern is observed for the earlier crisis peak in November 2008. Therefore, the stock exposure measure has an extremely asymmetric effect on the distribution of cumulative stock returns, with the most negative impact found for the best performing stocks. The result suggests that when faced with funding constraints and investor redemption requirements, distressed equity funds first liquidated the best performing stocks rather than stocks with recent large capital losses.

Figure 2 graphically illustrates how the fire sale effect of exposed stocks increases with their return quantiles in February 2009. Specifically, we repeat the quantile regressions for U.S. stocks over the entire range of quantiles from 0.05 to 0.95. Panel A plots for each quantile the fixed effect $\alpha_0^k$, which captures the return performance for nonexposed stocks (blue line) and the corresponding fixed effect $\alpha_0^k + \alpha_1^k$ for exposed stocks (red line). Panel B plots $\alpha_1^k$, which represents the quantile-specific cumulative return wedge between exposed and nonexposed stocks due to fire sale discounts. The graph

[12] U.S. nonfinancial stocks accounted for around 80% of the U.S. stock market in June 2007.

clearly shows that the discount effect of stock exposure is concentrated among the best performing stocks in the right tail of the cumulative return distribution.

### 4.3 Fund Redemptions and Fund Holding Changes

When facing liquidity constraints or anticipating investor redemption, exposed equity funds were likely to engage in fire sales. We denote by $\Delta\widetilde{H}^s(k)$ the (percentage) aggregate holding change in stock $s$ over $k$ semesters of all funds with initial positions in June 2007. Analogous to the return regression, the holding change is related to the dummy variables $DExp^s$ and $DFsh^s$. The 1% of smallest and largest holding changes are discarded from the linear regression given by

$$\Delta\widetilde{H}^s(k) = \beta_0^k + \beta_1^k DExp^s + \beta_2^k DFsh^s + \nu_s.$$

The fire sale hypothesis implies $\beta_1^k < 0$ because exposed stocks should show a faster holding decline for the initial owners in June 2007. To test for the Stock Performance Dependent Fire Sale Hypothesis, we extend the above specification by a dummy variable $DHighR^s$, marking all U.S. stocks in the 30% quantile with the highest cumulative return over the $k$ semesters since June 2007. A second dummy $DExp^s \times DHighR^s$ is defined as the product of the stock exposure dummy $DExp^s$ and the high-return dummy $DHighR^s$. The extended specification becomes

$$\Delta\widetilde{H}^s(k) = \beta_0^k + \beta_1^k DExp^s + \beta_2^k DFsh^s + \beta_3^k DHighR^s + \beta_4^k (DExp^s \times DHighR^s) + \nu_s,$$

where the interaction term captures incrementally larger holding reduction for those exposed stocks that do relatively well during the crisis. More pronounced position liquidations in these stocks imply $\beta_4^k < 0$.

Table 6 provides the regression results for U.S. stocks. For each incremental semester, we first report the baseline specification and then the extended specification. Exposed stocks (with $DExp^s = 1$) show an accelerated decrease in the aggregate holdings by funds that are initial owners in June 2007. The additional cumulative decrease amounts to $-0.85\%$, $-1.61\%$, $-2.16\%$, and $-2.70\%$ over a period of $k = 1, 2, 3, 4$ semesters, respectively. Compared to the average holding decreases of $-2.56\%$, $-4.78\%$, $-6.40\%$, and $-7.40\%$ (reported in Table 1), these figures reveal approximately 35% more net fund selling for the 30% most exposed stocks than for an average stock.

The dummy interaction term $DExp^s \times DHighR^s$ is statistically significant and shows that exposed stocks with good crisis performance had more dramatic holding reductions. The incremental holding decrease captured by the coefficient $\beta_4^k$ is $-0.34\%$, $-0.92\%$, $-1.23\%$, and $-1.33\%$ relative to $-0.84\%$, $-1.45\%$, $-1.77\%$, and $-2.16\%$ measured by the coefficient $\beta_1^k$. The ratio of $-1.33\%$ to $-2.16\%$ suggests a 60% greater decrease of exposed stock holdings if the stock was among the 30% best performing stocks. This finding matches the return evidence from the quantile regressions in Table 5 and supports the Stock Performance Dependent Fire Sale Hypothesis.

In order to provide some fund redemption evidence, we match the Thomson Reuters International Fund database (which does not have any fund flow data) to the Lipper fund database, and the analysis here is based on the 8,250 funds for which we could find a match. Based on the fund return and fund net asset value (TNA) data from Lipper, we estimate a fund's monthly net dollar flow by its TNA at the end of the month minus the product of its TNA at the beginning of the month and one plus the contemporaneous fund return. We then calculate a fund's cumulative net fund flow as its cumulative dollar flow since July 2007 relative to its asset holdings in June 2007. We excluded the 1% of funds with extreme monthly cumulative net flows because of concerns about reporting errors.

Figure 3 plots the average cumulative net flow from July 2007 to December 2009 separately for exposed and nonexposed funds. Exposed funds started to experience net investor outflows after July 2007, which accumulated to a sizeable average fund outflow of about 8% in November 2008. By contrast, for nonexposed funds the average net cumulative inflow remains positive over the full 30-month period.

Figure 4 compares the distribution of cumulative holding changes $\Delta\widetilde{H}^s(4)$, from July 2007 to June 2009, between exposed and nonexposed U.S. nonfinancial stocks. Exposed stocks feature a much larger left tail distribution, indicating that large aggregate holding reductions were much more frequent for these stocks. Such drastic holding reductions by distressed funds are in line with the results reported in Figure 3. Redemption pressure faced by distressed (or exposed) funds appears to translate into selling pressure for exposed stocks. The holdings evidence here is also consistent with our earlier finding that the crisis returns of exposed stocks were much more negative than the returns of nonexposed stocks in the same industry.

# 5 Robustness and Extension

## 5.1 Stock Selection Biases

Our research design assumes that the ownership concentration of distressed (or exposed) funds in any nonfinancial stock corresponds to a random treatment effect. The underlying assumption is that the nonfinancial stock picks are not systematically different between exposed and nonexposed funds in terms of the expected stock returns. Hence, concentrated ownership of exposed funds in any nonfinancial stock becomes a 'quasi random' coincidence, which does not feature any performance bias other than the fire sale effect.

To verify this assumption, we first examine whether the exposed, nonfinancial stocks feature any abnormal returns prior to the crisis relative to the nonexposed, nonfinancial stocks. Such abnormal returns can indicate omitted risk factors. Following Fama and French (2010), we form an equal-weighted portfolio and a value-weighted portfolio, separately for the two types of U.S. stocks each month from January 2002 to December 2006. We then test for their differences in risk-adjusted returns, allowing the risk factor loadings to differ across the two types of stocks. Table 8, Panel A shows that the abnormal return differences between exposed and nonexposed stocks are insignificant after controlling for the standard risk factors in the literature (i.e., the market, size, book-to-market, and momentum factors). Using a similar approach, we also form value- and equal-weighted portfolios of the nonfinancial stock holdings of, separately, exposed funds and nonexposed funds.[13] Panel B of the table again shows that the risk-adjusted return differences between the nonfinancial holdings of the two types of funds are insignificant. The overall result suggests that exposed stocks were not priced according to any omitted risk factor.

We can also examine the similarity of stock portfolios held by different types of funds. Formally, for any pair of funds $(f_1, f_2)$, we define their portfolio overlap (in nonfinancial sector stocks) as the minimum common portfolio weight in any stock $s$, summed across all nonfinancial sector stocks that both funds share; that is

$$Overlap(f_1, f_2) = \sum_{s \,\in\, Nonfinancials} \min[\widehat{w}^{f_1,s}, \widehat{w}^{f_2,s}],$$

where $\widehat{w}^{f_1,s}$ and $\widehat{w}^{f_2,s}$ represent the portfolio weight of nonfinancial stock $s$ in funds $f_1$ and $f_2$, respectively. We examine such portfolio overlap for the 10% most distressed funds (i.e., funds with the greatest investment loss from financial stocks over the period July 2007–June 2008). We label this group of funds as Group A. We then match this group of funds with the same number of other funds based on their country codes and the size of their total asset holdings in nonfinancial stocks. The group of matched funds is labeled as Group B. The portfolio overlap statistic is then calculated for (i) pairs of funds in Group A, (ii) pair of funds in Group B, and (ii) pairs of one fund from Group A and one fund from Group B, based on fund holdings in December 2006.

[13] Specifically, we use a fund's nonfinancial stock holdings at the beginning of the semester to estimate the fund's monthly portfolio returns in the subsequent six months. The returns of the equal- and asset value-weighted portfolios of exposed funds and of nonexposed funds are then calculated each month from January 2002 to December 2006.

Figure 5 plots the distributions of the three portfolio overlap measures sorted by quantiles. All three overlap measures show considerable independence of stock picks across funds. The average overlap for funds in Group A is 2.9%, compared to 2.5% for funds in Group B and 2.4% for the cross-group pairs. The similarity in stock selections appears to be economically small for all three groups. In particular, any two funds differ on average in 97% of stock picks, suggesting a limited scope of clustering on stocks with particular unobserved risk factors. Furthermore, the evidence on the full long-run price reversal of exposed, nonfinancial stocks that we present in Figure 1 and Table 3 is another piece of evidence that the distressed equity funds on average did not pick a 'below average' portfolio of nonfinancial stocks. Therefore, the underperformance of exposed nonfinancial stocks during the crisis cannot be explained by the poor nonfinancial stock pick of their distressed fund owners.

## 5.2 International Propagation

International stock ownership allows for better global asset diversification but may also create channels for crisis propagation beyond the U.S. borders. Our analysis so far examined ownership-related underpricing only for U.S. nonfinancial stocks. Yet it is interesting to extend the analysis to nonfinancial stocks outside the U.S. as well.

The larger role of mutual funds in the U.S. stock market suggests that stock exposure through distressed funds is likely to be more widespread and pronounced in the U.S. than in other countries. Figure 6 plots the stock exposure distribution separately for the $4,663$ U.S. stocks (Panel A), $11,646$ developed market stocks ex U.S. stocks (Panel B), and $5,407$ emerging market stocks (Panel C). As expected, the tail of the stock exposure distribution is fatter for U.S. stocks compared to other developed market or emerging market stocks. Nevertheless, both developed and emerging markets feature a sizable left tail of exposed stocks, for which we can again define a dummy ($DExp^s$) marking the 30% most exposed stocks for each country. The cross-country average exposure among these 30% most exposed stocks is $-0.46\%$ and $-0.30\%$ for, respectively, developed market stocks ex U.S. and emerging market stocks, compared to $-0.63\%$ in the corresponding U.S. stock sample.[14]

Table 8 reports the international evidence for all non-U.S. stocks (Panel A), developed market stocks ex U.S. (Panel B), and emerging market stocks (Panel C). Around the first peak of the crisis (Nov. 7, 2008), the additional underpricing for the 30% most exposed non-U.S. stocks amounts to 16.8% compared to 31.5% for U.S. stocks. The corresponding relative underpricing for emerging market stocks is 15.7%. International fund ownership linkages therefore played an economically significant

[14] Our international sample of nonfinancial stocks spreads across 22 developed markets and 18 emerging markets.

role in the international transmission of the U.S. mortgage market crisis. We conjecture that the gradually decreasing equity home bias and the globalization of the equity fund industry are likely to make this international transmission mechanism even more potent in the future.

## 6 Conclusions

Open-end mutual funds have increased their share of the U.S. market capitalization from 4.6% in 1980 to 21.5% in 2007 (French, 2008, p.1539) and have thus become a key institution in equity markets. Our evidence shows that they played an important role in the transmission of the 2007/08 crisis from financial stocks to nonfinancial stocks, resulting in very large temporary price discounts for many nonfinancial stocks.

Our identification scheme is based on equity funds' return shortfall induced by financial sector positions between July 2007 and June 2008. This initial phase of the financial crisis is marked by dramatic value losses of many bank stocks and the corresponding underperformance of the mutual funds that invest in them. We then study the price externality of such investment losses in financial sector stocks for the pricing of nonfinancial stocks. For each nonfinancial stock, we aggregate its fund owners' return losses from financial stock investment. This aggregation results in a measure that captures the financial distress of the nonfinancial stock's fund owners and therefore the selling pressure faced by the stock.

The analysis carefully controls for real linkages between the banking sector and various industries by excluding banking-related industries as well as conglomerates that have more than 1% of total sales in these banking-related industries from our sample of nonfinancial stocks. Our findings are also robust to the control of various firm characteristics, including the Amihud illiquidity measure, receivables-to-sales ratio, price-to-book ratio, leverage ratio, short-term debt-to-asset ratio, and dividend yield, as well as industry fixed effects. An analysis of the 30% most exposed, U.S. nonfinancial stocks reveals their dramatic risk-adjusted underperformance. Their relative stock underpricing peaked at 40.9% in late February 2009, which is strong evidence that "distressed funds" played an important role in deepening the stock market downturn. Our analysis shows that some 10% of the 53% crisis-related U.S. stock market index decline can be attributed to distress selling by mutual funds.

Our findings cannot be explained by any common omitted firm characteristics between financial and nonfinancial stocks because such an explanation would imply the greatest price discounts among the worst-performing nonfinancial stocks. However, we find that the selling pressure is greatest for stocks that perform relatively well during the crisis—suggesting that funds seek to avoid large loss realization from selling the most depressed stocks. We also find that fund ownership played an important role for the international transmission of the stock market downturn even though magnitudes here are smaller because of weaker ownership exposure links. Specifically, exposed nonfinancial stocks underperform nonexposed industry peers by about 26% and 18% at the crisis peak for other developed markets ex U.S. and emerging markets, respectively. Overall, we conclude that the fund ownership structure at the outset of the crisis in June 2007 had an astonishingly large effect on the crisis performance of individual stocks and stock groups.

# Appendix

This appendix describes the construction of the risk factors. They are based on monthly stock returns in U.S. dollars from Datastream over the five-year period from July 2002 to June 2007. We exclude non-common stocks such as REITs, closed-end funds, warrants, etc. We also exclude those firms that are incorporated outside their home countries, as well as those indicated by Datastream as duplicates. To filter out the recording errors in Datastream, we assign missing values to $R_t$ and $R_{t-1}$ if $(1 + R_t)(1 + R_{t-1}) < 0.5$ and at least one of them is greater than or equal to 300%. $R_t$ is the stock return in month $t$. For weekly and daily data, we use 200% as the cut-off instead. In addition, in view of Datastream's practice to set the return index to a constant once a stock ceases trading, we treat those constant values as missing values in the inactive file.

In the first step, we determine domestic factors for each country. The domestic market factor is given by the excess return in U.S. dollars of the country's equity index return over the U.S. Treasury Bill rate. We calculate country index returns using the MSCI country market indices obtained from Datastream. For the size and book-to-market factors we follow a methodology similar to Fama and French (1993). All stocks reporting a market capitalization at the end of June and a positive book-to-market ratio are double sorted into two size groups and three book-to-market classifications. Half the stocks are classified as large-cap ($B$) and the other half as small-cap ($S$). For the book-to-market classification, the bottom 30% of firms are classified as $L$, the middle 40% as $M$, and the highest 30% as $H$. The intersection of the rankings allows for six value-weighted portfolios: $HB$, $MB$, $LB$, $HS$, $MS$, and $LS$. Formally, we define

$$SMB = \frac{1}{3}(HS + MS + LS) - \frac{1}{3}(HB + MB + LB)$$
$$HML = \frac{1}{2}(HB + HS) - \frac{1}{2}(LB + LS).$$

The monthly returns for $SMB$ and $HML$ are then calculated from July in one year to June in the next. The momentum factor ($MOM$) is constructed on a monthly basis. We rank stocks at the end of month $t-1$ based on their cumulative returns from $t-13$ to $t-2$ (i.e., prior 2–12 month returns by skipping month $t-1$) and market value at the end of $t-1$. Stock inclusion in the portfolio construction requires nonmissing values for the cumulative return and market value. For the market-cap classification, half of the stocks are again classified as large-cap ($B$) and the other half as small-cap ($S$). For the past returns classification, the bottom 30% are classified as $LR$ (low return), the middle

40% as $MR$, and the highest 30% as $HR$. The momentum factor is defined as

$$MOM = \frac{1}{2}(SHR + BHR) - \frac{1}{2}(SLR + BLR).$$

For the U.S. factors, we use the data posted on Kenneth R. French's website. If a country has fewer than 50 stocks qualifying for the portfolio construction, we set $SMB$, $HML$, and $MOM$ factors as missing for the respective year.

In the second step, we calculate a country's international factors as the weighted average domestic factors of all other countries. The weights are given by the relative stock market capitalization of each country at the beginning of the year. The stock market capitalization data is obtained from the World Development Indicator. A complete sample of domestic and international factors by country over the period 1981 to 2010 is available at www.sandylai-research.com.

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Table 1: Summary Statistics on Regression Variables

Reported are the summary statistics for all U.S. nonfinancial stocks. Fund exposure, $Exp^f$, is measured by the return loss of a fund due to investment in financial stocks over the one-year period from July 1, 2007 to June 30, 2008. Stock exposure, $Exp^s$, measures the ownership-weighted average exposure of all funds owning the stock. The dummy variable $DExp^s$ marks with 1 the 30% of U.S. stocks with the highest stock exposure. We also define a separate measure of stock exposure $Exp^s(2007/2)$ and the corresponding dummy variable $DExp^s(2007/2)$, which take into account fund losses in financial stocks for only the second semester of 2007. Fund share, $Fsh^s$, denotes the aggregate ownership of all funds in stock $s$ relative to the stock's market capitalization in June 2007. The dummy variable $DFsh^s$ marks with 1 the 30% of U.S. stocks with the largest fund share. Cumulative risk-adjusted returns, $r_s^{Ex}(k)$, denote the return from July 1, 2007, to the stated month or $k$ semesters later. The risk adjustment is based on an eight-factor international asset pricing model with factor loadings estimated for the five-year pre-crisis period, July 2002–June 2007. Percentage change in aggregate fund holdings $\Delta\widetilde{H}^s(k)$ denotes the aggregate change (over $k$ semesters) of all fund positions in stock $s$ relative to the aggregate positions in June 2007, multiplied by 100.

| Variable | Obs. | Mean | Median | STD | Min | Max |
|---|---|---|---|---|---|---|
| Fund Exposure Measure | | | | | | |
| $Exp^f$ | 22,621 | −0.026 | −0.022 | 0.027 | −0.455 | 0.000 |
| Stock Exposure Measures | | | | | | |
| $Exp^s(2007/2) \times 100$ | 4,663 | −0.116 | −0.076 | 0.128 | −0.975 | 0.000 |
| $Exp^s \times 100$ | 4,663 | −0.268 | −0.183 | 0.292 | −2.485 | 0.000 |
| $DExp^s(2007/2)$ | 4,663 | 0.300 | 0.000 | 0.458 | 0.000 | 1.000 |
| $DExp^s$ | 4,663 | 0.300 | 0.000 | 0.458 | 0.000 | 1.000 |
| Fund Share Measures | | | | | | |
| $Fsh^s$ | 4,663 | 0.171 | 0.140 | 0.156 | 0.000 | 0.882 |
| $DFsh^s$ | 4,663 | 0.300 | 0.000 | 0.458 | 0.000 | 1.000 |
| Cumulative Risk-Adjusted Stock Returns | | | | | | |
| $r_s^{Ex}(1)$ (Dec. 2007) | 3,691 | 0.080 | −0.029 | 0.607 | −0.822 | 3.246 |
| $r_s^{Ex}(2)$ (June 2008) | 3,599 | 0.085 | −0.087 | 0.839 | −0.934 | 5.100 |
| $r_s^{Ex}(3)$ (Dec. 2008) | 3,497 | 0.107 | −0.265 | 1.483 | −0.993 | 14.211 |
| $r_s^{Ex}(4)$ (June 2009) | 3,389 | −0.017 | −0.296 | 1.112 | −0.992 | 8.349 |
| $r_s^{Ex}(5)$ (Dec. 2009) | 3,179 | −0.070 | −0.327 | 1.065 | −0.996 | 9.329 |
| $r_s^{Ex}$ (Nov. 7, 2008) | 3,449 | 0.302 | −0.141 | 1.801 | −0.987 | 16.381 |
| $r_s^{Ex}$ (Feb. 27, 2009) | 3,411 | 0.378 | −0.226 | 2.285 | −0.994 | 22.411 |
| Percentage Change in Aggregate Fund Holdings | | | | | | |
| $\Delta\widetilde{H}^s(1)$ (Dec. 2007) | 4,203 | −2.563 | −1.042 | 4.212 | −24.003 | 5.229 |
| $\Delta\widetilde{H}^s(2)$ (June 2008) | 4,221 | −4.786 | −2.528 | 6.401 | −33.187 | 5.681 |
| $\Delta\widetilde{H}^s(3)$ (Dec. 2008) | 4,177 | −6.400 | −3.801 | 7.715 | −36.681 | 5.258 |
| $\Delta\widetilde{H}^s(4)$ (June 2009) | 4,170 | −7.406 | −4.745 | 8.500 | −38.425 | 5.621 |
| $\Delta\widetilde{H}^s(5)$ (Dec. 2009) | 4,119 | −8.845 | −6.738 | 8.903 | −39.999 | 3.879 |

Table 2: Differences between Exposed and Nonexposed Stocks

Exposed stocks are the 30% of U.S. nonfinancial stocks with fund owners experiencing the largest return losses due to investments in financial stocks over the one-year period from July 2007 to June 2008, and nonexposed stocks are the remaining 70% of stocks. Panel A reports the mean and median of exposed and nonexposed stocks for stock capitalization in the natural logarithm of U.S. dollars (LnSize), Amihud illiquidity measure (Illiquidity), the price-to-book ratio, the receivables-to-sales ratio, leverage (or the total debt-to-asset ratio), the short-term (ST) debt-to-asset ratio, and dividend yield. The market capitalization and the price-to-book ratio are based on the data in June 2007 from Datastream. The receivables-to-sales ratio, leverage, the short-term (ST) debt-to-asset ratio, and dividend yield are based on the latest fiscal year-end data prior to July 2007 obtained from the Compustat database. Panel B reports the distribution of the number of funds holding an exposed stock (Columns 1–3) and a nonexposed stock (Columns 4–6) in June 2007. We distinguish between exposed and nonexposed fund owners. Fund exposure is measured by the return loss of a fund due to ownership in financial stocks over the one-year period from July 2007 to June 2008. The 30% of funds with the largest exposure to the financial sector are marked as exposed funds and the remaining 70% as nonexposed funds.

| Panel A: Firm Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| | Exposed Stocks | | | Nonexposed Stocks | | |
| Variable | Obs. | Mean | Median | Obs. | Mean | Median |
| LnSize | 1,399 | 21.238 | 21.120 | 3,264 | 18.553 | 18.709 |
| Illiquidity | 1,350 | 0.037 | 0.001 | 2,392 | 0.890 | 0.034 |
| Receivables-to-Sales | 1,340 | 0.159 | 0.149 | 2,143 | 0.203 | 0.154 |
| Price-to-Book | 1,345 | 3.063 | 2.326 | 2,539 | 3.890 | 2.659 |
| Leverage | 1,350 | 0.212 | 0.196 | 2,183 | 0.168 | 0.082 |
| ST Debt-to-Assets | 1,365 | 0.027 | 0.005 | 2,225 | 0.031 | 0.003 |
| Dividend Yield | 1,367 | 0.010 | 0.000 | 2,259 | 0.009 | 0.000 |

| Panel B: Fund Ownership Distribution | | | | | | |
|---|---|---|---|---|---|---|
| | Exposed Stocks | | | Non-Exposed Stocks | | |
| | All Fund Owners | Exp. Fund Owners | Non-Exp. Fund Owners | All Fund Owners | Exp. Fund Owners | Non-Exp. Fund Owners |
| Percentile | | | | | | |
| p1 | 11 | 5 | 6 | 1 | 0 | 0 |
| p5 | 41 | 15 | 22 | 1 | 0 | 1 |
| p10 | 71 | 22 | 44 | 1 | 0 | 1 |
| p25 | 126 | 42 | 77 | 5 | 1 | 3 |
| p50 | 189 | 64 | 116 | 21 | 7 | 13 |
| p75 | 297 | 118 | 163 | 68 | 18 | 49 |
| p90 | 476 | 272 | 230 | 138 | 37 | 100 |
| p95 | 616 | 348 | 285 | 199 | 52 | 150 |
| p99 | 996 | 561 | 475 | 397 | 181 | 259 |
| N | 1,394 | 1,394 | 1,394 | 2,796 | 2,796 | 2,796 |
| Mean | 241 | 109 | 131 | 52 | 15 | 37 |
| SD | 191.1 | 115.3 | 90.7 | 80.2 | 28.6 | 55.9 |

Table 3: OLS Regressions for Cumulative Stock Returns

The cumulative risk-adjusted stock returns (starting from July 1, 2007) over one to five consecutive semesters are regressed on two dummy variables. The dummy variable $DExp^s$ marks with 1 the 30% of U.S. stocks with fund owners most exposed to financial stocks. A fund owner's exposure is measured by its return loss in financial stocks from July 1, 2007 to June 30, 2008. In the first regression (Column 1), the contemporaneous stock exposure dummy $DExp^s(2007/2)$ takes into account fund owners' return loss in financial stocks for only the second semester of 2007. The dummy variable $DFsh^s$ marks with 1 the 30% of U.S. stocks with the largest overall fund ownership in June 2007. The last two columns regress the cumulative weekly stock returns from June 29, 2007 to the twin peaks of the crisis (November 7, 2008 and February 27, 2009) on the two dummy variables. All regressions include industry fixed effects. The $t$-values based on robust standard errors are reported in brackets.

| | Cumulative Risk-Adjusted Returns (by) | | | | | | |
|---|---|---|---|---|---|---|---|
| | End of Semester | | | | | Peak of Crisis | |
| | Dec. 2007 | June 2008 | Dec. 2008 | June 2009 | Dec. 2009 | Nov. 7, 2008 | Feb. 29, 2009 |
| $DExp^s(2007/2)$ | −0.116 | | | | | | |
| | [−5.02] | | | | | | |
| $DExp^s$ | | −0.153 | −0.206 | −0.096 | −0.033 | −0.315 | −0.409 |
| | | [−4.25] | [−3.48] | [−1.96] | [−0.73] | [−4.44] | [−4.19] |
| $DFsh^s$ | 0.100 | 0.209 | 0.205 | 0.227 | 0.230 | 0.120 | 0.269 |
| | [4.13] | [5.59] | [3.29] | [4.56] | [4.78] | [1.61] | [2.73] |
| *Obs.* | 3,691 | 3,599 | 3,497 | 3,389 | 3,179 | 3,449 | 3,411 |
| $Adj.R^2$ | 0.023 | 0.053 | 0.013 | 0.032 | 0.035 | 0.011 | 0.023 |

Table 4: Robustness of Cumulative Stock Returns Evidence

This table repeats the baseline results in Table 3 with additional controls for various firm characteristics, including the Amihud illiquidity measure (Illiquidity), the receivables-to-sales ratio, the price-to-book ratio, leverage (the total debt-to-asset ratio), the short-term (ST) debt-to-asset ratio, and dividend yield, measured based on the latest fiscal year-end data prior to July 2007.

| | Cumulative Risk-Adjusted Returns (by) | | | | |
|---|---|---|---|---|---|
| | Dec. 2007 | June 2008 | Dec. 2008 | June 2009 | Dec. 2009 |
| $DExp^s(2007/2)$ | −0.091 | | | | |
| | [−3.66] | | | | |
| $DExp^s$ | | −0.145 | −0.183 | −0.073 | −0.010 |
| | | [−3.81] | [−2.90] | [−1.44] | [−0.20] |
| $DFsh^s$ | 0.087 | 0.179 | 0.201 | 0.233 | 0.235 |
| | [3.44] | [4.63] | [3.08] | [4.49] | [4.66] |
| Illiquidity | 0.002 | 0.002 | −0.004 | −0.010 | −0.006 |
| | [0.30] | [0.44] | [−0.50] | [−2.88] | [−1.35] |
| Receivables-to-Sales | 0.000 | 0.001 | 0.002 | 0.001 | 0.005 |
| | [0.27] | [0.46] | [0.77] | [0.22] | [2.35] |
| Price-to-Book | 0.000 | 0.000 | 0.001 | 0.003 | 0.000 |
| | [1.44] | [0.27] | [1.65] | [3.38] | [1.03] |
| Leverage | 0.171 | 0.278 | −0.305 | −0.288 | −0.211 |
| | [2.18] | [2.39] | [−1.83] | [−2.05] | [−1.65] |
| ST Debt-to-Asset | −0.314 | −0.534 | −0.884 | −0.359 | −0.769 |
| | [−1.46] | [−1.98] | [−2.14] | [−0.91] | [−2.65] |
| Dividend Yield | −0.225 | −0.390 | −0.503 | −0.081 | 0.024 |
| | [−0.87] | [−1.30] | [−2.07] | [−0.36] | [0.12] |
| *Obs.* | 2,783 | 2,711 | 2,643 | 2,591 | 2,495 |
| $Adj.R^2$ | 0.041 | 0.091 | 0.035 | 0.063 | 0.083 |

Table 5: Quintile Cumulative Stock Return Regressions with Liquidity Controls

Reported are quantile regressions for the cumulative (weekly) U.S. stock returns starting from June 29, 2007 to November 7, 2008 and February 27, 2009. The dummy variable $DExp^s$ (marking the 30% of U.S. stocks with the highest exposure to distressed funds) and the dummy variable $DFsh^s$ (marking the 30% of U.S. stocks with the highest overall fund ownership) are the same as those defined in Table 1. The dummy variable $DLiq^s$ marks the 30% most liquid U.S. stocks, based on the Amihud illiquidity measure. $LnSize^s$ is the natural logarithm of stock capitalization value. The explanatory power of the regression is reported for the 25%, 50%, 75%, and 90% quantiles of the cumulative stock returns. All regressions include industry fixed effects. The $t$-values based on bootstrapped standard errors are reported in brackets.

| | Cumulative Risk-Adjusted Returns (by) | | | | | |
|---|---|---|---|---|---|---|
| | Nov.7 2008 | Feb. 27 2009 | Nov.7 2008 | Feb. 27 2009 | Nov.7 2008 | Feb. 27 2009 |
| Liquidity Control | $DLiq^s$ | | $LnSize^s$ | | $DLiq^s$ and $LnSize^s$ | |
| Quantile 25% | | | | | | |
| $DExp^s$ | 0.041 | 0.001 | −0.005 | −0.030 | −0.010 | −0.038 |
| | [1.89] | [0.02] | [−0.17] | [−0.69] | [−0.34] | [−1.37] |
| $DFsh^s$ | 0.096 | 0.077 | 0.062 | 0.067 | 0.051 | 0.052 |
| | [2.48] | [2.22] | [2.22] | [1.80] | [1.97] | [2.25] |
| $DLiq^s$ | 0.193 | 0.235 | | | 0.047 | 0.104 |
| | [6.87] | [7.87] | | | [1.53] | [2.21] |
| $LnSize^s$ | | | 0.062 | 0.060 | 0.056 | 0.044 |
| | | | [11.19] | [12.37] | [7.07] | [7.62] |
| Quantile 50% | | | | | | |
| $DExp^s$ | −0.038 | −0.029 | −0.110 | −0.039 | −0.107 | −0.077 |
| | [−1.12] | [−0.48] | [−2.47] | [−0.80] | [−2.45] | [−1.57] |
| $DFsh^s$ | 0.145 | 0.143 | 0.143 | 0.131 | 0.131 | 0.130 |
| | [3.64] | [2.27] | [4.01] | [3.48] | [3.40] | [2.93] |
| $DLiq^s$ | 0.151 | 0.253 | | | 0.042 | 0.129 |
| | [3.31] | [6.25] | | | [0.98] | [2.33] |
| $LnSize^s$ | | | 0.051 | 0.059 | 0.046 | 0.042 |
| | | | [8.98] | [6.21] | [5.84] | [4.59] |
| Quantile 75% | | | | | | |
| $DExp^s$ | −0.232 | −0.313 | −0.222 | −0.301 | −0.219 | −0.325 |
| | [−5.12] | [−3.76] | [−2.58] | [−4.17] | [−3.62] | [−3.91] |
| $DFsh^s$ | 0.092 | 0.237 | 0.107 | 0.231 | 0.097 | 0.225 |
| | [1.33] | [3.70] | [2.24] | [2.85] | [1.40] | [3.19] |
| $DLiq^s$ | 0.048 | 0.235 | | | 0.070 | 0.185 |
| | [0.96] | [3.04] | | | [1.11] | [1.70] |
| $LnSize^s$ | | | 0.002 | 0.047 | −0.008 | 0.021 |
| | | | [0.16] | [2.30] | [−0.33] | [1.02] |
| Quantile 90% | | | | | | |
| $DExp^s$ | −0.694 | −0.921 | −0.667 | −0.700 | −0.649 | −0.808 |
| | [−4.87] | [−4.37] | [−3.17] | [−4.45] | [−3.86] | [−5.04] |
| $DFsh^s$ | 0.211 | 0.219 | 0.171 | 0.212 | 0.201 | 0.196 |
| | [1.40] | [1.25] | [1.19] | [1.12] | [1.60] | [1.09] |
| $DLiq^s$ | −0.274 | 0.071 | | | −0.134 | 0.235 |
| | [−2.63] | [0.41] | | | [−0.78] | [1.30] |
| $LnSize^s$ | | | −0.085 | −0.061 | −0.069 | −0.082 |
| | | | [−2.68] | [−1.44] | [−1.32] | [−1.60] |
| *Obs.* | 3,449 | 3,411 | 3,449 | 3,411 | 3,449 | 3,411 |
| Q25% *Pseudo* $R^2$ | 0.058 | 0.050 | 0.064 | 0.056 | 0.059 | 0.050 |
| Q50% *Pseudo* $R^2$ | 0.042 | 0.044 | 0.048 | 0.050 | 0.043 | 0.044 |
| Q75% *Pseudo* $R^2$ | 0.036 | 0.042 | 0.038 | 0.044 | 0.037 | 0.042 |
| Q90% *Pseudo* $R^2$ | 0.160 | 0.190 | 0.157 | 0.190 | 0.167 | 0.191 |

Table 6: OLS Regressions for Aggregate Fund Holding Changes

For each stock, the percentage change in the aggregate fund holdings relative to positions in June 2007 over one to four consecutive semesters is regressed on dummy variables. The dummy variable $DExp^s$ marks with 1 the 30% of U.S. stocks with fund owners most exposed to financial stocks. A fund owner's exposure is measured by its return loss in financial stocks from July 1, 2007 to June 30, 2008. In the first set of regressions (Columns 1–2), the contemporaneous stock exposure dummy $DExp^s(2007/2)$ takes into account fund owners' return loss in financial stocks for only the second semester of 2007. The dummy variable $DFsh^s$ marks the 30% of U.S. stocks with the largest fund ownership share in June 2007. The dummy $DHighR$ marks the 30% of U.S. stocks with the highest cumulative return over the $k$ semester(s) under consideration. The dummy $DExp^s \times DHighR$ represents the interaction of the stock exposure dummy $DExp^s$ (or $DExp^s(2007/2)$) and the high crisis-return dummy $DHighR$. All regressions include industry fixed effects. The $t$-values based on robust standard errors are reported in brackets.

| | Percentage Change in Aggregate Fund Holdings | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Dec. 2007 | | June 2008 | | Dec. 2008 | | June 2009 | |
| $DExp^s(2007/2)$ | −0.848 | −0.843 | | | | | | |
| | [−4.08] | [−3.97] | | | | | | |
| $DExp^s$ | | | −1.612 | −1.488 | −2.158 | −1.772 | −2.697 | −2.159 |
| | | | [−5.00] | [−4.48] | [−5.97] | [−4.70] | [−7.07] | [−5.16] |
| $DFsh^s$ | −2.531 | −2.508 | −5.415 | −5.364 | −7.491 | −7.515 | −8.608 | −8.639 |
| | [−11.91] | [−11.79] | [−16.46] | [−16.46] | [−20.45] | [−20.89] | [−22.33] | [−22.69] |
| $DHighR$ | | −0.507 | | −1.080 | | −1.246 | | −1.161 |
| | | [−3.59] | | [−5.73] | | [−5.89] | | [−5.21] |
| $DExp^s$ | | −0.341 | | −0.917 | | −1.235 | | −1.330 |
| $\times DHighR$ | | [−0.99] | | [−1.99] | | [−2.40] | | [−2.47] |
| *Obs.* | 4,203 | 4,203 | 4,221 | 4,221 | 4,177 | 4,177 | 4,170 | 4,170 |
| $Adj.R^2$ | 0.150 | 0.154 | 0.259 | 0.269 | 0.326 | 0.338 | 0.352 | 0.361 |

Table 7: Test of Abnormal Pre-Crisis Return Difference

We test for the risk-adjusted return differences ($\alpha$ differences) (i) between exposed and nonexposed stocks and (ii) between exposed and nonexposed funds, prior to the crisis. Exposed stocks are the 30% of U.S. nonfinancial stocks with fund owners experiencing the largest return losses due to investments in financial stocks over the one-year period from July 2007 to June 2008, and nonexposed stocks are the remaining 70% of stocks. Similarly, the 30% of funds with the largest exposure to the financial sector are marked as exposed funds and the remaining 70% as nonexposed funds. Following Fama and French (2010), we form an equal-weighted portfolio and a value-weighted portfolio, separately for the exposed and nonexposed stocks each month from January 2002 to December 2006. We then test for their differences in risk-adjusted returns controlling for the standard risk factors in the literature (i.e., the market, size, book-to-market, and momentum factors) and allowing the risk factor loadings to differ across the two types of stocks. Using a similar approach, we also form value- and equal-weighted portfolios of the U.S. nonfinancial stock holdings of, separately, exposed funds and nonexposed funds. The difference in regression intercept ($\alpha$) and the associated standard deviation and $T$-value, as well as the adjusted $R^2$ of the regression are reported.

| | Diff. in $\alpha$ | Std. Dev. | $T$-value | $Adj.R^2$ |
|---|---|---|---|---|
| Exposed vs. Non-Exposed Stocks | | | | |
| Equal Weighted Portfolio | 0.0044 | 0.0047 | 0.93 | 0.926 |
| Value Weighted Portfolio | −0.0028 | 0.0028 | −0.99 | 0.954 |
| Exposed vs. Non-Exposed Funds | | | | |
| Equal Weighted Portfolio | −0.0005 | 0.0019 | −0.26 | 0.977 |
| Value Weighted Portfolio | −0.0016 | 0.0019 | −0.85 | 0.976 |

Table 8: International Evidence

The return regressions of Table 3 are repeated for nonfinancial stocks in the international markets. Panels A, B, and C reports the results for all non-U.S. stocks, developed market stocks excluding the U.S. stocks, and emerging market stocks, respectively. The regressions use equal country weights, and all stocks are given equal weights within a country.

| Panel A: All non-U.S. Stocks | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Cumulative Risk-Adjusted Returns (by) End of Semester | | | | | Peak of Crisis | |
| | Dec. 2007 | June 2008 | Dec. 2008 | June 2009 | Dec. 2009 | Nov. 7, 2008 | Feb. 29, 2009 |
| $DExp^s(2007/2)$ | −0.031 | | | | | | |
| | [−2.53] | | | | | | |
| $DExp^s$ | | −0.076 | −0.134 | −0.025 | −0.019 | −0.168 | −0.235 |
| | | [−3.63] | [−2.84] | [−0.79] | [−0.50] | [−3.10] | [−3.16] |
| $DFsh^s$ | −0.024 | 0.007 | 0.054 | 0.002 | 0.022 | 0.065 | 0.133 |
| | [−1.92] | [0.33] | [1.12] | [0.06] | [0.58] | [1.15] | [1.74] |
| *Obs.* | 14,691 | 14,666 | 14,651 | 14,631 | 14,608 | 14,622 | 14,618 |
| $Adj.R^2$ | 0.206 | 0.269 | 0.253 | 0.232 | 0.212 | 0.228 | 0.235 |

| Panel B: Developed Market Stocks ex U.S. | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Cumulative Risk-Adjusted Returns (by) End of Semester | | | | | Peak of Crisis | |
| | Dec. 2007 | June 2008 | Dec. 2008 | June 2009 | Dec. 2009 | Nov. 7, 2008 | Feb. 29, 2009 |
| $DExp^s(2007/2)$ | −0.047 | | | | | | |
| | [−3.18] | | | | | | |
| $DExp^s$ | | −0.085 | −0.134 | −0.029 | −0.026 | −0.168 | −0.261 |
| | | [−3.21] | [−2.12] | [−0.67] | [−0.48] | [−2.28] | [−2.58] |
| $DFsh^s$ | −0.004 | 0.017 | 0.115 | 0.037 | 0.046 | 0.135 | 0.275 |
| | [−0.29] | [0.64] | [1.71] | [0.80] | [0.89] | [1.72] | [2.58] |
| *Obs.* | 9,969 | 9,938 | 9,921 | 9,904 | 9,882 | 9,900 | 9,897 |
| $Adj.R^2$ | 0.165 | 0.170 | 0.200 | 0.199 | 0.162 | 0.173 | 0.191 |

| Panel C: Emerging Market Stocks | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Cumulative Risk-Adjusted Returns (by) End of Semester | | | | | Peak of Crisis | |
| | Dec. 2007 | June 2008 | Dec. 2008 | June 2009 | Dec. 2009 | Nov. 7, 2008 | Feb. 29, 2009 |
| $DExp^s(2007/2)$ | −0.014 | | | | | | |
| | [−0.68] | | | | | | |
| $DExp^s$ | | −0.062 | −0.124 | −0.014 | −0.006 | −0.157 | −0.175 |
| | | [−1.82] | [−1.84] | [−0.30] | [−0.12] | [−2.07] | [−1.70] |
| $DFsh^s$ | −0.045 | −0.009 | −0.037 | −0.051 | −0.015 | −0.041 | −0.083 |
| | [−2.17] | [−0.28] | [−0.57] | [−1.07] | [−0.27] | [−0.56] | [−0.82] |
| *Obs.* | 4,722 | 4,728 | 4,730 | 4,727 | 4,726 | 4,722 | 4,721 |
| $Adj.R^2$ | 0.238 | 0.367 | 0.313 | 0.283 | 0.314 | 0.287 | 0.283 |

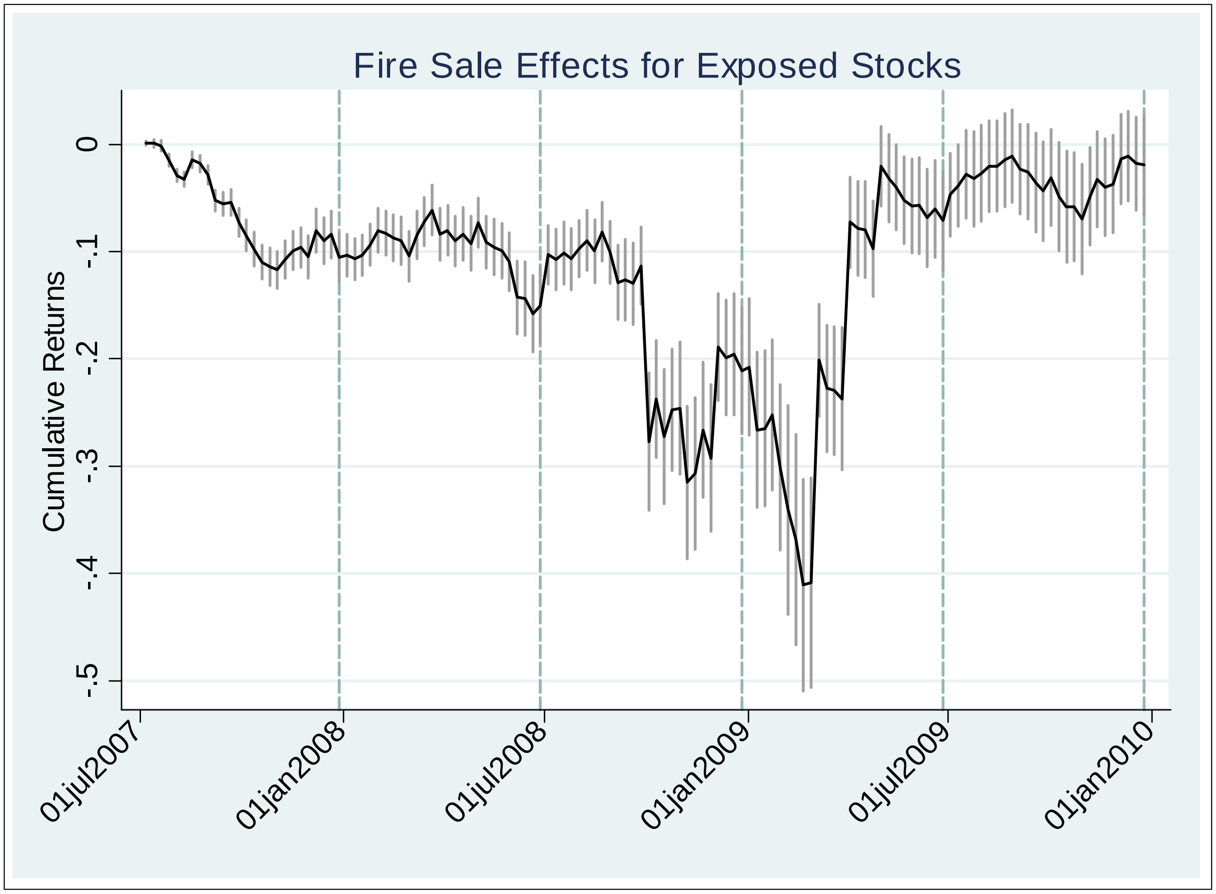


Figure 1: The graph shows the underperformance of exposed, nonfinancial stocks relative to other nonfinancial stocks in the same industry after accounting for risk premia from a model with four local and four international risk factors. Exposed stocks are the 30% of U.S. nonfinancial stocks with fund owners most exposed to financial stocks. The vertical bars provide robust standard errors (±1 standard deviation) around the point estimate of the average cumulative risk-adjusted returns.

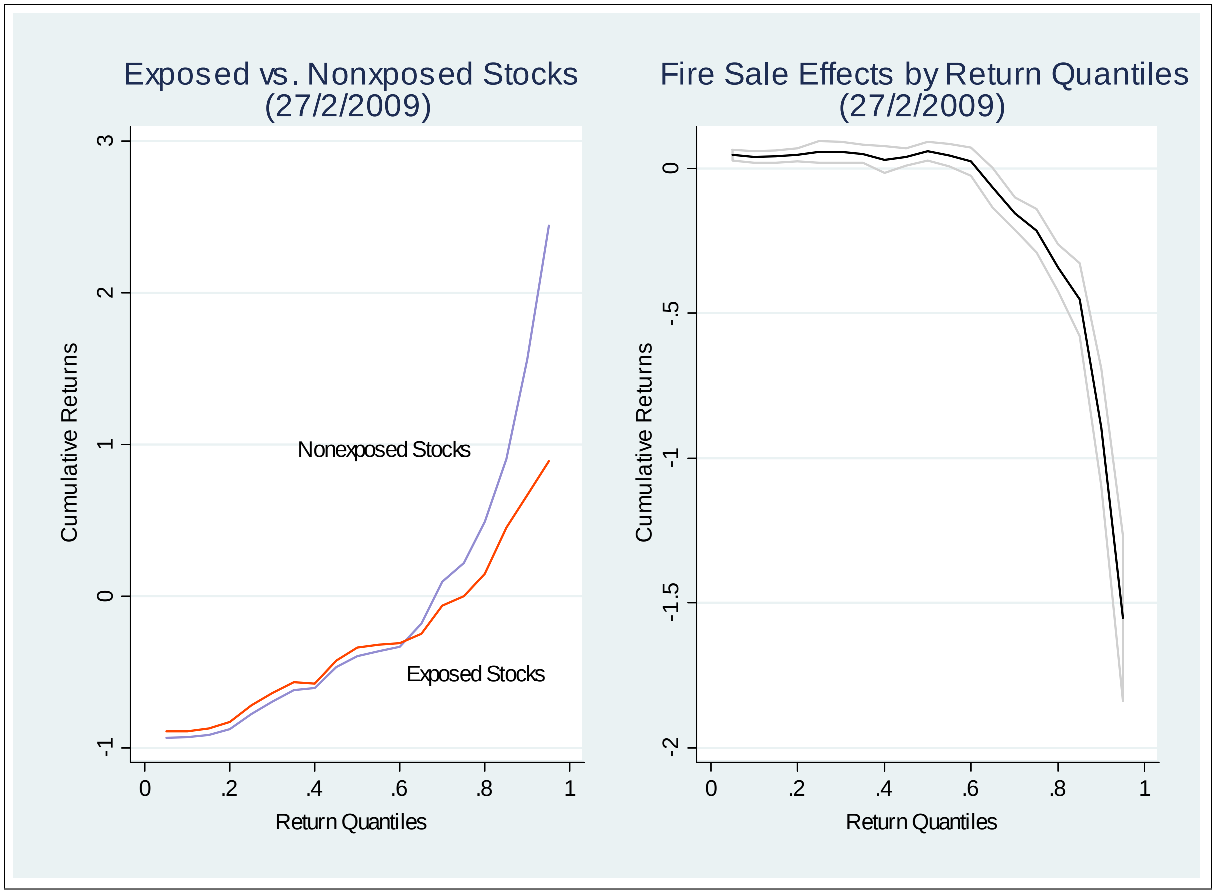


Figure 2: The graph on the left shows the relative performance of exposed and nonexposed U.S. stocks by stock return quantiles, controlling for industry fixed-effects. The y-axis denotes the cumulative (weekly) risk-adjusted returns from June 29, 2007 to February 27, 2009. The x-axis denotes the stock return quantiles. The graph on the right plots the cumulative risk-adjusted return difference between exposed and nonexposed stocks. The robust standard errors ($\pm 1$ standard deviation) around the point estimate of the return difference are also plotted.

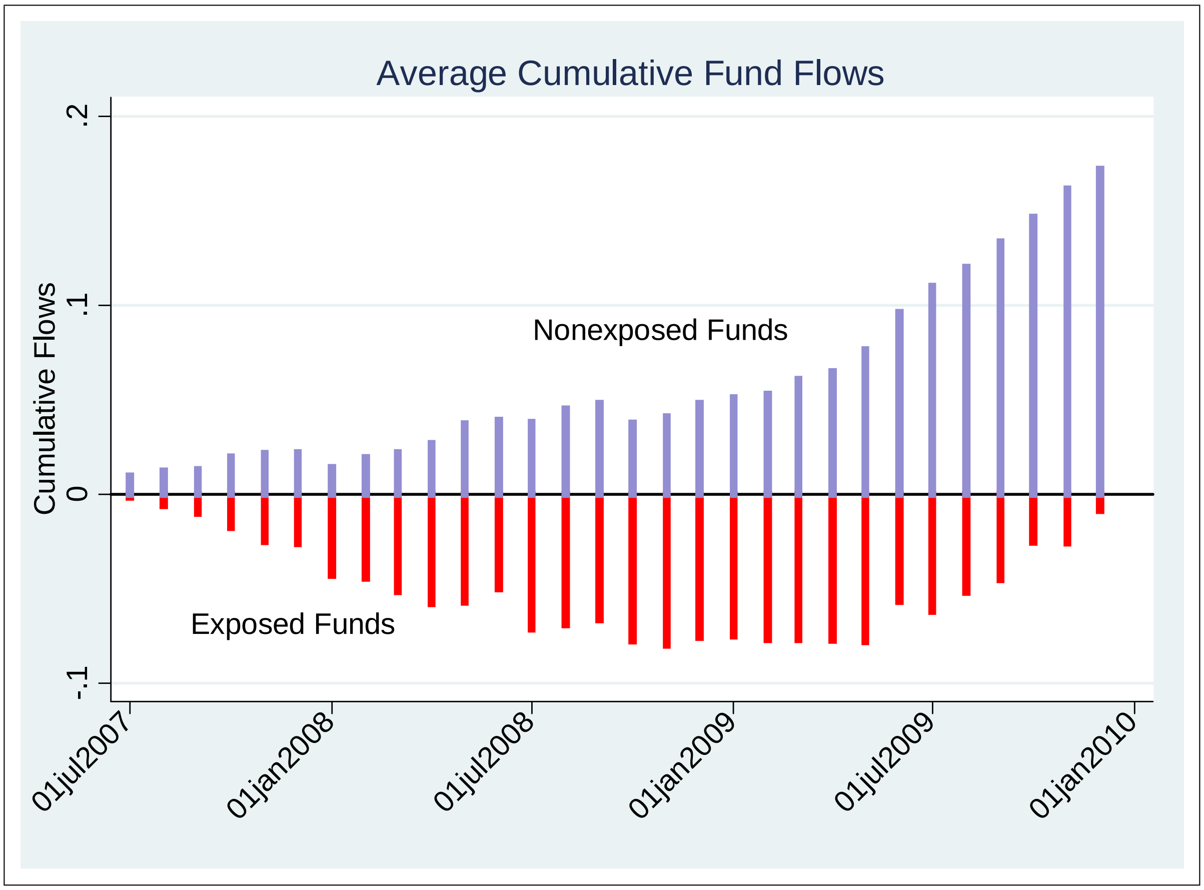


Figure 3: Plotted are the average cumulative fund flows for the exposed funds (i.e., the 30% funds with the largest investment losses in financial stocks over the one-year period from July 2007 to June 2008) and the nonexposed funds (i.e., the remaining 70% of funds). A fund's cumulative fund flow is estimated by its net cumulative dollar flows since July 2007 relative to its asset holdings in June 2007.

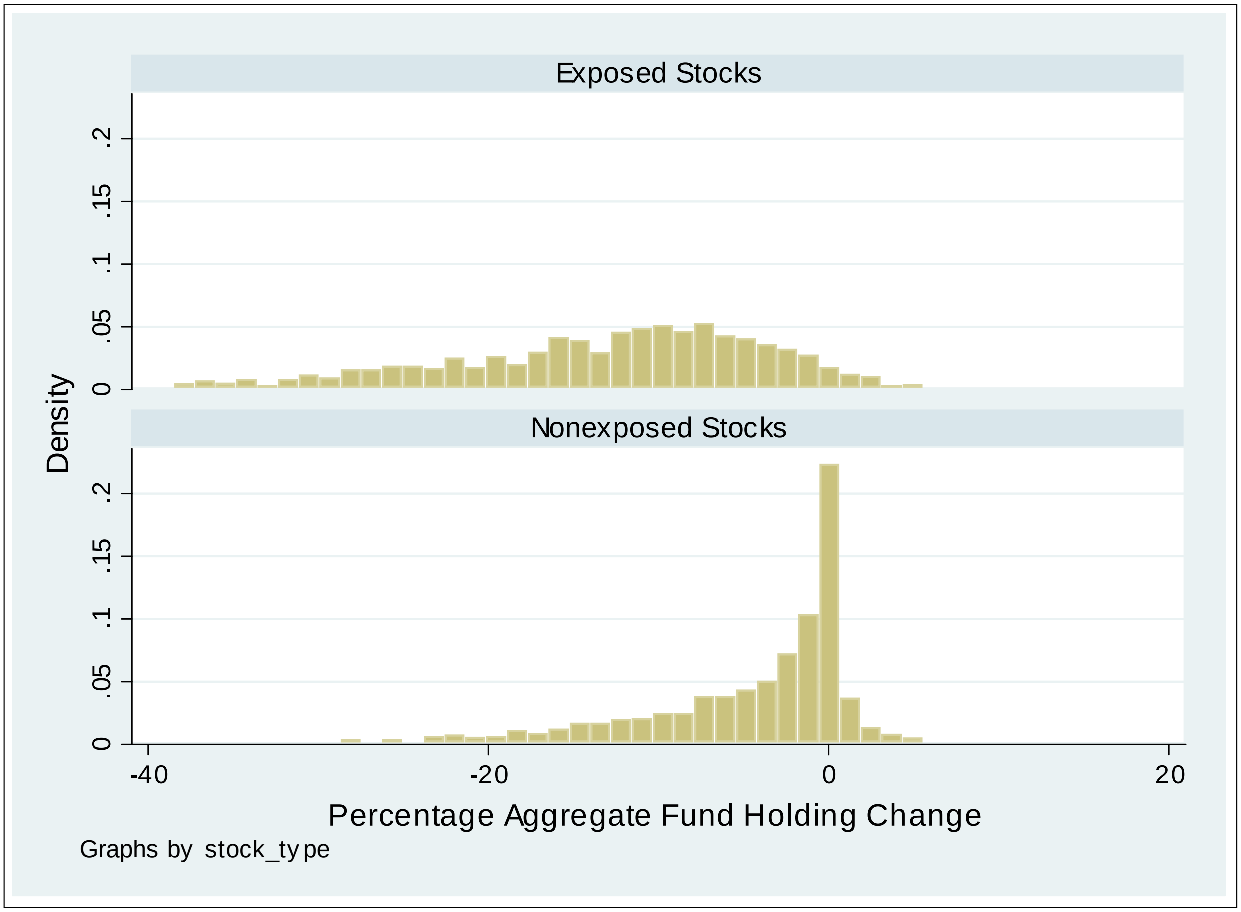


Figure 4: Plotted is the distribution of the percentage change in the aggregate fund holdings over four consecutive semesters relative to positions in June 2007, i.e., $\Delta\widetilde{H}^s(4)$. Exposed stocks are the 30% of U.S. nonfinancial stocks with fund owners experiencing the largest return losses due to investments in financial stocks over the one-year period from July 2007 to June 2008, and nonexposed stocks are the remaining 70% of stocks.

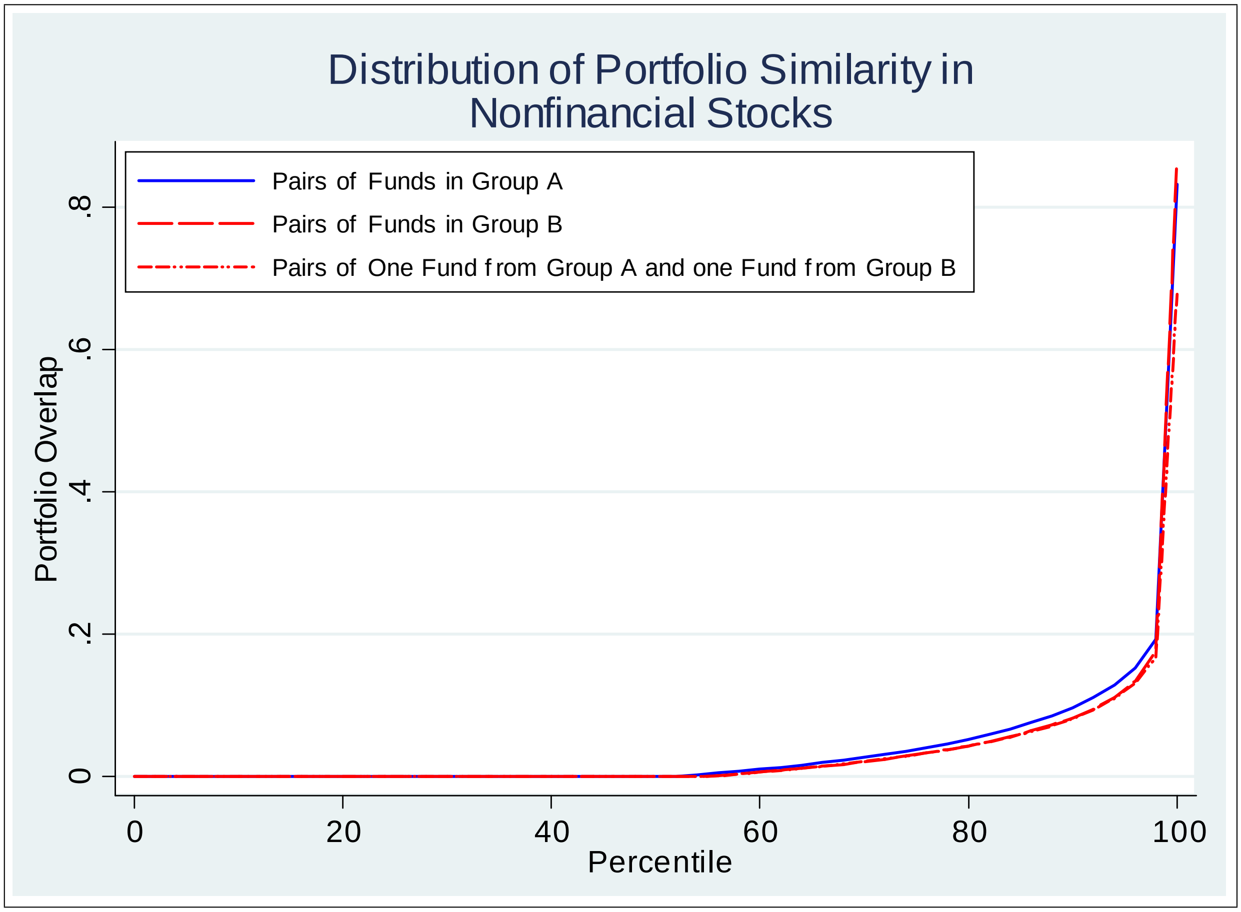


Figure 5: Group A consists of the 10% most distressed funds (i.e., funds with the greatest investment loss in financial stocks over the one-year period from July 2007 to June 2008). We then match this group of funds with the same number of other funds based on their country codes and the size of their total asset holdings in nonfinancial stocks. The group of matched funds is labeled as Group B. The portfolio overlap statistic is then calculated for (i) pairs of funds in Group A, (ii) pair of funds in Group B, and (ii) pairs of one fund from Group A and one fund from Group B, based on fund holdings in December 2006.

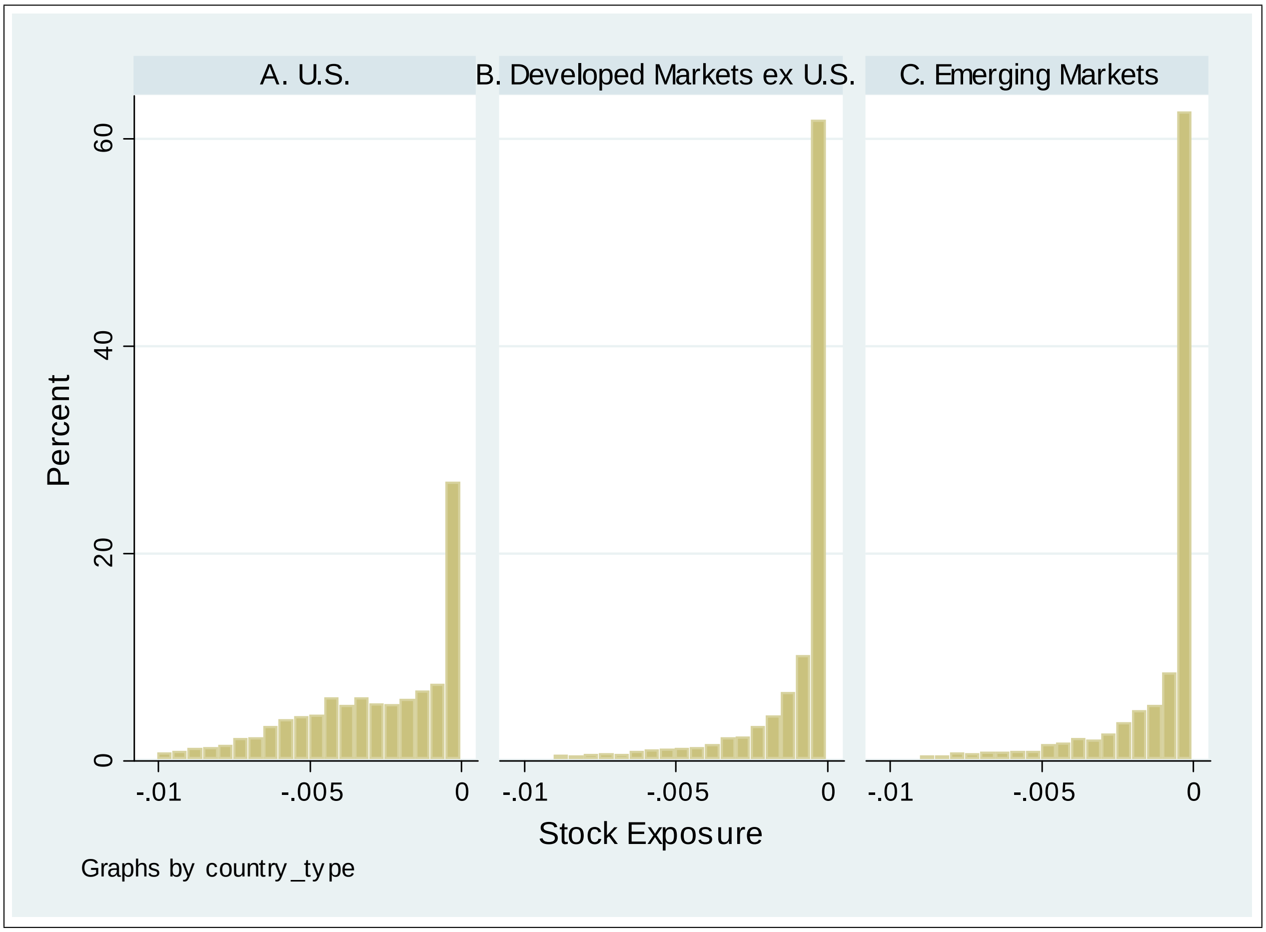


Figure 6: Plotted are the distributions of stock exposure $Exp^s$ for nonfinancial stocks in the U.S. (Panel A), developed markets excluding the U.S. (Panel B), and emerging markets (Panel C). Stocks with less than $-0.01$ of stock exposure account for only a small proportion of the population and are therefore not plotted.