The Role of Equity Funds in the Financial Crisis Propagation

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Abstract

The early stage of the recent 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 non-financial stocks owned by the respective funds. We find that (i) ownership links to these "distressed equity funds" lead to large underperformance of the most exposed non-financial stocks, and in aggregate this contributes an additional 10% to the overall stock market downturn; (ii) distressed fire sales and the associated price discounts are concentrated among those exposed stocks which perform relatively well; and (iii) stocks with higher fund ownership generally performed much better throughout the crisis.

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1 Introduction

Financial sector stocks accounted for only 15% 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 non-financial stocks as well. This paper examines asset fire sales by distressed equity funds as a channel for such a price contagion and shows that equity funds played a major role in propagating the crisis.

A large empirical literature documents 'price contagion' across countries and asset classes.[1] Yet, as Forbes and Rigobon (2002) argue, it is often difficult to separate contagion from ordinary asset interdependence. Our new approach focuses on ownerhsip data at the stock and fund/investor level for a clear identification of the contagion channel. In the current paper, we use a new comprehensive sample on the equity positions of 20,477 equity funds around the world. For each fund, we calculate *fund exposure* to financial stocks as the losses induced by financial sector positions in the initial phase of the financial crisis. Exposed funds faced larger investor redemptions and therefore had to engage in asset fire sales of their non-financial stocks. To capture this selling pressure on non-financial stocks, we define *stock exposure* as the ownership weighted average fund exposure of all mutual funds owning that stock. Thus, non-financial stocks held by funds with heavy loadings on underperforming financial stocks would be considered highly exposed stocks. Our identifying assumption is that the stock picks among non-financial stocks by exposed funds are random in the sense that they do not feature any performance bias other than the fire sales effect.

Our empirical analysis focuses on the relative return of *exposed stocks*, i.e., the 15% of non-financial stocks worldwide with the highest stock exposure.[2] Exposed stocks are found particularly in the U.S. stock market, where they represent 29.5% of all U.S. stocks and cover all industries. This allows us to control for industry-specific asset sensitivities to the crisis using industry fixed effects. We show that non-financial stocks with high exposure to distressed funds considerably underperformed during the financial crisis. For example, the stock price for the 29.5% most exposed U.S. stocks underperformed relative to non-exposed industry peers by 35% 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." Our analysis suggests that some 10% of the 52% crisis-related decline in the U.S. stock market can be attributed to distressed selling by mutual funds.

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

[2] Our findings do not qualitatively depend on the choice of this particular cut-off.

Our paper also uncovers two additional insights about the 2008 stock market crash. First, the fire sales discount is most pronounced for exposed stocks that perform relatively well during the crisis. This somewhat counterintuitive result can be explained by fund discretion about which asset positions to liquidate. Faced with funding constraints and investor redemption requirements, distressed equity funds liquidated the best performing stocks rather than stocks with recent large capital losses. Thus, fire sales were more pronounced for the 10% best performing stocks. For these stocks, we find that average fire sales discounts are above 80%. Second, we find that while ownership by distressed funds adversely affected the performance of a stock during the crisis, the opposite holds for overall fund ownership. Stocks in the top 15% quantile of the highest aggregate fund ownership suffered considerably lower capital depreciation than otherwise similar stocks. This suggests that investors who delegate investment decisions might have a lower propensity for equity sales or "flight to quality" than direct investors. The implication is that during bad times (i.e. when the overall index is strongly declining), stocks mostly held by funds experience less selling pressure than those primarily held directly. We test this hypothesis using VAR (vector autoregression) techniques to identify the Granger causality of index changes on the relative overperformance of stocks with high fund ownership. High frequency data confirms that the performance gap during the crisis between stocks with high and low fund ownership can be traced back to index return shocks on the previous day. This suggests that a stock's sensitivity to "flight to quality" is strongly determined by its fund ownership share.

Our analysis relates to a growing literature on limits of arbitrage and fire sales surveyed by Gromb and Vayanos (2010), and Shleifer and Vishny (2011), respectively. This literature has highlighted the role of funding constraints of financial intermediaries in determining asset prices (see Shleifer and Vishny (1992), Gromb and Vayanos (2002), Brunnermeier and Pedersen (2009), and Adrian and Shin (2010)). For equity funds, Coval and Stafford (2007) demonstrate that funding constraints following large investor outflows trigger fire sales with strong and persistent return effects for several months to a year. This paper extends this line of research by quantifying the return effect of funding constraints in the recent financial crisis. Furthermore, financial crises may give rise to a larger and more pervasive asset mispricing. For example, covered arbitrage relationships in the foreign exchange market hold almost perfectly for covered interest parity during normal times, but appear to have broken down during the financial crisis (Baba and Packer, 2009). Rinne and Suominen (2010) show that asset liquidity in U.S. stocks generally dropped during the 2007/08 crisis. Aragon and Strahan (2009) show that this liquidity drop applied in particular to stocks traded by hedge funds connected to the investment bank, Lehman Brothers. Recent theoretical work has also linked liquidity variations to information problems. A more extensive arbitrage breakdown may arise endogenously from larger asset valuation complexity if a crisis generates new unknown liquidity externalities (Caballero and Simsek, 2011). Hence, limits of arbitrage may shift during a crisis. The large-scale fire sales discounts documented in this paper is suggestive of such a displacement of arbitrage boundaries.

Our paper contributes to a larger research agenda on financial crisis transmission. Previous work has used portfolio data at the fund level to identify channels of asset contagions. For example, Fernando, Gelos, and Reinhart (2006) find that rebalancing towards the index ('retrenchment') by global equity funds during the previous emerging market crises (Thailand 1997, Russia 1998, and Brazil 1999) had a pronounced effect on the cross-section of international equity index returns. Manconi, Massa, and Yasuda (2011) find that in 2007/08, 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 Peria (2010) examines 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 2007/2008 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. (2011) 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 owernship characteristics of individual stocks without any simple factor structure representation. Similar to Bartram, Griffin and Ng (2010), we argue that ownership linkages are an important driver of stock returns.

Section 2 lays out this paper's principal hypotheses. Section 3 discusses data issues and variable definitions. Section 4.1 presents evidence for the fire sales discounts along the time line of the crisis. Section 4.2 uses quantile regressions to document the asymmetric effect of fire sales discounts by stock performance quantiles. Sections 4.3 presents evidence of distressed fund selling which matches the return evidence. The hypothesis of different propensities for "flight to quality" for directly and indirectly invested capital is examined in Section 4.4. Section 5 discusses various robustness issues and Section 6 concludes.

2 Hypotheses

The first fallout of the subprime crisis in 2007 was a substantial value loss for bank stocks.[3] 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.[4] As a consequence, equity funds with large share ownership in financial stocks suffered a substantial negative shock to their fund performance. In this paper, we explore how such fund exposure to bank stocks was propagated to other (non-financial) stocks through common fund ownership. Bank-stock-exposed equity 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 (Chevalier and Ellison (1997); Sirri and Tufano (1998); Del Guercio and Tkac (2002); Huang, Wei, and Yan (2007); Ivkovic and Weisbenner (2009); and Ferreira et al. (2010)). To meet redemption requirements from investors, such equity funds might will have to liquidate other (non-financial) stocks in their equity portfolio, which in turn depreciates the equity values of non-financial stocks.[5] This mechanism can be summarized in the following hypothesis:

> **H1: Simple Fire Sales Hypothesis**
>
> Non-financial stocks linked by stock ownership to funds with high exposure to banking stocks underperform during the financial crisis. Aggregate fund holdings decrease in such stocks relative to other stocks.

Empirically, we can test this hypothesis by defining a stock exposure dummy, which marks all non-financial stocks with distressed equity funds as principal owners. Fund distress or fund exposure itself is measured by the percentage value loss experienced by a fund in the second semester of 2007 and the first semester of 2008 due to investments in financial stocks. In addition to a negative return effect for exposed stocks, the fire sales 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 stocks than for non-exposed stocks.

The above hypothesis does not discriminate between the type of stocks a distressed equity fund might choose to sell. We highlight three arguments why funds might mostly sell their best performing stocks. First, if stock prices generally feature more pronounced deviations from fundamental values

[3] 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 back securities by S&P and Moody's, on July 10, 2007.

[4] These numbers are calculated based on the S&P1500 Banking index.

[5] See also Pulvino (1998) for related evidence that fire sales by distressed firms (airlines) also produce lower asset values (for used airplanes).

during a crisis, then a simple heuristic decision rule suggests that a fund first sells stocks with the highest realized crisis returns. Such stocks are least likely to suffer from temporary underpricing. By contrast, stocks in the lower performance quantiles provide the hope for a later price reversal and hence are less likely to experience fire sales. Second, U.S. tax law encourages mutual funds to pass on capital gains from asset sales to investors. To minimize investors' capital gains taxes, fund managers have an incentive to sell overperforming stocks during the market downturn when capital losses are more abundant.[6] Third, the behavioral finance literature has highlighted the so-called "disposition effect" as a reason why underperforming stock positions are less likely to be liquidated. Evidence on such a disposition effect among mutual fund managers is provided by Franzini (2006). All three arguments allow us to refine the unconditional simple fire sales hypothesis as follows:

H2: Stock Performance Dependent Fire Sales Hypothesis

The relative underperformance of exposed stocks is bigger for stocks that perform better during the financial crisis, because exposed funds pick the best performing stocks for fire sales.

A straightforward procedure to explore hypothesis H2 is to measure the fire sales effect for different stock performance quantiles. Hypothesis H2 predicts that the coefficient for the stock exposure dummy is considerably larger in absolute value for stocks at the higher return quantiles than lower return quantiles. Alternatively, we can directly look at the decrease in fund holdings for stocks that were both exposed and performed relatively well in the crisis. The interaction of these two effects should mark the stocks with the largest relative fund holdings changes.

While distressed funds may have a negative influence on the crisis performance of stocks they initially own, we do not expect that such an effect will pertain to equity fund ownership in general. Here, even the opposite hypothesis can be stated. Professional equity fund managers might be less prone to panic sales of equity than retail investors with direct investments. After all, fund managers' own economic future might depend more on their performance relative to peer managers, while retail investors might be more concerned with absolute value losses. Moreover, retail investors who delegate their capital to fund managers might be less performance sensitive in their decisions to reduce or liquidate equity investments as compared to investors who manage their own capital directly. Such investor self-selection can generate a propensity for stocks with low fund ownership to be more prone to "flight to quality" than stocks with high fund ownership. All else being equal, a high initial share

[6] We thank Gerard Hoberg for pointing out the tax aspect of asset fire sales.

of equity fund ownership might therefore imply a much better crisis performance for a stock.

H3: Fund Share Stability Hypothesis

Non-financial stocks with high equity fund ownership perform better during the financial crisis. Investors who delegate stock selection to funds are less prone to "flight for quality" than investors who invest their capital directly.

Our data allows us to calculate the proportion of a stock's market capitalization held by funds. Based on the Fund Share Stability Hypothesis, we predict that fund ownership is an important positive determinant for the cross-sectional risk-adjusted crisis performance of stocks. A cross-sectional regression analysis of crisis returns provides a first straightforward test.

In addition, our analysis goes one step further to identify a "panic effect" afflicting directly invested capital. We estimate a VAR that identifies the role of lagged return shocks of the U.S. stock market index on an (equally weighted) long-short portfolio of the 15% of stocks with the lowest fund ownership minus the 15% of stocks with the highest fund ownership. This allows us to explore how the impulse response of the long-short portfolio to (negative) market-wide shocks has changed during the crisis relative to the pre-crisis period. If "flight to quality" is triggered by shocks to the market index and its propensity is higher for directly invested (non-fund) capital, then the long-short portfolio return should show a strong positive cumulative impulse response to index return shocks during the crisis.

3 Data and Variable Definitions

3.1 Fund Holding Data

Our fund holding date is from the Thomson Reuters mutual fund database, which contains information on equity mutual funds worldwide. The detailed holdings file provides fund name, management company name, country code, and reporting date. In addition, it provides the security number and number of shares held by a fund, net changes in shares held since prior report dates, the security country code, security price in U.S. dollars, and shares outstanding. Most funds report only at six month intervals — hence the analysis is carried out at a semi-annual frequency. To reduce data outliers and limit the role of non-synchronous reporting, we apply a number of data filters. We retain holding data only from the last reporting date of a fund in each half-year. We require a fund to have at least an average of 10 million dollars in equity holdings, and it must hold at least five stock positions in a semester. Also discarded are funds with asset weights producing a Herfindahl-Hirschman index above 20% as this characterizes a non-diversified fund with extreme investment biases in very few stocks. The final sample includes 27,274 mutual funds with equity investments in 25 developed and 54 emerging markets over the period from 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 over the three-year period is unbalanced. Table 1 summarizes fund holdings for June 2007 by mutual fund domicile. A total of 20,477 funds reported stock positions with a combined total net asset value (TNA) of 16 trillion dollars. Our data coverage therefore exceeds the Lipper Hindsight database used by Ferreira, Massa, and Matos (2011), who reported total net assets of 10.9 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. This percentage, at 73%, is somewhat smaller for U.S. domiciled funds.

3.2 Fund Exposure and Stock Exposure

In the first step, we identify exposure of a fund to financial stocks.[7] 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

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

We calculate the bank stock related fund return as the value loss over a semester attributable to financial stock ownership, 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 (banks) worldwide. The average return is measured for the arithmetic midpoint between the beginning and the end of semester weights. Fund exposure is defined as return shortfall due to bank stock investments below the -1% threshold, that is,

$$Exp^f(t) = \begin{cases} 0 & \text{if } \overline{r}_{f,t}^{Financials} > -0.01 \\ \overline{r}_{f,t}^{Financials} & \text{if } \overline{r}_{f,t}^{Financials} \leq -0.01 \end{cases} .$$

[7] Funds that had more than 75% of their asset holdings in financial stocks were deemed to be financial sector funds. For those funds, the investment focus on banking stocks might be non-discretionary, so investors may not attribute underperformance to a poor sectorial fund allocation. We therefore exclude such funds from the sample and focus on those with discretionary investment in financial stocks.

Below a -1% return shortfall, funds may face more investor scrutiny and large fund redemptions such that fund fire sales become important. 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 $Exp^f(2008/1)$. Both fund return losses combined measure the total fund exposure given by

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

The mean (median) fund exposure to financial stocks (i.e., return loss due to bank investment) is -2.12% (-1.37%) with a skewness of -2.3. The 25%, 15% and 10% lowest fund exposure quantiles are given by -3.45%, -4.56%, and -5.53%, respectively.

In the second step, we aggregate the exposure of funds with their ownership shares in any non-financial stock to an ownership share 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 total fund ownership in stock s in June 2007 and Fsh^s denote the total fund ownership relative to the stock capitalization in June 2007. The exposure of a non-financial stock Exp^s to banking stocks (via common 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 banking stocks. Such stocks should therefore face the largest selling pressure if fund exposure captures the need for fire sales by individual funds. We highlight that we examine stock exposure only for non-financial firms to reduce the complication of any valuation effect arising from distressed assets on a firm's balance sheet. Using the Compustat industry segment file, we also exclude from the sample all conglomerates that have finance divisions accounting for more than one percent of total sales.

Summary statistics on stock exposure are reported in Table 2. The mean (median) stock exposure is -0.11% (-0.01%) with a skewness of -8.1. The 25%, 15% and 10% most negative stock exposure quantiles are -0.12%, -0.24%, and -0.35%, 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 distribution of stock exposure is highly skewed and its effect on return and holding change might be non-linear. It is therefore useful to define a dummy variable $DExp^s$ that marks all stock exposures below a certain quantile $Q(Exp^s)$, where

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

Our empirical analysis focuses on the 15% quantile, but using the 10% or 20% quantile gives qualitatively similar results. Most of the analysis in this paper is based on the 15% exposure threshold applied to all stocks worldwide. U.S. stocks are strongly represented in the global sample of exposed stocks with $1,447$ (or 35.1%) stocks compared to $1,781$ (or 43.2%) for other developed markets and 894 (or 21.7%) for emerging markets.

Stock exposure is therefore more frequent for the U.S. market, where 29.5% of stocks are labeled "exposed" compared to 13.3% and 13.3% for other developed markets and emerging markets, respectively. We also note that the U.S. sample contains many of the most strongly exposed stocks: The 10% quantile for Exp^s is -0.005 in the U.S. sample, compared to only -0.003 and -0.003 in the other developed market and emerging market stock sample, respectively. For this reason, some of our analysis will focus on the subset of U.S. stocks. For the sample of U.S. stocks (in June 2007), the median number of exposed fund owners (i.e., the 15% of funds with the highest fund exposure) and that of non-exposed fund owners (i.e., the remaining 85% of funds) are 5 and 51 funds, respectively. For the subsample of exposed U.S. stocks, the corresponding numbers are 20 and 166 funds, respectively. We highlight that stocks show considerable dispersion in the number of funds investing in them and this coarseness of fund ownership translates into a large dispersion of stock exposure.[8]

Table 3 provides a comparison of exposed and non-exposed stocks. For each stock, we examine its market capitalization value on June 30, 2007 and its average monthly stock liquidity from July 2006 to June 2007. Following Bekaert, Harvey, and Lundblad (2007), we calculate a stock's liquidity by $ln(1 - ZR)$, where ZR refers to the proportion of zero daily returns. Exposed stocks tend to be larger and more liquid than non-exposed stocks. This corresponds to the general finding that fund ownership is biased toward larger and more liquid stocks; this should simultaneously attenuate any return effect of fire sales, which might be even more pronounced for small and illiquid stocks. Exposed

[8]For more detail on the distribution of the number of fund owners, see Table A4 of the Web Appendix.

stocks also tend to differ in their loadings on standard risk factors used in the asset pricing literature. The loading on the size factor SMB in particular differs between exposed and non-exposed stocks. This is not surprising given that exposed stocks are on average larger. A comparison of crisis returns by stock exposure should therefore be based on risk-adjusted returns.

3.3 Fund Holding Change and Aggregate Holding Change

The fund ownership data allows 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 $\Delta h^{f,s}$ in stock s over k semesters (from t to $t+k$) can be expressed as (for $f \in F(s)$)

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

The stock holding change aggregated across all funds follows as the ownership weighted average of individual fund holding change, that is,

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

We then define the stock capitalization scaled aggregate 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 each fund f in stock s relative to the total capitalization of the stock.

The aggregate fund holdings decrease over consecutive semesters as shown in Table 2. The average aggregate holding change $\Delta \widetilde{H}(k)$ for $k = 1, 2, 3, 4, 5$ is given by -1.5%, -2.7%, -3.5%, -4.1%, and -4.3%, respectively. Section 4.2 explores whether this aggregate fund holding decrease is more pronounced for stocks with mostly exposed fund owners.

3.4 Risk Adjustment of Returns

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 and is discussed in the appendix.

A country's international factors are calculated in a 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,

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

where $r_{s,t}$ denotes a stock's monthly (cum dividend) return in U.S. dollars net of the one-month treasury bill rate. Table 3 reports summary statistics of factor loadings separately for exposed stocks and non-exposed stocks. 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. Unreported t-test shows that all eight factors have explanatory power for the cross-section of returns. The observation that domestic risk factors play an important role in the pricing of international stocks corroborates the recent evidence advanced by Eun et al. (2010) that investors can enhance the risk-return trade-off of their portfolios by holding country-specific version of SMB, HML, and MOM factor funds in addition to the global version of these funds.

With the estimated factor loadings $\widehat{\beta}_{i,j}$, the monthly risk adjusted (or excess) return during the crisis period from July 2007 to December 2009 is defined as

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

Finally, the total risk adjusted (or excess) return of stock s over k semesters (or $6 \times k$ months) is denoted by

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

The summary statistics for cumulative risk adjusted (excess) returns of all non-financial stocks are stated in Table 2. The standard deviation of cumulative excess returns increases from 0.473 to 1.409 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 0.980 and 1.008 as we consider returns extending until June 2009 and December 2009, respectively. This reveals some degree of excess return reversal for non-financial stocks in 2009.

4 Evidence on the Role of "Fund Distress"

4.1 Stock Exposure Effects on the Crisis Time Line

Did losses in financial stock investments by a fund affect the performance of other (non-financial) stocks held by the same fund? The dummy variable $DExp^s$ indicates the 15% of stocks with the most distressed fund ownership. Similarly, we define a dummy $DFsh^s$ indicating the 15% of stocks with the highest share of fund ownership relative to total stock capitalization as of June 2007. A simple OLS regression of the risk-adjusted returns $r_s^{Ex}(k)$ over k semesters on this dummy variable reveals 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 simple fire sales hypothesis predicts $\alpha_1^k < 0$. The dummy variable $DExp^s$ should allow for direct identification of the fire sales effect if the (non-financial) stock picks of exposed funds are not systematically different from those of non-exposed funds with respect to expected stock returns. Our identifying assumption here is that high ownership concentration of exposed funds in a particular stock is comparable to a random treatment effect across stocks with similar aggregate fund ownership. Supporting evidence for this assumption is provided in Section 5.1. First, we show that the portfolio weights of non-financial stocks are as dispersed in exposed funds as in non-exposed funds. Second, we examine the total fund performance in the three year period prior to the crisis. We find no evidence for any economically significant performance difference between exposed and non-exposed U.S. funds. Thus, the evidence suggests that (conditional on a stock's aggregate fund ownership share) stock exposure can be regarded as a random attribute unrelated to any expected over- or underperformance beyond the fire sales effect itself.

The variable $DFsh^s$ serves as a control variable because higher overall fund ownership allows for more exposure to exposed funds. In addition, the high fund ownership dummy also provides a test for the Fund Share Stability Hypothesis, whereby stocks with a large share of fund-managed capital perform better during the crisis. The regression discards the 1% highest and lowest return outliers. We include country and industry fixed effects, as well as their interaction in the regression. The coefficient α_1^k therefore captures (risk-adjusted) fire sales discounts over k semesters for the 15% most exposed stocks relative to other stocks in the same industry and country.

Panel A of Table 4 reports the regression results for the pooled sample of all stocks. For the return period from July 1, 2007 to December 31, 2007, 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 -3.8% after one semester in December 2007, -7.2% after two semesters in June 2008, and -9.7% after three semesters in December 2008. For June 2009 (after four semesters) we find a reversal of the discount to -5.1%, 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, indicating that stocks with high fund ownership experience better crisis performance. The latter effect is economically large and increasing over time to 10.0% by December 2009. This provides support for the Fund Share Stability Hypothesis. Also, the relative overperformance for the 15% of stocks with the highest fund ownership appears more persistent compared to the fire sales effect identified by the stock exposure dummy.

Panel B of Table 4 reports the results for the subsample of U.S. stocks. The exposure dummy $DExp^s$ here marks 29.5% of all U.S. sample stocks, including many stocks from the lower tail distribution of Exp^s. It is therefore not surprising to find much stronger fire sales effects. The crisis underperformance reaches -12.7% in June 2008 and -16.9% in December 2008. Thereafter, this effect diminishes until full reversal is reached by December 2009. Similar to the full sample, stocks with high overall fund ownership are associated with much better crisis performance than otherwise similar stocks. Their return difference reaches a cumulative total of 18.6% by June 2009.

Panels C and D of Table 4 report corresponding results for the (non-U.S.) developed market and emerging market stocks. For emerging market stocks, the fire sales effect captured by $DExp^s$ is statistically and economically significant at -7.3% in June 2008. The corresponding return shortfall for exposed stocks in developed markets outside the U.S. is only -3.8%. For emerging market stocks, high fund ownership ($DFsh^s = 1$) is also associated with strong overperformance in June 2008 and December 2008, while non-U.S. developed markets provide no evidence for the Fund Share Stability Hypothesis. If "panic sales" by direct retail investors cause a stock price decline, then it may not be surprising to find weaker effects outside the U.S. because of the more concentrated (non-retail) stock ownership in those markets in general.

The cross-sectional analysis so far has focused on five event dates given by the end of each semester. These dates are unlikely to coincide with the peak of the crisis and may therefore underestimate the maximal fire sales discount. We therefore repeat the above regressions using cumulative risk-adjusted returns with weekly return increments (instead of semester return increments) to obtain a finer time series. The regressions after 26, 52, 78, 104, 156 weeks coincide with the previous regressions after $k = 1, 2, 3, 4, 5$ semesters. The coefficient for the exposure dummy $DExp^s$ and a confidence interval (of ±1 SE) is plotted in Figure 1. The five reported regressions corresponding to the end-of-semester dates are highlighted by dashed vertical lines. The fire sales effect for U.S. stocks shows negative twin peaks around November 7, 2008 and February 27, 2009, with an average return shortfall of −27.18% and −35.23%, respectively, for exposed stocks. By comparison, the point estimate for (the end of) December 2008 (reported in Table 4, Panel B) yields only −16.9%. The end-of-semester results from the earlier return regressions therefore considerably underestimate two event peaks.

These results also highlight that crisis propagation through fund exposure played a quantitatively important role for the overall index decline in the second part of 2008. An incremental return shortfall of 35% for the 29.5% exposed U.S. stocks implies an aggregate effect of 10% value decline for an (equally weighted) U.S. stock index. Considering the fact that exposed stocks are on average larger than non-exposed 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 sales 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 refinement of the simple fire sales hypothesis. Funds may choose to sell first the best performing or the most crisis resilient stocks, which may limit loss realizations and preserve the chance of price reversal for the most depressed stocks in the fund portfolio. This implies that the negative effect of stock exposure should increase with the overall performance of a stock during the financial crisis. We therefore estimate regressions for the 25%, 50%, 75%, 90%, and 95% quantiles of the cumulative excess return distribution as a linear function of the stock exposure dummy $DExp^s$ and the fund ownership dummy $DFsh^s$. 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 sales discounts as shown in Figure 1. The regression includes fixed effects for all countries. Table 5 reports the corresponding regression results. For the full sample (all stocks) in February 2009, the coefficient of the stock exposure dummy decreases from a positive of 6.3% and 3.9% for the 25% and 50% quantiles, respectively, to −10.2%, −42.9%, and −97.2% for the 75%, 90%, and 95% 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 most of the negative impact found for the best performing stocks. For the subsample of U.S. stocks, the corresponding coefficient for the exposure dummy decreases from an insignificant 3.7% and −0.7% for quantiles 25% and 50%, respectively, to −23.6%, −82.9%, and −155.2% for the following three cumulative return quantiles (75%, 90% and 95%) for February 2009. Figure 2 graphically illustrates how the fire sales effect of exposed stocks increases with their return quantiles. This concentration of the fire sales effect in the best performing stock quantiles is strong evidence for the Stock Performance Dependent Fire Sales Hypothesis.

For the dummy variable $DFsh^s$, we find large positive coefficient estimates in the 25% and 50% quantiles, but not in the 90% and 95% quantiles. This suggests that the stabilizing effect of high fund ownership was strongest for stocks with median or poor performance. This intuitive result supports the Fund Share Stability Hypothesis. Less institutional ownership by mutual funds may correlate with a higher proportion of retail ownership. The panic selling of retail investors induces poor stock performance so that the relative stability contribution of fund ownership is most evident in the median and low performance quantiles.

4.3 Fund Redemption and Fund Holding Changes

This section explores how fund exposure to financial stocks implied higher investor redemptions and stock fire sales to finance these redemptions. We first look at the redemption pressure faced by exposed funds relative to non-exposed funds. 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." The analysis here is based on 8,250 funds for which we could 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 3 shows the average cumulative net subscription/redemption from July 2007 through December 2009 separately for exposed and non-exposed funds. Exposed funds started to 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.

In the absence of sufficient cash holdings, exposed equity funds had to finance their substantial investor redemption by equity fire sales. It is therefore instructive to examine fund holding changes in a stock as a function of stock exposure. We denote by $\Delta\widetilde{H}^s(k)$ the aggregate percentage holding change in stock s over k semesters of all funds with initial positions in June 2007. First, we take a closer look at the distribution of holding changes. Figure 4 compares the distribution of holding changes $\Delta\widetilde{H}^s(4)$

from July 2007 to June 2009 between exposed stocks and non-exposed 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 can explain the earlier finding that the crisis returns of exposed stocks, reported in Tables 4 and 5, were much more negative than the returns of non-exposed stocks in the same industry and country.

Analogous to the return regression, the holding change is related to the dummy variable $DExp^s$, marking the 15% of stocks with the most distressed fund owners, and the dummy variable $DFsh^s$, marking the 15% of stocks with the highest aggregate fund ownership. 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 sales hypothesis implies $\beta_1^k < 0$ as exposed stocks should show a faster holding decline for the initial owners in June 2007. To test for the Stock Performance Dependent Fire Sales Hypothesis, we extend the above specification by a dummy variable $DHighR^s$, marking all stocks in the 25% 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 which do relatively well during the crisis. More pronounced position liquidations in these stocks imply $\beta_4^k < 0$.

Table 6, Panels A to C, provide the regression results for all stocks, U.S. stocks, and non-U.S stocks, respectively. 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 -1.06%, -1.87%, -2.27%, and -2.71% over a period of $k = 1, 2, 3, 4$ semesters, respectively. Compared to the average holding decreases of -1.47%, -2.68%, -3.51%, and -4.14% (reported in Table 2), these figures reveal approximately 65% more net fund selling for the 15% 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 β_4^k is -0.41%, -0.77%, -1.43%, and -1.20% relative to -0.93%, -1.63%, -1.79%, and -2.31% measured by the coefficient β_1^k. The ratio of -1.20% to -2.31% suggests a 52% more decrease of exposed stock holdings if the stock was among the 25% best performing stocks. This finding supports the Stock Performance Dependent Fire Sales Hypothesis and matches the return evidence from the quantile regressions in Table 5.

Finally, we note that stocks with high aggregate fund ownership ($DFsh^s = 1$) also experienced a more pronounced reduction in fund holdings. This may not be surprising if concentrated fund ownership in any stock has a transitory (or time varying) component, but this mean reversion toward lower fund ownership appears to have occurred without any distressed selling, as revealed by the positive return effect of the $DFsh^s$ dummy in the return regressions.

4.4 Asymmetric "Flight to Quality" by Ownership Type

The relative crisis resilience of stocks with high fund ownership is surprising and calls for further analysis. A possible explanation is that capital under fund management has a lower propensity for "flight to quality," thereby creating less selling pressure for stocks with high fund ownership. By contrast, direct retail investors might be more prone to panic sales, and direct retail ownership might be higher for stocks with low fund ownership. The second part of this hypothesis can be examined using the NYSE trading volume data which separately accounts for retail trading volume.[9] We calculate the percentage of retail trading for all $1,793$ NYSE traded stocks in our sample over a one year period prior to July 2007 and find that it has a strong negative correlation of -0.584 with the fund ownership share. A high fund ownership share in a stock therefore proxies for low retail trading and therefore also for low direct retail ownership.

Two arguments may explain why retail investors show more "flight to quality" during a crisis. First, households may self-select into either fund investors or (direct) retail investors. Those who are willing to delegate their portfolio decisions might be less confident in their investment judgment and request fund redemption only under severe relative underperformance of the fund under consideration. Direct investors follow the market more closely and might be more prone to "flight to quality" as a panic reaction to large absolute losses. Second, household investors might wish to reduce their stock exposure during the crisis, via disposing of directly invested capital and/or fund investments. Since

[9] We thank NYSE Technologies Global Market Data for providing this data. See http://www.nyxdata.com/Data-Products/ReTrac-EOD.

fund redemption can be more costly (given redemption and loading fees), any desire to reduce aggregate stock exposure may first and foremost concern directly invested stock capital.

Important to the "flight to quality" phenomenon is a strong reaction to negative past return shocks on the whole market or market index. An asymmetric "flight to quality" propensity implies that the impulse response to an index shock should be larger for stocks with a high share of directly invested (retail) stock capital. We therefore construct an (equally weighted) long-short portfolio with long positions in the 15% of stocks with the lowest fund ownership and a short position in the 15% of stocks with the highest fund ownership (DMF = Direct Minus Fund ownership). The portfolio return R_t^{DMF} captures the "flight to quality sentiment" of direct investors relative to those investors who delegate fund management decisions. The daily return on such a long-short portfolio is combined with the daily return on the U.S. market index (MSCI USA U$ - TOT RETURN IND.) to build a simple structural VAR in $y_t = (R_t^{DMF}, R_t^{Index})^T$ with innovations $\epsilon_t = (\epsilon_{1t}, \epsilon_{2t})^T$ of the form

$$Ay_t = (C_1 L + C_2 L^2 + ... + C_k L^p) y_t + B\epsilon_t,$$

where L^p is the lag operator (for p lags of y_t) and $C_1, C_2, ..., C_p$ are unconstrained 2×2 matrices capturing the delayed influence of the lagged dependent variables. Identification is achieved under the restrictions

$$A = \begin{bmatrix} 1 & 0 \\ a_{21} & 1 \end{bmatrix} \quad \text{and} \quad B = \begin{bmatrix} b_{11} & 0 \\ 0 & b_{22} \end{bmatrix}.$$

This identification structure allows for a contemporaneous effect of the long-short portfolio return R_t^{DMF} on the index return R_t^{Index}. By contrast, the index return R_t^{Index} influences the long-short portfolio, a proxy for "flight to quality sentiment," only with a lag of one or more trading days. Such a delayed reaction is particularly plausible for retail investors, who may observe index changes at the end of the day and only execute their trades on the following trading day. Of particular interest is the role of index innovations ϵ_{2t} on the portfolio return R_t^{DMF}. Under a high "flight to quality" propensity for directly invested capital, we should expect such index innovations to have a strong positive effect on R_t^{DMF}.

We estimate the VAR for three different time periods of 12 months each: namely, 01/07/2006 – 30/06/2007, 01/07/2007 – 30/06/2008, and 01/07/2008 – 30/06/2009, which are referred to as the pre-crisis period, crisis period I, and crisis period II, respectively. The pre-crisis period serves as a suitable benchmark against which to assess the change in the dynamics between index returns R_t^{Index} and portfolio returns R_t^{DMF}during the crisis. For both crisis periods, the AIC and HQIC criteria indicate that a lag order length $p = 2$ is sufficient to capture the system dynamics. For both crisis periods, the most statistically significant VAR coefficient is c^1_{12}, which captures the effect of the index return on the long-short portfolio return at the one-day lag. The parameter estimates are 0.346 and 0.173 (with corresponding z-statistics of 4.72 and 4.47) for crisis periods I and II, respectively. Hence, the portfolio return reacts strongly and positively to the index return on the previous trading day.

More generally, causality tests show that the index return is not Granger caused by the portfolio return. Conversely, there is strong evidence that the stock index return predicts future returns of the long-short portfolio during both crisis periods, but not during the pre-crisis period. The respective Wald tests reject exclusion of the index return from the return dynamics of the long-short portfolio at levels of $\chi^2(2) = 25.27$ and $\chi^2(2) = 33.67$ for crisis periods I and II, respectively. For the pre-crisis period, we cannot assert a similar role for the index return as indicated by the Wald test statistic of $\chi^2(2) = 2.30$.

Figure 5, Panel A, plots the cumulative impulse response of the DMF portfolio return to a unit shock to the index return for all three time periods. The pre-crisis period does not provide any evidence for a stable relationship between index shocks and returns of the long-short portfolio, as indicated by the wide confidence intervals. This relationship changes during the two crisis periods. A 1% innovation to the index return now implies an average of 0.41% cumulative return impact on the long-short portfolio during crisis period I and of 0.26% still during crisis period II. The 95% confidence interval around the point estimates narrows particularly for crisis period II.

The fund ownership variable is negatively correlated with retail trading volume and therefore proxies (inversely) for retail ownership. Alternatively, we can construct an (equally weighted) long-short portfolio directly from the NYSE share trading of retail investors, using long positions in the 15% of NYSE stocks with the highest retail trading and short positions in the 15% stocks with the lowest retail trading (RMI = Retail Minus Institutional trading). Figure 5, Panel B, shows the analogous impulse response function of the RMF portfolio following a unit market return shock. Stocks dominated by retail investor trading show a strong additional return effect on the days after an index shock. The cumulative return effect after 5 days (to a unit index return shock) is 0.27 and 0.22 during crisis periods I and II, respectively. These estimates suggest that given the 50% price drop of the stock market index during the crisis, stocks predominantly held directly by retail investors should show a return shortfall – compared to those held mostly by funds – of approximately 12%.

In summary, the considerable economic magnitude of the estimated VAR effects suggests that "flight to quality" as a reaction to (negative) market-wide shocks concerned directly invested (retail) equity capital much more than capital under delegated management. Higher fund ownership made a stock more immune to "flight to quality" sales. The VAR evidence therefore explains the results in Tables 4 and 5, which show that higher fund ownership correlates with a better crisis performance.

5 Robustness Issues

5.1 Stock Selection Biases of Exposed relative to Non-Exposed Funds

Our research design assumes that the ownership concentration of exposed funds in a particular (non-financial) stock corresponds to a random treatment effect. The underlying assumption is that exposed funds and non-exposed funds do not choose systematically different stocks outside the financial sector. Hence, concentrated ownership of exposed funds in any single stock becomes a 'quasi random' coincidence. The holding data allows us to examine this assumption by documenting the similarity of stock portfolios based on the average overlap of their portfolio weights. For any pair of funds (f_1, f_2), we define portfolio overlap in the non-financial sector as the sum of the minimum common weight in each stock given by

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

where $\widehat{w}^{f_1,s}$ and $\widehat{w}^{f_2,s}$ represent the portfolio weight of non-financial stock s in funds f_1 and f_2, respectively. Use the set of all exposed funds and a matching set of non-exposed funds with the same fund size distribution. We calculate the average portfolio overlap within the group of exposed funds and compare it with the overlap across the groups of exposed and non-exposed funds (with one fund from each group to form a pair). If exposed funds do not have any particular investment biases that are different from non-exposed funds with respect to non-financial stocks, then the average portfolio overlap for a pair of exposed funds and for a pair of exposed and non-exposed funds should be similar.

Table 7 shows the average portfolio overlap within (the exposed fund) group and across (the exposed and non-exposed fund) groups. The portfolio overlap is zero for 40.5% of the within group pairs and 46.3% of the cross group pairs. The mean (median) portfolio overlap is just 5.2% (0.9%) and 3.0% (0.2%) for within and cross group pairs, respectively. At the 90% quantile with the highest overlap, we find an average portfolio overlap of 16.4% for the exposed funds compared to 10.4% between exposed and non-exposed funds. This means that 90% of exposed fund pairs have common non-financial stock weights of less than 20%. While we can statistically reject the hypothesis that stock weight overlap among exposed funds is as low as between exposed and non-exposed funds, the result nevertheless shows that the non-financial portfolio allocations of exposed funds are qualitatively as dispersed as those of non-exposed funds. This provides evidence against any economically large selection bias in the non-financial stock allocations of exposed funds.

A second test of investment differences between exposed and non-exposed funds concerns their pre-crisis performance. We identify 284 exposed funds and 1,721 non-exposed funds with a minimum reporting history of 3 years from July 2003 to June 2006 and obtain their total fund returns data from the Lipper database. The two samples show no significant difference in their average total fund return after adjusting for the four U.S. risk factors. This is again evidence against any large systematic difference in investment biases between exposed and non-exposed funds.

5.2 Stock Characteristics and Changing Risk Premia

The investment bias of mutual funds toward large caps implies that stock exposure occurs more often for large stocks. In principle, this should bias the results against finding strong fire sales effects as large stocks tend to be more liquid. It is interesting to confirm this intuition by splitting the sample into small caps and all other stocks (large and mid caps). We define small caps as all stocks with a capitalization below the 10% size quantile of all NYSE listed firms in June 2007. Table 8, Panel A, repeats the regressions in Table 4, Panel B, for the respective subsamples. Small caps do indeed show a stronger fire sales effect than larger stocks for both June 2008 and December 2008. The difference is statistically significant at the 1% level.

An alternative stock sort is undertaken based on the Bekaert, Harvey, and Lundblad (2007) stock liquidity measure $ln(1 - ZR)$, where the monthly liquidity measure is averaged over the period from July 2006 to June 2007 and the sample of all U.S. stocks is split at the median. Liquidity and small cap status have a correlation of 0.63 in the U.S. stock sample. As shown in Panel B, illiquid stocks feature a much stronger fire sales effect with a return shortfall of -28.7% for exposed stocks in June 2008, compared to only -9.3% featured by liquid stocks. This difference is statistically significant at the 1% confidence level. In unreported results, we also sort stocks based on the Amihud illiquidity measure and find similar results.[10]

An additional robustness test consists of changing the inclusion threshold for stock exposure. The analysis so far has focused on the 15% globally most exposed stocks. As argued earlier, this global threshold amounts to an effective threshold at the 29.5% quantile of stock exposure for U.S. stocks. We therefore explore whether censoring U.S. stock exposure at the 20% stock exposure cutoff or at the 35% cutoff produces similar results. The corresponding evidence is shown in Panel C of Table 8. The fire sales effect (for June 2008) of originally -12.7% (Table 4, Panel B) changes to -15.9% and

[10] The Amihud illiquidity measure requires the trading volume data, so it is available only for U.S. stocks.

-12.1% for the 20% and 35% U.S. exposure cutoff, respectively. This shows that the estimated fire sales effect is not very sensitive to our choice of the exposure cutoff.

We also explore the relationship between fund holding changes and stock liquidity in more details. We find that while more liquid stocks generally have a higher fund turnover, there is no evidence for an important interaction between stock liquidity and stock exposure — in other words, accelerated holding reductions for exposed stocks occurred across all levels of stock liquidity. Therefore, our earlier finding that distressed fire sales are more pronounced among best performing stocks cannot be explained by the liquidity effect. This result is again confirmed when we repeat the quantile regressions in Table 5 with stock liquidity measures as additional control variables: the strong dependence of the stock exposure effect on the return quantile is quantitatively unchanged.[11]

Exposed stocks differ from non-exposed stocks in their average dividend yield, price-to-book and receivable-to-sales ratios as shown in Table 3. We therefore include these stock characteristics as additional controls in the baseline regressions in Table 4. The dividend yield and price-to-book ratio show no explanatory power for the cross-section of cumulative returns. However, a higher receivable-to-sales ratio is associated with a more negative crisis return. This may not be surprising as a high receivable-to-sales ratio can proxy for those liquidity constrained firms which finance large working capital requirements in the distressed commercial paper market. Controlling for the receivable-to-sales ratio has no qualitative effect on the results reported in Table 4. Therefore, corporate liquidity problems proxied by the receivable-to-sales ratio do not account for the fire sales effect measured by the stock exposure dummy.

Time changing risk premia and/or factor loadings represent another robustness concern. Risk premia for certain factors might plausibly increase during the crisis and/or factor loadings may jointly increase (by a common factor), producing a similar scaling effect on the expected excess return to what we have documented in this paper. The return effect from either of the two changes can be captured by including stock betas as additional control variables in the cumulative return regressions of Table 4. Results reported in Panel D of Table 8 show that such a more flexible specification does not qualitatively alter the regression coefficients for the stock exposure variable. Therefore, the return evidence documented in this paper cannot be explained by premium changes for the standard risk factors. Furthermore, the risk factor based story cannot account for the parallel evidence in holding changes that we document in Section 4.3.

[11] See the Web Appendix to this paper for additional unreported robustness evidence. The Appendix is available at www.haraldhau.com or www.sandylai-research.com.

6 Conclusions

During financial crises, funding liquidity is reduced and investment losses may therefore trigger widespread fire sales of selected assets. This paper studies this phenomenon for mutual funds during the 2007 – 2008 financial crisis. Our evidence supports the view that fire sales discounts became very widespread during the crisis.

Our identification scheme is based on the return shortfall of mutual funds due to investments in financial stocks between July 1, 2007 and June 30, 2008. This initial phase of the financial crisis is marked by dramatic value losses of many bank stocks and 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 non-financial stocks. For each non-financial stock, we aggregate the underperformance of funds due to banking sector investment with their ownership share in the stock; this results in a measure of stock exposure which captures the financial distress of the stock's fund owners. The analysis carefully controls for real linkages between the banking sector and various industries using industry fixed effects.

An analysis of the 15% globally most exposed non-financial stocks reveals their dramatic risk-adjusted underperformance. Unlike Coval and Stafford (2007), we do not condition our analysis directly on fund outflows because of concerns about outflow endogeneity in the context of the crisis. Instead, we directly identify a contagion channel that originated from (*ex post*) poor asset allocation decisions in financial sector stocks. For the sample of U.S. stocks, we show that the price discount for exposed stocks peaked at 35% in late February 2009, which is strong evidence that "distressed funds" played an important role in deepening the crisis. At least 10% out of the 52% U.S. stock market index decline can be attributed to distressed selling by mutual funds.

An additional insight concerns the asset choice of distressed fund selling. The Stock Performance Dependent Fire Sales Hypothesis suggests that selling pressure should be greatest for stocks that perform relatively well during the crisis. This way, funds seek to avoid large loss realization from selling the most depressed stocks. The much stronger price effect of the exposure dummy on the best performing stocks supports this hypothesis. Paradoxically, stocks least affected by the crisis in terms of their fundamental values may thus become subject to the largest mispricing.

While ownership by distressed funds had a negative effect on stock performance during the crisis, the opposite holds for overall fund ownership, which correlates with positive excess returns. This suggests that institutional ownership generally has a stabilizing influence on a stock's crisis resilience — presumably because indirectly (mutual fund) invested capital has a lower propensity for "flight to quality" than directly invested (retail) capital. Additional evidence to support this interpretation comes from daily return data on the U.S. market index and two long-short portfolios with positive portfolio weights in stocks with the lowest fund ownership share (or highest retail volume) and negative weights in stocks with the highest fund ownership share (or lowest retail volume). U.S. stock index returns Granger cause (with a one- to two-day lag) returns on these two long-short portfolios during the financial crisis, but not prior to it. The impulse response of the long-short portfolio return to index shocks is sufficiently large to explain the significant role that the aggregate fund ownership plays for the cross-section of crisis returns. Stock-specific investor propensity for "flight to quality" is therefore an important determinant for the crisis resilience of a stock.

Overall, we conclude that the fund ownership structure at the outset of the crisis in June 2007 had a surprisingly strong effect on the crisis performance of individual stocks and stock groups. The generally positive effect of higher fund ownership is counterbalanced by the extremely poor performance of (fewer) stocks owned mostly by distressed funds. This dual result prevents us from drawing more general conclusions about the role of increasing fund investment for stock market stability during a financial crisis. Future empirical research should provide more insights into the difference between (retail) investors self-selected into funds and direct investors, and how this choice affects the consequent crisis behavior.

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, where 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 non-missing 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.

A country's international factors are calculated in a 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. 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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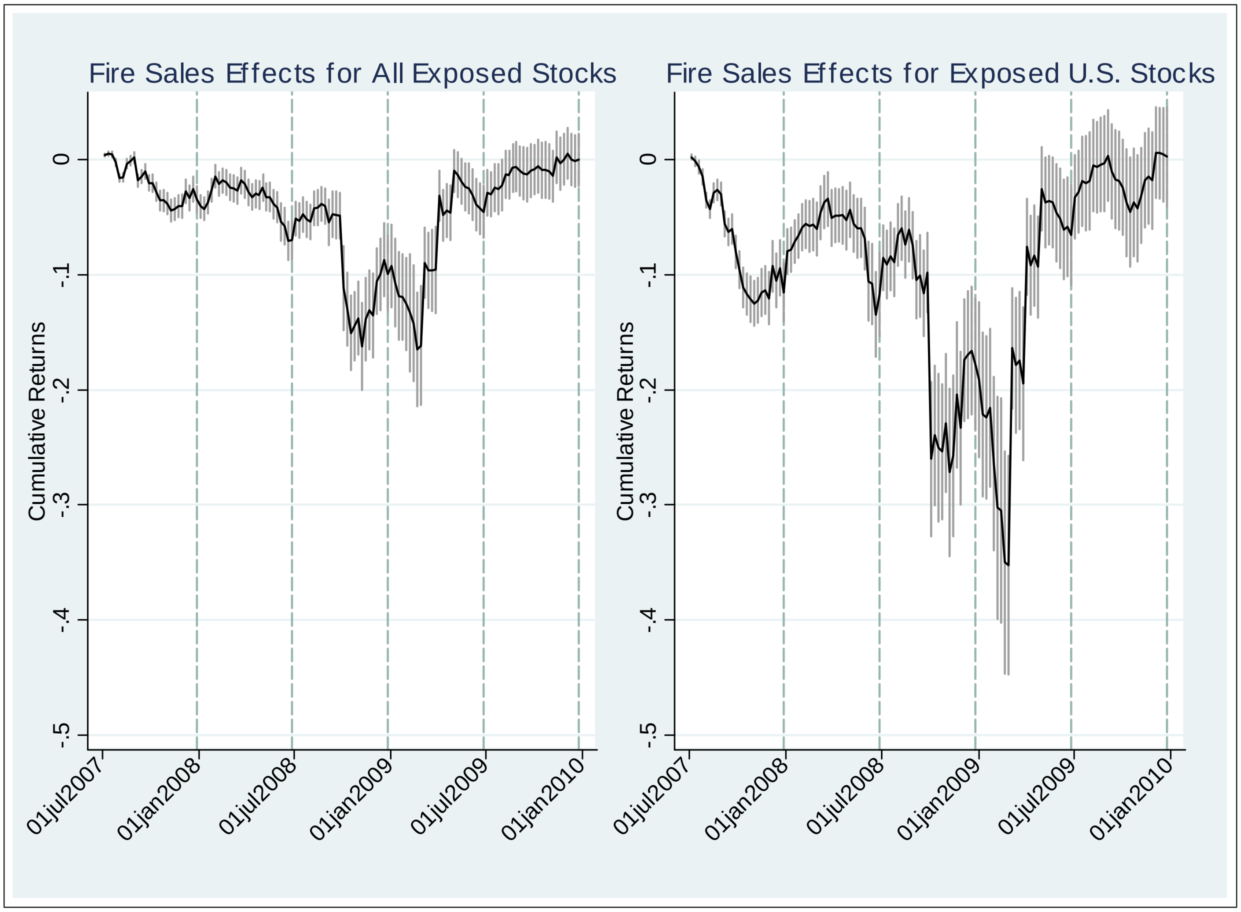

Figure 1: The graphs show the cumulative underperformance of exposed stocks worldwide and in the U.S. relative to stocks in the same country and industry and after accounting for risk premia from a model with four local and four international risk factors. Exposed stocks are the 15% of all non-financial stocks worldwide for which (weighted by stock ownership shares) fund owners experienced the highest fund return shortfall due to stock positions in financial stocks in the second semester of 2007 and first semester of 2008. The vertical bars provide robust standard errors ($\pm 1\ SE$) around the point estimate of the average cumulative underperformance.

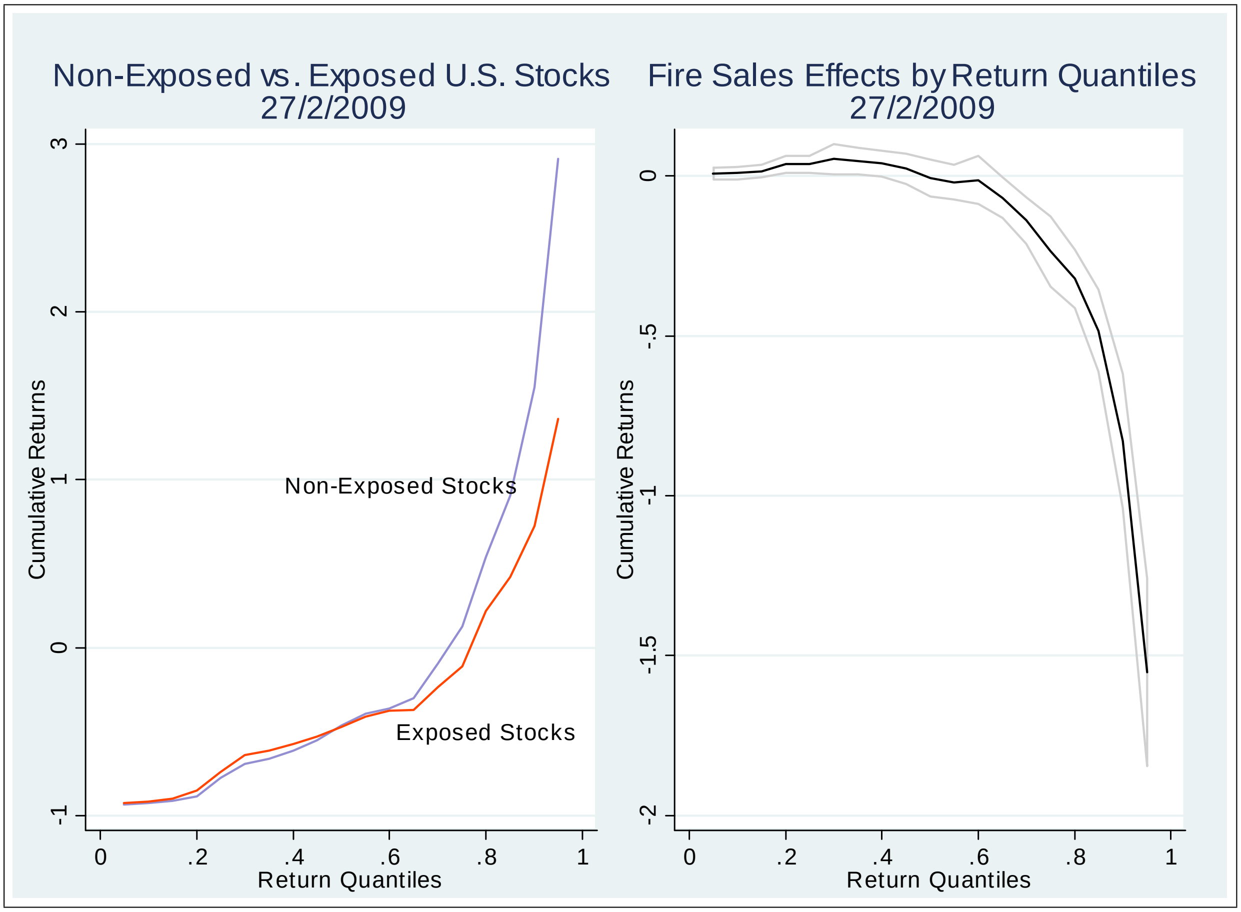

Figure 2: The graph on the left shows the relative performance of exposed and non-exposed U.S. stocks by stock return quantiles, controlling for industry fixed-effects. The y-axis denotes the cumulative (weekly) returns from June 29, 2007 to February 27, 2009, adjusting for risk premia from a model with four local and four international risk factors. The x-axis denotes the quantiles of the cumulative stock returns. The right graph plots the performance difference between the exposed and non-exposed U.S. stocks. The robust standard errors (± 1 SE) around the point estimate of the average cumulative underperformance are also plotted.

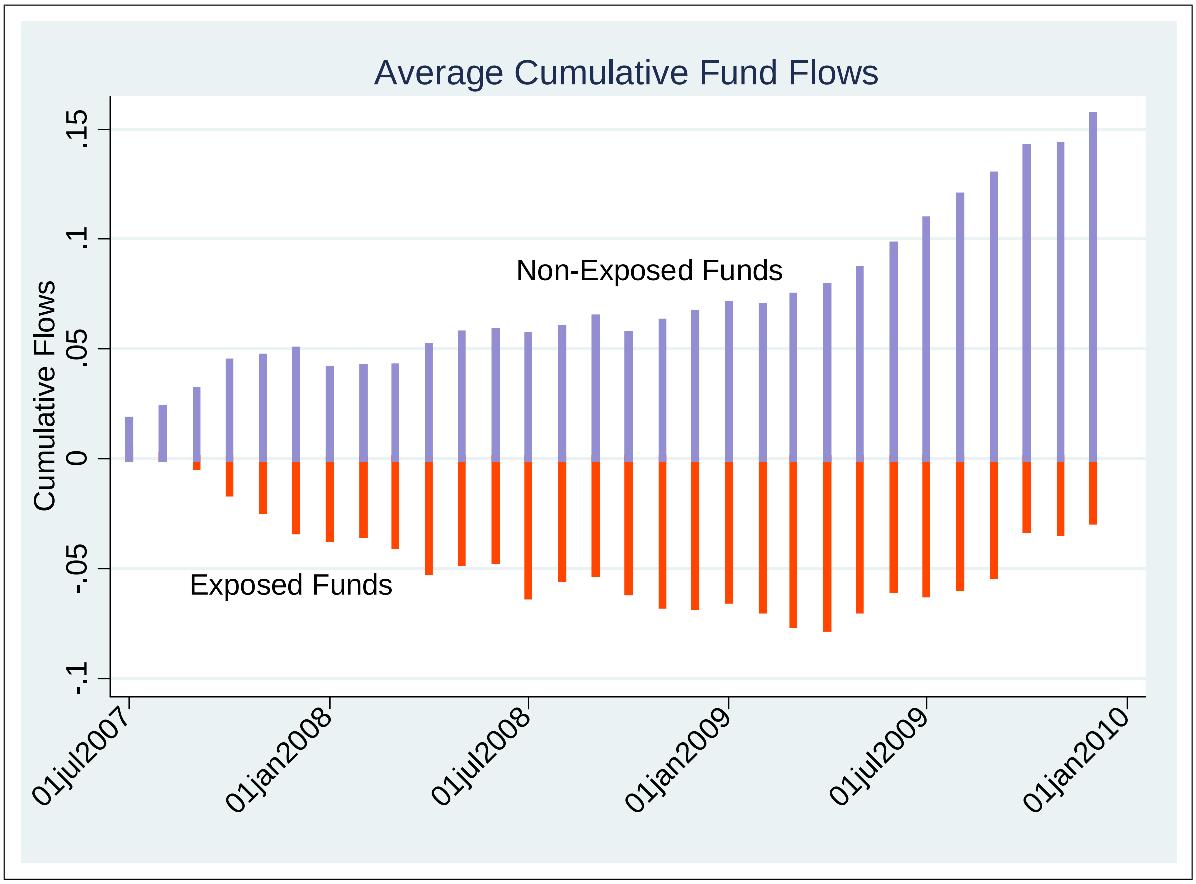

Figure 3: Plotted are the average cumulative fund flows (in percentage of total assets under management relative to holding in June 2007) for the 15% of funds with the highest investment losses in financial sector stocks (exposed funds) and the remaining 85% of funds (non-exposed funds).

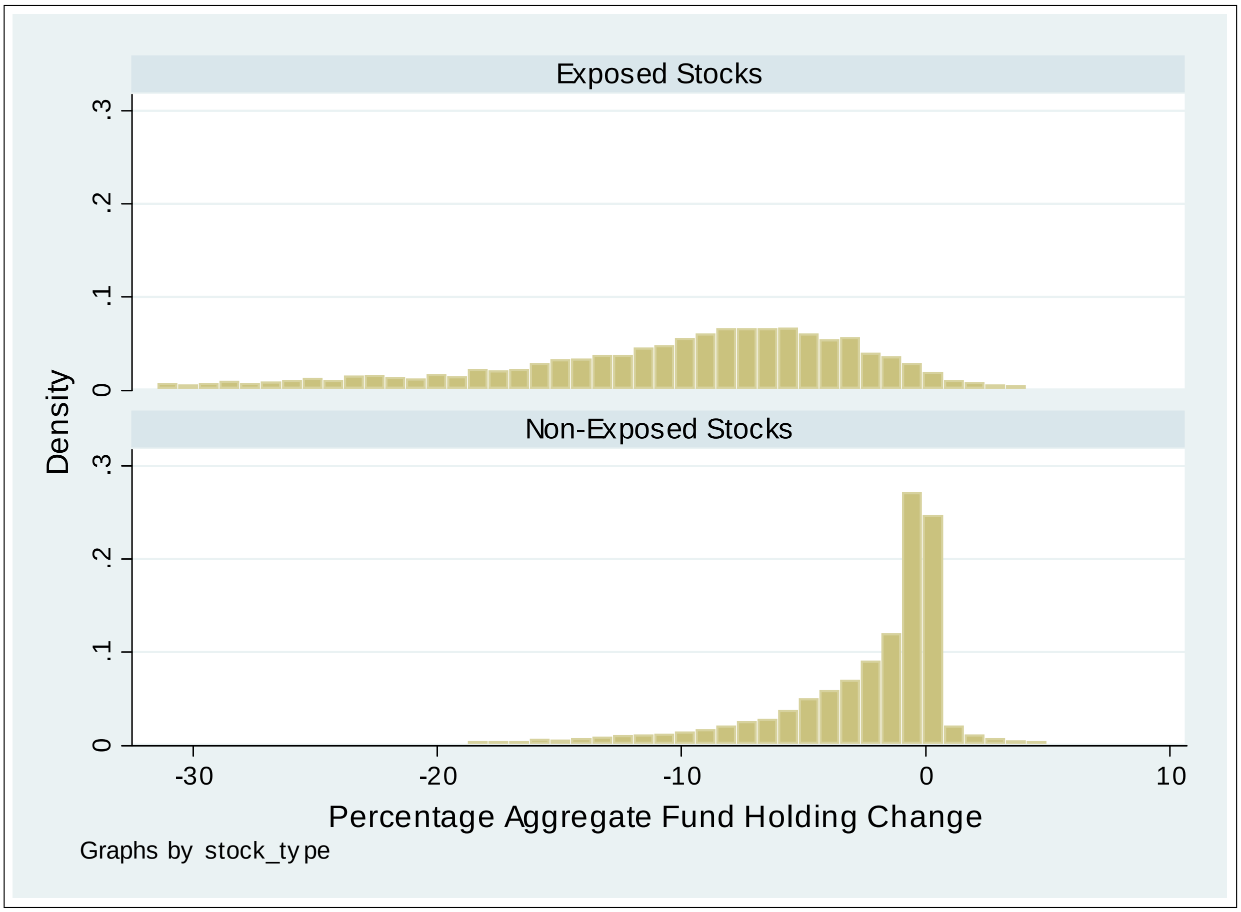

Figure 4: Plotted is the distribution of the percentage change $\Delta\widetilde{H}^s(4)$ in the aggregate stock holdings in stock s for funds with stock positions in June 2007 over four consecutive semesters. Exposed stocks are the 15% of stocks with the most distressed funds as their owners.

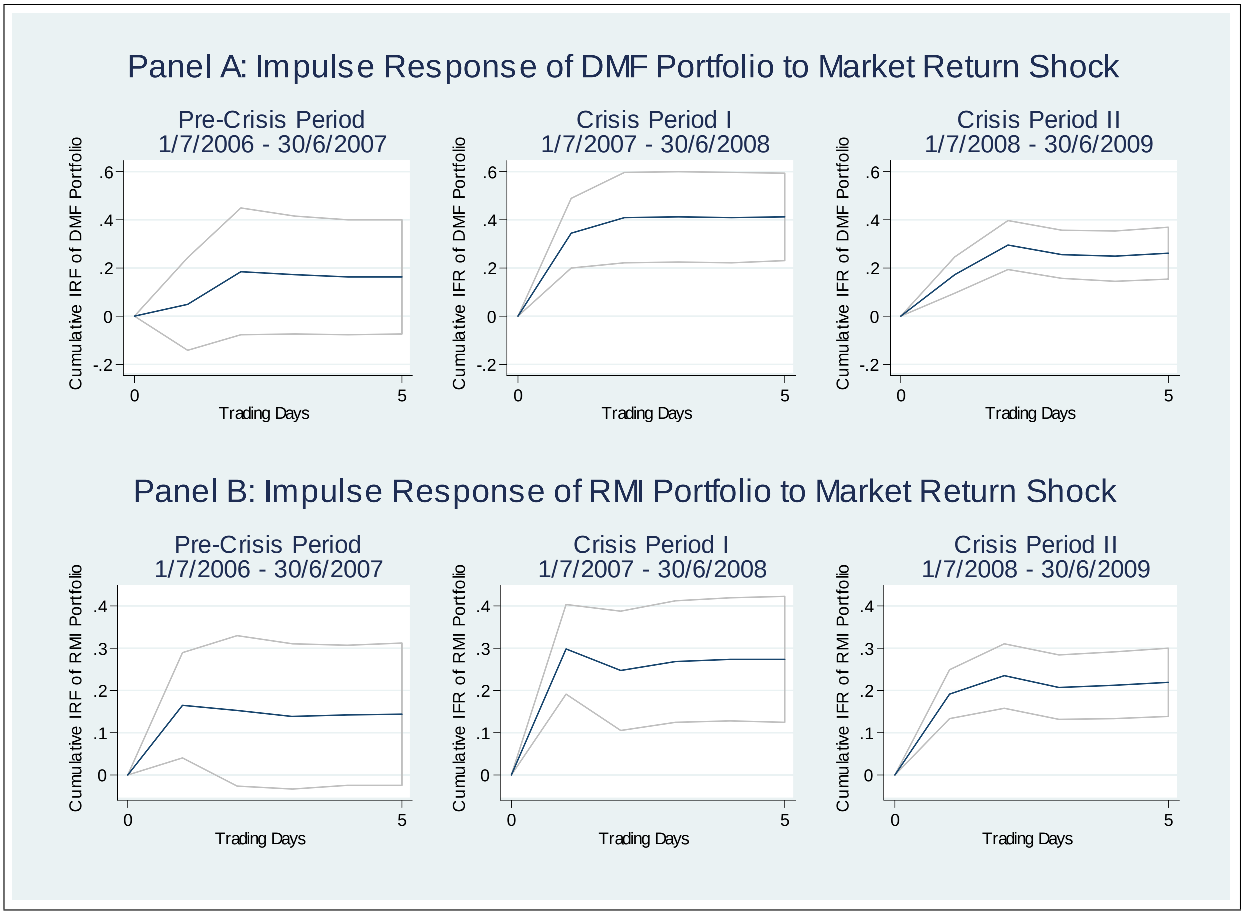

Figure 5: In Panel A, we estimated a VAR consisting of the daily MSCI return index for all U.S. stocks and in an equally weighted long-short portfolio DMF (Direct Minus Fund) consisting of the 15% of U.S. stocks with the lowest share of fund investment minus the 15% of U.S. stocks with the highest share of fund investment in June 2007. In Panel B, we use (instead of the DMF portfolio) a long-short portfolio RMI (Retail Minus Institutional) consisting of (equally weighted) long position in the 15% of NYSE stocks with the highest percentage of retail trading volume minus the 15% of stocks with the lowest percentage retail trading volume. Plotted are the cumulative impulse response functions (IRFs) for the DMF and RMI portfolio return after a unit innovation to the U.S. index return for three separate time periods. The upper and lower line provides a 95% confidence interval for the point estimates.

Table 1: Number and Size of Equity Mutual Funds by Fund Domicile

This table presents the number of funds and total net assets (in million U.S. dollars) of the sample funds by fund domicile in June 2007. A domestic fund invests only in domestic securities.

Fund Domicile	All Funds		Domestic Funds		International Funds	
	Number of Funds	TNA ($ million)	Number of Funds	TNA ($ million)	Number of Funds	TNA ($ million)
Argentina	72	121,789	1	3	71	121,786
Australia	173	61,875	36	4,704	137	57,171
Austria	180	16,680	6	309	174	16,371
Bahrain	1	7	0	0	1	7
Belgium	321	80,172	1	9	320	80,163
Bermuda	5	32,690	0	0	5	32,690
Brazil	553	2,522,445	545	2,320,667	8	201,778
Canada	785	400,222	117	35,170	668	365,052
Cayman Islands	3	59	0	0	3	59
Channel Islands	13	5,722	0	0	13	5,722
Chile	96	4,449	46	1,964	50	2,486
China	134	60,539	127	57,115	7	3,424
Cyprus	1	7	0	0	1	7
Czech Republic	8	4,581	0	0	8	4,581
Denmark	134	47,216	0	0	134	47,216
Estonia	3	1,517	0	0	3	1,517
Finland	95	14,652	1	41	94	14,611
France	808	418,337	37	5,074	771	413,264
Germany	3,074	580,628	79	16,419	2,995	564,209
Greece	123	7,865	23	2,668	100	5,197
Hong Kong	189	98,952	0	0	189	98,952
Hungary	4	333	0	0	4	333
Iceland	1	42	0	0	1	42
India	289	35,663	268	24,359	21	11,305
Ireland	119	178,834	0	0	119	178,834
Italy	173	28,906	6	316	167	28,590
Japan	509	493,747	368	427,748	141	65,999
Liechtenstein	46	4,179	0	0	46	4,179
Luxembourg	303	41,416	0	0	303	41,416
Malaysia	143	2,266	88	1,210	55	1,056
Mexico	74	8,807	56	4,631	18	4,176
Morocco	1	54	1	54	0	0
Netherlands	177	113,181	2	650	175	112,531
New Zealand	1	18	0	0	1	18
Norway	117	27,709	8	253	109	27,456
Poland	24	533,343	2	4,759	22	528,584
Portugal	102	8,554	25	1,616	77	6,938
Russia	2	235	1	28	1	206
Saudi Arabia	1	167	1	167	0	0
Singapore	249	245,811	3	120	246	245,691
South Africa	174	33,535	14	1,004	160	32,531
Spain	3,090	89,529	156	5,159	2,934	84,370
Sweden	340	160,482	1	651	339	159,831
Switzerland	618	207,109	68	44,816	550	162,292
Taiwan	197	8,864	191	8,669	6	195
Thailand	32	446	31	431	1	15
Turkey	2	37	2	37	0	0
U.S. Virgin Islands	1	119	0	0	1	119
United Kingdom	1,805	1,977,506	73	32,815	1,732	1,944,691
United States	5,112	7,363,411	1,383	1,174,411	3,729	6,189,000
Total	20,477	16,044,706	3,767	4,178,044	16,710	11,866,662

Table 2: Summary Statistics on Regression Variables

Reported are summary statistics for all non-financial stocks. 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 model with factor loadings estimated for the five-year pre-crisis period, July 2002–June 2007. Percentage change in aggregate fund holdings, $\Delta\widetilde{H}^s(k)$, states the change (over k semesters) in the sum of all fund positions in a stock s relative to the aggregate positions in June 2007. The reported summary statistics exclude the 1% highest and lowest returns and aggregate fund holdings. 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 with 1 the 15% of stocks with fund owners most exposed to financial stocks. We also define a separate measure of stock exposure $Exp^s(2007/2)$ and the corresponding dummy variable, $DExp^s(2007/2)$, which accounts only for fund losses in financial stocks for the second semester of 2007. Fund share, Fsh^s, measures the aggregate holdings of all funds in a stock as a percentage of the stock's market capitalization. The dummy variable $DFsh^s$ marks with 1 the 15% of stocks with the largest Fsh^s value.

Variable	Obs.	Mean	Median	STD	Min	Max
Cumulative Risk Adjusted Stocks Returns						
$r_s^{Ex}(1)$ (Dec. 2007)	19,233	0.053	−0.019	0.473	−0.827	3.214
$r_s^{Ex}(2)$ (June 2008)	19,100	0.045	−0.084	0.695	−0.936	5.191
$r_s^{Ex}(3)$ (Dec. 2008)	18,952	0.156	−0.183	1.409	−0.994	14.404
$r_s^{Ex}(4)$ (June 2009)	18,817	0.041	−0.172	0.980	−0.992	8.408
$r_s^{Ex}(5)$ (Dec. 2009)	18,569	0.016	−0.197	1.008	−0.996	9.130
r_s^{Ex} (Nov. 7, 2008)	18,856	0.246	−0.136	1.605	−0.988	16.672
r_s^{Ex} (Feb. 27, 2009)	18,807	0.316	−0.182	1.999	−0.995	23.219
Percentage Change in Aggregate Fund Holdings						
$\Delta\widetilde{H}^s(1)$ (Dec. 2007)	21,434	−1.468	−0.376	2.812	−17.533	4.514
$\Delta\widetilde{H}^s(2)$ (June 2008)	21,585	−2.682	−0.973	4.284	−25.130	5.306
$\Delta\widetilde{H}^s(3)$ (Dec. 2008)	20,960	−3.505	−1.394	5.204	−29.007	4.563
$\Delta\widetilde{H}^s(4)$ (June 2009)	21,234	−4.142	−1.812	5.846	−31.187	4.719
$\Delta\widetilde{H}^s(5)$ (Dec. 2009)	20,460	−4.335	−1.958	5.927	−30.828	4.488
Fund Exposure Measures						
Fund Exposure	27,268	−0.021	−0.014	0.027	−0.455	0.000
Stock Exposure Measures						
$Exp^s(2007/2) \times 100$	27,457	−0.033	0.000	0.097	−6.649	0.000
$Exp^s \times 100$	27,485	−0.108	−0.009	0.229	−10.410	0.000
$DExp^s(2007/2)$	27,457	0.150	0.000	0.357	0.000	1.000
$DExp^s$	27,485	0.150	0.000	0.357	0.000	1.000
Fund Share Measures						
Fsh^s	28,681	0.076	0.025	0.112	0.000	0.948
$DFsh^s$	28,681	0.150	0.000	0.357	0.000	1.000

Table 3: Differences between Exposed and Non-Exposed Stocks

Exposed stocks are defined as 15% of the (non-financial) stocks that have mutual fund owners who experienced large portfolio losses due to investments in the banking sector over the two semesters from July 2007 to June 2008. We compare the mean (median) of exposed and non-exposed stocks for stock capitalization (U.S. dollar value in logs), proportion of zero daily returns (ZR) and the loadings on the eight risk factors of an international asset pricing model. The last two columns report test statistics for the equality of the mean (t-test) and median (Fisher's exact test), respectively. We calculate the proportion of zero daily returns every month and then average it over the period from July 2006 to June 2007. The factor loadings for each stock are estimated for the period July 1, 2002 to June 30, 2007. The factors are the market factor (MKT_t), the firm size factor (SMB_t), the value factor (HML_t), and the momentum factor (MOM_t). Domestic factors are estimated based on all local stocks and international factors are the weighted average of all international factors exclusive of home country factors with weights given by the market capitalization of each country at the beginning of the year. Dividend yield and the receivable-to-sales ratio are based on the latest fiscal year-end data prior to July 2007 available in the Compustat database. The price-to-book ratio are based on the data in June 2007 from Datastream.

	Exposed Stocks			Non-Exposed Stocks			Difference Test	
Variable	Obs.	Mean	Median	Obs.	Mean	Median	Mean (t-stat.)	Median (p-value)
Capitalization (log)								
All Stocks	4,122	21.076	21.059	20,965	18.978	18.945	−61.40	0.00
U.S. Stocks	1,447	21.273	21.120	3,459	18.450	18.693	−38.58	0.00
DM Stocks	1,781	21.104	21.235	11,665	18.929	18.796	−44.62	0.00
EM Stocks	894	20.702	20.667	5,841	19.389	19.359	−19.97	0.00
Proportion of Zero Daily Returns (ZR)								
All Stocks	4,112	0.100	0.051	20,704	0.234	0.140	34.12	0.00
U.S. Stocks	1,443	0.035	0.019	3,385	0.191	0.077	23.15	0.00
DM Stocks	1,777	0.142	0.074	11,533	0.243	0.161	17.72	0.00
EM Stocks	892	0.122	0.068	5,786	0.241	0.137	13.41	0.00
Dom. Loadings								
MKT_t^{Dom}	3,595	0.886	0.853	16,167	0.844	0.799	−1.32	0.00
SMB_t^{Dom}	3,595	0.589	0.436	16,167	0.991	0.805	13.88	0.00
HML_t^{Dom}	3,595	0.219	0.218	16,167	0.319	0.306	3.43	0.00
MOM_t^{Dom}	3,595	−0.065	−0.006	16,167	−0.075	−0.014	−0.37	0.56
Intern. Loadings								
MKT_t^{Int}	3,595	0.157	0.083	16,167	0.080	0.038	−2.55	0.01
SMB_t^{Int}	3,595	0.100	0.068	16,167	0.315	0.136	4.78	0.00
HML_t^{Int}	3,595	0.171	0.138	16,167	0.328	0.187	2.57	0.10
MOM_t^{Int}	3,595	−0.041	−0.002	16,167	−0.037	−0.017	0.11	0.42
U.S. Stock Characteristics								
Dividend Yield	1,398	0.012	0.002	2,353	0.009	0.000	−0.92	0.00
Price-to-Book	1,391	3.019	2.289	2,649	3.855	2.651	7.46	0.00
Receivable-to-Sales	1,371	0.174	0.148	2,220	0.210	0.155	2.77	0.05

Table 4: 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 different dummy variables. The dummy variable $DExp^s$ marks with 1 the 15% of stocks with fund owners most exposed to financial stocks. Fund exposure 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. For the first regression in column (1), the contemporaneous exposure measure is $DExp^s(2007/2)$, which is based on the return loss in financial stocks over only six months from July 1, 2007 to December 31, 2007. The dummy variable $DFsh^s$ marks with 1 the 15% of stocks with the highest share of fund ownership relative to stock market capitalization in June 2007. All regressions include fixed effects for each country, each industry and their interaction. Discarded as observations are the 1% highest and lowest cumulative return observations. Reported in brackets are the t-values based on robust standard errors.

Panel A: All Stocks

	Cumulative Risk Adjusted Returns (by)				
	Dec. 2007	June 2008	Dec. 2008	June 2009	Dec. 2009
$DExp^s(2007/2)$	−0.038				
	[−3.25]				
$DExp^s$		−0.072	−0.097	−0.051	0.003
		[−4.18]	[−2.88]	[−2.21]	[0.15]
$DFsh^s$	−0.002	0.068	0.069	0.099	0.100
	[−0.16]	[3.36]	[1.75]	[3.59]	[3.45]
Obs.	19,208	19,076	18,928	18,793	18,548
$Adj.R^2$	0.029	0.047	0.038	0.056	0.041

Panel B: U.S. Stocks

	Cumulative Risk Adjusted Returns (by)				
	Dec. 2007	June 2008	Dec. 2008	June 2009	Dec. 2009
$DExp^s(2007/2)$	−0.118				
	[−4.59]				
$DExp^s$		−0.127	−0.169	−0.084	0.001
		[−3.44]	[−2.82]	[−1.85]	[0.02]
$DFsh^s$	0.079	0.167	0.150	0.186	0.174
	[3.04]	[4.34]	[2.28]	[3.84]	[3.69]
Obs.	3,813	3,722	3,612	3,494	3,269
$Adj.R^2$	0.026	0.050	0.012	0.028	0.037

Table 4: Continued

Panel C: Developed Market Stocks ex U.S.					
	Cumulative Risk Adjusted Returns (by)				
	Dec. 2007	June 2008	Dec. 2008	June 2009	Dec. 2009
$DExp^s(2007/2)$	−0.012				
	[−1.04]				
$DExp^s$		−0.038	−0.060	−0.036	0.001
		[−1.68]	[−1.15]	[−1.04]	[0.03]
$DFsh^s$	−0.030	−0.022	−0.046	0.027	0.026
	[−2.07]	[−0.84]	[−0.81]	[0.67]	[0.58]
Obs.	10,487	10,443	10,412	10,387	10,370
$Adj.R^2$	0.021	0.031	0.036	0.058	0.019

Panel D: Emerging Market Stocks					
	Cumulative Risk Adjusted Returns (by)				
	Dec. 2007	June 2008	Dec. 2008	June 2009	Dec. 2009
$DExp^s(2007/2)$	0.058				
	[1.37]				
$DExp^s$		−0.073	−0.082	−0.047	0.001
		[−2.39]	[−1.27]	[−1.25]	[0.03]
$DFsh^s$	−0.061	0.104	0.286	0.111	0.152
	[−2.28]	[2.51]	[2.99]	[1.97]	[2.72]
Obs.	4,908	4,911	4,904	4,912	4,909
$Adj.R^2$	0.108	0.145	0.100	0.146	0.163

Table 5: Quantile Regressions for Cumulative Stock Returns

Reported are quantile regressions for the cumulative (weekly) stock returns starting from June 29, 2007 to November 7, 2008 and February 27, 2009. The dummy variable $DExp^s$ (marking the 15% of stocks with the highest exposure to distressed funds) and the dummy $DFsh^s$ (marking the 15% of stocks with the highest fund share) are the same as in Table 2. Their explanatory power is reported for the 25%, 50%, 75%, 90%, and 95% quantile of the cumulative stock returns. Regressions for all stocks include fixed effects for each country. Regressions for the U.S. stocks and for the non-U.S. stocks include industry fixed effects. Reported in brackets are the t-values based on bootstrapped standard errors.

	Cumulative Risk Adjusted Returns					
	All Stocks		U.S. Stocks		Non-U.S. Stocks	
	Nov. 2008	Feb. 2009	Nov. 2008	Feb. 2009	Nov. 2008	Feb. 2009
Quantile 25%						
$DExp^s$	0.064	0.063	0.066	0.037	0.018	0.039
	[7.35]	[4.38]	[1.82]	[1.03]	[1.34]	[3.71]
$DFsh^s$	0.082	0.085	0.184	0.188	0.031	−0.015
	[5.25]	[4.47]	[5.64]	[5.61]	[1.48]	[−0.91]
Quantile 50%						
$DExp^s$	0.027	0.039	0.009	−0.007	−0.005	0.013
	[2.02]	[2.23]	[0.19]	[−0.14]	[−0.27]	[0.79]
$DFsh^s$	0.096	0.121	0.202	0.254	0.039	0.018
	[4.50]	[5.23]	[4.09]	[6.01]	[1.56]	[0.70]
Quantile 75%						
$DExp^s$	−0.086	−0.102	−0.157	−0.236	−0.051	−0.057
	[−3.28]	[−2.94]	[−2.24]	[−2.61]	[−1.89]	[−1.85]
$DFsh^s$	0.049	0.105	0.075	0.316	0.020	0.029
	[1.43]	[2.24]	[0.92]	[3.78]	[0.71]	[0.63]
Quantile 90%						
$DExp^s$	−0.391	−0.429	−0.696	−0.829	−0.177	−0.183
	[−5.04]	[−4.13]	[−4.21]	[−7.72]	[−1.75]	[−1.72]
$DFsh^s$	−0.088	−0.087	−0.056	0.188	0.102	0.201
	[−1.39]	[−0.83]	[−0.31]	[1.02]	[0.93]	[1.17]
Quantile 95%						
$DExp^s$	−0.774	−0.972	−1.140	−1.552	−0.403	−0.079
	[−4.13]	[−6.96]	[−4.23]	[−4.91]	[−2.70]	[−0.37]
$DFsh^s$	−0.358	−0.257	−0.438	−0.058	0.328	0.099
	[−1.93]	[−1.26]	[−1.39]	[−0.21]	[2.06]	[0.46]
Obs.	18,832	18,783	3,562	3,525	15,270	15,258
Q25% *Pseudo* R^2	0.037	0.027	0.058	0.049	0.027	0.025
Q50% *Pseudo* R^2	0.024	0.014	0.042	0.044	0.022	0.022
Q75% *Pseudo* R^2	0.023	0.013	0.036	0.043	0.031	0.030
Q90% *Pseudo* R^2	0.036	0.032	0.083	0.113	0.057	0.050
Q95% *Pseudo* R^2	0.051	0.048	0.161	0.195	0.083	0.069

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 four consecutive semesters is regressed on two-to-four different dummy variables. The dummy variable $DExp^s$ marks with 1 the 15% of stocks with fund owners most exposed to financial stocks. 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. For the first regression in column (1), the contemporaneous exposure measure is $DExp^s(2007/2)$, which is based on the return loss in financial stocks over only six months from July 1, 2007 to December 31, 2007. The dummy variable $DFsh^s$ marks the 15% of stocks with the highest share of fund ownership relative to stock market capitalization in June 2007. The dummy $DHighR$ marks the 25% of stocks with the highest cumulative return over the k semesters 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 fixed effects for each country, each industry, and their interaction. Discarded as observations are the 1% highest and lowest percentage holding changes. Reported in brackets are the t-values based on robust standard errors.

Panel A: All Stocks

	Percentage Change in Aggregate Fund Holdings							
	Dec. 2007		June 2008		Dec. 2008		June 2009	
$DExp^s(2007/2)$	−1.058	−0.929						
	[−12.65]	[−10.33]						
$DExp^s$			−1.870	−1.629	−2.274	−1.789	−2.712	−2.313
			[−15.41]	[−12.15]	[−16.36]	[−11.55]	[−18.03]	[−13.75]
$DFsh^s$	−2.095	−2.110	−4.482	−4.515	−6.285	−6.325	−7.506	−7.535
	[−22.67]	[−22.89]	[−33.00]	[−33.35]	[−40.70]	[−41.09]	[−44.42]	[−44.74]
$DHighR$		−0.077		−0.403		−0.430		−0.514
		[−1.70]		[−6.27]		[−5.72]		[−6.32]
$DExp^s$ $\times DHighR$		−0.410		−0.771		−1.432		−1.197
		[−2.75]		[−3.74]		[−6.06]		[−4.74]
Obs.	21,434	21,434	21,585	21,585	20,959	20,959	21,234	21,234
Adj.R^2	0.180	0.181	0.304	0.308	0.387	0.392	0.424	0.428

Panel B: U.S. Stocks

	Percentage Change in Aggregate Fund Holdings							
	Dec. 2007		June 2008		Dec. 2008		June 2009	
$DExp^s(2007/2)$	−0.853	−0.836						
	[−4.90]	[−4.59]						
$DExp^s$			−0.721	−0.618	−0.811	−0.141	−1.007	−0.241
			[−2.70]	[−2.19]	[−2.62]	[−0.43]	[−3.00]	[−0.67]
$DFsh^s$	−2.320	−2.345	−5.444	−5.508	−7.590	−7.684	−8.839	−8.920
	[−13.54]	[−13.80]	[−23.17]	[−23.78]	[−28.34]	[−29.07]	[−30.52]	[−31.16]
$DHighR$		−0.419		−1.019		−0.806		−0.867
		[−3.72]		[−6.32]		[−4.52]		[−4.46]
$DExp^s$ $\times DHighR$		−0.243		−0.634		−2.198		−2.410
		[−1.00]		[−1.67]		[−5.11]		[−5.26]
Obs.	4,313	4,313	4,325	4,325	4,270	4,270	4,261	4,261
Adj.R^2	0.185	0.189	0.298	0.308	0.364	0.376	0.387	0.398

Table 6: Continued

Panel C: Non-U.S. Stocks								
	Percentage Change in Aggregate Fund Holdings							
	Dec. 2007		June 2008		Dec. 2008		June 2009	
$DExp^s(2007/2)$	−1.139	−1.037						
	[−12.71]	[−10.37]						
$DExp^s$			−2.351	−2.130	−2.883	−2.557	−3.429	−3.291
			[−18.71]	[−14.91]	[−20.37]	[−15.88]	[−22.51]	[−19.17]
$DFsh^s$	−1.992	−1.995	−4.005	−4.018	−5.617	−5.628	−6.867	−6.880
	[−17.66]	[−17.68]	[−23.43]	[−23.53]	[−29.09]	[−29.20]	[−32.27]	[−32.38]
$DHighR$		0.019		−0.194		−0.273		−0.366
		[0.39]		[−2.94]		[−3.59]		[−4.44]
$DExp^s$		−0.313		−0.657		−0.927		−0.425
$\times DHighR$		[−1.77]		[−2.75]		[−3.49]		[−1.51]
Obs.	17,121	17,121	17,260	17,260	16,689	16,689	16,973	16,973
$Adj.R^2$	0.173	0.173	0.293	0.295	0.377	0.380	0.422	0.424

Table 7: Portfolio Overlap 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 stocks. For any pair of funds (f_1, f_2), we define portfolio overlap in the non-financial sector as

$$Overlap(f_1, f_2) = \sum_{s \,\in\, Non-Financials} \min[w^{f_1,s}, w^{f_2,s}],$$

where $\widehat{w}^{f_1,s}$ and $\widehat{w}^{f_2,s}$ represent the portfolio share in non-financial stock s of funds f_1 and f_2, respectively. 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 group. We test of equality of the distribution using the median test and the Wilcoxon-Mann-Whitney ranksum test.

	$Overlap(f_1, f_2)$ Between all Pairs of Two Exposed Stocks (1)	$Overlap(f_1, f_2)$ Between all Pairs of Exp. and Non-Exp. Stocks (2)
Percentiles		
1%	0.000	0.000
5%	0.000	0.000
10%	0.000	0.000
25%	0.000	0.000
50%	0.009	0.002
75%	0.089	0.038
90%	0.164	0.104
95%	0.204	0.148
99%	0.286	0.238
Obs.	$299,925$	$600,625$
Mean	0.052	0.030
STD	0.075	0.054
Skewness	1.966	2.634
Kurtosis	9.078	12.297
Percentage zeros	40.5%	46.3%
Median Test	$\chi^2(1) = 4002.88$	
	$p = 0.00$	
Wilcoxon Test	$z = 106.70$	
	$p = 0.00$	

Table 8: Robustness

The return regressions in Table 4 are repeated for different subsamples of U.S. stocks and for alternative stock exposure definitions. Panel A labels small caps all stocks smaller than the 10% size quantile of NYSE listed stocks in June 2007. In Panel B, we sort stocks based on the liquidity measure into liquid (illiquid) stocks above (below) the median liquidity. The liquidity measure is calculated as $ln(1-ZR)$, where ZR is the proportion of zero daily returns. We calculate ZR every month and then average it over the period from July 2006 to June 2007. Panel C reports regression results for the 20% and 35% most exposed U.S. stocks compared to the effective 29.5% cutoff for U.S. stocks in Table 4, Panel B, when defining $DExp^s$ based on the 15% most exposed stocks globally.

Panel A: Stock Capitalization

	Cumulative Risk Adjusted Returns			
	Large and Mid Caps		Small Caps	
	June 2008	Dec. 2008	June 2008	Dec. 2008
$DExp^s$	−0.116	−0.142	−0.198	−0.321
	[−2.56]	[−2.04]	[−2.93]	[−2.64]
$DFsh^s$	0.184	0.056	0.068	0.053
	[3.17]	[0.62]	[1.08]	[0.44]
Obs.	1,737	1,707	1,985	1,905
$Adj.R^2$	0.113	0.049	0.029	−0.002

Panel B: Stock Liquidity

	Cumulative Risk Adjusted Returns			
	Liquid Stocks		Illiquid Stocks	
	June 2008	Dec. 2008	June 2008	Dec. 2008
$DExp^s$	−0.093	−0.151	−0.287	−0.390
	[−2.25]	[−2.18]	[−3.40]	[−2.92]
$DFsh^s$	0.153	0.108	0.134	0.049
	[2.97]	[1.30]	[1.64]	[0.36]
Obs.	1,960	1,921	1,730	1,661
$Adj.R^2$	0.120	0.045	0.001	0.003

Panel C: Alternative Exposure Definitions

	Cumulative Risk Adjusted Returns			
	20% Cutoff		35% Cutoff	
	June 2008	Dec. 2008	June 2008	Dec. 2008
$DExp^s$	−0.159	−0.149	−0.121	−0.183
	[−4.84]	[−2.81]	[−2.94]	[−2.80]
$DFsh^s$	0.167	0.120	0.174	0.174
	[4.86]	[2.03]	[4.17]	[2.58]
Obs.	3,722	3,612	3,722	3,612
$Adj.R^2$	0.052	0.011	0.050	0.012

Panel D: Control for Factor Betas

	Cumulative Risk Adjusted Returns			
	Market Beta Only		All Betas	
	June 2008	Dec. 2008	June 2008	Dec. 2008
$DExp^s$	−0.127	−0.146	−0.089	−0.120
	[−3.50]	[−2.71]	[−3.07]	[−2.47]
$DFsh^s$	0.149	0.153	0.148	0.116
	[3.91]	[2.53]	[4.69]	[2.16]
Obs.	3,722	3,612	3,722	3,612
$Adj.R^2$	0.078	0.158	0.384	0.356

Web Appendix

The Role of Equity Funds in the Financial Crisis Propagation

Supplement not for Journal Publication

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May 7, 2011

Web Appendix

The Role of Equity Funds in the Financial Crisis Propagation

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Table A1: Pre-Crisis Performance Differences Between Exposed and Non-Exposed Funds

Of the U.S. funds which we were able to match with the Lipper database in June 2007, we labeled 403 funds as "exposed" due to large fund return losses from financial stock investments and 2391 as "non-exposed" funds. For 284 (70.5%) of the exposed funds and 1721 (72.0%) of the non-exposed funds, we are able to obtain a complete 3 year pre-crisis performance history of monthly total fund returns, from July 2003 to June 2006. We report a mean and median test of performance differences across the two fund groups based on (i) unadjusted raw fund returns, and (ii) fund alphas for a four U.S. factor model (market, BMS, HML, and momentum).

		Exposed Funds			Non-Exposed Funds			Difference Tests	
		Obs.	Mean $\times 100$	Median $\times 100$	Obs.	Mean $\times 100$	Median $\times 100$	Mean $T-stat$	Median χ^2
(i)	Raw returns	284	1.203	1.123	1,721	1.267	1.203	1.81	6.42
(ii)	α for four U.S. factors	284	0.013	−0.037	1,721	0.043	−0.011	1.30	2.34

Table A2: Quantile Regressions for Cumulative Stock Return Regressions with Liquidity Controls

Reported are quantile regressions for the cumulative (weekly) stock returns starting from June 29, 2007 to November 7, 2008 and February 27, 2009. The dummy variable $DExp^s$ (marking the 15% of stocks with the highest exposure to distressed funds) and the dummy $DFsh^s$ (marking the 15% of stocks with the highest funds share) are the same as in Table 2. The dummy variable $DLiq^s$ marks the 15% most liquid stocks, where the liquidity measure is calculated as $ln(1-ZR)$ and ZR is the proportion of zero daily returns. The last two columns use $ln(1-ZR)$ instead of $DLiq^s$ as the liquidity control variable. Their explanatory power is reported for the 25%, 50%, 75%, 90%, and 95% quantile of the cumulative stock returns. All regressions include industry fixed effects. Reported in brackets are the t-values based on bootstrapped standard errors.

	Cumulative Risk Adjusted Returns					
	U.S. Stocks		U.S. Stocks		U.S. Stocks	
	Nov. 2008	Feb. 2009	Nov. 2008	Feb. 2009	Nov. 2008	Feb. 2009
Liquidity Control	none		$DLiq^s$		$ln(1-ZR)$	
Quantile 25%						
$DExp^s$	0.066	0.037	0.040	0.024	0.074	0.052
	[1.82]	[1.03]	[1.12]	[0.80]	[2.39]	[1.50]
$DFsh^s$	0.184	0.188	0.078	0.072	0.177	0.188
	[5.64]	[5.61]	[2.21]	[3.47]	[5.50]	[7.39]
$DLiq^s$ or $ln(1-ZR)$			0.187	0.184	−0.008	−0.026
			[4.75]	[6.71]	[−0.22]	[−0.99]
Quantile 50%						
$DExp^s$	0.009	−0.007	−0.041	−0.051	0.017	0.003
	[0.19]	[−0.14]	[−1.07]	[−0.95]	[0.48]	[0.08]
$DFsh^s$	0.202	0.254	0.063	0.096	0.206	0.255
	[4.09]	[6.01]	[1.36]	[2.61]	[5.74]	[6.06]
$DLiq^s$ or $ln(1-ZR)$			0.260	0.317	−0.028	−0.044
			[7.79]	[6.74]	[−0.83]	[−1.20]
Quantile 75%						
$DExp^s$	−0.157	−0.236	−0.235	−0.265	−0.144	−0.228
	[−2.24]	[−2.61]	[−3.13]	[−2.93]	[−3.02]	[−2.35]
$DFsh^s$	0.075	0.316	0.038	0.157	0.115	0.357
	[0.92]	[3.78]	[0.58]	[1.62]	[2.09]	[3.95]
$DLiq^s$ or $ln(1-ZR)$			0.195	0.331	−0.182	−0.176
			[2.83]	[3.87]	[−1.65]	[−1.38]
Quantile 90%						
$DExp^s$	−0.696	−0.829	−0.696	−0.874	−0.659	−0.768
	[−4.21]	[−7.72]	[−4.11]	[−3.76]	[−4.27]	[−4.91]
$DFsh^s$	−0.056	0.188	0.029	0.184	0.215	0.302
	[−0.31]	[1.02]	[0.17]	[0.68]	[1.67]	[1.67]
$DLiq^s$ or $ln(1-ZR)$			−0.102	0.059	−1.018	−0.344
			[−0.63]	[0.30]	[−1.69]	[−0.82]
Quantile 95%						
$DExp^s$	−1.140	−1.552	−0.899	−1.552	−0.968	−1.465
	[−4.23]	[−4.91]	[−3.33]	[−4.25]	[−4.03]	[−4.51]
$DFsh^s$	−0.438	−0.058	−0.190	0.113	0.108	0.266
	[−1.39]	[−0.21]	[−0.62]	[0.34]	[0.43]	[0.86]
$DLiq^s$ or $ln(1-ZR)$			−0.608	−0.173	−2.600	−0.939
			[−1.92]	[−0.40]	[−2.40]	[−0.84]
Obs.	3,562	3,525	3,540	3,504	3,540	3,504
Q25% *Pseudo* R^2	0.058	0.049	0.063	0.055	0.058	0.049
Q50% *Pseudo* R^2	0.042	0.044	0.047	0.050	0.042	0.044
Q75% *Pseudo* R^2	0.036	0.043	0.038	0.045	0.038	0.043
Q90% *Pseudo* R^2	0.083	0.113	0.084	0.112	0.090	0.113
Q95% *Pseudo* R^2	0.161	0.195	0.159	0.196	0.177	0.200

Table A3: OLS Regressions for Cumulative Stock Returns with Added Risk Factors

Panel A reproduces the baseline results for U.S. stocks reported in Table 4. Panels B and C include additional control variables of domestic and international market betas and size betas, respectively. Panel D controls for all 8 betas.

Panel A: Baseline Results for U.S. Stocks (Table 4)					
	Cumulative Risk Adjusted Returns (by)				
	Dec. 2007	June 2008	Dec. 2008	June 2009	Dec. 2009
$DExp^s(2007/2)$	−0.118				
	[−4.59]				
$DExp^s$		−0.127	−0.169	−0.084	0.001
		[−3.44]	[−2.82]	[−1.85]	[0.02]
$DFsh^s$	0.079	0.167	0.150	0.186	0.174
	[3.04]	[4.34]	[2.28]	[3.84]	[3.69]
Obs.	3,813	3,722	3,612	3,494	3,269
$Adj.R^2$	0.026	0.050	0.012	0.028	0.037
Added Risk Factors					
MKT_t^{Dom}, MKT_t^{Int}	no	no	no	no	no
SMB_t^{Dom}, SMB_t^{Int}	no	no	no	no	no
HML_t^{Dom}, HML_t^{Int}	no	no	no	no	no
MOM_t^{Dom}, MOM_t^{Int}	no	no	no	no	no

Panel B: Market Betas as Added Controls					
	Cumulative Risk Adjusted Returns (by)				
	Dec. 2007	June 2008	Dec. 2008	June 2009	Dec. 2009
$DExp^s(2007/2)$	−0.121				
	[−4.95]				
$DExp^s$		−0.127	−0.146	−0.066	0.013
		[−3.50]	[−2.71]	[−1.64]	[0.34]
$DFsh^s$	0.054	0.149	0.153	0.125	0.141
	[2.14]	[3.91]	[2.53]	[2.86]	[3.08]
Obs.	3,813	3,722	3,612	3,494	3,269
$Adj.R^2$	0.098	0.078	0.158	0.244	0.139
Added Risk Factors					
MKT_t^{Dom}, MKT_t^{Int}	yes	yes	yes	yes	yes
SMB_t^{Dom}, SMB_t^{Int}	no	no	no	no	no
HML_t^{Dom}, HML_t^{Int}	no	no	no	no	no
MOM_t^{Dom}, MOM_t^{Int}	no	no	no	no	no

Table A3(Continued)

Panel C: SMB Betas as Added Controls

	Cumulative Risk Adjusted Returns (by)				
	Dec. 2007	June 2008	Dec. 2008	June 2009	Dec. 2009
$DExp^s(2007/2)$	-0.079				
	$[-3.28]$				
$DExp^s$		-0.092	-0.162	-0.125	-0.041
		$[-2.60]$	$[-2.73]$	$[-2.83]$	$[-0.98]$
$DFsh^s$	0.126	0.224	0.275	0.221	0.207
	[5.18]	[6.03]	[4.42]	[4.73]	[4.62]
Obs.	$3,813$	$3,722$	$3,612$	$3,494$	$3,269$
Adj.R^2	0.134	0.111	0.090	0.110	0.115
Added Risk Factors					
MKT_t^{Dom}, MKT_t^{Int}	no	no	no	no	no
SMB_t^{Dom}, SMB_t^{Int}	yes	yes	yes	yes	yes
HML_t^{Dom}, HML_t^{Int}	no	no	no	no	no
MOM_t^{Dom}, MOM_t^{Int}	no	no	no	no	no

Panel D: Market, SMB, HML, and MOM Betas as Added Controls

	Cumulative Risk Adjusted Returns (by)				
	Dec. 2007	June 2008	Dec. 2008	June 2009	Dec. 2009
$DExp^s(2007/2)$	-0.087				
	$[-4.51]$				
$DExp^s$		-0.089	-0.120	-0.092	-0.055
		$[-3.07]$	$[-2.47]$	$[-2.43]$	$[-1.55]$
$DFsh^s$	0.086	0.148	0.116	0.079	0.052
	[4.34]	[4.69]	[2.16]	[1.84]	[1.26]
Obs.	$3,813$	$3,722$	$3,612$	$3,494$	$3,269$
Adj.R^2	0.414	0.384	0.356	0.342	0.330
Added Risk Factors					
MKT_t^{Dom}, MKT_t^{Int}	yes	yes	yes	yes	yes
SMB_t^{Dom}, SMB_t^{Int}	yes	yes	yes	yes	yes
HML_t^{Dom}, HML_t^{Int}	yes	yes	yes	yes	yes
MOM_t^{Dom}, MOM_t^{Int}	yes	yes	yes	yes	yes

Table A4: Fund Ownership Distribution by Stock Type

We report the distribution of the number of U.S. funds holding a U.S. stock (columns (1)-(3)), an exposed U.S. stock (columns (4)-(6)), or a non-exposed U.S. stock (columns (7)-(9)) in June 2007. We distinguish between all funds owners, exposed funds owners, and non-exposed funds owners, respectively. 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. We exclude from the sample funds which invest more than 75% of capital in the banking sector. The 15% of funds with the largest fund exposure are marked as exposed funds and the remaining 85% as non-exposed funds.

	All U.S. Stocks			Exposed U.S. Stocks			Non-Exposed U.S. Stocks		
	All Fund Owners	Exp. Fund Owners	Non-Exp. Fund Owners	All Fund Owners	Exp. Fund Owners	Non-Exp. Fund Owners	All Fund Owners	Exp. Fund Owners	Non-Exp. Fund Owners
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Percentile									
p1	1	0	1	6	1	5	1	0	1
p5	1	0	1	35	4	30	1	0	1
p10	2	0	2	66	6	57	1	0	1
p25	10	1	9	122	11	107	5	0	5
p50	56	5	51	187	20	166	21	2	19
p75	164	14	149	315	36	273	70	5	64
p90	290	32	260	490	82	419	148	10	137
p95	428	59	370	626	111	529	203	13	191
p99	738	141	625	996	219	802	312	25	299
N	4,366	4,366	4,366	1,439	1,439	1,439	2,927	2,927	2,927
Mean	115	14	101	244	34	210	51	4	47
SD	156.5	28.1	132.9	198.1	41.7	163.6	70.5	5.2	66.6
Skewness	2.8	5.2	2.5	2.0	3.3	1.9	2.4	2.7	2.4
Kurtosis	14.6	41.2	12.5	9.0	17.9	8.3	10.3	14.2	10.5

Table A5: OLS Regressions for Cumulative Stock Returns with Additional Control Variables

Using the U.S. results in Table 4 as the baseline model (Panel A), Panel B includes additional control variables of dividend yield and the price-to-book ratio. Panel C controls for the receivable-to-sales ratio. Panel D controls for dividend yield, the price-to-book ratio, and the receivable-to-sales ratio.

Panel A: Baseline Results for U.S. Stocks (Table 4)

	Cumulative Risk Adjusted Returns (by)				
	Dec. 2007	June 2008	Dec. 2008	June 2009	Dec. 2009
$DExp^s(2007/2)$	−0.118				
	[−4.59]				
$DExp^s$		−0.127	−0.169	−0.084	0.001
		[−3.44]	[−2.82]	[−1.85]	[0.02]
$DFsh^s$	0.079	0.167	0.150	0.186	0.174
	[3.04]	[4.34]	[2.28]	[3.84]	[3.69]
Obs.	3,813	3,722	3,612	3,494	3,269
$Adj.R^2$	0.026	0.050	0.012	0.028	0.037

Panel B: Control for Dividend Yield and Price-to-Book Ratio

	Cumulative Risk Adjusted Returns (by)				
	Dec. 2007	June 2008	Dec. 2008	June 2009	Dec. 2009
$DExp^s(2007/2)$	−0.113				
	[−4.14]				
$DExp^s$		−0.108	−0.169	−0.070	0.002
		[−2.81]	[−2.72]	[−1.47]	[0.05]
$DFsh^s$	0.087	0.169	0.221	0.235	0.219
	[3.18]	[4.05]	[3.20]	[4.58]	[4.42]
Dividend Yield	−0.226	−0.401	−0.435	−0.036	0.035
	[−0.83]	[−1.31]	[−1.93]	[−0.15]	[0.16]
Price-to-Book	0.001	0.000	0.001	0.002	0.000
	[1.62]	[0.41]	[1.05]	[3.06]	[0.30]
Obs.	2,975	2,898	2,821	2,773	2,664
$Adj.R^2$	0.039	0.079	0.028	0.047	0.069

Table A5(Continued)

Panel C: Control for the Receivable-to-Sales Ratio

	Cumulative Risk Adjusted Returns (by)				
	Dec. 2007	June 2008	Dec. 2008	June 2009	Dec. 2009
$DExp^s(2007/2)$	−0.119				
	[−4.45]				
$DExp^s$		−0.117	−0.181	−0.086	−0.011
		[−3.10]	[−2.99]	[−1.84]	[−0.26]
$DFsh^s$	0.090	0.170	0.232	0.246	0.234
	[3.33]	[4.17]	[3.41]	[5.00]	[4.92]
Receivable-to-Sales	−0.001	−0.002	−0.004	−0.001	−0.001
	[−2.14]	[−3.14]	[−3.99]	[−1.24]	[−1.56]
Obs.	3,084	3,006	2,925	2,856	2,740
$Adj.R^2$	0.036	0.073	0.027	0.052	0.070

Panel D: Control for Dividend Yield, Price-to-Book, and Receivable-to-Sales

	Cumulative Risk Adjusted Returns (by)				
	Dec. 2007	June 2008	Dec. 2008	June 2009	Dec. 2009
$DExp^s(2007/2)$	−0.117				
	[−4.24]				
$DExp^s$		−0.111	−0.176	−0.079	−0.007
		[−2.88]	[−2.83]	[−1.64]	[−0.15]
$DFsh^s$	0.082	0.165	0.217	0.237	0.228
	[2.97]	[3.93]	[3.13]	[4.62]	[4.64]
Dividend Yield	−0.227	−0.404	−0.443	−0.031	0.046
	[−0.82]	[−1.32]	[−1.93]	[−0.13]	[0.22]
Price-to-Book	0.001	0.000	0.001	0.002	0.000
	[1.72]	[0.52]	[1.41]	[3.15]	[0.50]
Receivable-to-Sales	−0.001	−0.002	−0.004	−0.002	−0.001
	[−2.11]	[−3.53]	[−4.87]	[−2.04]	[−1.60]
Obs.	2,918	2,844	2,769	2,721	2,616
$Adj.R^2$	0.039	0.080	0.032	0.051	0.073