The Role of Equity Funds in the Financial Crisis Propagation

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Abstract

The early stage of the 2007/08 financial crisis was marked by large value losses for bank stocks. This paper identifies the equity funds most affected by this valuation shock and examines its consequences for the nonfinancial stocks owned by the respective funds. We document three key empirical findings. First, ownership links to these distressed equity funds lead to large temporary underperformance of the most exposed nonfinancial stocks. Second, distressed equity funds make the better performing stocks in their portfolio the preferred liquidation choice, which implies clustering of fire sale discounts among stocks in the high return quantiles. Third, stocks with higher overall fund ownership generally performed better throughout the crisis.

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1 Introduction

Financial sector stocks accounted for only 20% of the total U.S. stock market value in 2007. Their widespread exposure to the subprime market not only hurt their own stock prices, but eventually led to a near 50% value decrease for nonfinancial stocks as well.[1] Is the price drop in nonfinancial stocks fully justified by their fundamentals, or is there a price contagion from financial to nonfinancial stocks? Using fund ownership data at the stock and fund/investor level, this paper identifies the common fund owners between financial and nonfinancial stocks as an important channel for price contagion during the crisis. Our analysis suggests that at least one fifth of the 53% crisis-related decline for the U.S. stock market is attributable to price contagion via such common fund ownership. By examining the 2007/08 crisis development in the stock market from this new angle of joint equity fund ownership between crisis and noncrisis stocks, our study identifies a sharp macroeconomic picture of crisis-induced transitory equity price dynamics. In particular, we highlight that the propagation of financial instability does not require leverage of financial intermediaries and that leverage regulation alone may not always be sufficient for crisis containment (Shin, 2013; Kashyap, 2014).

A large empirical literature documents 'price contagion' across countries and asset classes.[2] Yet, as Forbes and Rigobon (2002) argue, it is often difficult to separate contagion from ordinary asset interdependence. This paper uses a new comprehensive sample on the equity positions of $22,621$ equity funds around the world for a clear identification of a contagion channel. Our identification is based on a two-step process (illustrated in Figure 1), which features a fund exposure channel measuring a fund's exposure based on fund losses in financial stocks and a implied stock exposure channel measuring stock exposure to fire sales by distressed funds. For each fund, we calculate *fund exposure* to financial stocks as the fund's return losses induced by financial sector positions in the initial phase of the financial crisis. Distressed equity funds with large losses faced larger investor redemptions and, therefore, had to engage in asset fire sales

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

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

of their financial and/or nonfinancial stocks. To capture the selling pressure of a nonfinancial stock owned by distressed funds, we define its *stock exposure* as the ownership-weighted average *fund exposure* of all mutual funds owning the stock. Thus, nonfinancial stocks held by funds with heavy loadings on underperforming financial stocks would be considered highly exposed stocks, which have high exposure to the financial sector via their fund owners.

Separation of the stock universe into financial and nonfinancial stocks allows for a better identification of causal effects. We do not condition our analysis directly on fund outflows because of concerns about outflow endogeneity in the context of the crisis. Funds with poor overall performance are likely to experience larger outflows, so that conditioning the analysis on fund outflows would generate a sample bias toward funds holding underperforming (financial and nonfinancial) stocks. To avoid such a selection bias, we capture fund distress as (ex-post) poor asset allocations in financial sector stocks only, while measuring fire-sale effects exclusively for nonfinancial stocks.[3]

Our empirical analysis focuses on the relative return of *exposed stocks*, i.e., the 30% of nonfinancial stocks with the highest stock exposure. We show that nonfinancial stocks with high exposure to distressed funds underperformed considerably during the financial crisis. The price for the exposed U.S. stocks underperformed relative to nonexposed industry peers by 44.4% at the peak of the stock market downturn. This highlights the role of funding constraints for mutual funds and their importance for stock market "contagion."

In our research design, we carefully exclude stocks in banking-related industries (e.g., banking, insurance, real estate, and financial trading) from our sample of nonfinancial stocks. In addition, we exclude conglomerates that have more than 1% of total sales in these banking-related industries as well as in building materials and construction industries. We also exclude all stocks held by funds investing mainly in real estate, construction, and home building sectors.[4] Our findings are also robust to the control of various firm characteristics and accounting measures, including the Amihud illiquidity measure, receivables-to-sales ratio, price-to-book ratio, leverage ratio, short-term debt-to-asset ratio, and dividend yield. Importantly, our results can-

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

[4]We identify such funds via the Thomson Reuters U.S. fund database in June 2007.

not be explained by any omitted characteristics that are common between financial stocks and exposed, nonfinancial stocks—such an explanation implies the greatest price discount among the worst-performing exposed, nonfinancial stocks (due to their shared firm characteristics with financial stocks). Contrary to the omitted variable hypothesis, we find that the fire-sale discount is most pronounced for those exposed stocks that performed relatively well during the crisis.

The pronounced concentration of fire-sale discounts for the best-performing stocks also suggests that distressed funds preferred to liquidate stock positions for which selling did not imply realizing large capital losses. As a paradoxical consequence, large transitory stock underpricing primarily afflicted those stocks that had no real crisis exposure other than being owned by the distressed equity funds with large exposure to the financial sector. This has further implications for macroeconomic research on the real effects of a financial crisis. Such research might easily arrive at biased results for the real transmission mechanism unless it properly controls for fund ownership linkages. Hau and Lai (2013) provide evidence that justifies such a concern. They show that stock underpricing induced by fund ownership linkages reduced firm investment and employment substantially during the 2007/08 crisis. Unlike the study by Hau and Lai (2013), which focuses on the real effect of stock underpricing, the current paper provides a comprehensive analysis of the propagation of the crisis across different stock classes in the U.S. and abroad.

The subprime crisis started out in the U.S. with an initial impact on bank stocks, which was then propagated *through joint equity fund ownership* to other non-financial stocks in the U.S. and in other countries. The fund ownership channel identified in this paper accounts for a relative underperformance of exposed stocks of 26.1% in other developed countries and 17.5% in emerging countries at the peak of the crisis. Furthermore, we find that while ownership by distressed funds adversely affected the performance of a stock during the crisis, the opposite is true for nondistressed fund ownership. Stocks in the top 30% quantile of the highest aggregate overall fund ownership suffered considerably lower capital depreciation than stocks in the bottom quantile.

This study adds to a nascent literature that uses portfolio data to identify channels of asset contagions. In particular, Broner, Gelos, and Reinhart (2006) find that rebalancing toward the index ('retrenchment') by global equity funds during the previous emerging market crises (i.e., Thailand in 1997, Russia in 1998, and Brazil in 1999) had a pronounced effect on the cross-section of international equity index returns. Manconi, Massa, and Yasuda (2012) find that during the 2007/08 crisis, fixed-income mutual funds transmitted the crisis from the securitized bond market to the corporate bond market. Badertscher, Burks, and Easton (2012) find little support that the mandatory bank asset value write-down during the recent financial crisis results in banks fire-selling debt securities. Our study focuses on another group of institutional investors (i.e., equity mutual funds) and finds that the initial value losses in some equity funds led to significant stock fire sales, which substantially worsened the crisis.

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

Our analysis also relates to a growing body of literature on stock market mispricing and limits of arbitrage surveyed by Kothari (2001), Lee (2001), and Gromb and Vayanos (2010). This literature has highlighted the role of funding constraints of financial intermediaries in determining asset prices. Financial crises may give rise to a greater and more pervasive asset mispricing. For example, Rinne and Suominen (2010) show that asset liquidity in U.S. stocks generally dropped during the 2007/08 crisis. 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). As a result, limits of arbitrage may shift during a crisis. The large-scale fire sale discounts documented in this paper suggest such a displacement of arbitrage boundaries.

Section 2 discusses the hypotheses. Section 3 explains the data sources and sample selection and discusses measurement issues. Section 4.1 presents evidence for the fire-sale discounts along the timeline of the crisis; Section 4.2 uses quantile regressions to document the asymmetric effect of fire-sale discounts by stock performance quantiles; Section 4.3 reports fire sales discounts conditional on a larger set of firm characteristics; Section 4.4 examines the fund holding changes directly; followed by evidence on international propagation of the crisis in Section 4.6. The robustness issues related to stock selection biases are examined in Section 5. Section 6 concludes.

2 Hypotheses

The first fallout of the subprime crisis in 2007 was a substantial value loss for bank stocks. The mean return for U.S. financial stocks in the second semester of 2007 and the first semester of 2008 was a catastrophic −27.4% and −32.5%, respectively.[5] Next we describe four testable hypotheses about the transmission of this shock to nonfinancial stocks.

2.1 Simple Fire Sales Hypothesis

As a consequence of the price cash of many financials, equity funds with large shares of ownership in these financial stocks suffered a substantial negative shock to their fund performance. Such funds were likely to face strong investor outflows. The so-called "fund flow-performance relationship" has been extensively documented in the literature (see, for example, Chevalier and Ellison (1997) and Sirri and Tufano (1998)). To meet redemption requirements from investors, such equity funds would have to liquidate part of their portfolio, which in turn could depreciates the equity values of the stocks they sell.[6] The distressed selling of nonfinancial stocks by their fund owners, therefore, effectively spreads the crisis from financial sector stocks to nonfinancial sector stocks.

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

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

We first explore whether the common fund ownership between financial stocks and nonfinancial stocks during the 2007 financial crisis represents a channel of price contagion from the former to the latter. We call this hypothesis the *Simple Fire Sale Hypothesis*. If this hypothesis holds, we expect that the subset of nonfinancial stocks linked by common fund ownership to poorly performing financial stocks would underperform during the financial crisis. Furthermore, such price contagion should lead only to temporary mispricing, which we expect to fully revert in the long run.

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

2.2 Stock Performance Contingent Fire Sales

The *simple fire sales hypothesis* does not discriminate between the types of stocks a distressed equity fund may choose to sell. Yet, this choice should be a crucial one for a distressed fund: If it sells stocks with a (temporary) highly depressed stock price (due to other fire sales), the fund will further aggravate its underperformance. Superior return performance during the crisis could be a fund's best signal that the stock is not subject to other fire sales, whereas underperforming stocks is likely to have suffered fire sales by other distressed owners. Hence, a heuristic decision rule suggests that a fund first sells stocks with the highest-realized crisis returns because other (relatively poor-performing) stocks provide hope for a later price reversal. Paradoxically, this implies that stocks in the higher performance quantiles are more likely to suffer from temporary underpricing. We call this the *performance-dependent fire sales hypothesis*.

A simple model can illustrate the equilibrium implications for stock returns of such performance contingent fire sales. Assume stock returns R^s of stock s can be decomposed into a long-run (fundamental) component η_s and a short-run discount due to fire sales FS^s,

$$R^s = \eta^s - FS^s,$$

where we normalized the elasticity of the stock return to the fire sale quantity FS^s to minus one for every stock. Let $DExp^s$ be a binary distributed variable independent from R^s and denotes 1 if a stock is subject to fire sales and 0 otherwise with an equal probability of 1/2. If distressed funds cannot distinguish between the fundamental component η^s and the (temporary) distress component FS^s, they may just condition their fire sales on the stock return performance since the beginning of the crisis, that is

$$FS^s = \begin{cases} a + bR^s & \text{if} \quad DExp^s = 1 \\ 0 & \text{if} \quad DExp^s = 0 \end{cases}$$

where $a > 0$ and $b \geq 0$. In the special case $b = 0$, fire sales do not depend on stock performance. On the other hand, $b > 0$ is an indication of stock performance dependent fire sales. The equilibrium return in this simple setting is easily obtained as

$$R^s = \begin{cases} \frac{1}{1+b}\eta^s - \frac{1}{1+b}a = \eta^s - (\frac{b}{1+b}\eta^s + \frac{1}{1+b}a) & \text{if} \quad DExp^s = 1 \\ \eta^s & \text{if} \quad DExp^s = 0 \end{cases}$$

The equilibrium stock performance in this setting is simultaneously determined by the fundamental component η^s and the fire sales effect by $-\frac{b}{1+b}\eta^s - \frac{1}{1+b}a$. Generally, the parameters a and b are very difficult to infer if one cannot observe the stock exposure dummy $DExp^s$. But unlike the fund manager, we can use comprehensive fund ownership data to undertake an analysis conditional on (ex-post) knowledge of $DExp^s$. In particular, consider the linear quantile regression

$$Q_{R|DExp}(\tau) = \alpha_\tau + \beta_\tau DExp^s$$

for the τ-th stock return quantile. Let $Q_\eta(\tau)$ denote the τ-th quantile of the distribution of η. Asymptotically, the quantile regression coefficients follow as

$$\begin{aligned} \alpha_\tau &= Q_\eta(\tau) \\ \beta_\tau &= -\frac{b}{1+b}Q_\eta(\tau) - \frac{1}{1+b}a, \end{aligned}$$

which implies that the coefficient β_τ becomes increasingly negative for higher stock return quantiles if and only if $b > 0$.

Apart from incomplete information about the cross-sectional distribution of fire sales, other considerations could also motivate the preferred fire sales of better performing stocks. U.S. tax law encourages mutual funds to pass on capital gains from asset sales to investors because the marginal tax rate for funds is typically higher than the rate for investors. To further minimize investors' capital gains taxes, fund managers may have an incentive to realize capital gains during the market downturn, when fund investors might have more capital losses from elsewhere to offset these gains. (Seida and Wempe, 2000.)[7] By contrast, the fund window dressing literature (see, for example, O'Neal (2001), Meier and Schaumburg (2006), and Sias (2006)) argues that poorly performing funds are particularly prone to concealing their poor stock picks by replacing underperforming stocks with overperforming stocks just before they report their asset holdings, suggesting that stocks in the lower performance quantiles are more likely to be sold by distressed funds.

2.3 Liquidity Considerations for Fire Sales

The theoretical literature has focused on ex-ante stock market liquidity as a key determinant of a fund manager's optimal liquidation policy; yet it obtained conflicting predictions. The traditional view is that liquid stocks should be liquidated first to minimize price impact (Scholes, 2000), but some recent work focusing on strategic interaction and the option value of liquidity shows that the initial selling of illiquid stocks may instead be a better policy (Duffie and Ziegler, 2003; Brown, Carlin and Lobo, 2010).

In light of the theoretical ambiguity, it is interesting to compare the liquidity characteristics of the exposed stocks that funds choose to sell most. This *liquidity-dependent fire sales hypothesis* predicts that (ex-ante) more liquid stocks are most likely to be subject fire sales. We concede that our analysis here is limited to publicly listed equity stakes, which generally feature a high degree of liquidity. Moreover, funds tend to invest in more liquid stocks, further limiting the role of ex-ante stock liquidity as a determinant of fund fire-sale policies. We examine this hypothesis in more details in Section 4.4.

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

2.4 Fund Ownership and Crisis Resilience

Our last hypothesis concerns the return effect of overall equity fund ownership. While distressed funds may have a negative influence on the crisis performance of the stocks that they initially own, such a negative effect seems unlikely to pertain to equity fund ownership in general. In fact, the opposite may hold. As shown by Kumar and Lee (2006), retail investors tend to concentrate their holdings and trading in stocks with low institutional ownership, as opposed to stocks with high institutional ownership. If retail investors generally exhibit a higher propensity for "panic sales" or "flight to quality" than institutional investors or fund investors during a crisis, then stocks with high retail ownership or low fund ownership can temporarily underperform other stocks. In this case, nondistressed equity fund ownership serves as a stabilizing force in the stock market during a crisis. Our empirical analysis should therefore condition on the ex-ante degree of institutional ownership.

3 Data and Measurement Issues

3.1 Sample Selection

Our analysis focuses on the crisis-related underpricing of U.S. nonfinancial stocks. We also extend the evidence to nonfinancial stocks outside the U.S. in Section 4.6. Our measure of stock exposure is based on the worldwide fund holdings data from the Thomson Reuters International Mutual Fund database. The use of worldwide fund holdings is warranted because foreign funds hold a nonnegligible share of U.S. stocks. A detailed description of this database is provided in Covrig, Defond, and Hung (2007). They use the data from 1999–2002 to examine whether the adoption of International Accounting Standards are able to attract more foreign capital, whereas we use the data from 2007–2009 to examine the transmission of the subprime mortgage crisis from financial stocks to nonfinancial stocks. The Thomson Reuters data account for both pure equity funds and the equity holdings of balanced funds, which also hold other assets, such as bonds. In the latter case, only the equity portion of the fund holdings is reported. Most international funds only report at six-month intervals—hence, the analysis related to fund holdings is carried out on a semi-annual basis. For funds with multiple reporting dates within a semester, we retain only the last reporting date.[8]

Based on fund holdings data, we remove funds that had more than 75% of their asset holdings in financial stocks because these funds are likely to be financial sector funds. For those funds, the investment on banking stocks might be nondiscretionary, so investors might not attribute underperformance to a poor fund allocation. We therefore exclude such funds from the sample and focus on those with discretionary investment in financial stocks. We also exclude index funds and ETFs from our sample.[9] A general index selling by institutions is not likely to affect exposed and nonexposed stocks differently because, presumably, index selling does not distinguish between these two types of nonfinancial stocks. Our final sample includes a total of 22,621 funds reporting stock positions with a combined total net equity value of US$9.7 trillion as of June 2007.

We obtain the daily, weekly, and monthly global stock return data from Datastream. All return calculations are based on the total return index to account for dividend payments and capital measures. Global banking stocks are defined based on Datastream industry code 102. In order to have a cleaner measure of the crisis transmission effect from financial to nonfinancial stocks, we remove banking-related industries from the sample of nonfinancial stocks. We identify banking, insurance, real estate, and financial trading as banking-related industries based on the SIC codes described under the Fama and French 48 industry classification scheme. For international stocks, we use Datastream industry codes 36, 42, 46, 77, 85, 102, 106, 108, 111–113, 133, 141, 152, 160–167, and 184 to identify them. In addition, using the Compustat industry segment file, we further exclude conglomerates that have more than 1% of total sales in industries closely related to banking or housing industries, including banking, insurance, real estate, financial trading, building materials, and construction industries.[10] We further exclude

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

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

[10]Specifically, the SIC codes for these six industries are as follows: Banks (SIC codes: 6000, 6010-6036, 6040-

stocks that are held by real estate, construction, and home building sector funds.

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

3.2 Fund Exposure and Stock Exposure

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

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

6062, 6080-6082, 6090-6113, 6120-6179, and 6190-6199), Insurance (SIC codes: 6300, 6310-6331, 6350-6351, 6360-6361, 6370-6379, and 6390-6411), Real estate (SIC codes: 6500, 6510, 6512-6515, 6517-6532, 6540-6541, 6550-6553, and 6590-6611), Financial Trading (SIC codes: 6200-6299, 6700, 6710-6726, 6730-6733, 6740-6779, 6790-6795, and 6798-6799), and Building Materials (SIC Codes: 0800-0899, 2400-2439, 2450-2459, 2660-2661, 2950-2952, 3200-3200, 3240-3241, 3250-3259, 3261-3261, 3264-3264, 3270-3275, 3280-3281, 3290-3293, 3295-3299, 3420-3423, 3440-3442, 3446, 3448-3452, 3490-3499, 3996), and Construction (SIC Codes: 18, 1500-1511, 1520-1549, 1600-1799).

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

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

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

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

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

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

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

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

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

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

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

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

Summary statistics on U.S. stock exposure are reported in Table 1. The mean (median) stock exposure is -0.26% (-0.17%) with a skewness of -1.5. The 25%, 15%, and 10% most negative stock exposure quantiles are -0.42%, -0.55%, and -0.64%, respectively. For example, a stock exposure of -0.42% will be obtained if 10% of a stock's capitalization is owned by funds that, on average, lost 4.2% of their portfolio returns from financial stock investments.

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

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

Our empirical analysis focuses on the 30% quantile.[11] We define the 30% U.S. stocks with most negative Exp^s as *exposed stocks,* and the remaining 70% as *nonexposed stocks*. For expositional purposes, we can also define *exposed funds* and *nonexposed funds* analogously, but based on Exp^f. Panel B of Table 2 shows considerable dispersion in the number of funds investing in the two types of stocks. For the subsample of exposed (nonexposed) stocks, the average number of exposed and nonexposed fund owners are, respectively, 105 and 130 (15 and 36) funds in June 2007. Such coarse fund ownership across stocks translates into a large dispersion of stock exposure.

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

3.3 Fund Holding Change and Aggregate Holding Change

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

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

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

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

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

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

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

The aggregate fund holdings decrease over consecutive semesters for U.S. nonfinancial stocks is shown in Table 1. The average aggregate holding change for $k = 1, 2, 3, 4, 5$ is given by -2.5%, -4.7%, -6.3%, -7.3%, and -8.8%, respectively. Section 4.3 explores whether this aggregate fund holding decrease is more pronounced for stocks with distressed fund owners.

3.4 Risk Adjustment of Returns

Our analysis of the fire sale effects on stock prices first removes risk premia from the return analysis. For this risk adjustment, we use the international version of the Carhart (1997) four-factor model. For each country, we construct a domestic and an international version of the four factors: The market factor (MKT), the size factor (SMB), the book-to-market factor (HML), and the momentum factor (MOM). The factor construction is based on monthly stock returns in U.S. dollars over the five-year period from July 2002 to June 2007. We calculate the international factors of a country as the weighted-average domestic factors of all other countries. The weights are given by the relative stock market capitalization of each country at the beginning of the year.

We estimate the loadings of each stock s on the domestic and international risk factors ($j = Dom, Int$) using a regression over 60 months, from July 2002 to June 2007. With the estimated factor loadings, we can calculate the expected return $er_{s,t}$ for each stock s in month t during the crisis period, July 2007–December 2009. The cumulative expected return over q weeks (since month t) is then calculated as follows:

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

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

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

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

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

The summary statistics for cumulative risk-adjusted returns of all U.S. nonfinancial stocks are stated in Table 1. The standard deviation of cumulative excess returns increases from 0.605 to 1.496 as the return horizon under consideration increases from one semester (December 2007) to three semesters (December 2008). The cumulative excess return dispersion decreases thereafter to 1.115 and 1.073, respectively, as we consider returns extending until June 2009 and December 2009. This reveals some degree of excess return reversal for nonfinancial stocks in 2009. We describe the factor construction and the estimation of the expected returns in detail in the appendix.

4 Evidence

4.1 Stock Exposure Effects on the Crisis Timeline

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

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

The dummy variable $DExp^s$ denotes the 30% U.S. nonfinancial stocks with the highest distressed fund ownership. Similarly, we define a dummy $DFsh^s$ for the 30% U.S. nonfinancial stocks with the highest overall fund ownership relative to the stock capitalization in June 2007. If common fund owners facilitate the transmission of crisis from financial stocks to nonfinancial stocks, we should observe $\alpha_1^k < 0$. $DFsh^s$ serves as a control variable because higher overall fund ownership allows for more exposure to distressed funds. The regression discards the 1% highest and lowest return outliers. We include industry-fixed effects in the regression. The coefficient α_1^k therefore captures risk-adjusted fire-sale discounts over k semesters for the 30% most exposed nonfinancial stocks relative to other nonfinancial stocks in the same industry.

Table 3 reports the regression results for U.S. stocks. Column 1 is for the return period from July 1, 2007 to December 31, 2007, in which the stock exposure dummy $DExp^s(2007/2)$ is based on contemporaneous fund return losses in the second semester of 2007. The exposure dummy reveals an underperformance of -10.6% after one semester in December 2007, -14.1% after two semesters in June 2008, and -22.7% after three semesters in December 2008. For June 2009 (after four semesters) we find a reversal of the discount to -10%, 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. Therefore, stocks with high overall fund ownership experience better crisis performance—a finding consistent with the greater general crisis resilience of institutional fund ownership.

Figure 2, Panel A, plots the coefficient for the exposure dummy $DExp^s$ and a confidence interval (of ± 1 standard deviation) using cumulative risk-adjusted returns with weekly return increments. The regressions after 26, 52, 78, 104, 156 weeks coincide with regressions after $k = 1, 2, 3, 4, 5$ semesters. The corresponding dates for the five end-of-semester regressions are highlighted by dashed vertical lines. The fire sale effect shows negative twin peaks around November 7, 2008, and February 27, 2009, with an average return shortfall of -32.7% and -44.4%, respectively, for exposed stocks. The estimation results for the twin peaks are reported in the last two columns of Table 3.

Our results highlight that crisis propagation through fund exposure played a quantitatively important role for the overall index decline during 2007/09. An incremental return shortfall of 44.4% for the 30% exposed stocks implies an aggregate effect of 10% ($= 44.4\% \times 30\% \times 80\%$) value decline for an equally weighted U.S. stock index.[12] Considering the fact that exposed stocks are, on average, larger than nonexposed stocks, the contribution of this effect to the decline of the overall U.S. stock market index, which is value-weighted, is likely to be at least as large. It is therefore not surprising that the maximum fire sale effects identified above are close to the two weekly U.S. stock index minima on November 7, 2008 and March 6, 2009.

4.2 Stock Exposure Effects by Stock Performance Quantile

Discretionary liquidation of stock positions by distressed funds implies a *performance-dependent fire sale hypothesis*. We therefore estimate regressions for the 25%, 50%, 75%, and 90% quantiles of the cumulative excess return distribution as a linear function of the stock exposure dummy $DExp^s$. We use November 7, 2008 and February 27, 2009 as the reference dates for the cumulative returns because they represent the twin peaks of the fire-sale discounts as shown in Figure 2. As before, the regressions controls for the fund ownership dummy $DFsh^s$ and industry-fixed effects. In addition, we control for stock liquidity proxied by either $DLiq^s$ (a dummy for the 30% most liquid U.S. stocks based on the Amihud illiquidity measure) or $LnSize^s$ (the natural logarithm of firm size).

Table 4 reports the regression results. When controlling for (ex-ante) stock liquidity in Column 4, the coefficient of the stock exposure dummy at the crisis peak in February 2009 decreases from 2.1% and -2.8% for the 25% and 50% quantiles to -30.1% and -92.1% for the 75% and 90% quantiles, respectively. A similar pattern is observed for the earlier crisis

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

peak in November 2008. Therefore, the stock exposure measure has an extremely asymmetric effect on the distribution of cumulative stock returns, with the most negative impact found for the best-performing stocks. The result suggests that when faced with funding constraints and investor redemption requirements, distressed equity funds first liquidated the best-performing stocks, rather than stocks with recent large capital losses. In Section 4.4, we confirm this insight by examining directly the fund holding changes.

4.3 Stock Exposure Effects and Firm Characteristics

Could the stock exposure effects we document in the previous subsections be due to the differences in firm characteristics between exposed and nonexposed stocks? We explore such a possibility in this section. Firms with a higher receivables-to-sales ratio can be more adversely affected by the liquidity crunch experienced by the commercial paper market during the crisis. A high price-to-book, leverage, or short-term debt-to-asset ratio can indicate the vulnerability of a firm during the crisis, due to a higher default risk. Firms with a higher dividend yield may experience a higher before-tax stock return. A higher stock illiquidity can amplify the fund sale effect. We therefore include these stock characteristics as additional controls.

The results, reported in Table 5, indicate that none the firm characteristics shows any strong statistical significance in the cross-section of cumulative stock returns at the peak of the crisis. In particular, (ex-ante) stock illiquidity is not a priced firm characteristics, in line with the evidence reported by Lou and Saka (2011). Moreover, controlling for these firm characteristics has no qualitative effect on the results reported in Table 3. Therefore, we conclude that differences in firm characteristics between exposed and nonexposed stocks cannot account for the fire sale effect measured by the stock exposure dummy.[13]

Could any omitted firm characteristics that are common between financial stocks and exposed, nonfinancial stocks explain our findings? As discussed in the data section, we try to eliminate such a possibility by removing banking-related industries from our sample of nonfinancial stocks. We also exclude conglomerates that have more than 1% of total sales in banking, insurance, real estate, financial trading, building material, and construction industries, as well

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

as stocks that are held by real estate, construction, and home building sector funds. Importantly, any common omitted firm characteristics between financial and nonfinancial stocks would imply the greatest price discounts among the worst-performing nonfinancial stocks (due to their shared firm characteristics with financial stocks). However, contrary to the omitted variable hypothesis, the evidence presented in Section 4.2 shows that the fire sale discount is most pronounced for those exposed stocks that performed relatively well during the crisis.

4.4 Fund Holding Changes

When facing liquidity constraints or anticipating investor redemption, exposed equity funds were likely to engage in fire sales. Here we directly examine the fund holding changes. We denote by $\Delta\widetilde{H}^s(k)$ the (percentage) aggregate holding change in stock s over k semesters of all funds with initial positions in June 2007. Figure 3 compares the distribution of cumulative holding changes $\Delta\widetilde{H}^s(4)$, from July 2007 to June 2009, between exposed and nonexposed U.S. nonfinancial stocks. Exposed stocks feature a much larger left-tail distribution, indicating that large aggregate holding reductions were much more frequent for these stocks. Such drastic holding reductions by distressed funds are consistent with the fund redemption evidence we obtained from the Lipper Fund Database and matches the return evidence provided in Section 4.1.[14]

Analogous to the return regressions, we relate fund holding changes to the dummy variables $DExp^s$ and $DFsh^s$ in three different regression specifications that discard the 1% of smallest and largest holding changes. The baseline specification is given by

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

and reported for cumulative holding changes by the end of December 2007, June 2008, December 2008, and June 2009, in Table 6, Columns 1a, 2a, 3a, and 4a, respectively. The simple fire sale

[14] We are not able to gauge the exact redemption pressure faced by our sample funds because the Thomson Reuters International Fund database does not provide any fund flow data. However, for a subset of 8,250 funds, for which we are able to obtain the fund return and fund net asset value (TNA) data from Lipper, we find that exposed funds started to experience net investor outflows (estimated using fund returns and fund TNA) after July 2007. This accumulated to a sizeable average fund outflow of about 7% in late 2008 and early 2009. By contrast, the average net cumulative inflow for nonexposed funds remained positive from July 2007 to December 2009 .

hypothesis implies $\beta_1^k < 0$ because exposed stocks should feature a faster holding decline for the initial owners in June 2007. This is confirmed by the regression evidence. The additional cumulative decrease amounts to -0.73%, -1.54%, -1.98%, and -2.48% over a period of $k = 1$, 2, 3, 4 semesters, respectively. Compared to the average holding decreases of -2.53%, -4.72%, -6.31%, and -7.32% (reported in Table 1), these figures reveal approximately 32% more net fund-selling for the 30% most exposed stocks than for an average stock.

The variable $\Delta\widetilde{H}^s$ aggregates holding changes only for those funds that initially hold a strictly positive position in the stock in July 2007. Therefore, the coefficient for $DFsh^s$ is strongly influenced by a general mean reversion property of the high fund share variable, suggesting a persistently negative sign for the coefficient of $DFsh^s$. Indeed, we find the $DFsh^s$ estimate to be significantly negative. An alternative explanation comes from the finding in the literature suggesting that stocks with low fund ownership typically feature more retail ownership and trading (Kumar and Lee (2006)). If retail investors engage in panic sales during the crisis and equity funds act as the liquidity supplier, we are likely to observe more funds buying stocks with low fund ownership (or high retail ownership), which again implies a negative sign for $DFsh^s$.

In Columns 1b to 4b of Table 6, we extend the specification to include a dummy variable $DHighR^s$ marking all U.S. stocks in the 30% quantile with the highest cumulative return over the k semesters since June 2007 and an additional dummy $DLiq^s$ marking the 30% stocks with the highest (ex-ante) liquidity. The corresponding regression coefficients reveal the incremental holding changes of funds in better performing or more liquid stocks, respectively. Stock performance and stock liquidity both influence the stock retention policy of funds. The 30% best performing stocks show incremental holding decreases of -0.66%, -1.26%, -1.66% and -1.59% for each consecutive semester, whereas the corresponding incremental sales for the 30% most liquid stocks are -1.80%, -2.30%, -2.26% and -2.50%. Therefore, equity funds tend to sell their more liquid stocks more quickly and this is not surprising.

In Columns 1c to 4c we add additional interaction terms $DExp^s \times DHighR^s$ and $DExp^s \times DLiq^s$, which focus on the role of stock performance and stock liquidity for the fund fire sales choice specifically of exposed stocks. Exposed stocks (as potential fire-sales stocks) show an accelerated selling pattern over the crisis for overperforming stocks, whereas less selling occurs for the most liquid exposed stocks. By June 2009, the 30% best-performing *exposed* stocks experience an incremental -1.59% fund holding reduction compared to a 1.85% holding increase for the 30% most liquid stocks. Distressed funds therefore liquidated better performing stocks at an accelerated pace, whereas they retain the more liquid stocks relative to their usual fast turnover of such stocks.

Overall, the evidence on fund holdings provides direct support for the performance-dependent fire sales hypothesis. Distressed funds strongly prefer to fire sell stocks in the top performance quantiles. By contrast, stock liquidity appears to be a stock retention factor for distressed funds in line with theoretical work emphasizing the hedging value of liquid stock positions against even more distress and uncertain future investor redemptions (Duffie and Ziegler, 2003; Brown, Carlin, and Lobo, 2010).

4.5 International Propagation

International stock ownership allows for better global asset diversification but may also create channels for crisis propagation beyond the U.S. borders. So far, our analysis has examined ownership-related underpricing only for U.S. nonfinancial stocks, yet it is interesting to extend the analysis to nonfinancial stocks outside the U.S.

The larger role of mutual funds in the U.S. stock market suggests that stock exposure through distressed funds is likely to be more widespread and pronounced in the U.S. than in other countries. Figure 4 plots the stock exposure distribution separately for the $4,470$ U.S. stocks (Panel A), $11,646$ developed market stocks ex U.S. stocks (Panel B), and $5,407$ emerging market stocks (Panel C). The international sample spreads across 22 developed markets and 18 emerging markets. As expected, the tail of the stock exposure distribution is fatter for U.S. stocks, compared to other developed market or emerging market stocks. Nevertheless, both developed and emerging markets feature a sizable left tail of exposed stocks, for which we can again define a dummy ($DExp^s$) marking the 30% most exposed stocks for each country. The cross-country average stock exposure among these 30% most exposed nonfinancial stocks is -0.46% and -0.30% for, respectively, developed market stocks ex U.S. and emerging market stocks, compared to -0.63% in the corresponding U.S. stock sample.

Table 7 reports the cumulative risk-adjusted return evidence for all non-U.S. stocks (Panel

A), developed market stocks ex U.S. (Panel B), and emerging market stocks (Panel C) from July 2007 to the end of each subsequent semester, as well as to the twin peaks of the crisis. Around the first peak (Nov. 7, 2008), the additional underpricing for the 30% most exposed non-U.S. stocks amounts to 16.8%, compared to 32.7% for U.S. stocks (reported in Table 3). The corresponding relative underpricing for emerging market stocks is 15.7%. The weekly cumulative risk-adjusted returns for international stocks (presented in Panels B, C, and D of Figure 2) again show a very similar pattern to those for U.S. stocks (in Panel A). Therefore, international fund ownership linkages played an economically significant role in the international transmission of the U.S. mortgage market crisis. We conjecture that the gradually decreasing equity home bias and the globalization of the equity fund industry are likely to make this international transmission mechanism even more potent in the future.

5 Robustness

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

To verify this assumption, we examine whether the nonfinancial holdings of exposed feature any abnormal returns prior to the crisis, relative to nonexposed funds. Following Fama and French (2010), we form an equal-weighted portfolio and a value-weighted portfolio separately for the two types of funds each month, from January 2002 to December 2006. We then test for differences in risk-adjusted returns, allowing the risk factor loadings to differ across the two types of funds. The results are presented at the bottom two rows of Table 1. We find that the abnormal return differences between nonfinancial holdings of exposed and nonexposed funds are insignificant after controlling for the standard risk factors in the literature (i.e., the market, size, book-to-market, and momentum factors), suggesting that exposed stocks were not priced according to any omitted risk factor.[15]

[15] Specifically, we use a fund's nonfinancial stock holdings at the beginning of the semester to estimate its

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

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

where $\widehat{w}^{f_1,s}$ and $\widehat{w}^{f_2,s}$ represent the portfolio weight of nonfinancial stock s in funds f_1 and f_2, respectively. We examine such portfolio overlap for the 10% most distressed funds (i.e., funds with the greatest investment loss from financial stocks from July 2007 to June 2008) that hold at least one U.S. nonfinancial stock in June 2007. We then match this group with the same number of other funds, based on their country codes and the size of their total asset holdings in nonfinancial stocks. The portfolio overlap statistic is then calculated for (i) pairs of funds in the exposed group, (ii) pair of funds in the nonexposed group, and (iii) pairs of one fund from the exposed and one from the nonexposed group, based on fund holdings in June 2007.

Table 8 presents the distributions of the three portfolio overlap measures, sorted by percentiles. All three overlap measures show considerable independence of stock picks across funds. The average overlap for the exposed fund pairs is 0.9%, compared to 1% for nonexposed fund pairs and 0.8% for the cross-group pairs. Thus, the similarity in stock selections appears to be economically small for all three groups. In particular, any two funds differ, on average, in 99% of their stock picks. A relative difference in the overlap of stock picks by only 0.1% is therefore economically small. Such minimal difference in overlap greatly limits the scope for within group clustering on stocks with particular unobserved risk factors.

Furthermore, the evidence on the full, long-run price reversal of exposed, nonfinancial stocks that we present in Figure 2 and Table 3 is another piece of evidence that the distressed equity funds on average did not pick a 'below average' portfolio of nonfinancial stocks. Therefore, the underperformance of exposed nonfinancial stocks during the crisis cannot be explained by the poor nonfinancial stock pick of their distressed fund owners.

monthly returns in the subsequent six months. The returns of the equal- and asset value-weighted portfolios of exposed and nonexposed funds are then calculated separately each month, from January 2002 to December 2006.

6 Conclusions

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

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

The analysis carefully controls for real linkages between the banking sector and various industries by excluding banking-related industries, as well as conglomerates that have more than 1% of total sales in these banking-related industries, from our sample of nonfinancial stocks. Our findings are also robust to the control of various firm characteristics, including the Amihud illiquidity measure, receivables-to-sales ratio, price-to-book ratio, leverage ratio, short-term debt-to-asset ratio, and dividend yield, as well as industry-fixed effects. An analysis of the 30% most exposed U.S. nonfinancial stocks reveals their dramatic risk-adjusted underperformance. Their relative stock underpricing peaked at 44.4% in late February 2009, which is strong evidence that "distressed funds" played an important role in deepening the stock market downturn.

Our findings cannot be explained by any common omitted firm characteristics between financial and nonfinancial stocks because such an explanation would imply the greatest price discounts among the worst-performing nonfinancial stocks; yet we find the opposite. Fire sale discounts are large for stocks in the high return quantile if they held by distressed funds. The evidence from fund holdings directly confirms that funds indeed seek to avoid loss realization from selling underperforming stocks. Paradoxically, fund fire sales and the corresponding temporary stock price discounts are clustered among the best performing stocks with distressed fund ownership. Contrary to the focus of the theoretical literature, liquidity considerations play a secondary role for the liquidation choice of distressed funds, whereas crisis returns play a primary role.

We also find that fund ownership played an important role in the international transmission of the stock market downturn, even though magnitudes here are smaller because of weaker ownership exposure links. Specifically, exposed nonfinancial stocks underperform nonexposed industry peers by about 26% and 18% at the crisis peak for other developed markets ex U.S. and emerging markets, respectively. Furthermore, 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. This suggest that institutional fund ownership generally tends to be more crisis resilient than retail ownership.

Overall, we conclude that the fund ownership structure at the outset of the crisis in June 2007 had an astonishingly large effect on the crisis performance of nonfinancial stocks both in the U.S. and abroad. While better regulation of leveraged financial intermediaries is a necessary condition for financial stability, it might not be a sufficient condition to prevent the propagation of financial instability and the temporary mispricing of large segments of the equity market.

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 of the stocks are classified as large-cap (B) and the other half as small-cap (S). For the book-to-market classification, the bottom 30% of firms are classified as L, the middle 40% as M, and the highest 30% as H. The intersection of the rankings allows for six value-weighted portfolios: HB, MB, LB, HS, MS, and LS. Formally, we define

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

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

(B) and the other half as small-cap (S). For the past returns classification, the bottom 30% are classified as LR (low return), the middle 40% as MR, and the highest 30% as HR. The momentum factor is defined as

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

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

In the second step, we calculate a country's international factors as the weighted average domestic factors of all other countries. The weights are given by the relative stock market capitalization of each country at the beginning of the year. The stock market capitalization data is obtained from the World Development Indicator.

To obtain estimates of expected returns during the crisis period, we first estimate the loadings of each stock s on the domestic and international risk factors ($j = Dom$, Int) using a regression over 60 months, from July 2002 to June 2007, as follows:

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

where $r_{s,t}$ denotes a stock's monthly (cum dividend) return in U.S. dollars net of the one-month Treasury Bill rate. For the pre-crisis period, July 2002 to June 2007, the average factor loadings on the market, size, and value factors are positive. A negative average loading is found only for the momentum factor. Untabulated results show that all eight factors have nonnegligible explanatory power for the cross-section of returns. This is consistent with the recent evidence by Eun et al. (2010), Hou, Karolyi, and Kho (2011), and Karolyi and Wu (2012) on the importance of both local and global factors in stock returns.

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

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

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Table 1: Summary Statistics

Reported are the summary statistics for all U.S. nonfinancial stocks. Fund exposure, Exp^f, is measured by the return loss of a fund due to investment in financial stocks over the one-year period from July 1, 2007 to June 30, 2008. Stock exposure, Exp^s, measures the ownership-weighted average exposure of all funds owning the stock. The dummy variable $DExp^s$ marks with 1 the 30% of U.S. stocks with the highest stock exposure. We also define a separate measure of stock exposure $Exp^s(2007/2)$ and the corresponding dummy variable $DExp^s(2007/2)$, which take into account fund losses in financial stocks for just the second semester of 2007. Fund share, Fsh^s, denotes the aggregate ownership of all funds in stock s relative to the stock's market capitalization in June 2007. The dummy variable $DFsh^s$ marks with 1 the 30% of U.S. stocks with the largest fund share. Cumulative risk-adjusted returns, $r_s^{Ex}(k)$, denote the return from July 1, 2007, to the stated month or k semesters later. The risk adjustment is based on an eight-factor international asset pricing model with factor loadings estimated for the five-year pre-crisis period, July 2002–June 2007. Percentage change in aggregate fund holdings $\Delta\widetilde{H}^s(k)$ denotes the aggregate change (over k semesters) of all fund positions in stock s, relative to the aggregate positions in June 2007, multiplied by 100. Also reported are the the difference in the total equity value under management and risk-adjusted return between exposed and nonexposed U.S. funds, prior to the crisis. Exposed funds are the 30% of funds with the largest exposure to the financial sector over the one-year period from July 2007 to June 2008 and the remaining 70% are marked as nonexposed funds. Following Fama and French (2010), we form an equal-weighted portfolio and a value-weighted portfolio of the U.S. nonfinancial stock holdings of, separately, exposed and nonexposed funds each month from January 2002 to December 2006. We then test for their differences in risk-adjusted returns, controlling for the standard risk factors in the literature (i.e., the market, size, book-to-market, and momentum factors) and allowing the risk factor loadings to differ across the two types of stocks. The difference in regression intercept (α) and the associated T-value and the adjusted R^2 of the regression are reported.

Variable		Obs. (1)	Mean (2)	Median (3)	STD (4)	Min (5)	Max (6)
Fund exposure measure							
Exp^f		22,621	−0.026	−0.022	0.027	−0.455	0.000
Stock exposure measures							
$Exp^s(2007/2) \times 100$		4,470	−0.114	−0.073	0.127	−0.975	0.000
$Exp^s \times 100$		4,470	−0.263	−0.171	0.289	−2.485	0.000
$DExp^s(2007/2)$		4,470	0.291	0.000	0.455	0.000	1.000
$DExp^s$		4,470	0.292	0.000	0.455	0.000	1.000
Fund share measures							
Fsh^s		4,470	0.168	0.134	0.155	0.000	0.882
$DFsh^s$		4,470	0.295	0.000	0.456	0.000	1.000
Cumulative risk-adjusted stock returns							
$r_s^{Ex}(1)$	(Dec. 2007)	3,535	0.078	−0.031	0.605	−0.822	3.246
$r_s^{Ex}(2)$	(June 2008)	3,447	0.075	−0.091	0.826	−0.934	5.100
$r_s^{Ex}(3)$	(Dec. 2008)	3,346	0.103	−0.275	1.496	−0.993	14.211
$r_s^{Ex}(4)$	(June 2009)	3,241	−0.027	−0.305	1.115	−0.992	8.349
$r_s^{Ex}(5)$	(Dec. 2009)	3,035	−0.078	−0.333	1.073	−0.996	9.329
r_s^{Ex}	(Nov. 7, 2008)	3,299	0.305	−0.150	1.827	−0.987	16.381
r_s^{Ex}	(Feb. 27, 2009)	3,262	0.374	−0.245	2.294	−0.994	22.411
Percentage change in aggregate fund holdings							
$\Delta\widetilde{H}^s(1)$	(Dec. 2007)	4,022	−2.530	−0.997	4.203	−24.003	5.229
$\Delta\widetilde{H}^s(2)$	(June 2008)	4,035	−4.717	−2.410	6.382	−33.187	5.681
$\Delta\widetilde{H}^s(3)$	Dec. 2008)	3,991	−6.305	−3.605	7.730	−36.681	5.258
$\Delta\widetilde{H}^s(4)$	(June 2009)	3,986	−7.322	−4.644	8.488	−38.425	5.621
$\Delta\widetilde{H}^s(5)$	(Dec. 2009)	3,930	−8.767	−6.708	8.891	−39.999	3.879
Total equity value under management by U.S. funds in billion dollars (June 2007)							
Exposed funds		1,487	1.878	0.266	7.622	< 0.001	125.486
Nonexposed funds		3,471	0.983	0.179	4.293	< 0.001	154.405

Abnormal pre-crisis return difference between exposed and nonexposed U.S. funds

	Difference. in α	T-value	$Adj.R^2$
Equal weighted portfolio	−0.0004	−0.22	0.979
Value weighted portfolio	−0.0012	−0.66	0.979

Table 2: Differences between Exposed and Nonexposed Stocks

Exposed stocks are the 30% of U.S. nonfinancial stocks with fund owners experiencing the largest return losses due to investments in financial stocks over the one-year period from July 2007 to June 2008, and nonexposed stocks are the remaining 70% of stocks. Panel A reports the mean and median of exposed and nonexposed stocks for stock capitalization in the natural logarithm of U.S. dollars (LnSize), Amihud illiquidity measure (Illiquidity), the price-to-book ratio, the receivables-to-sales ratio, leverage (or the total debt-to-asset ratio), the short-term (ST) debt-to-asset ratio, and dividend yield. The market capitalization and the price-to-book ratio are based on the data in June 2007 from Datastream. The receivables-to-sales ratio, leverage, the short-term (ST) debt-to-asset ratio, and dividend yield are based on the latest fiscal year-end data prior to July 2007 obtained from the Compustat database. The average daily Amihud illiquidity measure is calculated over the period from July 1, 2006 to June 30, 2007. Panel B reports the distribution of the number of U.S. funds holding an exposed stock (Columns 1–3) and a nonexposed stock (Columns 4–6) in June 2007. We distinguish between exposed and nonexposed fund owners. Fund exposure is measured by the return loss of a fund due to ownership in financial stocks over the one-year period from July 2007 to June 2008. The 30% of funds with the largest exposure to the financial sector are marked as exposed funds, and the remaining 70% as nonexposed funds.

Panel A: Firm characteristics

	Exposed stocks			Nonexposed stocks		
Variable	Obs. (1)	Mean (2)	Median (3)	Obs. (4)	Mean (5)	Median (6)
LnSize	1,330	21.154	21.066	3,110	18.472	18.666
Illiquidity	1,284	0.039	0.001	2,243	0.898	0.037
Receivables-to-sales	1,273	0.160	0.150	1,999	0.206	0.155
Price-to-book	1,276	3.110	2.333	2,395	3.925	2.690
Leverage	1,283	0.208	0.190	2,041	0.163	0.074
ST debt-to-assets	1,297	0.027	0.004	2,081	0.031	0.003
Dividend yield	1,299	0.009	0.000	2,114	0.009	0.000

Panel B: Fund ownership distribution

	Exposed stocks			Nonexposed stocks		
	All fund owners (1)	Exp. fund owners (2)	Nonexp. fund owners (3)	All fund owners (4)	Exp. fund owners (5)	Nonexp. fund owners (6)
Percentile						
p5	40	15	21	1	0	1
p10	72	22	44	1	0	1
p25	125	41	76	5	1	3
p50	186	63	115	21	7	13
p75	289	105	162	67	18	48
p90	470	264	229	133	36	96
p95	583	334	281	196	50	147
N	1,271	1,271	1,271	2,698	2,698	2,698
Mean	234	105	130	51	15	36
STD	183.0	108.5	89.1	78.5	28.0	54.8

Table 3: OLS Regressions for Cumulative Stock Returns

The cumulative risk-adjusted stock returns (starting from July 1, 2007) over one to five consecutive semesters are regressed on two dummy variables. The dummy variable $DExp^s$ marks with 1 the 30% of U.S. stocks with fund owners most exposed to financial stocks. A fund owner's exposure is measured by its return loss in financial stocks from July 1, 2007 to June 30, 2008. In the first regression (Column 1), the contemporaneous stock exposure dummy $DExp^s(2007/2)$ takes into account fund owners' return loss in financial stocks for only the second semester of 2007. The dummy variable $DFsh^s$ marks with 1 the 30% of U.S. stocks with the largest overall fund ownership in June 2007. The last two columns regress the cumulative weekly stock returns from June 29, 2007 to the twin peaks of the crisis (November 7, 2008 and February 27, 2009) on the two dummy variables. The sample includes all U.S. nonfinancial stocks, which excluding stocks in banking, insurance, real estate, and financial trading industries. Firms with more than 1% of their sales in these four industries as well as in construction and construction materials industries are also excluded. Also excluded are the stocks held by U.S. funds with investment objectives in real estate, construction, and home building sectors as of June 2007. All regressions include industry fixed effects. The t-values based on robust standard errors are reported in brackets.

	Cumulative risk-adjusted returns (by)						
	End of semester					Peak of crisis	
	Dec. 2007 (1)	June 2008 (2)	Dec. 2008 (3)	June 2009 (4)	Dec. 2009 (5)	Nov. 7, 2008 (6)	Feb. 27, 2009 (7)
$DExp^s(2007/2)$	−0.106						
	[−4.51]						
$DExp^s$		−0.141	−0.227	−0.100	−0.033	−0.327	−0.444
		[−3.98]	[−3.62]	[−1.93]	[−0.67]	[−4.35]	[−4.36]
$DFsh^s$	0.083	0.182	0.200	0.225	0.227	0.112	0.256
	[3.45]	[4.98]	[3.04]	[4.23]	[4.41]	[1.40]	[2.46]
Obs.	3,507	3,419	3,318	3,213	3,007	3,271	3,234
Adj.R^2	0.021	0.044	0.012	0.029	0.033	0.011	0.021

Table 4: Quantile Cumulative Stock Return Regressions

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

	Cumulative risk-adjusted returns (by)			
	Nov.7 2008 (1)	Feb. 27 2009 (2)	Nov.7 2008 (3)	Feb. 27 2009 (4)
Quantile 25%				
$DExp^s$	0.004	−0.024	0.061	0.021
	[0.11]	[−0.53]	[1.70]	[0.71]
$DFsh^s$	0.051	0.048	0.096	0.098
	[1.63]	[0.97]	[2.97]	[3.32]
$LnSize^s$	0.061	0.057		
	[7.41]	[7.09]		
$DLiq^s$			0.174	0.213
			[5.25]	[6.55]
Quantile 50%				
$DExp^s$	−0.102	−0.038	−0.024	−0.028
	[−2.94]	[−0.73]	[−0.45]	[−0.62]
$DFsh^s$	0.131	0.109	0.145	0.161
	[2.93]	[1.73]	[2.70]	[3.81]
$LnSize^s$	0.055	0.060		
	[7.78]	[8.00]		
$DLiq^s$			0.138	0.245
			[3.62]	[5.92]
Quantile 75%				
$DExp^s$	−0.216	−0.293	−0.216	−0.301
	[−3.08]	[−3.12]	[−3.21]	[−2.80]
$DFsh^s$	0.096	0.209	0.101	0.236
	[1.20]	[1.83]	[1.44]	[4.09]
$LnSize^s$	0.006	0.050		
	[0.38]	[2.65]		
$DLiq^s$			0.032	0.204
			[0.57]	[2.55]
Quantile 90%				
$DExp^s$	−0.701	−0.762	−0.765	−0.921
	[−3.44]	[−3.57]	[−4.71]	[−5.10]
$DFsh^s$	0.147	0.228	0.127	0.232
	[1.15]	[1.24]	[0.99]	[1.80]
$LnSize^s$	−0.071	−0.061		
	[−1.70]	[−1.28]		
$DLiq^s$			−0.160	−0.022
			[−2.15]	[−0.19]
Obs.	3,275	3,238	3,275	3,238
Q25% *Pseudo* R^2	0.058	0.050	0.064	0.056
Q50% *Pseudo* R^2	0.042	0.044	0.048	0.050
Q75% *Pseudo* R^2	0.036	0.042	0.038	0.044
Q90% *Pseudo* R^2	0.160	0.190	0.157	0.190

Table 5: Cumulative Stock Returns and Firm Characteristics

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

	Cumulative risk-adjusted returns (by)						
	End of semester					Peak of crisis	
	Dec. 2007	June 2008	Dec. 2008	June 2009	Dec. 2009	Nov. 7, 2008	Feb. 27, 2009
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$DExp^s(2007/2)$	−0.078						
	[−3.15]						
$DExp^s$		−0.131	−0.205	−0.076	−0.011	−0.278	−0.386
		[−3.56]	[−3.10]	[−1.41]	[−0.23]	[−3.59]	[−3.55]
$DFsh^s$	0.066	0.150	0.195	0.234	0.235	0.139	0.323
	[2.62]	[4.02]	[2.83]	[4.26]	[4.39]	[1.68]	[3.05]
Illiquidity	0.001	0.002	−0.004	−0.011	−0.007	−0.004	−0.013
	[0.14]	[0.49]	[−0.52]	[−2.95]	[−1.56]	[−0.34]	[−1.03]
Receivables-to-sales	0.001	0.000	0.002	−0.000	0.005	0.002	−0.003
	[0.33]	[0.24]	[0.65]	[−0.02]	[2.23]	[0.69]	[−0.51]
Price-to-book	0.000	0.000	0.001	0.003	0.000	0.002	0.003
	[1.48]	[0.26]	[1.69]	[3.43]	[1.01]	[1.92]	[2.01]
Leverage	0.134	0.216	−0.311	−0.324	−0.224	−0.260	−0.368
	[1.81]	[1.95]	[−1.79]	[−2.24]	[−1.70]	[−1.33]	[−1.45]
ST debt-to-asset	−0.326	−0.451	−0.856	−0.240	−0.750	−0.976	−0.397
	[−1.48]	[−1.62]	[−1.96]	[−0.58]	[−2.47]	[−2.08]	[−0.51]
Dividend yield	−0.168	−0.280	−0.438	−0.056	0.011	−0.528	−0.379
	[−0.63]	[−0.93]	[−1.88]	[−0.25]	[0.06]	[−1.62]	[−1.11]
Obs.	2,612	2,544	2,477	2,428	2,335	2,474	2,451
$Adj.R^2$	0.042	0.083	0.032	0.057	0.077	0.044	0.037

Table 6: OLS Regressions for Aggregate Fund Holding Changes

For each stock, the percentage change in the aggregate fund holdings relative to positions in June 2007 over one to four consecutive semesters is regressed on dummy variables. The dummy variable $DExp^s$ marks with 1 the 30% of U.S. stocks with fund owners most exposed to financial stocks. A fund owner's exposure is measured by its return loss in financial stocks from July 1, 2007 to June 30, 2008. In the first set of regressions (Columns 1–4), the contemporaneous stock exposure dummy $DExp^s(2007/2)$ takes into account fund owners' return loss in financial stocks for only the second semester of 2007. The dummy variable $DFsh^s$ marks the 30% of U.S. stocks with the largest fund ownership share in June 2007. The dummy $DHighR^s$ marks the 30% of U.S. stocks with the highest cumulative return over the k semester(s) under consideration. The dummy variable $DLiq^s$ marks the 30% most liquid U.S. stocks, based on the average daily Amihud illiquidity measure over the period from July 1, 2006 to June 30, 2007. The dummy $DExp^s \times DHighR^s$ represents the interaction of the stock exposure dummy $DExp^s$ (or $DExp^s(2007/2)$) and the high crisis-return dummy $DHighR^s$.The dummy $DExp^s \times DLiq^s$ represents the interaction of the stock exposure dummy $DExp^s$ (or $DExp^s(2007/2)$) and the liquidity dummy $DLiq^s$. All regressions include industry fixed effects. The t-values based on robust standard errors are reported in brackets.

	Percentage change in aggregate fund holdings (by)					
	Dec. 2007			June 2008		
	(1a)	(1b)	(1c)	(2a)	(2b)	(2c)
$DExp^s(2007/2)$	−0.727	−0.399	−0.726			
	[−3.33]	[−1.79]	[−2.80]			
$DExp^s$				−1.535	−1.138	−1.475
				[−4.50]	[−3.25]	[−3.69]
$DFsh^s$	−2.700	−2.192	−2.047	−5.646	−5.013	−4.815
	[−12.13]	[−9.69]	[−8.97]	[−16.21]	[−14.51]	[−13.81]
$DHighR^s$		−0.662	−0.518		−1.264	−0.991
		[−4.84]	[−3.64]		[−6.80]	[−5.22]
$DLiq^s$		−1.797	−2.587		−2.297	−3.398
		[−8.54]	[−7.95]		[−7.90]	[−7.86]
$DExp^s$			−0.519			−0.972
$\times DHighR^s$			[−1.45]			[−2.04]
$DExp^s$			1.387			1.928
$\times DLiq^s$			[3.38]			[3.35]
Obs.	3,994	3,994	3,994	4,007	4,007	4,007
$Adj.R^2$	0.155	0.183	0.187	0.267	0.292	0.296

	Dec. 2008			June 2009		
	(3a)	(3b)	(3c)	(4a)	(4b)	(4c)
$DExp^s$	−1.977	−1.518	−1.653	−2.481	−1.902	−1.841
	[−5.19]	[−3.90]	[−3.59]	[−6.23]	[−4.65]	[−3.58]
$DFsh^s$	−7.827	−7.270	−7.089	−9.031	−8.428	−8.275
	[−20.32]	[−18.96]	[−18.35]	[−22.46]	[−20.85]	[−20.27]
$DHighR^s$		−1.656	−1.258		−1.578	−1.106
		[−7.89]	[−5.90]		[−7.11]	[−4.96]
$DLiq^s$		−2.264	−3.376		−2.497	−3.526
		[−6.73]	[−7.12]		[−6.97]	[−7.22]
$DExp^s$			−1.325			−1.586
$\times DHighR^s$			[−2.48]			[−2.84]
$DExp^s$			1.945			1.850
$\times DLiq^s$			[2.98]			[2.67]
Obs.	3,963	3,963	3,963	3,958	3,958	3,958
$Adj.R^2$	0.334	0.356	0.360	0.362	0.382	0.385

Table 7: International Evidence

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

Panel A: All non-U.S. stocks

	Cumulative risk-adjusted returns (by)						
	End of semester					Peak of crisis	
	Dec. 2007 (1)	June 2008 (2)	Dec. 2008 (3)	June 2009 (4)	Dec. 2009 (5)	Nov. 7, 2008 (6)	Feb. 27, 2009 (7)
$DExp^s(2007/2)$	−0.031						
	[−2.53]						
$DExp^s$		−0.076	−0.134	−0.025	−0.019	−0.168	−0.235
		[−3.63]	[−2.84]	[−0.79]	[−0.50]	[−3.10]	[−3.16]
$DFsh^s$	−0.024	0.007	0.054	0.002	0.022	0.065	0.133
	[−1.92]	[0.33]	[1.12]	[0.06]	[0.58]	[1.15]	[1.74]
Obs.	14,691	14,666	14,651	14,631	14,608	14,622	14,618
Adj.R^2	0.206	0.269	0.253	0.232	0.212	0.228	0.235

Panel B: Developed market stocks ex U.S.

	Cumulative risk-adjusted returns (by)						
	End of semester					Peak of crisis	
	Dec. 2007 (1)	June 2008 (2)	Dec. 2008 (3)	June 2009 (4)	Dec. 2009 (5)	Nov. 7, 2008 (6)	Feb. 29, 2009 (7)
$DExp^s(2007/2)$	−0.047						
	[−3.18]						
$DExp^s$		−0.085	−0.134	−0.029	−0.026	−0.168	−0.261
		[−3.21]	[−2.12]	[−0.67]	[−0.48]	[−2.28]	[−2.58]
$DFsh^s$	−0.004	0.017	0.115	0.037	0.046	0.135	0.275
	[−0.29]	[0.64]	[1.71]	[0.80]	[0.89]	[1.72]	[2.58]
Obs.	9,969	9,938	9,921	9,904	9,882	9,900	9,897
Adj.R^2	0.165	0.170	0.200	0.199	0.162	0.173	0.191

Panel C: Emerging market stocks

	Cumulative risk-adjusted returns (by)						
	End of semester					Peak of crisis	
	Dec. 2007 (1)	June 2008 (2)	Dec. 2008 (3)	June 2009 (4)	Dec. 2009 (5)	Nov. 7, 2008 (6)	Feb. 29, 2009 (7)
$DExp^s(2007/2)$	−0.014						
	[−0.68]						
$DExp^s$		−0.062	−0.124	−0.014	−0.006	−0.157	−0.175
		[−1.82]	[−1.84]	[−0.30]	[−0.12]	[−2.07]	[−1.70]
$DFsh^s$	−0.045	−0.009	−0.037	−0.051	−0.015	−0.041	−0.083
	[−2.17]	[−0.28]	[−0.57]	[−1.07]	[−0.27]	[−0.56]	[−0.82]
Obs.	4,722	4,728	4,730	4,727	4,726	4,722	4,721
Adj.R^2	0.238	0.367	0.313	0.283	0.314	0.287	0.283

Table 8: Distribution of Pairwise Fund Portfolio Overlap

Reported are the pairwise fund portfolio overlap statistics for (i) exposed fund pairs, (ii) nonexposed fund pairs, and (iii) pairs of one fund from the exposed group and one from the nonexposed group, based on fund holdings in June 2007. For any pair of funds, we define their portfolio overlap (in nonfinancial sector stocks) as the minimum common portfolio weight in any stock s, summed across all nonfinancial sector stocks that both funds share. We examine such portfolio overlap for the 10% most distressed funds (i.e., funds with the greatest investment loss from financial stocks from July 2007 to June 2008) that hold at least one U.S. non-financial stock in June 2007. We then match this group with the same number of other funds, based on their country codes and the size of their total asset holdings in nonfinancial stocks. p5, p10, p25, p50, p90, and p95 denote the 5th, 10th, 25th, 50th, 90th, and 95th percentile of the fund portfolio overlap distribution. Also reported are mean and standard deviation (STD) of the overlap, the percentage of fund pairs with no overlap in fund holdings (Percentage Zero), and the total number of fund paris (N). We also report the z-statistic and p-value for the ranksum test for the null hypothsis that the exposed fund pairs have the same distribution as the nonexposed fund pairs or the cross group fund pairs.

	Exposed fund pairs (1)	Nonexposed fund pairs (2)	Cross group fund pairs (3)
p5	0.000	0.000	0.000
p10	0.000	0.000	0.000
p25	0.000	0.000	0.000
p50	0.000	0.000	0.000
p75	0.005	0.009	0.006
p90	0.026	0.032	0.027
p95	0.053	0.055	0.046
Mean	0.009	0.010	0.008
STD	0.024	0.026	0.020
Percentage of zeros	68.8%	63.6%	67.6%
Number of pairs	$444,153$	$444,153$	$889,249$
Ranksum test			
Exposed funds vs. nonexposed fund pairs:		z–stat $= -54.37$	(p-value $= 0.00$)
Exposed fund vs. gross group fund pairs:		z–stat $= -13.07$	(p-value$= 0.00$)

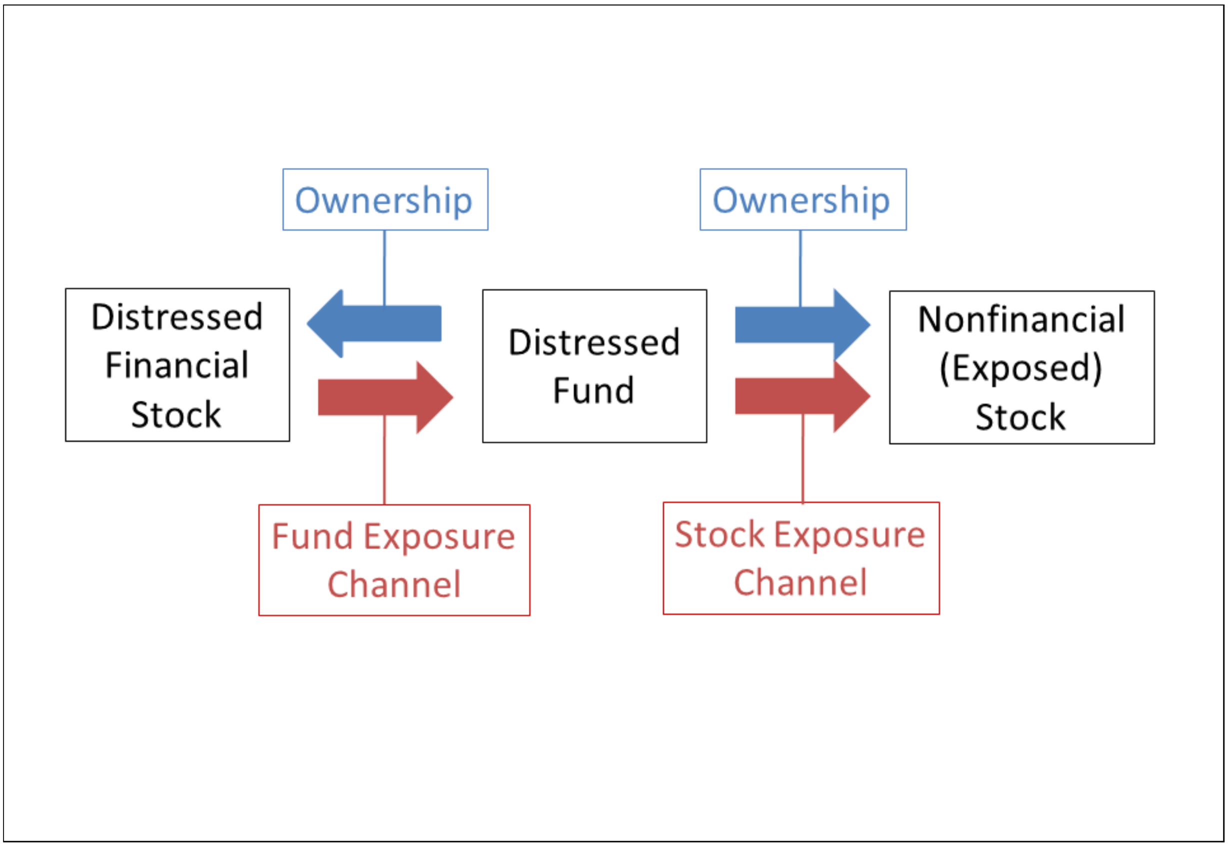

Figure 1: Contagion channels of fund exposure and stock exposure

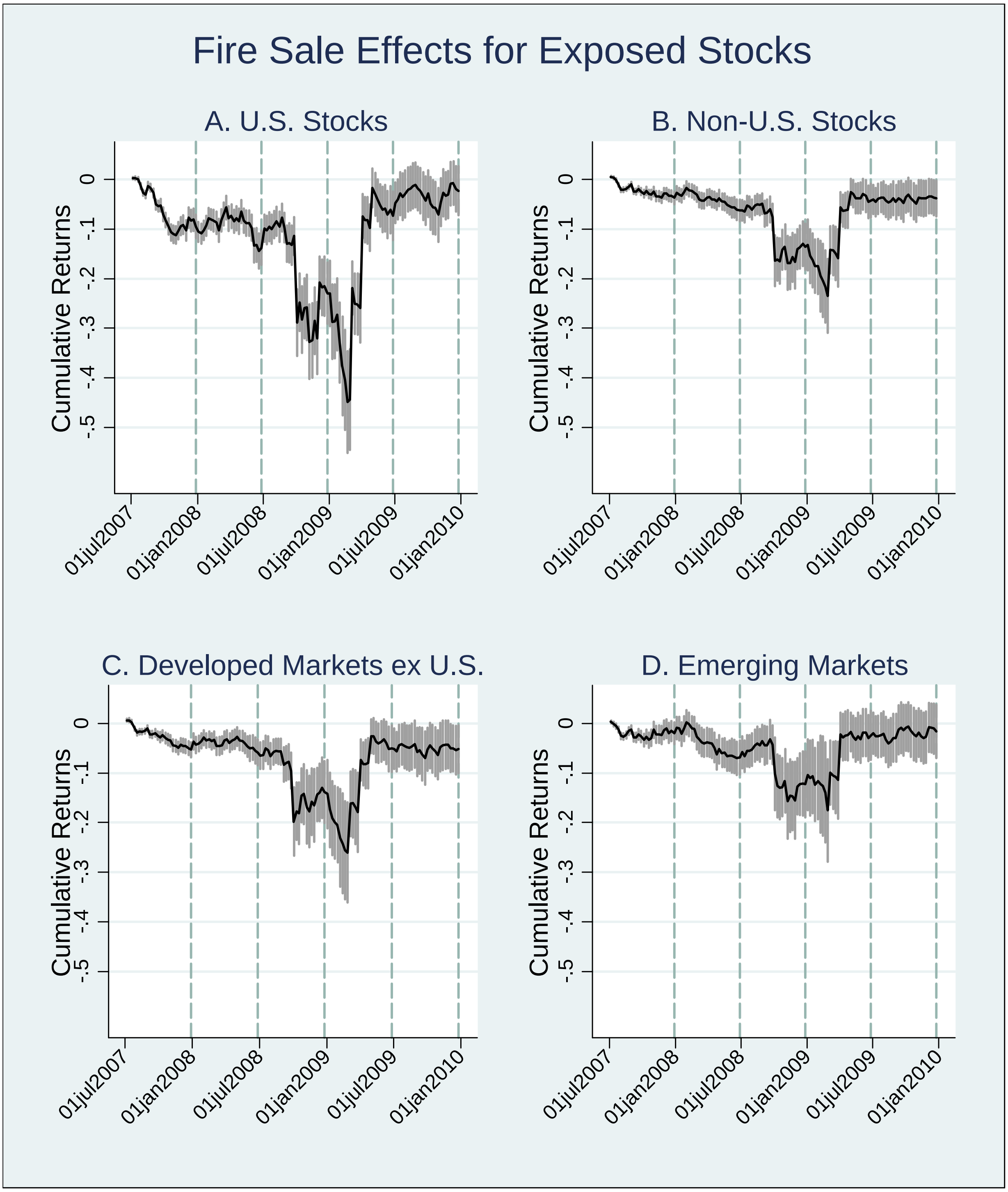

Figure 2: The graph shows the underperformance of exposed, nonfinancial stocks relative to other nonfinancial stocks in the same industry after accounting for risk premia from a model with four local and four international risk factors. Exposed stocks are the 30% of nonfinancial stocks with their fund owners most exposed to the financial sector during the one-year period from July 2007 to June 2008. Panels A, B, C, and D plot the graph for, respectively, U.S. stocks, all non-U.S. stocks, developed market stocks excluding the U.S., and emerging market stocks. The vertical bars provide robust standard errors (±1 standard deviation) around the point estimate of the average cumulative risk-adjusted returns.

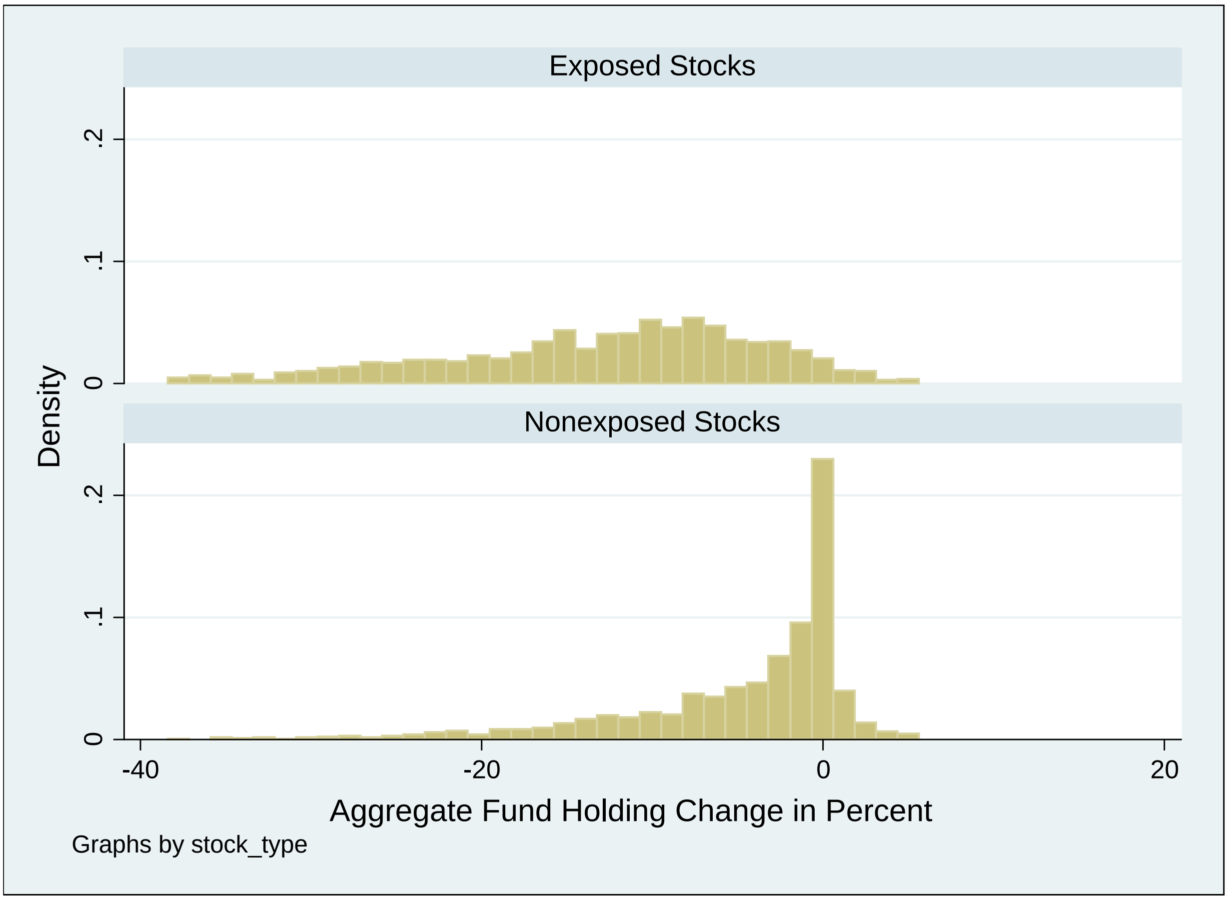

Figure 3: Plotted is the distribution of the percentage change in the aggregate fund holdings over four consecutive semesters relative to positions in June 2007, i.e., $\Delta\widetilde{H}^s(4)$. Exposed stocks are the 30% of U.S. nonfinancial stocks with fund owners experiencing the largest return losses due to investments in financial stocks over the one-year period from July 2007 to June 2008, and nonexposed stocks are the remaining 70%.

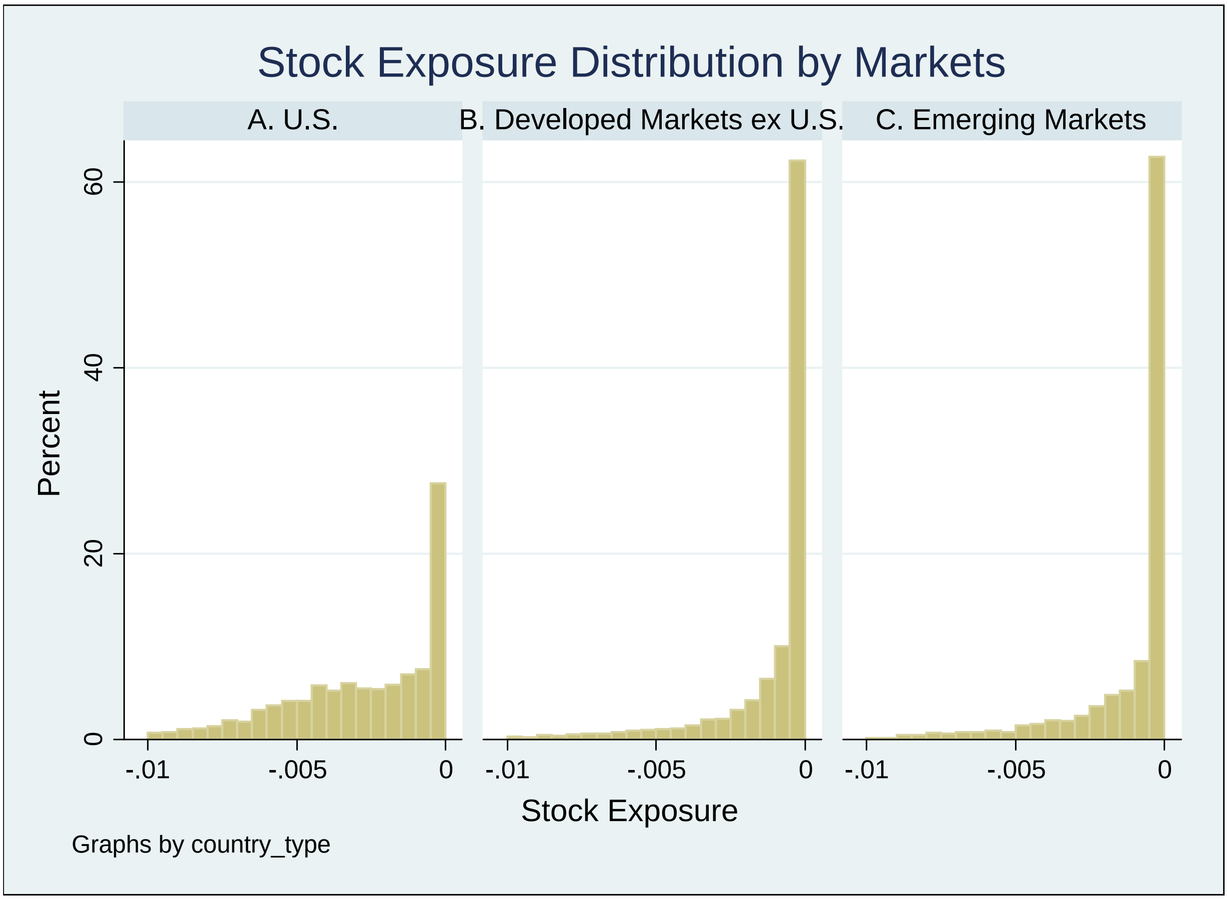

Figure 4: Plotted are the distributions of stock exposure Exp^s for nonfinancial stocks in the U.S. (Panel A), developed markets excluding the U.S. (Panel B), and emerging markets (Panel C). Stocks with less than -0.01 of stock exposure account for only a small proportion of the population and are therefore not plotted.