Corporate Responses to Stock Price Fragility*

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Abstract

We study whether stock price fragility (exposure to non-fundamental demand shocks) stemming from changes in the composition of equity ownership poses a salient corporate risk. We model ex-ante corporate responses to higher potential for *future* stock market misvaluation and then empirically document that within firm variation in equity fragility has effects in line with the model: higher fragility raises cash holdings and lowers investment. Multiple natural experiments support a causal interpretation of the results. The results are shown to be more prominent in the face of high uncertainty and financial constraints. The evidence presents a new dimension in the feedback channel which connects the stock market and corporate policies.

Keywords: Financial fragility, Precautionary cash holding, Real effects of misvaluation
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1 Introduction

The interaction between corporate finance and financial markets is at the heart of financial economics. Firms rely on financial markets in different ways and so might be affected by shocks that originate in them. One of the key questions that has been the focus of a large volume of research is whether non-fundamental mispricing shocks in the equity market affect firms' behavior. Such concerns are often voiced in practice. Take, for example, George Soros in a testimony in 1994 before Congress, arguing that: "In certain circumstances, financial markets can affect the so called fundamentals which they are supposed to reflect. When that happens, markets enter into a state of dynamic disequilibrium and behave quite differently from what would be considered normal by the theory of efficient markets. Such boom/bust sequences do not arise very often, but when they do, they can be very disruptive, exactly because they affect the fundamentals of the economy."[1]

A common strategy for evaluating such forces in previous empirical research was to identify mispricing shocks and analyze their effect on various corporate-finance outcomes, such as corporate investment (e.g., Baker et al. (2003) or Hau and Lai (2013)) and takeovers (e.g. Dong et al. (2006) or Edmans et al. (2012)). The debate that often follows naturally, given the difficulties in identifying mispricing, centers on the extent to which shocks to prices indeed reflect non-fundamental changes.[2]

Another approach to answer the important question of whether financial-market shocks affect firms is to ask whether firms change their behavior when they anticipate that their stock price fragility has increased and, thus, that they are more prone to future mispricing. This is the analysis we undertake in this paper. To the best of our knowledge, despite the large literature trying to understand the relation between financial-market shocks and the real economy, our paper is the first one to provide such analysis. Documenting that firms respond in a precautionary manner to an increased risk of mispricing offers a new way, which sidesteps the controversy around identifying non-fundamental changes in prices, to understand the important relation between shocks in financial markets and corporate finance decisions. It also provides vastly new implications, pointing to the effect that financial-market shocks have before they materialize. Corporations react directly to the increased threat of mispricing.

[1] See: https://www.valuewalk.com/2014/06/george-soros-mit-speech/.

[2] See recent critiques on the Edmans et al. (2012) fund-flows measure of mispricing by Berger (2019) and Wardlaw (2020), and, on the other hand, recent papers showing that the measure continues to work after addressing these critiques (Dessaint et al. (2020), Gredil et al. (2019), and Bian et al. (2018)).

To capture the risk that firms face due to stock-price fragility, we use the measure developed by Greenwood and Thesmar (2011). The logic behind their measure is that firms that face greater correlation in the liquidity needs of their stocks' owners are prone to higher idiosyncratic volatility in order flows and ultimately in stock prices. Such firms are considered to be more exposed to stock price fragility. Hence, their measure links the ownership composition of stocks to the non-fundamental demand that these stocks might face. Greenwood and Thesmar (2011) build their measure based on the readily available data on mutual fund ownership. They note that fragility has increased dramatically over the last two decades due to changes in the landscape of the mutual fund industry, e.g., its concentration of holdings.[3] Following their approach, we focus on mutual funds' holdings to measure fragility. We then examine whether stock price fragility affects important aspects of firms' behavior, such as their cash holding and investment.

Why would non-fundamental changes in prices be a concern to firms? Stock prices serve as a signal to many decision makers who end up taking actions that affect the firms' investments, operations, and cash flows. A recent literature has developed around this idea to explore the feedback effect from stock prices to firms' investments and cash flows (see Bond et al. (2012) for a survey and Luo (2005), Chen et al. (2006), and Foucault and Fresard (2014), among others, for empirical evidence). While the feedback effect is usually perceived to have a beneficial role since it helps provide information to decision makers and guide them into making more efficient decisions, it can be destabilizing in certain circumstances when speculators' incentives are affected by the expected feedback leading them to trade in a way that is not aligned with information available (see models by Goldstein and Guembel (2008), Goldstein et al. (2013), and Brunnermeier and Oehmke (2013), among others).

More specific to our setting, in the presence of a feedback effect, mispricing is expected to affect firms' investments and operations. As prices move for fundamental and non-fundamental reasons, decision makers update their views and decisions - and are sometimes affected by non-fundamental changes in price since it is difficult to disentangle fundamental from non-fundamental changes (see, e.g., Edmans et al. (2012), Khan et al. (2012), Hau and Lai (2013), and Dessaint et al. (2019)). If decision makers learning from the price are potential creditors or other capital providers, mispricing shocks will affect the access that the firm has to capital, and ultimately also its ability to invest and operate. Hence, a greater anticipated volatility in stock prices due to potential for misvaluation may concern firms and encourage them to take precautionary steps.

[3]See related evidence on fragility in Ben-David et al. (2021).

We start the paper by providing a simple model to illustrate the channel. Firms choose how much cash buffer to keep in the business. The cost of an increased cash buffer is the forgone return on alternative illiquid investment opportunities. The benefit comes from the fact that the firm may face a future financing need if its cash balances fall below a certain level. The cost of raising cash in the future depends on the pricing of the securities of the firm in the market, a feature that we take as given but is motivated by the feedback-effect literature described above. While all firms face some risk of equity misvaluation raising their cost of raising capital in the future, changes in the degree of misvaluation risk should affect the benefit of increasing current cash holdings. This implies that firms exposed to greater stock fragility will hold more cash and invest less in capital expenditure. The model is in the same tradition as in Baker et al. (2003) (building on Stein (1996)) in which a firm, after observing its current stock market valuation, decides on investment and whether to issue new equity. We differ from previous work on corporate responses to mispricing by modeling the *ex ante* decision of precautionary corporate behavior.

It is important to emphasize that the above mechanism does not rely on any asymmetry between underpricing and overpricing. A fragile stock price implies a higher probability of bigger overpricing just like it does for bigger underpricing. The key, however, is that the gains from overpricing do not play any role in the choice of cash buffer of the firm, since the firm may always exploit these gains when they arise regardless of its level of cash. It is only the loss from underpricing that is forced on the firm when it faces cash shortage, and this is why the firm will attempt to reduce cash shortages when it expects a higher likelihood of severe underpricing.

After setting up the model to illustrate the mechanism, we proceed to the main part of the paper, which is the empirical analysis based on the model's predictions. As mentioned above, we use stock holdings by US mutual funds to build the measure of stock price fragility developed by Greenwood and Thesmar (2011). The key premise behind this measure is that fragility depends on the structure of ownership in the firm's stock. If liquidity needs are more correlated among shareholders or if there is greater concentration in holdings, then the firm faces more fragility with respect to possible mispricing.[4]

[4]The Greenwood and Thesmar (2011) fragility measure builds on evidence that liquidity needs of mutual funds can drive stock prices of individual firms. This goes back to Coval and Stafford (2007). There is also evidence by Anton and Polk (2014) and Koch et al. (2016) that ownership patterns matter for stock price fragility. To the best of our knowledge only one other paper brings this measure of fragility to a corporate-finance context. Xiao (2018) documents a negative link between noise trading and firm performance as measured by returns on assets, cash flows and operating profits. His results emphasize managerial learning from the market rather than real effects through access to capital.

Our main set of results relate this measure of fragility to cash holdings and other precautionary corporate decisions. Panel regressions control for industry-time and firm fixed effects as well as a set of additional time variant firm characteristics. We show a strong positive (negative) relation between the level of fragility and the firm's choice of cash holdings (capital expenditures, R&D, payout). These within-firm specifications imply that firm policies respond to changing institutional ownership patterns and the resulting stock price fragility. Firms take precautionary actions – increasing their cash buffers and reducing their expenditures – when they are subject to greater stock price fragility due to the characteristics of their investors base. These results emphasize how the real effect of financial markets extends beyond what happens when prices are shocked: anticipation of future shocks also causes firms to increase their precautionary behavior.

An obvious concern about the previous results is whether they indeed indicate a causal effect of fragility on corporate policies. There is a possibility that investors expect a corporate policy change in the future (such as an announcement of a higher future cash holding target for a firm) which could change the ownership composition and thereby the degree of financial fragility. Alternatively, potential endogeneity may be due to an omitted variable that is correlated with both shareholder composition and corporate cash policies. While there are no obvious alternative channels which could generate the results we obtain after controlling for both firm and industry-year fixed effects, we examine the effect of multiple episodes of financial institution mergers which provide exogenous shocks to stock price fragility to buttress the panel regression evidence.

First, we look at the very prominent 2009 merger between Blackrock and Barclays Global Investors (BGI), which previously has been used as an exogenous shock to ownership concentration. For example, Massa et al. (2020b) used it to examine the response of other funds to an increase in holding concentration and Azar et al. (2018a) used it to examine the effect of the increased ownership concentration on product market (airlines) competition. As highlighted by Massa et al. (2020b), the merger has several attractive features for identification purposes: It came as a surprise, it affected many stocks (stocks held by both BlackRock and BGI represent more than 60% of world market capitalization), and it was associated with a substantial change in ownership concentration for many affected stocks (concentration increased by 8.5% in the quintile of stocks with the highest overlap of portfolios). The results from a close examination of the BlackRock and BGI merger support the notion that the panel regressions capture a causal effect. With an exogenous change in ownership concentration and financial fragility, we again document that firms adjust their cash holding in the expected direction in response to

fragility risk.

Second, since the BlackRock-BGI merger is widely debated in the context of the literature investigating the effect of common ownership on *product market competition* (see e.g. Dennis et al. (2018), Azar et al. (2018b), Lewellen and Lowry (2020)), we follow Lewellen and Lowry (2020) and evaluate the effect of other episodes of financial institution mergers that occur in non-crisis years. For their two largest mergers, where we can reasonably expect to find a meaningful effect on fragility, we again establish that cash holdings increase in response to greater financial fragility. That said, we note that the concerns raised in this literature about the BGI-BlackRock merger do not seem as relevant for the purpose of our study. Examinations of common ownership on product market competition hinge on very different mechanisms than what concerns us here. When studying the effects of common ownership on product market competition, issues of passive vs. actively managed funds and possibilities for fund managers to control corporate managers take center stage. In contrast, the mechanism of interest in this paper rests on the well documented premise that more concentrated mutual fund ownership of a firm is associated with greater stock price volatility.

Additional important analysis in our paper demonstrates that fragility does not affect corporate policies equally across firms and over time. Consistent with the theory, we find that firms increase their cash buffers in response to heightened fragility when they are constrained or face high uncertainty and when aggregate conditions are stressed or uncertain. In particular, we show that the sensitivity of cash holdings to fragility is higher for firms which are small, have more volatile earnings, and do not have a bond rating. Similarly, we show that the sensitivity is increasing in times when the volatility in the market is high, according to the VIX measure and when investor sentiment is low (the latter measured by the index proposed by Baker and Wurgler (2006)). These results lend further support to our interpretation about the mechanism via which stock fragility affects corporate policies.

Across the different specifications we consistently document non-trivial effects. Using within firm variation in stock price fragility we find that a one standard deviation increase in stock price fragility raises cash holding by around 2.1% when evaluated at the mean. The corresponding effect for earnings volatility, a highly salient motivation for precautionary cash holding, is around 1.9%. We also note that treated firms raised their cash holdings by around 1.6 percentage points in response to the exogenous change in stock price fragility associated with the BlackRock-BGI merger. In sum, the empirical results support the hypothesis that stock price fragility is something managers pay attention to

when they set corporate policies and that the effects are important.

In addition to the stock price feedback (or 'real effects') literature, this paper relates to two broader streams of the literature not explicitly discussed above. First, we relate to extensive work on links from uncertainty to investment. Uncertainty can stem from firm or project risk - as is the focus of theory by Bernanke (1983) - and there is broad evidence that firms adjust investment and/or the propensity to save when facing such risks (see Baker et al. (2016) and Riddick and Whited (2009)). Our results highlight that uncertainty exists in external financing access or cost, regardless of project risk, if there are concerns regarding the supply of bank credit (Peek and Rosengren (2000) and Becker and Ivashina (2015)) or the ability to go public (Pástor and Veronesi (2005)) in addition to general macroeconomic uncertainty (Jurado et al. (2015)). Stock price fragility is a specific but potentially economically important and distinct source of financing uncertainty. We are the first to provide evidence that managers identify increasing stock fragility – and the resulting potential exposure to non-fundamental shocks – as a salient risk.[5]

Second, we relate to work on precautionary cash holding and financial flexibility - using financial policies to ensure cost-efficient access to capital in a wide range of states of the world (see, e.g., Denis (2011)). A precautionary motive for cash holdings is supported by numerous studies, for instance Bates et al. (2009) or Faulkender et al. (2018). While the precautionary cash literature is not new, this paper is the first to demonstrate that fragility is indeed a salient risk for public firms, providing an important piece of evidence in support of the feedback-effect theory. Another implication is that the costs of market fragility are not just captured by the events following price changes, but rather that there is significant cost imposed on firms due to the need to protect themselves against this risk. Firms may forego investments and hoard cash when this exposure increases. Overall, it is possible that growth of the asset management industry and the associated increase in equity fragility may be a force deterring firms from public markets.

The next section presents our model and then Section 3 presents the data and the measure of financial fragility. Section 4 presents the results from the panel analysis of fragility on our prime variable of interest, cash holding, but also on measures of investment

[5]To this end, we are similar in spirit to Ivashina and Scharfstein (2010) and Balakrishnan et al. (2014). Ivashina and Scharfstein (2010) documents an uptick in credit line drawdowns following Lehman Brothers' failure as firms sought to lock in future financing options when there was bank market uncertainty. Balakrishnan et al. (2014) shows firms responding to an analyst loss by increasing disclosure to improve liquidity. Further, we complement the investor horizon literature (Derrien et al. (2013)) with a new perspective on investor composition risk.

and liquidity management. Section 5 uses asset management mergers to examine the causal impact of more concentrated institutional ownership on cash holding and the other variables of interest. Section **??** explores alternative mechanisms, related to bank lending and weak product market competition, that in principle could be driving results. Section 6 concludes.

2 Model

There are three dates, 0, 1, and 2. At date 0, the firm decides how much to invest in a long term illiquid project maturing at date 2, and how much cash (or liquid assets) to keep in the business. At date 1, the firm's intermediate earnings are realized, exposing it to potential financing needs. At that point, the firm can raise more cash in the capital markets, generating either a gain or loss, depending on the mispricing of its stock (or other securities), which is realized at the same time. Finally, at date 2, the long-term investment matures and all cash flows realize. Below, we start by describing the actions of the firm at date 1, and then go back to describe its choices at time 0.

Date 1: Financing Needs, Mispricing, and the Firm's Interaction with Capital Markets

At date 1, the firm's cash balance is given by $c \equiv x + e$, where x is the initial cash balance the firm carried from date 0, and e is the realization of earnings generated during the period. We assume that e is distributed with a cumulative distribution function $F(e)$ and a density function $f(e)$ in the range $[\underline{e}, \overline{e}]$, where $\underline{e} < 0 < \overline{e}$.

At date 1, the firm can raise new cash $\Delta c \geq 0$ in the capital market, up to a ceiling of $\overline{\Delta c}$. The terms at which the firm is able to do this depend on the market price of its stock (or other securities). In particular, the terms of financing depend on the degree of mispricing. We use Δp to denote the level of mispricing. If the firm's stock is overpriced, then $\Delta p > 0$, and if it is underpriced, then $\Delta p < 0$. If $\Delta p > 0$, the firm generates a net profit from raising new cash, and if $\Delta p < 0$, it generates a net loss from doing so. We assume that the mispricing Δp is distributed with a cumulative distribution function $G(\Delta p)$ and a density function $g(\Delta p)$. We assume that the density function is symmetric around the mean of zero. That is, we do not want to have any asymmetry between overpricing and underpricing built into the model. For simplicity, we also keep the mispricing Δp independent of the earnings e.

We use Δp^+ to denote the positive realizations of Δp, and we use Δp^- to denote the absolute value of the negative realizations of Δp. Thus, both Δp^+ and Δp^- are positive. We use the function $G\left(\Delta c, \Delta p^+\right) \geq 0$ to denote the financing gain whenever $\Delta p > 0$ and $L\left(\Delta c, \Delta p^-\right) \geq 0$ to denote the financing loss whenever $\Delta p < 0$. Both $G\left(\cdot,\cdot\right)$ and $L\left(\cdot,\cdot\right)$ are increasing and weakly convex in the first element. They are increasing in the second element as well, and exhibit a positive cross-derivative. That is, $G_1 > 0,\ L_1 > 0,\ G_{11} \geq 0,\ L_{11} \geq 0,\ G_2 > 0,\ L_2 > 0,\ G_{12} > 0,\ L_{12} > 0$. We set $G\left(\cdot,\cdot\right)$ and $L\left(\cdot,\cdot\right)$ to be zero when $\Delta c = 0$ or $\Delta p = 0$.

For continuation of its operation, we assume that the firm's cash balances must stay at or above a threshold c^* between dates 1 and 2. Hence, if the firm finds itself with a lower cash balance c, it will need to go to the capital market and raise additional cash to bring it back at least to the threshold. We assume that the ceiling $\overline{\Delta c}$ faced by the firm for raising cash is sufficiently high to cover the firm's maximum potential cash shortfall, i.e., $\overline{\Delta c} > c^* - x - \underline{e}$.

Given the possibility of mispricing and the resulting financing gains and losses, and given the potential financing needs, the firm's optimal date-1 behavior will be as follows:

$$\Delta c = \begin{array}{ccc} \overline{\Delta c} & if & \Delta p > 0 \\ c^* - x - e & if & \Delta p \leq 0 \text{ and } x + e < c^* \\ 0 & Otherwise & \end{array} . \tag{1}$$

Hence, whenever the firm experiences a positive mispricing Δp^+, it will get a financing gain of $G\left(\overline{\Delta c}, \Delta p^+\right)$. Whenever the firm experiences a negative mispricing Δp^- and faces a cash shortfall because $x + e$ is below the threshold c^*, it will incur a financing loss of $L\left(\left(c^* - x - e\right), \Delta p^-\right)$. Otherwise, if the firm has a negative mispricing and no cash shortfall, it will refrain from raising new cash and will have no financing gain or loss.

Date 0: The Initial Decision of the Firm on Cash Holdings

At date 0, the firm has to choose its starting cash balance x. The firm faces an opportunity cost given by investment in a long-term project that matures at date 2. Hence, for a choice of cash x to be carried between date 0 and date 1, the firm is giving up return of $h\left(x\right)$ in the long-term project at date 2. We assume that the long-term project is completely illiquid and has no liquidation value at date 1. We assume that $h\left(x\right)$ is an increasing and convex function, i.e., $h'\left(x\right) > 0$ and $h''\left(x\right) > 0$.

For simplicity, we assume that there is no discounting in this environment. Then,

given the description so far, and the choice of the firm in date 1, as given by Equation (2), the firm chooses cash balance x at date 0 to maximize the following objective function:

$$\begin{aligned} V &= x + E[e] - h(x) \\ &\quad + \int_{\Delta p=0}^{\Delta p=\infty} G\left(\overline{\Delta c}, \Delta p^{+}\right) g(\Delta p)\, d\Delta p \\ &\quad - \int_{e=\underline{e}}^{e=c^{*}-x} \left(\int_{\Delta p=-\infty}^{\Delta p=0} L\left((c^{*}-x-e), \Delta p^{-}\right) g(\Delta p)\, d\Delta p \right) f(e)\, de. \end{aligned} \tag{2}$$

Here, the first line captures the direct payoff from cash balances minus the cost due to the forgone investment. The second line captures the gains from additional financing whenever the firm finds itself in a situation of overpriced securities. The third line captures the losses from additional financing whenever the firm finds itself in a situation of cash shortfall and underpriced securities.

The first-order condition coming out of the maximization of V in Equation (2) is:

$$h'(x) = 1 + \int_{e=\underline{e}}^{e=c^{*}-x} \left(\int_{\Delta p=-\infty}^{\Delta p=0} L_1\left((c^{*}-x-e), \Delta p^{-}\right) g(\Delta p)\, d\Delta p \right) f(e)\, de. \tag{3}$$

Essentially, the firm equates the marginal cost from increasing its cash buffer with the marginal benefit. On the left-hand side, the marginal cost is the marginal return lost from the alternative long-term project. On the right-hand side, the marginal benefit is the sum of the direct benefit from increasing the cash balance and the indirect benefit due to the decrease in financing losses incurred whenever the firm finds itself in an underpricing situation and a cash shortfall. By keeping a larger cash buffer, the firm can reduce those future financing losses because it does not need to raise as much cash in case of underpricing. Note that the financing gains in case of overpricing do not enter the first-order condition at all. This is because the firm will maximize these financing gains whenever the mispricing is positive and raise the maximum amount possible $\overline{\Delta c}$ irrespective of how much cash x it kept from date 0 to date 1.

There is a unique solution to (3) because the left-hand side is increasing in x and the right-hand side is decreasing in x. Hence, the level of cash buffer chosen by the firm is pinned down uniquely by this equation.

The Effect of Stock Price Fragility

Our main goal is to understand the effect that stock price fragility has on the choice of cash buffer made by the firm at date 0. Stock price fragility implies that higher levels of mispricing should be expected both on the negative side and on the positive side. We capture this in the model by comparing two distributions of mispricing $g(\Delta p)$ and $g'(\Delta p)$; both are symmetric functions around the mean of Δp, i.e., around zero. We say that $g'(\Delta p)$ represents more fragility than $g(\Delta p)$ if there exists a value $\widehat{\Delta p} > 0$, such that:

$$\begin{array}{lll} g'(\Delta p) > g(\Delta p) & iff & \Delta p > \widehat{\Delta p} \quad or \quad \Delta p < -\widehat{\Delta p} \\ g'(\Delta p) < g(\Delta p) & iff & -\widehat{\Delta p} < \Delta p < \widehat{\Delta p} \end{array} . \tag{4}$$

Essentially, $g'(\Delta p)$ is a mean-preserving spread of $g(\Delta p)$

Under the definition of fragility in Equation (4) and the first-order condition in Equation (3), it is clear that the firm chooses a higher level of cash buffer x when it faces mispricing distribution that represents more fragility $g'(\Delta p)$. Under the distribution $g'(\Delta p)$, weight is shifted from lower values of Δp^- to higher values of Δp^-. Then, because the cross derivative of the loss function $L(\Delta c, \Delta p^-)$ is positive ($L_{12} > 0$), the marginal benefit of cash buffer on the right-hand side of (3) increases for every level of x. Since the marginal cost on the left-hand side does not change for a given x, and since it is increasing in x, the solution to the equation then has to generate a higher x in equilibrium.

Intuitively, a more fragile stock price entails a higher probability of bigger underpricing. This increases the cost of the firm when it needs to raise cash if it faces a shortfall in its cash balance. The firm prepares for this in advance by increasing its cash buffer and reducing the likelihood and magnitude of cash shortfalls. It is important to emphasize again that we did not assume any asymmetry between underpricing and overpricing. A fragile stock price implies a higher probability of bigger overpricing just like it does for bigger underpricing. The key, however, is that the gains from overpricing do not play any role in the choice of cash buffer of the firm, since the firm will always exploit these gains when they arise regardless of its level of cash. It is only the loss from underpricing that is forced on the firm when it faces cash shortage, and this is why the firm will attempt to reduce cash shortages when it expects greater likelihoods of underpricing with greater magnitude.

In the model the firm makes a choice about one variable x, capturing greater cash

buffer and lower long-term investment. In our empirical investigation, we hypothesize that firms facing greater fragility will increase cash and reduce other spending such as capital expenditures.

3 Data and Empirical Model

Our sample construction begins with quarterly corporate data from Compustat starting with 2001 Q1 up to and including 2017 Q4. Variables that are reported as year-to-date are transformed to quarterly flow variables based on the fiscal year-end. We exclude companies with primary SIC codes between 4900 and 4999, between 6,000 and 6,999, or greater than 9,000. We also restrict the sample to firms with positive book equity (CEQQ), sales (SALEQ), and leverage.

We control for firm size using the natural logarithm of total assets (ATQ). Total assets are also used to scale all dependent variables. *Cash* is cash and short-term investments (CHEQ). *CapEx* is capital expenditures (CAPXY) net of sales of property, plant, and equipment (SPPEY). *R&D* is research and development expenditures (XRDQ). *Dividends* is dividends (DIVQ) and *Repurchase* of common equity is measured by total stock repurchases (PRSTKQ) minus the book value of preferred stock (PSTKQ). Short-term debt (*ST Debt*) is debt in current liabilities (DLCQ) plus long term debt due in one year (DD1Q).

Debt is measured as current liabilities (DLCQ) plus long-term debt (DLTTQ). Market equity is the product of share price (PRC) and number of shares outstanding (CSHOQ). *MktLev* is defined as debt divided by debt plus market equity. *Oper. Cash Flow* is operating income after depreciation (OIBDPQ) minus total interest and related expenses (XINTQ) minus total income taxes (TXTQ). *Fixed Assets* is total property plant and equipment (PPENTQ) scaled by total assets. *Inventory* is total inventories (INVTQ) scaled by total assets. We measure *Earnings volatility* as the 12 quarter rolling standard deviation of income before extraordinary items (IBQ) after it has been scaled by total assets (ATQ). *Institutional ownership* is the sum of 13F owner shares scaled by total shares outstanding in a quarter.

In various robustness exercises we also use measures that capture various aspects related to the stock market valuation of firms. *Market-to-book* is measured as total assets plus market valuation minus common equity over total assets (ATQ+PRCCQ×CSHOQ-CEQQ)/ATQ). *Volatility of returns* are measured as quarterly standard deviation of returns. Stambaugh et al. (2015) develop a firm-specific index of mispricing that builds

on the index of 11 "anomaly" variables. The index can take on values from 0 to 100 with 50 indicating that a stock is neither under- nor overvalued and we create the variable *Misprice* defined as the absolute deviation of the index from 50.[6] We also use the index of *Investor sentiment* from Baker and Wurgler (2006) to identify low sentiment quarters, the text-based measure based on Hoberg et al. (2014) to identify firms that operate in especially fluid product markets and the text based Herfindahl measure of product market concentration (*TNIC HHI*) that builds on Hoberg and Phillips (2010, 2016).[7]

Description of Fragility

The measure of fragility is constructed following Greenwood and Thesmar (2011) for 2001 Q1-2017 Q4. Mutual fund holdings are collected from the Thomson Reuters S-12 file as of the filing data (FDATE). For all mutual funds in the sample, total net assets are collected from the CRSP mutual fund file. Mutual funds with less than 5 million dollars in total net assets are excluded. Funds with missing data are excluded.

Stock level data is collected from the CRSP Stock File. To join data with the CRSP Stock File, a two-step process is used: stocks are first joined by CUSIP. When the CUSIP within the holdings data fails to match with the CRSP file, the NCUSIP within CRSP is matched to the CUSIP in the holdings file. This reflects how the two databases record CUSIPs: Thomson Reuters maintains the original CUSIPand CRSP uses the firm's most recent CUSIP and backfills through time. In CRSP, NCUSIP generally corresponds with the historical CUSIP.

At the stock level, fragility captures the volatility of non-fundamental demand from mutual funds. *Fragility G* is defined as:

$$G_{it} = \left(\frac{1}{\theta_{it}}\right)^2 W_{it}' \Omega W_{it}, \tag{5}$$

where W_{it} is a vector of each mutual fund investor's portfolio allocation weight to stock i, Ω_t is the covariance matrix of monthly dollar flows for the firm's mutual fund owners, and θ_{it} is the market capitalization of the firm's stock. Each element of W_i is equal to the number of shares of stock i held by fund j multiplied by the price of stock i, divided by the total net assets of fund j.

Holdings data is joined with the CRSP mutual fund file using MFLINKS. Holdings

[6]To ease interpretation of the associated coefficient we also divide by 10.

[7]Data sources for these additional data are, respectively, http://finance.wharton.upenn.edu/ stambaug/, http://people.stern.nyu.edu/jwurgler/ and https://hobergphillips.tuck.dartmouth.edu/.

are aggregated to the portfolio level according to wficn, the unique portfolio identifier within MFLINKS. Monthly percentage flows are calculated for each fund from the CRSP mutual fund file:

$$f_{jt}^{\%} = \frac{TNA_{jt} - TNA_{jt-1}(1 + R_{jt})}{TNA_{jt-1}} \tag{6}$$

where TNA_{jt} is the total net assets and R_{jt} is the return to fund j at time t. Each quarter t, a covariance matrix of percentage flows, $\Omega_t^{\%}$, is calculated using all available months as of January 1990. *Fragility* requires the covariance matrix of dollar flows Ω_t, which is not estimated directly due to heteroskedasticity as discussed in Greenwood and Thesmar (2011). Instead, $\Omega_t^{\%}$ is transformed by the following equation:

$$\widehat{\Omega}_t = diag(TNA_t)\Omega_t^{\%} diag(TNA_t) \tag{7}$$

where TNA_t is a matrix with values equal to each fund's total net assets on the diagonal elements and zero elsewhere. Finally, *Fragility* is estimated by the following equation:

$$G_{it} = \left(\frac{1}{\theta_{it}}\right)^2 W_{it}' \widehat{\Omega}_t W_{it}, \tag{8}$$

Description of the Herfindahl Measure of Ownership Concentration

We examine multiple financial institution mergers as natural experiments. For BlackRock-BGI, we focus on the years 2008 to 2010 and a Herfindahl index of ownership concentration is measured using all the institutional investors included in the Thomson Reuters S34 (13F) file. This is computed as the sum of the squared fractional positions of each investor for a given stock:

$$Herfindahl_t = \sum_{j=1}^{N} \left(\frac{Shares_{jt}}{SharesOutstanding_t}\right)^2 \tag{9}$$

where $Shares_j$ represents the number of shares held by institution j. The firm's shares outstanding is recorded from the CRSP Stockfile at quarter end. In the S34 file, each institutional investor (manager) has a distinct manager number (mgrno). Following Azar et al. (2018a), holdings are aggregated to the parent company's manager number using

a mapping key from Martin Schmalz's website.[8] This combines several managers under BlackRock, for example.

To join holdings data with the CRSP Stock File, a two-step process is used: stocks are first joined by CUSIP. When the CUSIP within the holdings data fails to match with the CRSP file, the NCUSIP within CRSP is matched to the CUSIP in the holdings file. This reflects how the two databases record CUSIPs: Thomson Reuters maintains the original CUSIP and CRSP uses the firm's most recent CUSIP and backfills through time. In CRSP, NCUSIP generally corresponds with the historical CUSIP. Fractional holdings are winsorized at the 0.5% and the 99.5% levels. For each firm-quarter, the Herfindahl index is measured as the sum of the squared fractional positions of all the institutional investors. To calculate what the Herfindahl measure would be had BlackRock and BGI been the same entity before the merger, the mgrno for BGI (7900) is set to the mgrno of BlackRock (9385) and the procedure is repeated. The fraction of holdings from BlackRock, BGI, and all the total of institutional investors are also recorded.

To confirm the Blackrock-BGI evidence, we also examine the Lewellen and Lowry (2019) mergers which occur during our sample period but not during the financial crisis. For these eight mergers (First Union-Wachovia, Goldman Sachs-Ayco, Bank of America-Fleet Boston, JP Morgan-Bank One, Wells Fargo-Strong Capital, Transamerica-Westcap, MSDW-Frontpoint, and Goldman Sachs-Level Global), we follow the same procedure as with the Blackrock-BGI merger and calculate the equivalent Herfindahl measure of ownership concentration.

Summary statistics

We present summary statistics on the main variables used in regressions in Table 1. Unless otherwise noted, variables used as explanatory variables are lagged one quarter in regressions. All variables are winsorized at the 1st and 99th percentiles.

[Table 1 about here]

Empirical Model

To investigate the relationship between changes in the exposure to non-fundamental price shocks, we pursue two distinct sets of analyses. First, we explore corporate responses to

[8]The mapping key is available within the replication package for Azar et al. (2018a) on Martin-Schmalz's website. https://sites.google.com/site/martincschmalz/.

changing fragility within firms. We regress cash holdings and our measures of investment and liquidity management on the Greenwood and Thesmar (2011) fragility measure and other observable corporate factors such as firm size. We also include firm fixed effects and to control for developments over time at the industry level we include interacted time× industry fixed effects (where time is quarterly and industry measured at the SIC three-digit level), which we refer to as quarter-industry fixed effects. Our main specifications estimate

$$\frac{DEP_{it}}{Assets_{it}} = \phi_i + \gamma_{qt-ind} + \alpha\sqrt{Fragility_{it-1}} + \beta X_{it-1} + \epsilon_{it}, \tag{10}$$

where DEP is our measure of cash holding($Cash$), of investment ($CapEx, R\&D$) or of liquidity management ($Repurchase$, $Dividends$, $STdebt$) for firm i in quarter t. ϕ_i is a firm fixed effect, γ_{qt-ind} is a quarter-industry fixed effect, $Fragility_{it-1}$ is the Greenwood-Thesmar measure of fragility that varies by firm and quarter. Greenwood and Thesmar (2011) show that the volatility of returns is proportional to the square root of their fragility measure and following their specification we include the square root of $Fragility$ rather than $Fragility$ in levels. In line with common practice, we use one lag of the explanatory variables in the regressions to alleviate concerns related to that corporate policies are determined jointly and in the baseline specifications X_{it-1} contains $Earnings\ volatility$, $Ln(Assets)$, $Institutional\ ownership$, $MktLev$, $OperCashFlow$, $FixedAssets$ and $Inventory$. The error term is denoted by ϵ_{it} and the standard errors are adjusted for clustering at the firm level. In later tables, we present evidence on corporate responses to exogenous shocks to fragility stemming from financial institution mergers.

4 The Effect of Stock Price Fragility on Cash Holding, Investment and Liquidity Management

The key prediction of our model is that firms facing a greater risk of mispricing in the future, i.e. firms with a more fragile stock price, are likely to hold more cash in order to lower the probability of costly cash shortfalls. Table 2 examines this prediction and reports results from regressions with cash scaled by assets as the dependent variable and a set of controls in addition to firm and quarter-industry fixed effects.

Column (1) reports the estimation results for the baseline specification. The coefficient on fragility is positive and statistically significant. While a precautionary motive for cash

holdings has been documented in many other studies, see e.g. Bates et al. (2009) or Almeida et al. (2014), we identify that firms respond to risk from the financial markets - specifically the composition of their institutional investors. Thus, we highlight a distinct channel of risk and one that is increasing over time. The regressions control for a number of other factors that are common in cash holding regressions and broadly conform to expectations. For instance, we confirm well established results that larger firms on average hold less cash (see e.g. Bates et al. (2009)).

[Table 2 about here]

The point estimate on $\sqrt{Fragility}$ in Column (1) indicates that a one standard deviation increase in fragility is associated with an increase in *Cash* by 2.1% when set in relation to mean cash holdings (.22). To compare the magnitude of this effect to a well established source of variability note that much of the literature uses the standard deviation of earnings to capture the motivation for precautionary cash holding (often averaged at the industry level as in Opler et al. (1999) or Bates et al. (2009)). In our sample a one standard deviation increase in earnings volatility is associated with increased cash holdings by 1.9% (when evaluated at the mean cash holding). Thus, the effect of stock price fragility on cash holding is of approximately the same magnitude as the effect of a leading motivation for precautionary cash holding. This underscores that the effect of within firm changes in fragility on cash holding is non-trivial and supports the notion that stock price fragility is something managers pay attention to when they set corporate policies. The remaining columns in Table (2) explore robustness in various dimensions. Column (2) reports results when the years of the financial crisis, 2008-2009, have been excluded and as seen the estimated coefficient on $\sqrt{Fragility}$ is stable.

While our focus is on precautionary cash levels, we recognize that our measure of cash may be distorted by the large levels of cash held by some multinational corporations for tax motivated reasons (see e.g. Faulkender et al. (2018)). Excluding firms which hold cash for both precautionary and tax reasons should provide a cleaner measure of precautionary cash responses. Column (3) therefore excludes multinational corporations and as seen by a comparison with Column (1), the estimated association between fragility and cash holding is stronger for domestic firms.

The measure of stock price fragility captures sensitivity to non-fundamental demand among instutional owners and the benchmark specification also controls for the percentage share of instutional ownership. To explore whether other aspects of institutional ownership affect the relation between stock price fragility and cash holding, Column (4)

controls for concentration of ownership among institutional owners as measured by HHI and for breadth among institutional owners, which aims to capture the effects of short-selling constraints on the stock price (Chen et al. (2002)Porras Prado et al. (2016)). As seen, the effect of stock price fragility is robust to the inclusion of these variables.

The theory we presented implies that firms that expect a greater potential for future variability increase their level of precautionary cash holding. We chose to use the Greenwood and Thesmar (2011) measure of stock price fragility as a measure of the potential for future variability. One might also use measures of realized stock price volatility as well as other alternative measures that try to capture (the scope for) misvaluation. In this spirit, the estimates reported in Column (5) include volatility of returns as well as a measure of mispricing in the previous quarter based on Stambaugh et al. (2015).

Furthermore, one potential concern is that the results might merely reflect current misvaluation, rather than expectations of the scope for future misvaluation. To allay such concerns we first note that Greenwood and Thesmar (2011) and Ben-David et al. (2021) establish that greater stock fragility for a firm strongly predicts volatility and that the Greenwood and Thesmar (2011) measure of fragility is a measure of sensitivity to shocks, and not directly related to current over- or undervaluation. However, as a robustness exercise, we may want to control for the current level of misvaluation. As discussed by Derrien et al. (2013), many of the measures used rely on the relation between market value and accounting value of a firm as measured by market-to-book or (Tobin's) Q.[9] Regression analysis of for instance capital investment on market-to-book (or Q) have been used to examine the feedback effect of stock market valuation on corporate policy, either by using "raw" market-to-book measures or by in addition estimating a valuation based on fundamentals (see e.g. Baker et al. (2003) for early influential work highlighting the importance of a feedback effect or Edmans et al. (2012) for the latter approach).

To explore concerns related to current misvaluation, we note that in regressions with firm fixed effects an overvalued stock is likely to be associated with a temporarily high market-to-book ratio and vice versa for an undervalued stock.[10] Based on this reasoning Column (5) of Table 2 therefore also includes the market-to-book value. In line with

[9]It seems almost tautological that this would be the way to measure misvaluation but other measures are possible - one may argue that realized excess returns for a stock in future periods implies that it is undervalued today, see e.g. Baker et al. (2003) or Polk and Sapienza (2008).

[10]Without further assumptions we can not of course ascribe all the effect of an increase in market-to-book ratios to overvaluation - successful implementation of a new strategy would raise the market-to-book ratio and may or may not be accompanied by an overvaluation. However, on average we do not expect overvaluation to be associated with falling market-to-book values (or vice versa) and the expected correlation between market-to-book values and overvaluation is expected to be positive.

e.g. Bates et al. (2009), we find that the market-to-book value is positively associated with cash holding. Of key interest for our present purposes however is that the estimated coefficient on stock fragility is essentially the same as in the benchmark regression reported in Column (1). Thus, controlling for a measure that is highly likely to be correlated with current misvaluation does not affect the economic or statistical significance of stock price fragility on cash holding. We interpret this as further support for the notion that expectations of future stock fragility have an incremental impact on corporate policy.

Let us note that adding control variables that aim to capture misvaluation as in Column (5) can be a useful robustness test, but also runs the risks that these additional variables act as "bad controls" (Angrist and Pischke (2008)). Current mispricing and return volatility can be seen as outcomes of stock price fragility, and if our interest is in the scope for mispricing we do not want to control for all the channels through which fragility might operate. For this reason we see Column (5) as an interesting robustness check but view the results in Column (1) as our benchmark estimates.

We follow Greenwood and Thesmar (2011) and use $\sqrt{Fragility}$ as a regressor but it would perhaps be more standard to include $Fragility$ in levels, as seen in Column (6) such a specification also implies a positive and statistically significant relationship between stock price fragility and cash holding. Finally, given the inherently forward-looking nature of management responses to stock price fragility in our model, one could hypothesize that cash holdings might adjust in the same quarter that fragility changes. Column (7) therefore presents a specification where the current level of fragility is included and as seen the point estimate increases somewhat but is nevertheless of similar economic and statistical significance.

Risk of Misvaluation and External Financing Needs

In our model, a firm holds a cash buffer to avoid having to raise funds in a future situation when a cash shortfall coincides with an undervalued stock. The mechanism in the model therefore suggests some conditions under which the motivation to hold a cash buffer should be especially strong. Much of the variation in cash holding will be captured by the quarter-industry and firm fixed effects, but here we delve further into variation across firms and time. Table 3 reports how firms adjust cash when fragility is interacted with proxies for the expected cost of non-fundamental price shocks.

First, the cost of equity misvaluation is expected to be higher for firms with more limited access to the capital markets. In the spirit of Gilchrist and Himmelberg (1995)

and Almeida et al. (2004), Column (1) examines the impact of fragility for unrated firms and Column (2) focuses on smaller firms (defined as those with total assets in the bottom three quartiles). As seen, the interaction terms between fragility and the proxies for weaker access to capital markets are positive and a higher potential cost of misvaluation is associated with a greater precautionary cash response to changing fragility.

Furthermore, the probability of a shortfall in cash holdings should be greater in more volatile product markets (Froot et al. (1993)). Column (3) examines the effect of earnings volatility where *High earnings volatility* is an indicator equal to one if the firm observation is in the top quartile of prior quarter earnings volatility (defined by the rolling 12-quarter standard deviation). As in the model, the combined effects of greater scope for cash shortfalls and greater scope for misvaluation associate with greater cash buffers. Similarly, in Column (4) we interact stock price fragility with a dummy variable that is one for firms that are in the top quartile of the text based measure of product market "fluidity" developed by Hoberg et al. (2014).

The consequences of stock price fragility should be increasing in the extent of financial constraints faced by the firm. We create the indicator *High financial constraints* that is one if the observation belongs to the top quartile of financial constraints in the respective fiscal year when relying on the text based measure of financial constraints developed by Hoberg and Maksimovic (2014). In Column (5) we see that more financially constrained firms are more sensitive to stock price fragility.

[Table 3 about here]

The expected cost of misvaluation should be a function of the ease with which the market corrects misvaluation and the cost of misvalued equity (both in alternative access to capital and in the cost of foregone projects). Columns (6) to (8) focus on the potential for misvaluation with proxies for stock price uncertainty (Zhang (2006)). Column (6) examines the effect of prior price volatility where *High stock volatility* is an indicator equal to one if the firm observation is in the top quartile of prior quarter stock price movement (quarter high price minus quarter low, scaled by the quarter low price). In Column (7), high VIX periods (top quartile) are used to represent aggregate uncertainty. Both uncertainty proxies load positively when interacted with *Fragility*, indicating a stronger precautionary cash response in cases with higher initial potential for equity misvaluation. Finally, Column (8) reports the coefficient on interaction between stock price fragility and a dummy variable that is one for the bottom quartile of the sentiment index of Baker and Wurgler (2006).

All the interaction effects suggested by theory are thus positive and, with the exception of product market fluidity, statistically significant at the five percent levels or higher. The magnitude of effects are non-trivial. For instance the specification in Column (1) implies that a one standard deviation increase in the stock price fragility is associated with an additional increase in cash holding for firms that have no bond rating of 2.6%.

Additional Robustness Examinations of the Effect of Fragility on Cash Holding

To explore whether it is only the largest changes in fragility that generate the observed patterns we estimate the baseline specification of Table 2 Column (1) but for samples where we the largest changes in fragility are excluded. Column (1) of Table 4 excludes the largest 25% of changes in fragility and Column (2) excludes the top 10 % of changes in fragility. Columns (3) and (4) perform the corresponding exercises but in addition excludes multinational corporations. Again we see that effects are stronger for domestic firms and from the stability of coefficients across the different specifications we conclude that the link between fragility and cash holding that we observe is not explained by outliers in terms of changes in fragility.

[Table 4 about here]

A concern raised by some observers is that changes in the competitive landscape may lead firms to increase cash and reduce investment. For instance, Gutierrez and Philippon (2017) find that industry concentration and common ownership associate with lower investment. While the relationship between common ownership and competition is widely debated (as noted in the Introduction), Table 5 shows that the baseline results are robust to the role of industry competition. Columns (1) and (3) evaluate the impact of within firm changes in fragility on cash holding controlling for the level of industry concentration using the Hoberg and Phillips (2016) textual analysis based TNIC3 HHI measure of concentration for the full sample as well as when MNCs are excluded. In Columns (2) and (4), the baseline analysis is repeated excluding observations with a TNIC3 HHI measure above the sample mean. Controlling for changes in competition have essentially no impact on our findings as can be seen by a comparison of the coefficents on fragility in Table 5 with the specifications in Table 2.

[Table 5 about here]

The Effect of Fragility on Investment and Liquidity Choices

The model focuses on precautionary cash holding in response to greater scope for costly cash shortfalls as a result of a more fragile stock price. The logic of the model also implies that greater fragility should be associated with less investment and more conservative liquidity management. We explore these dimensions in Table 6 and Column (1) presents a benchmark specification of capital expenditure on the same explanatory variables as in the cash holding regressions. The point estimate indicates that higher stock price fragility is associated with less investment, even if the relation is only statistically significant at the 10% level. The estimated coefficient in Column (1) implies that if fragility increases by one standard deviation capital expenditure/assets decreases by -.0003. While this may seem like a minuscule effect note that average investment rate is also low at .012 and a one standard deviation increase in fragility decreases capital investment by around 2.4%, when evaluated at the mean investment level.

[Table 6 about here]

Column (2) presents results from a regression with R&D expenditures as a measure of investment with quantitatively similar effects when set in relation to the mean and median levels of R&D expenditures. The literature on the effect of uncertainty on investment is very large, reflecting both the importance of the subject, the many different potential sources of uncertainty, and the theoretical possibility of both negative and positive relationships (see e.g. Bernanke (1983), Caballero (1991), Leahy and Whited (1996)). Many share a prior that higher uncertainty lowers investment and in this sense the results are not surprising. Note however that the source of uncertainty here is very specific and novel. Firms adjust investment in response to higher uncertainty regarding firm-specific but non-fundamental price movements.

Columns (3) to (5) explore aspects of financial flexibility - using financial policies to ensure cost-efficient access to capital in a wide range of states of the world (see e.g. Denis (2011), Almeida et al. (2014)). We expect firms faced with higher risk to payout less to shareholders and keep more financial muscle in the firm - a prediction that is borne out for other sources of risk in e.g. Hoberg and Prabhala (2008), Bonaimé et al. (2013) or Hoberg et al. (2014). We consider two ways of payouts separately, repurchases and dividend payments. In line with Massa et al. (2020a), we find in Column (3) that higher financial fragility is associated with a lower repurchase rate. Column (4) indicates that there is no statistically significant relationship with dividend payments.

Another aspect of financial flexibility that we explore concerns debt maturity. Shorter debt maturity exposes the firm to refinancing risk to a greater extent and our prior is that firms that are faced with a greater stock price fragility have a lower share of short-term debt. Previous evidence consistent with an important role of refinancing risk come from e.g. Harford et al. (2014). Column (5) shows that higher fragility is associated with less short term debt.

5 Asset Management Mergers as Natural Experiments

The BlackRock-BGI merger

The preceding analysis has shown that firms hold more cash and make other precautionary adjustments as the risk of future non-fundamental price shocks increases. The feedback effect creates a real cost to changes in ownership concentration. Combined, this supports the risk management hypothesis laid out in the model where managers recognize that greater fragility raises the probability of misvaluation and therefore adopt more cautious policies.

A possible concern with this evidence, however, is that changes in fragility are not exogenous and may be correlated with future investment or liquidity management changes. Fixed effects at the level of the firm and industry-quarter level are likely to capture much potential unobserved heterogeneity but one may nevertheless be concerned that fragility is partly endogeneous in the regressions above. For example, trading frenzies, which have been shown to affect real corporate outcomes (Goldstein et al. (2013)), may be based on expectations about future cash flows that are hard to capture by control variables. To address this, we first use the merger of BlackRock and Barclays Global Investors (BGI) as an exogenous shock to stock price fragility. The two institutional investors merged in 2009 with the announcement in June and the deal was completed in December. The merger followed an offer by CVC Capital to purchase the iShares piece of BGI earlier in 2009 which contained a 'go-shop' provision.

Tables 7 and 8 present the empirical evidence on this natural experiment. We limit the analysis to the years 2008-2010. Treated firms are identified as those held by both Blackrock and BGI at the end of 2008 (before the merger announcement, and preceding the CVC offer) and thus are exposed to an ownership concentration shock (*Merger*

Treatment). As pre-merger ownership is not randomly assigned, we restrict our control group to firms that are held by one of the firms thus mitigating the potential differences between the treated and control groups. The merger has two important event dates – the announcement and the deal completion. The merger was announced in June 2009 and the variable *Merger Treatment* takes the value 1 for firms treated firms for periods from the second quarter of 2009 onward and 0 otherwise. The merger was cleared by the European Commission in September 2009 and then completed in December 2009. As the mechanism that we focus on concerns expectations, the date when the proposed merger became publicly known is the natural event date but results are robust to other choices of the treatment period.

Identification of the effect of the merger on cash holdings relies on the assumption that the treated firms and control group would have followed the same developments if the merger had not occurred. In support of that assumption we examine developments of cash holding for the treated and control firms for the periods surrounding the merger. Figure 1 plots the estimated coefficient from a regression of cash holding on treatment before and after the merger (as well as firm fixed effects and the industry-quarter dummy variables that we use in all the benchmark specifications). The results support the notion that there are no differential trends in cash holding between treated and control firms prior to merger's announcement once fixed effects are controlled for. These findings motivate our use of a difference-in-difference specification to evaluate the effects of exogeneous changes in stock price fragility on cash holding. As noted we use the announcement date to determine the treatment indicator in regressions below. While the effect on fragility is likely to only materializes when the merger is completed, forward looking firms are likely to start responding already at the date of announcement, as indeed seen in Figure 1.

[Figure 1 about here]

In Table 7, we see that the *Merger Treatment* raises cash holdings. That is, firms which experience a shock to their ownership concentration due to the BlackRock-BGI merger respond to this increased future exposure to non-fundamental price shocks. We control for the same variables as in the benchmark regression of Column (2) in Table 2. In Column (1) we see that increased stock price fragility as a result of the BlackRock-BGI merger leads to increased cash holding and the effect is statistically significant at the 1% level. Treated firms on average raise their mean cash holding by 1.3 percentage points - set in relation to the overall mean for these years the change implies that cash holding as a share of assets increases from around .20 to .216. To evaluate this impact

one may for instance compare to the quantitative effects in one of the semimal papers on precautionary cash holding where Bates et al. (2009, p. 2011) state that "... we infer that the average cash ratio increased by 2.1 percentage points from the 1980s to 2006 because of the increase in cash flow volatility [which more than doubled during this time, from 7% to 16.3%]." In light of this our estimate of a 1.3 percentage points increase as a result of the BlackRock-BGI merger clearly points to a substantial effect of stock price fragility on cash holding.

The impact of increases in stock price fragility are expected to be higher when institutional ownership is higher and in Column (2) we introduce an interaction between an indicator variable that is one when the firm has an institutional ownership share that is above median in the merger sample and we see that effects are indeed stronger for this group. Columns (3) and (4) report corresponding regressions when multinational firms are excluded. The estimated effects are similar in this more limited sample.

[Table 7 about here]

Our evidence that firms respond to changes in stock fragility, and in particular the effect in association with the BlackRock-BGI merger, are complementary to Massa et al. (2020b) who establish that *other funds* responded to increased ownership concentration in connection with the BlackRock-BGI merger by lowering exposure to affected stocks and in particular this holds for open-ended funds. While that paper documents spillovers within the asset management industry, we show the corporate ramifications.

In Table 8 we explore the effect on investment, repurchases, dividends and short term debt of the BlackRock-BGI merger. We see that the results are consistent with a causal effect of higher fragility on investments (in capital expenditure and R&D) and repurchases. The effects are quantitatively non-trivial. For instance the coefficient on $CapEx/Assets$ of -0.002 can be set in relation to median $CapEx/Assets$ of 0.007.

[Table 8 about here]

Other Asset Management Mergers as Natural Experiments

The size of the BlackRock-BGI merger makes it an attractive candidate for examining the effect of exogenous changes in ownership concentration on company policies. Based on the previous literature, let us highlight two potential issues surrounding the use of the BlackRock-BGI merger as a natural experiment. First, as discussed in the introduction,

an active debate concerns the effects of changes in the degree of common ownership on product market competition and the mechanisms at play (see e.g. Azar et al. (2018a, Section V)). However, this does not affect the current research as the hypothesized mechanism investigated here does not rely on fund managers steering firms towards taking other firms' profits into account, but instead relies on greater financial fragility leading to more precautionary behavior.

A second potential concern is that the BlackRock-BGI merger occurred during the great recession - a period of great turbulence where finding firms that act as controls in a difference-in-difference estimation can be challenging. Lewellen and Lowry (2020) examine a broad range of asset management mergers and focus on various measures of return on assets to explore the effects of common ownership. They find that the effects of asset management mergers on return on assets are driven by mergers that occurred during the financial crisis of 2008-2009.

Starting with the Lewellen and Lowry (2020) list of financial institution mergers from 1980 and 2015 we assemble data on the eight mergers which occur during our sample period but outside of the financial crisis years 2008 and 2009. Unlike BlackRock-BGI which involved substantial increases in ownership concentration for the bulk of the treated firms and treated more than 2,000 firms in the sample, these are mostly smaller mergers both in impact and scope. Two of the mergers, Bank of America-Fleet (BoA-Fleet), announced in October 2003, and JP Morgan-Bank One (JPM-BankOne), announced in January 2004, stand out as the largest. Each of these mergers treated around 1,400 firms.[11] The Bank of America-Fleet merger created an approximately 470 billion combined assets under management and JP Morgan-Bank One created a domestic assets under management (AUM) pool of approximately 250 billion. For comparison, the Blackrock-BGI merger results in a combined 2.8 trillion AUM.

Since the BoA-Fleet and JPM-BankOne mergers are close in time and many of the treated firms are the same, we first create separate treatment variables for each of these two mergers based on the respective announcement quarter and then combine the treatment variables such that we use a dummy that takes the value of one if the firm is treated in at least one of these two mergers. Firms that are only held by one of the merging parties in each of the two mergers serve as controls.[12]

[11]The other mergers mostly treat many fewer firms: Wells Fargo-Strong affected around 800 firms in sample, First Union Wachovia and Morgan Stanley-Frontpoint around 300 and the remaining each fewer than 100 firms. For example, the Goldman-Level merger treats 62 firms.

[12]Thus, for instance a firm that is held by both Bank of America and Fleet Boston will be assigned the value one from Q4 2003 onward. Firms that were only held by one of the Bank of America and Fleet

[Table 9 about here]

Table 9 presents the baseline regressions for these mergers. Columns (1) and (2) document that fragility at level of family of funds increased at the time of the mergers for treated firms, even if the effect is only statistically significant at the 10% level, which possibly reflects the relatively limited scope of the merger. Columns (3) and (4) document that cash holdings increased at the time of merger announcement, consistent with forward looking behavior. The coefficient estimate is positive and statistically significant at the 5% level but lower than the estimated treatment effect of the much larger BlackRock-BGI merger. The point estimate indicate that being treated with the merger is associated with a .4 percentage point increase in cash holding. For a firm with mean level of cash holding in this sample it correspond to an increase from a cash/assets ratio of 22.2% to 22.6%. Columns (5) and (6) finally document that we do not identify economically or statistically significant effects on investments from these smaller mergers.

Summing up, we find that exogenous changes in ownership concentration support the notion that there is a causal effect from stock price fragility on cash holding. The results are strongest for BlackRock-BGI which is intuitively appealing since its size dwarfs the other asset management mergers that occur in sample. For the other large asset management mergers in sample we also document a statistically significant, though less quantitatively important effect on cash, as would be expected from Warusawitharana and Whited (2016) which finds that cash responds more than investment to misvaluation.

6 Conclusions

As equity holdings are increasingly concentrated in a limited number of institutional investors (Lewellen and Lewellen, 2018), there is a question of whether the resulting stock price fragility documented by Greenwood and Thesmar (2011) creates a salient risk to corporations. This paper documents a link between the risk of non-fundamental price shocks and precautionary corporate behavior. In doing so, we document a cost to changes in the composition of institutional investors. We motivate the empirical analysis with a model which highlights the growing benefit of precautionary savings as stock fragility - the risk of future misvaluation - increases. The empirical evidence supports the predictions from the model. Broadly speaking, greater financial fragility lowers investment and leads

Boston but by both of JPMorgan Chase and Bank One will be assigned the value one from Q1 2004 onward.

firms to hold more cash. Not only are the findings are both statistically and economically significant, the BlackRock-BGI merger provides a natural experiment which supports a causal interpretation of the evidence. While that merger was a salient event, the finding of significant effects in smaller mergers as well as the full sample indicates that firms monitor their exposure to non-fundamental price shocks and adjust their liquidity management to hedge the risk of future misvaluation.

In the current paper we have examined the implications of one mechanism that makes a firm's stock more susceptible to future swings in valuation that are unrelated to firm fundamentals. There are also other such mechanisms that would be of interest to study in future work. For instance, while a larger share of foreign owners may bring additional capital or other benefits, it may also make a firm's stock more vulnerable to various global shocks. This is a concern in particular for developing markets and would be interesting to investigate, even if the evidence in Bena et al. (2017) suggest that the balance of effects from foreign ownership on investment is positive. It also would be valuable to investigate whether firms attempt to manage their stock fragility through PIPES or increasing inside ownership. We leave these topics for future research.

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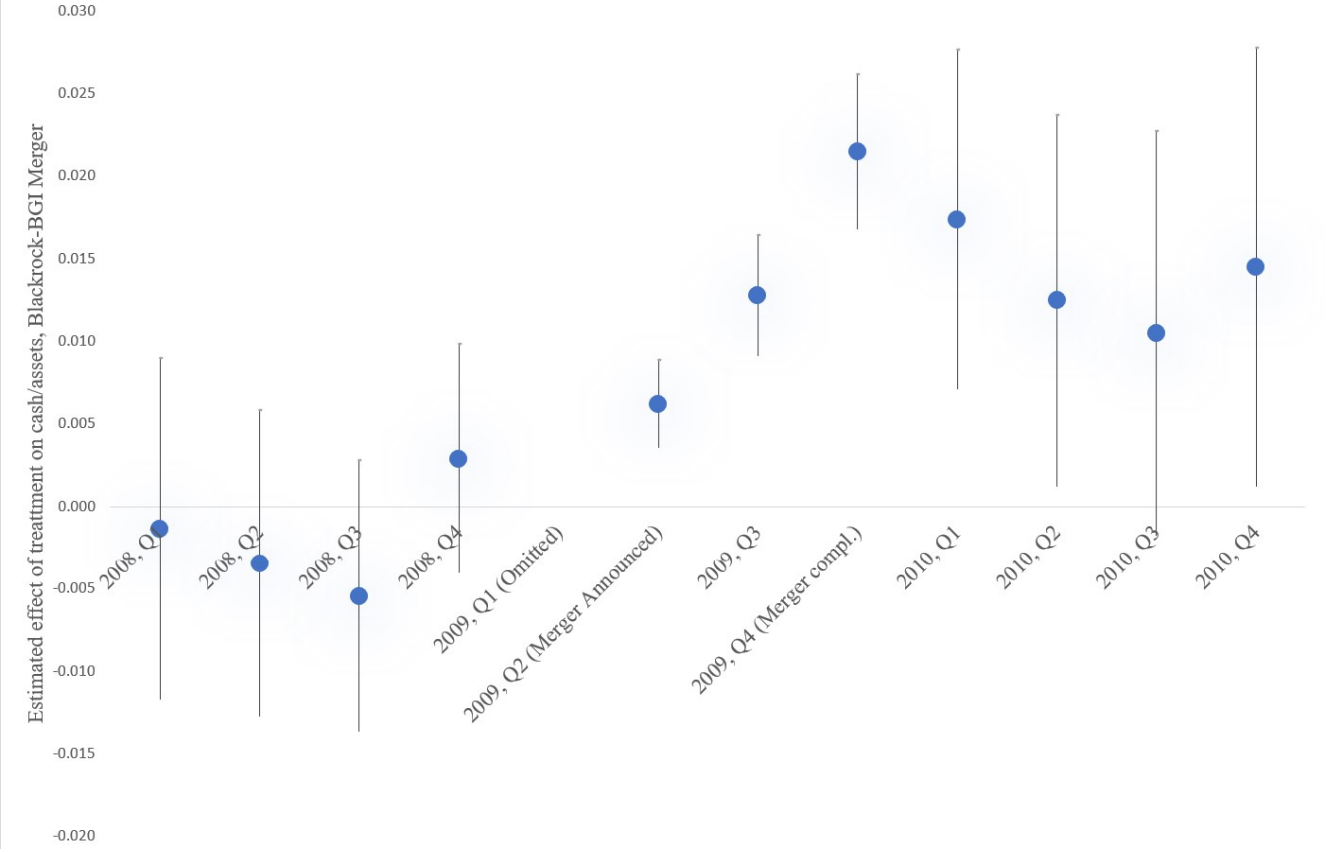
Figure 1: The Estimated Effect of the BlackRock-BGI Merger on Cash Holding: An Examination of Parallel Trends



The figure shows the estimated coefficient on treatment (leads and lags) surrounding the BlackRock-BGI merger together with the 95% confidence interval. The regression includes firm fixed effects as well as quarter-industry (SIC 3) fixed effects and is reported in Table IA.2 in the Online Appendix. Standard errors are adjusted for clustering at the firm level. The data is quarterly from 2008Q1-2010Q4. Merger Treatment equals one if the stock was jointly held by Blackrock and BGI in 2008 Q4 and 0 if the stock was held by only one of Blackrock and BGI in 2008Q4.

Table 1: Summary Statistics (2001-2017)

	Mean	Sd	P50	N
Cash/Assets	0.192	0.218	0.105	136,191
CapEx/Assets	0.012	0.017	0.007	135,833
R&D/Assets	0.024	0.034	0.014	73,532
Repurchases/Assets	0.005	0.013	0.000	127,111
Dividends/Assets	0.002	0.005	0.000	135,585
ST Debt/Assets	0.040	0.077	0.008	135,255
sqrt(Fragility)	0.004	0.004	0.003	136,191
Earnings volatility	0.025	0.047	0.010	136,191
Ln(Assets)	6.176	2.000	6.121	136,191
Inst Ownership	0.522	0.350	0.612	136,191
MktLev	0.196	0.207	0.135	136,191
FixedAssets	0.246	0.224	0.170	136,191
Inventory	0.124	0.138	0.084	136,191
OperCashFlow	0.010	0.051	0.020	136,191

Summary statistics for variables as used in baseline regressions. Greenwood and Thesmar's stock price fragility measure as well as additional firm-level control variables. The data is quarterly from 2001 - 2017 and the sample excludes utilities, financial firms, and SIC 9000 codes. We require positive book equity and positive sales. Variables that are reported as year-to-date are transformed to quarterly flow variables based on the fiscal year-end and generally scaled by book value of assets. Variables used as explanatory variables are lagged one quarter in regressions. All variables are winsorized at the 1st and 99th percentiles.

Table 2: Stock Fragility and Cash Holding

	(1) Cash/Assets	(2) Cash/Assets	(3) Cash/Assets	(4) Cash/Assets	(5) Cash/Assets	(6) Cash/Assets	(7) Cash/Assets
sqrt(Fragility)	0.678***	0.670***	0.947***	0.782***	0.739***		
	(0.221)	(0.245)	(0.285)	(0.223)	(0.243)		
Fragility						49.606***	
						(17.360)	
sqrt(Frag.)(current)							0.731***
							(0.237)
Inst Own. HHI				-0.166*	-0.368***	-0.365***	-0.363***
				(0.093)	(0.098)	(0.097)	(0.097)
Ln(IO Breadth)				0.001	-0.002	-0.003	-0.003
				(0.002)	(0.002)	(0.002)	(0.002)
Market-to-Book					0.006***	0.006***	0.006***
					(0.001)	(0.001)	(0.001)
Vol. of returns					0.063*	0.062*	0.061*
					(0.036)	(0.036)	(0.037)
Misprice					0.003***	0.003***	0.003***
					(0.001)	(0.001)	(0.001)
Earnings volatility	0.088***	0.067***	0.067***	0.088***	0.088***	0.088***	0.089***
	(0.019)	(0.020)	(0.023)	(0.019)	(0.026)	(0.026)	(0.026)
Ln(Assets)	-0.040***	-0.040***	-0.032***	-0.041***	-0.047***	-0.047***	-0.047***
	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)
Inst Ownership	0.015***	0.016***	0.020***	0.018	0.042***	0.043***	0.042***
	(0.005)	(0.005)	(0.007)	(0.011)	(0.012)	(0.012)	(0.012)
MktLev	-0.092***	-0.102***	-0.079***	-0.090***	-0.079***	-0.079***	-0.079***
	(0.006)	(0.007)	(0.008)	(0.006)	(0.008)	(0.008)	(0.008)
FixedAssets	-0.414***	-0.417***	-0.401***	-0.414***	-0.424***	-0.424***	-0.424***
	(0.017)	(0.018)	(0.022)	(0.017)	(0.021)	(0.021)	(0.021)
Inventory	-0.549***	-0.545***	-0.515***	-0.549***	-0.559***	-0.560***	-0.560***
	(0.024)	(0.025)	(0.033)	(0.025)	(0.029)	(0.029)	(0.029)
OperCashFlow	-0.045*	-0.061**	-0.052	-0.047*	-0.113***	-0.115***	-0.115***
	(0.026)	(0.028)	(0.032)	(0.027)	(0.029)	(0.029)	(0.029)
Sample	ALL	NO CRISIS	NO MNC	ALL	ALL	ALL	ALL
Quarter-Industry FE	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES
Adj. R2	0.862	0.865	0.882	0.862	0.868	0.868	0.868
Observations	136,191	119,524	66,990	136,191	94,157	94,245	94,072

Panel regression of cash holding on Greenwood and Thesmar's stock price fragility measure as well as additional firm-level control variables. The regressions include both firm and quarter-industry (SIC3) fixed effects and the standard errors are adjusted for clustering at the firm level. The data is quarterly from 2001 - 2017. Column (2) excludes 2008 and 2009 and column (3) excludes multinational corporations. Explanatory variables are lagged one quarter unless otherwise noted. Statistical significance at the 1, 5, or 10% levels is reported as ***, **, *, respectively.

Table 3: Stock Fragility and Cash. The Expected Cost of Misvaluation

	(1) Cash/Assets	(2) Cash/Assets	(3) Cash/Assets	(4) Cash/Assets	(5) Cash/Assets	(6) Cash/Assets	(7) Cash/Assets	(8) Cash/Assets
No bond rating x Frag.	0.978**							
	(0.403)							
Small x Frag.		1.153***						
		(0.412)						
High earnings vol. x Frag.			0.792**					
			(0.354)					
High Fluidity x Frag.				0.877*				
				(0.471)				
High Fin. Constr. x sqrt(Frag.)					4.663**			
					(2.350)			
High stock vol. x Frag.						0.963***		
						(0.238)		
High VIX period x Frag.							0.761***	
							(0.221)	
Low sent. x sqrt(Frag.)								0.887***
								(0.257)
No bond rating	-0.004							
	(0.004)							
Small		-0.004						
		(0.004)						
High earnings vol.			0.003					
			(0.002)					
High Fluidity				0.003				
				(0.003)				
High Fin. Constr.					0.019			
					(0.017)			
High stock vol.						-0.002		
						(0.001)		
High VIX period							0.001	
							(0.001)	
Low sentiment								0.004**
								(0.002)
sqrt(Fragility)	-0.043	-0.199	0.497**	0.468**	0.666***	0.455**	0.482**	0.408*
	(0.321)	(0.339)	(0.225)	(0.233)	(0.245)	(0.227)	(0.234)	(0.235)
Quarter-Industry FE	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Adj. R2	0.862	0.862	0.862	0.864	0.870	0.862	0.862	0.863
Observations	136,191	136,191	136,191	130,473	98,662	136,191	136,191	136,191

Panel regression of cash scaled assets on Greenwood and Thesmar's stock price fragility measure as well as additional firm-level control variables. The regressions include both firm and quarter-industry (SIC3) fixed effects as well as additional (unreported) controls: Earnings volatility, Ln(Assets), Inst. Ownership, MktLev, OperCashFlow, FixedAssets, and Inventory. Standard errors are adjusted for clustering at the firm level. No bond rating is a dummy variable that takes the value 1 when a firm lacks a bond rating and Small is defined as firms not in the top quartile by assets. High earnings volatility, High Stock volatility, High (product market) Fluidity, High Financial Constraints, High VIX period are dummy variables that take the value 1 for the top quartile and Low sentiment a dummy that is 1 for the bottom quartile of the Baker-Wurgler sentiment index. Statistical significance at the 1, 5, or 10% levels is reported as ***, **, *, respectively.

Table 4: Stock Fragility and Cash Holding: Robustness to Excluding Largest Changes in Stock Fragility

	Cash/Assets		Cash/Assets: No MNC	
	(1) Exclude top quartile	(2) Exclude top decile	(3) Exclude top quartile	(4) Exclude top decile
sqrt(Fragility)	0.880***	0.788***	1.322***	1.181***
	(0.253)	(0.239)	(0.334)	(0.315)
Earnings volatility	0.072***	0.082***	0.039	0.049*
	(0.021)	(0.020)	(0.027)	(0.027)
Ln(Assets)	-0.044***	-0.044***	-0.034***	-0.036***
	(0.003)	(0.003)	(0.005)	(0.005)
Inst Ownership	0.016***	0.014***	0.022***	0.022***
	(0.006)	(0.005)	(0.008)	(0.007)
MktLev	-0.096***	-0.093***	-0.077***	-0.074***
	(0.007)	(0.006)	(0.008)	(0.008)
FixedAssets	-0.422***	-0.414***	-0.405***	-0.396***
	(0.020)	(0.019)	(0.027)	(0.025)
Inventory	-0.554***	-0.565***	-0.507***	-0.522***
	(0.027)	(0.026)	(0.037)	(0.037)
OperCashFlow	-0.076***	-0.065**	-0.067*	-0.062*
	(0.028)	(0.027)	(0.035)	(0.034)
Quarter-Industry FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Adj. R2	0.869	0.869	0.892	0.891
Observations	96,524	115,068	44,431	53,539

Panel regression of cash holding on Greenwood and Thesmar's stock price fragility measure as well as additional firm-level control variables. The regressions include both firm and quarter-industry (SIC3) fixed effects and the standard errors are adjusted for clustering at the firm level. The data is quarterly from 2001 - 2017. Columns (1) and (3) exclude observations that belong to the top quartile of absolute changes in stock fragility and columns (2) and (4) exclude observations that belong to the top decile of absolute changes in stock fragility. Columns (3) and (4) also exclude multinational corporations. Statistical significance at the 1, 5, or 10% levels is reported as ***, **, *, respectively.

Table 5: Stock Fragility and Cash Holding: Robustness to Controlling for Product Market Concentration

	Cash/Assets		Cash/Assets: No MNC	
	(1) All	(2) Low HHI	(3) All	(4) Low HHI
sqrt(Fragility)	0.676***	0.746***	0.949***	0.909***
	(0.223)	(0.263)	(0.286)	(0.313)
TNIC HHI	0.003		0.008	
	(0.004)		(0.006)	
Earnings volatility	0.089***	0.094***	0.068***	0.065**
	(0.019)	(0.022)	(0.024)	(0.027)
Ln(Assets)	-0.041***	-0.041***	-0.031***	-0.031***
	(0.003)	(0.004)	(0.004)	(0.005)
Inst Ownership	0.015***	0.016***	0.022***	0.023***
	(0.005)	(0.006)	(0.008)	(0.008)
MktLev	-0.090***	-0.085***	-0.077***	-0.072***
	(0.006)	(0.007)	(0.008)	(0.009)
FixedAssets	-0.413***	-0.417***	-0.399***	-0.404***
	(0.017)	(0.020)	(0.022)	(0.024)
Inventory	-0.552***	-0.571***	-0.514***	-0.529***
	(0.025)	(0.030)	(0.034)	(0.041)
OperCashFlow	-0.050*	-0.051*	-0.056*	-0.046
	(0.027)	(0.028)	(0.032)	(0.031)
Quarter-Industry FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Adj. R2	0.863	0.874	0.883	0.896
Observations	133,461	98,585	64,553	48,298

Panel regression of cash holding on Greenwood and Thesmar's stock price fragility measure as well as additional firm-level control variables. The regressions include both firm and quarter-industry (SIC 3) fixed effects and the standard errors are adjusted for clustering at the firm level. The data is quarterly. TNIC HHI is the Hoberg and Phillips (2016) measure of industry concentration and Low HHI is defined as below the top quartile. Statistical significance at the 1, 5, or 10% levels is reported as ***, **, *, respectively.

Table 6: Stock Fragility, Investments and Liquidity Management

	(1) CapEx/Assets	(2) R&D/Assets	(3) Repurch/Assets	(4) Dividends/Assets	(5) ST Debt/Assets
sqrt(Fragility)	-0.043*	-0.089**	-0.055**	0.006	-0.343***
	(0.024)	(0.041)	(0.024)	(0.008)	(0.107)
Earnings volatility	-0.004**	-0.009**	-0.002***	0.000	0.000
	(0.002)	(0.004)	(0.001)	(0.000)	(0.008)
Ln(Assets)	0.000	-0.009***	0.001***	0.000	-0.006***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)
Inst Ownership	0.002***	0.001	0.001**	-0.000	-0.004
	(0.000)	(0.001)	(0.000)	(0.000)	(0.003)
MktLev	-0.018***	-0.004***	-0.011***	-0.003***	0.122***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.005)
FixedAssets	0.004*	0.013***	-0.002**	-0.001***	0.013*
	(0.002)	(0.003)	(0.001)	(0.000)	(0.007)
Inventory	0.002	-0.008**	-0.004***	-0.002***	0.093***
	(0.002)	(0.004)	(0.001)	(0.001)	(0.011)
OperCashFlow	0.012***	-0.109***	0.009***	0.003***	-0.057***
	(0.002)	(0.006)	(0.002)	(0.001)	(0.010)
Quarter-Industry FE	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES
Adj. R2	0.557	0.813	0.276	0.532	0.550
Observations	135,832	73,437	127,068	135,580	135,254

Panel regression of investment and liquidity decisions on Greenwood and Thesmar's stock price fragility measure as well as additional firm-level control variables. The regressions include both firm and quarter-industry (SIC3) fixed effects and the standard errors are adjusted for clustering at the firm level. The data is quarterly from 2001 - 2017. Statistical significance at the 1, 5, or 10% levels is reported as ***, **, *, respectively.

Table 7: Effect of Exogenous Shock to Fragility (BlackRock-BGI Merger) on Cash Holding

	All firms		No MNC	
	(1) Cash/Assets	(2) Cash/Assets	(3) Cash/Assets	(4) Cash/Assets
Merger Treatment	0.013***	0.006**	0.009***	0.002
	(0.002)	(0.003)	(0.003)	(0.004)
Merger Treatment x I.O. above median		0.011***		0.015***
		(0.003)		(0.005)
Inst. Own. above median		-0.007*		-0.007
		(0.003)		(0.005)
Inst Ownership	-0.003		-0.004	
	(0.009)		(0.011)	
Earnings volatility	0.204***	0.201***	0.165***	0.163***
	(0.029)	(0.029)	(0.046)	(0.046)
Ln(Assets)	-0.029***	-0.030***	-0.005	-0.007
	(0.007)	(0.007)	(0.009)	(0.009)
MktLev	-0.024***	-0.023***	-0.035***	-0.033***
	(0.008)	(0.007)	(0.012)	(0.012)
FixedAssets	-0.404***	-0.405***	-0.392***	-0.395***
	(0.033)	(0.033)	(0.046)	(0.046)
Inventory	-0.438***	-0.437***	-0.340***	-0.339***
	(0.035)	(0.035)	(0.049)	(0.049)
OperCashFlow	0.098***	0.101***	0.097***	0.101***
	(0.022)	(0.022)	(0.028)	(0.027)
Quarter-Industry FE	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Adj. R2	0.930	0.931	0.944	0.944
Observations	22,177	22,177	9,856	9,856

Panel regression of cash holding on Blackrock-BGI treatment indicator as well as additional firm-level control variables. The regressions include firm fixed effects and the standard errors are adjusted for clustering at the firm level. The data is quarterly from 2008Q1-2010Q4. Merger Treatment equals one if the stock was jointly held by Blackrock and BGI in 2008 Q4 and 0 if the stock was held by only one of Blackrock and BGI in 2008Q4. Columns (3)-(4) exclude multinational corporations from the sample. Statistical significance at the 1, 5, or 10% levels is reported as ***, **, *, respectively.

Table 8: Effect of Exogenous Shock to Fragility (BlackRock-BGI Merger) on Investment and Liquidity Management

	(1) CapEx/Assets	(2) R&D/Assets	(3) Repurch/Assets	(4) Dividends/Assets	(5) ST Debt/Assets
Merger Treatment	-0.002***	-0.001**	-0.002***	-0.000**	-0.005***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Earnings volatility	-0.005	-0.017*	0.003	0.001	0.020
	(0.004)	(0.008)	(0.002)	(0.001)	(0.016)
Ln(Assets)	-0.002	-0.013***	0.003***	0.001***	-0.001
	(0.001)	(0.003)	(0.001)	(0.000)	(0.003)
Inst Ownership	0.003**	0.001	-0.002	0.000	0.001
	(0.001)	(0.002)	(0.002)	(0.000)	(0.006)
MktLev	-0.017***	-0.000	-0.010***	-0.002***	0.084***
	(0.002)	(0.002)	(0.001)	(0.000)	(0.008)
FixedAssets	-0.033***	-0.004	-0.014***	-0.004***	-0.040**
	(0.007)	(0.011)	(0.003)	(0.001)	(0.016)
Inventory	0.009**	-0.005	-0.012***	-0.002	0.089***
	(0.004)	(0.007)	(0.003)	(0.001)	(0.024)
OperCashFlow	0.013***	-0.054***	-0.000	0.000	-0.062***
	(0.004)	(0.012)	(0.002)	(0.001)	(0.017)
Quarter-Industry FE	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES
Adj. R2	0.619	0.881	0.316	0.639	0.648
Observations	22,147	11,975	20,930	22,126	21,994

Panel regression of investment and liquidity management decisions on Blackrock-BGI treatment indicator as well as additional firm-level control variables. The regressions include firm fixed effects and the standard errors are adjusted for clustering at the firm level. The data is quarterly from 2008Q1-2010Q4. Merger Treatment equals one if the stock was jointly held by Blackrock and BGI in 2008 Q4 and 0 if the stock was held by only one of Blackrock and BGI in 2008Q4. Columns (3)-(4) exclude multinational corporations from the sample. Statistical significance at the 1, 5, or 10% levels is reported as ***, **, *, respectively.

Table 9: Effect of Bank of America-Fleet and JP Morgan-Bank One mergers on Fragility, Cash Holding and Investment

	(1) Sqrt(Frag. Family)	(2) Sqrt(Frag. Family)	(3) Cash/Assets	(4) Cash/Assets	(5) CapEx/Assets	(6) CapEx/Assets
Announcement	-0.001		0.004**		-0.000	
	(0.001)		(0.002)		(0.000)	
Merger		0.002*		0.000		0.000
		(0.001)		(0.002)		(0.000)
Earnings volatility	-0.010	-0.010	0.096**	0.096**	-0.013***	-0.013***
	(0.012)	(0.012)	(0.040)	(0.040)	(0.004)	(0.004)
Ln(Assets)	-0.000	-0.000	-0.044***	-0.044***	-0.000	-0.000
	(0.002)	(0.002)	(0.009)	(0.009)	(0.001)	(0.001)
Inst Ownership	0.045***	0.044***	0.010	0.010	0.005***	0.004***
	(0.005)	(0.005)	(0.010)	(0.010)	(0.001)	(0.001)
MktLev	0.026***	0.026***	-0.072***	-0.074***	-0.013***	-0.012***
	(0.006)	(0.006)	(0.012)	(0.012)	(0.002)	(0.002)
FixedAssets	0.024**	0.024**	-0.390***	-0.390***	-0.022***	-0.022***
	(0.010)	(0.010)	(0.034)	(0.034)	(0.005)	(0.005)
Inventory	0.013	0.013	-0.410***	-0.412***	0.002	0.002
	(0.011)	(0.011)	(0.045)	(0.045)	(0.004)	(0.004)
OperCashFlow	0.013	0.013	0.060	0.061	-0.002	-0.002
	(0.009)	(0.009)	(0.041)	(0.041)	(0.004)	(0.004)
Quarter-Industry FE	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Adj. R2	0.826	0.827	0.934	0.934	0.639	0.639
Observations	17,984	17,984	18,142	18,142	18,082	18,082

Panel regression of cash holding indicator variable for merger treatment as well as additional firm-level control variables. The regressions include firm fixed effects and the standard errors are adjusted for clustering at the firm level. The data is quarterly from Q1 2003 until Q3 2005. Announcement takes value 1 for treated firms in the BoA-Fleet merger 2003 Q4 onwards and the value 1 for treated firms in the JPM-Bank One merger from 2004 Q1 onwards. Announcement dummy is 0 for firms that were held by only one of the merging parties. Merger dummy defined analagously based on merger completion dates: 2004 Q2 for BoA-Fleet and 2004 Q3 for JPM-Bank One). Statistical significance at the 1, 5, or 10% levels is reported as ***, **, *, respectively.

Online Appendix

(1) Stock fragility and stock price volatility

The forward looking, precautionary, behavior that the current paper examines relies on an expectation on the part of firms that a higher stock price fragility is associated with a more volatile stock price. The seminal article by Greenwood and Thesmar (2011) documents this relation for 1990-2007, limiting their sample to firms in decile five or above in terms of market capitalization on the NYSE. Similarly Ben-David et al. (2021) document a robust positive relation between the Greenwood and Thesmar measure of stock price fragility and volatility for the universe of CRSP stocks 1980-2016. Both of these papers use quarterly data (as do we) and focus on daily volatility averaged over the quarter. Greenwood and Thesmar (2011) consider both total return volatility and various specifications of excess returns. Ben-David et al. (2021) consider total returns volatility and control for a number of other factors, in particular the share owned by the largest institutional investors.

In the following we document that the expected positive relationship between stock price fragility and stock price volatility also holds in the current data. Table IA.1 presents a regression analysis of the relation between daily stock price volatility and fragility, controlling for (the natural log of) market capitalization, institutional ownership and the inverse of price in addition to firm fixed effects and year×quarter fixed effects. Column (1) presents the results for the full sample and the point estimate on fragility is positive but not statistically significant at the 5 percent level (t-stat of 1.86 so statistically significant at 10 percent level however). As discussed however Greenwood and Thesmar (2011) note that in their model fragility is proportional to variance of returns and hence the *square root of fragility* should be proportional to the standard deviation of returns. In their regressions they therefore include the square root of fragility rather than fragility in levels. In Column (2) we therefore include the square root of fragility and the results indicate a statistically significant positive relation between fragility and stock price volatility. We expect a stronger positive relation for firms that are larger and with higher institutional ownership. To explore these dimensions Column (3) restricts the sample to observations with at least 20% institutional owners, Column (4) excludes microcap firms with less than 100 million in market capitalization and Column (5) considers the top five deciles by market capitalization. In sum, the current sample lines up well with previous evidence in that there is a positive relation between stock price fragility and volatility of returns.

Table IA.1: Return Volatility and Fragility

	(1) All firms	(2) All firms	(3) Inst own>0.2	(4) MarketCap>100	(5) Top 5 deciles
Fragility	3.323*				
	(1.782)				
sqrt(Fragility)		0.049**	0.081***	0.082***	0.082***
		(0.025)	(0.024)	(0.022)	(0.022)
Ln(MarketCap)	-0.005***	-0.005***	-0.003***	-0.002***	-0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
1/price	0.008***	0.009***	0.017***	0.018***	0.026***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.004)
Inst Ownership	0.001*	0.001	0.000	-0.001***	-0.002***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Year-Quarter FE	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES
Adj. R2	0.540	0.542	0.598	0.577	0.645
Observations	171,208	170,277	136,454	128,947	103,434

Panel regression of daily return volatility (average by quarter) on Greenwood and Thesmar's stock price fragility measure as well (natural log of) market capitalization, 1/stock price, institutional ownership as well as firm fixed effects and year×quarter fixed effects. Standard errors are adjusted for clustering at the firm level. Beyond the fragility measure, the data is quarterly Compustat from 2001 - 2017 with the exclusion of utilities, financial firms, and SIC 9000 codes. We require positive book equity and positive sales. Column (3) restricts sample to firms with at least 20% institutional ownership, Column (4) to firms with market capitalization above 100 million USD and Column (5) to firms in decile 5 or above by market capitalization. Statistical significance at the 1, 5, or 10% levels is reported as ***, **, *, respectively.

(2) BlackRock-BGI Merger - Additional Results

Table IA.2: The Estimated Effect of the BlackRock-BGI Merger on Cash Holding: An Examination of Parallel Trends

	(1) Cash/Assets
2008Q1 (Announce -5)	-0.001
	(0.005)
2008Q2 (Announce -4)	-0.003
	(0.005)
2008Q3 (Announce -3)	-0.005
	(0.004)
2008Q4 (Announce -2)	0.003
	(0.004)
2009Q2 (Announcement)	0.006***
	(0.001)
2009Q3 (Announce +1)	0.013***
	(0.002)
2009Q4 (Merger)	0.021***
	(0.002)
2010Q1 (Merger+1)	0.017***
	(0.005)
2010Q2 (Merger+2)	0.012**
	(0.006)
2010Q3 (Merger+3)	0.010*
	(0.006)
2010Q4 (Merger+4)	0.014**
	(0.007)
Quarter-Industry FE	YES
Firm FE	YES
Adj. R2	0.923
Observations	22,177

The table reports the estimated coefficient on treatment (leads and lags) surrounding the BlackRock-BGI merger. The regression includes firm fixed effects as well as quarter-industry (SIC 3) fixed effects. The coefficients are illustrated in Figure 1. Standard errors are adjusted for clustering at the firm level. The data is quarterly from 2008Q1-2010Q4. Merger Treatment equals one if the stock was jointly held by Blackrock and BGI in 2008 Q4 and 0 if the stock was held by only one of Blackrock and BGI in 2008Q4.

(3) Mergers Outside of Financial Crisis - Additional results

Table IA.3: Effect of Bank of America-Fleet and JP Morgan-Bank One Mergers on Cash Holding: An Examination of Parallel Trends

	(1) Cash/Assets
2003 Q1 (Announce BoA-3)	-0.006**
	(0.003)
2003 Q2 (Announce BoA-2)	-0.003
	(0.002)
2003 Q4 (Announce BoA)	0.009***
	(0.002)
2004 Q1 (Announce JPM)	0.004***
	(0.001)
2004 Q2 (Merge BoA)	0.004
	(0.006)
2004 Q3 (Merge JPM)	0.004
	(0.006)
2004 Q4 (Merge JPM +1)	0.000
	(.)
2005 Q1 (Merge JPM +2)	0.002
	(0.003)
2005 Q2 (Merge JPM +3)	-0.002
	(0.003)
2005 Q3 (Merge JPM +4)	-0.003
	(0.004)
Quarter-Industry FE	YES
Firm FE	YES
Adj. R2	0.915
Observations	22,836

The table reports the estimated coefficient on treatment (leads and lags) surrounding the Bank of America-Fleet and JP Morgan-Bank One mergers. The regression includes firm fixed effects as well as quarter-industry (SIC 3) fixed effects. The coefficients are illustrated in Figure YY. Standard errors are adjusted for clustering at the firm level. The data is quarterly from 2003Q1-2005Q3. Merger Treatment equals one if the stock was jointly held by merging parties in XXX.