

Trimming the Sails: Natural Disasters and Controlling Shareholder Divestments

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Abstract

We examine how natural disasters influence the portfolio allocation decisions of controlling shareholders. Exploiting severe natural disasters in Europe, we document that they prompt controlling shareholders to significantly reduce their aggregate equity holdings by approximately 14%, indicating sizable equity disinvestment. This effect intensifies with disaster severity and is mitigated by the number of the shareholder’s subsidiaries, yet is unrelated to industrial or geographic diversification. We test several mechanisms to explain this retrenchment. Ruling out performance, financial constraints, and cross-region capital reallocation, we identify the availability of potential buyers and non-European ownership status as the primary drivers of divestment. Collectively, our results suggest that natural disasters act as distinct portfolio-level shocks that reshape corporate ownership structures.

Keywords: Natural disaster; Equity investment; Ownership; Control.

JEL Classification: D25, G32.

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I Introduction

Climate change exposes firms and investors to increasingly frequent and severe natural disasters. Natural disasters are not only humanitarian crises but also major financial events that reallocate capital, shift risk, and test the resilience of firms.¹ In 2023 and 2024, disasters generated losses of roughly USD 450 billions, affected hundreds of millions of people, and caused more than 100,000 deaths worldwide (Centre for Research on the Epidemiology of Disasters (CRED), 2024, 2025). Prior studies show that disasters disrupt supply chains (Barrot and Sauvagnat, 2016; Pankratz and Schiller, 2024), reduce revenues and operating income (Pankratz *et al.*, 2023), lower leverage (Ginglinger and Moreau, 2023), increase precautionary cash holdings (Dessaint and Matray, 2017), and reduce employment in affected regions (Acharya *et al.*, 2023). Yet much less is known about how they affect the behavior of controlling shareholders—defined as investors who hold a controlling block of equity and exercise decisive influence over corporate strategies.

Ownership structures dominated by controlling shareholders are widespread globally (Aminadav and Papaioannou, 2020), and their prevalence has increased over the past decade (Fonseca *et al.*, 2023). Controlling shareholders often owns equity stakes in several firms (Faccio *et al.*, 2011), both listed and unlisted. When controlling shareholders hold stakes across multiple firms, they evaluate risk and investment at the portfolio level (Lyandres *et al.*, 2019), raising the possibility that shocks affecting one firm spill over to others. Put differently, natural disasters operate as portfolio-level shocks that can alter ownership structures. Given the central role of controlling shareholders in shaping firms' long-term strategic and financial responses to shocks, understanding how these owners react to disaster events is therefore important.

In this paper, we examine whether natural disasters prompt controlling shareholders to reduce their aggregate equity holdings in their portfolio firms. Because their portfolios are typically undiversified and concentrated in affiliated firms, disasters expose controlling shareholders to large risks. Partial exit through divestment provides a mechanism to limit downside exposure and protect long-term wealth. The blockholder literature shows that large shareholders actively adjust ownership in response to adverse information and

¹See, for example, Addoum *et al.* (2020), Akey and Appel (2021), Bartram *et al.* (2022), Benincasa *et al.* (2024), Bernstein *et al.* (2019), Collier *et al.* (2025), Engle *et al.* (2020), Shive and Forster (2020), Krueger *et al.* (2020), and Painter (2020).

heightened risk, with exit serving as a key governance channel (Edmans, 2009; Maug, 1998; Edmans and Manso, 2011; Edmans *et al.*, 2013). Also, undiversified owners reduce risk exposure when volatility rises (Panousi and Papanikolaou, 2012). Applying these insights to the setting of natural disasters, we expect controlling shareholders to scale down their equity stakes when disaster shocks raise the risk borne by their portfolios.

Reductions in equity stakes may serve both as a mechanism for limiting risk exposure and as a means of generating liquidity that can be reallocated within the affiliated firms. Accordingly, we also test whether divestments by controlling shareholders free up internal funds that are subsequently redeployed across subsidiaries, consistent with the internal capital market view that resources are directed toward affiliates with stronger prospects or lower exposure to shocks (Giroud and Mueller, 2019).

We test these hypotheses using ownership data from Moody’s DataHub (formerly Bureau van Dijk’s Orbis Historical) covering the period 2008–2021. Our sample includes all non-financial controlling owners with at least one listed portfolio company in the EU-27, Norway, Switzerland, or the United Kingdom. Following Lins *et al.* (2013), we identify the global ultimate owners as controlling shareholders using the 25.01% threshold to determine control. For all these controlling shareholders, we construct the portfolio of companies (henceforth subsidiaries) they own.² Consistent with Faccio *et al.* (2011) and Lyandres *et al.* (2019), we focus on controlling equity investments. Data on natural disasters are drawn from the Risk Data Hub compiled by the Joint Research Centre (Faiella *et al.*, 2020). We consider 98 natural disasters that generate economic losses exceeding €250 million, thereby restricting attention to severe events with the potential to produce meaningful economic and financial consequences. A disaster is linked to a subsidiary when the NUTS3 region hosting the subsidiary’s headquarters is classified as affected.³

Our empirical strategy is based on tests at the controlling shareholder–year level, which enables us to capture portfolio-wide adjustments in response to natural disasters. Following the suggestion of Baker *et al.* (2022), we implement a stacked difference-in-differences regression approach to account for the staggered treatment timing of our

²We restrict the sample to subsidiaries with total assets exceeding US\$1,000,000 in at least one sample year.

³As noted by Barrot and Sauvagnat (2016), production sites may be located outside the headquarters’ region, introducing potential measurement error. However, such error would bias the results against finding any effect, making our estimates conservative.

events (see, e.g., Gormley and Matsa, 2011; Gormley *et al.*, 2013; Iliev and Roth, 2023). For each treatment year, we construct a cohort of treated and matched control firms (not-yet treated and never treated). We then stack all the cohorts to perform our regression analysis.⁴

The evidence strongly supports our main hypothesis. On average, natural disasters reduce controlling shareholders' equity investments by about 14%. This finding establishes that disasters trigger significant portfolio-wide adjustments, consistent with the view that they are perceived as major shocks to the wealth and risk exposure of controlling shareholders. We also document that disinvestment is positively associated with the magnitude of the shock, measured by economic losses. This finding suggests that controlling shareholders are more responsive to disasters that generate substantial losses and physical damage. We also observe that controlling shareholders are more reluctant to partially exit when the natural disaster hits the region where their most important firms are located. Finally, we find that disinvestment in affected regions is not offset by increases in unaffected ones, suggesting that disasters trigger exit rather than intra-portfolio rebalancing. Thus, controlling shareholders with subsidiaries across multiple regions do not try to mitigate risk by shifting investments away from affected areas toward safer locations, as expected under the internal capital market view (Giroud and Mueller, 2019). While prior research shows that firms reallocate resources after climate shocks (Acharya *et al.*, 2023), our analysis at the shareholder–region–year level provides no evidence of such behavior.

Having established the main effects, we next investigate the underlying channels that may explain why controlling shareholders cut their equity investments after natural disasters. We examine buyer demand, diversification, underperformance and financial constraints, personal liquidity needs, and an increased reliance on external financing.

The first channel is the availability of potential buyers for the equity stakes owned by the controlling shareholder. Potential buyers—such as large or cash-rich firms—may view distressed markets as opportunities to acquire undervalued assets (Barro, 2006). Strong post-disaster buyer demand can, in turn, create more favorable conditions for controlling shareholders to divest, making it easier for them to unwind their positions.⁵

⁴We replicate the analysis with only never treated as control firms in a robustness analysis.

⁵Government interventions—such as reconstruction programs—can further mitigate risk and stimulate sector-specific demand (Cavallo *et al.*, 2011).

Consistent with this mechanism, we find that divestitures are more likely when a larger pool of potential acquirers—proxied by unaffected large and cash-rich firms operating in the same industry and region—is present. Conversely, when these potential acquirers are themselves exposed to the disaster, divestitures become less likely.

Diversification is the second channel. Controlling shareholders often exhibit limited diversification (e.g., Faccio *et al.*, 2011; Thesmar and Thoenig, 2011; Lyandres *et al.*, 2019). Because natural disasters reduce firm value and cash flows, such concentration can magnify portfolio risk and induce divestment. A more diversified portfolio may reduce the impact of localized shocks, potentially leading controlling shareholders to divest less—or even maintain investments—in affected areas (Roston, 2021). Supporting this prediction, we find that shareholders with more subsidiaries reduce their investments less following disasters. However, industry and geographical diversification does not appear to matter. These results suggest that breadth in the number of subsidiaries mitigates disaster effects, whereas other forms of diversification play little role.

A third potential driver is underperformance and financial constraints. Disasters exacerbate the vulnerability of already struggling and financially constrained firms (Collier *et al.*, 2025), increasing the incentive for controlling shareholders to reduce exposure. Thus, disasters could serve as an opportunity to exit weaker firms, particularly those already facing binding financial constraints. If this channel were operative, controlling shareholders would disproportionately cut investments in underperforming subsidiaries. Empirically, however, we find no such evidence. While portfolio performance, measured by ROE and ROA, has a marginal effect on reducing disinvestment, the association is small and economically insignificant. Moreover, financial constraints do not predict exits. These findings rule out the conjecture that disasters are used primarily to shed failing businesses.

Personal liquidity problems represents the fourth channel. If disasters impose liquidity pressures on controlling shareholders themselves, they may be forced to withdraw capital from portfolio firms. We test this mechanism by exploiting variation in shareholders' countries of origin. Non-European controlling shareholders should, on average, be less affected personally by European disasters. Yet the evidence runs counter to this prediction: non-European owners cut equity investment by about 25%.

A final channel is external financing. If disasters alter firms' financing mix, equity

reductions may be offset by new debt, leaving total assets stable. Similarly, new equity contributions from minority investors can support the same level of total assets. This channel predicts that portfolio firms should not shrink in size even if controlling shareholders reduce stakes. The evidence is consistent with this view. We find no strong decline in total assets. Thus, reductions in equity holdings do not appear to reflect asset contractions.

We also examine an additional source of heterogeneity in the effects of natural disasters, i.e. family ownership. Prior work shows that family owners adopt survival-oriented strategies to preserve control benefits (Lins *et al.*, 2013), suggesting they may be more reluctant than other owners to divest after a shock. Consistent with this view, we find that family owners are indeed less likely to reduce their equity investment following natural disasters.

A potential concern is that natural disasters may be partially anticipated, as some regions are persistently more exposed to such risks, allowing controlling shareholders to adjust behavior *ex ante*. Any resulting bias, however, would tend to attenuate post-disaster estimates rather than induce spurious effects.⁶ To further address this concern, we examine controlling shareholders whose firms are located in regions neighboring the disaster area (Dessaint and Matray, 2017). We find that controlling shareholders also respond to nearby disasters, consistent with our main results.

This paper makes four main contributions to the literature. First, we contribute to the literature on controlling shareholders’ portfolio decisions (e.g., Amihud and Lev, 1981; Faccio *et al.*, 2011; Lyandres *et al.*, 2019). Prior research has primarily examined how owners’ investment decisions shape firm behavior. For example, Faccio *et al.* (2011) show that firms controlled by diversified large shareholders undertake riskier investments than those controlled by non-diversified owners, while Lyandres *et al.* (2019) document that risk-averse investors jointly determine their portfolio structure as well as the level and riskiness of capital investment in controlled firms. We extend this literature by showing that external shocks—specifically, natural disasters—affect the portfolio investment behavior of controlling shareholders. By documenting systematic reductions in controlling shareholders’ equity investments following disasters, we uncover a novel dimension of how controlling shareholders manage their equity holdings under risk.

⁶While changes in perceived disaster risk could, in principle, affect shareholder behavior, economically meaningful updates to such beliefs typically occur only after a disaster is realized.

Second, we add to the growing literature on climate-related shocks. Prior work has documented that natural disasters have substantial effects on supply chains, operations, and investment. For instance, Barrot and Sauvagnat (2016) show that suppliers hit by disasters impose large output losses on their customers, and Pankratz and Schiller (2024) find that firms are more likely to terminate supplier relationships when temperature shocks exceed expectations. Lin et al. (2020) show that power plants increase investments in flexible production technologies in response to long-term climate change. Bartram *et al.* (2022) document that firms respond to local carbon regulation by shifting production to unaffected states. Pankratz *et al.* (2023) find that exposure to extremely high temperatures reduces revenues and operating income. Collier *et al.* (2025) observe that financial frictions compound the challenges posed by severe climate disasters, while Collier *et al.* (2024) document the positive role of emergency loans following natural disasters. Finally, Acharya *et al.* (2023) document that firms adjust to heat shocks by lowering employment in affected locations and increasing it in unaffected ones. We highlight a new channel: ownership. Our results show that disasters impact corporate control by prompting controlling shareholders to reduce equity stakes. This finding expands the scope of climate finance research by showing that climate shocks affect not only firm operations but also the allocation of ownership rights.

Third, we shed light on the dynamics of ownership in the aftermath of shocks. We show that aggregate equity reductions by controlling shareholders are not accompanied by declines in total assets, implying that other investors step in. This evidence connects the disaster literature with research on investor composition and capital structure (Ginglinger and Moreau, 2023), and suggests that natural disasters facilitate ownership turnover rather than asset contraction. In addition, our analysis rules out several alternative channels, including underperformance, financial constraints, and regional reallocation, thereby clarifying the conditions under which ownership changes occur.

Forth, our results have implications for policy debates on financial stability and climate risk. As the appreciation of climate-related risk increases (Stroebel and Wurgler, 2021) and regulators regularly warn about this source of risk (Rudebusch, 2021), understanding how large shareholders reallocate capital after disasters is critical. Our findings suggest that shocks can prompt ownership redistribution without reducing firm assets, raising questions about the resilience of ownership structures and the potential long-term

consequences for governance in climate-vulnerable economies.

The remainder of the paper is organized as follows. Section II describes the data and presents descriptive statistics. Section III reports the main results. Section IV presents robustness tests and additional analyses. Section V concludes.

II Data and methodology

Session II.A presents the data sources and discusses the major steps to build the dataset. Session II.B discusses the main identification strategy and tests to establish the relationship between natural disasters and owner’s portfolio investment, including firms’ investments. Finally, Session II.C presents the descriptive statistics relative to sample composition and main variables.

A Data sources

We obtain firm-level data from Moody’s DataHub, which integrates historical Orbis records. The DataHub provides detailed firm characteristics, ownership structures, and financial statements. Ownership information is compiled by Moody’s from multiple sources, including company disclosures (annual reports, websites, and private correspondence), regulatory filings, and third-party providers. We use the April 2024 delivery of the Ownership dataset, which reports the list of shareholders and their voting stakes for each firm. Importantly, these stakes reflect voting rights rather than cash-flow rights, as they account for dual-class shares and other special equity arrangements. Our sample spans 2008–2021.

We identify all controlling shareholders with at least one listed firm located in the EU-27 member states,⁷ as well as Norway, Switzerland, and the United Kingdom. We define the controlling shareholder as the global ultimate owner (GUO) holding at least 25.01% of the shares.⁸ We exclude controlling shareholders classified as banks, insurance companies, mutual and pension funds, nominees, trusts, or financial firms not elsewhere classified, unless their primary industrial activity is “activities of holding companies” (NACE Rev. 2 code 6420). For these controlling shareholders, we determine all the

⁷Austria, Belgium, Bulgaria, Croatia, Republic of Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden.

⁸If the GUO’s equity stake is missing in a given year, we impute it using the closest available observation from adjacent years.

listed and unlisted European firms in which they have a controlling interest, restricting attention to firms with total assets of at least \$1,000,000 in at least one sample year. For each firm, we collect core balance sheet items, including total assets, total liabilities, profits before taxes, and financial expenses. Consistent with Kalemli-Özcan *et al.* (2024), we prioritize unconsolidated accounts (U1 or U2) and use consolidated accounts (C1) only when unconsolidated accounts are unavailable.⁹ The resulting sample comprises 289,631 unique subsidiaries owned by 13,754 distinct controlling shareholders.

The natural disaster data are obtained from the Risk Data Hub maintained by the Joint Research Centre (Faiella *et al.*, 2020). This hub harmonizes multiple databases and metadata on past European natural disasters, including floods, earthquakes, forest fires, landslides, tsunamis, and volcanic eruptions. From this source, we extract information on affected areas at the NUTS3 level, the smallest geographical unit of analysis in Europe.¹⁰ We retain only events with available information on magnitude—measured by the number of injured and deceased individuals and/or reported economic losses. To focus on economically significant shocks, we define a natural disaster as an event with reported economic losses exceeding €250 million. Applying this threshold yields 98 events. We merge these disasters with the Orbis database using firm-level address information, which allows us to locate each firm at the NUTS3 level.

B Empirical strategy

Our empirical strategy operates at the controlling shareholder–year level, allowing us to examine how controlling shareholders adjust their portfolios in response to natural disasters. The key variable of interest is the year-to-year change in the controlling shareholder’s aggregate equity investment. Measuring this change would be straightforward if all sample firms were publicly listed: one could simply combine information on the controlling shareholder’s ownership percentage with each firm’s market equity value and aggregate these amounts across all holdings. However, for privately held firms—where equity market values are not observable—such data are unavailable. Because the majority

⁹Consolidated accounts (C1) represent only 3% of the sample, limiting concerns about double counting.

¹⁰NUTS3 size varies substantially both within countries (e.g., in Germany, a rural district can span 1,422 km^2 while an urban district may cover only 150 km^2) and across countries (e.g., in Spain the average NUTS3 has an area of 9,729 km^2). For comparison, at the 2000 U.S. Census the median land area of U.S. counties was 622 square miles (1,610 km^2).

of subsidiaries (firms) in controlling shareholders' portfolios are unlisted, we approximate equity values using book equity. We sum all the changes in the equity investments of the controlling shareholders across all subsidiaries in year t and divide it by the value of the controlling shareholder's equity portfolio in year $t - 1$. Our proxy of the portfolio-level equity change for GUO i in year t , $\Delta Equity_{i,t}$ is computed as:

$$\Delta Equity_{i,t} = \frac{\sum_{j \in i} \Delta Equity_{j,t}}{\sum_{j \in i} [\%shares_{j,t-1} \times Equity_{j,t-1}]}, \quad (1)$$

where $\Delta Equity_{j,t}$ is defined as $(\%shares_{j,t} - \%shares_{j,t-1}) \times Equity_{j,t-1}$ when the ownership data from Orbis reports a change in the percentage of equity owned by the controlling shareholder (i.e., $\%shares_{j,t} \neq \%shares_{j,t-1}$). To assure that the estimated measure is not affected by the natural disaster, we use the value of the equity in the subsidiary j at the end of the year $t - 1$.

However, a controlling shareholder may inject new equity without altering its ownership fraction, for example when an equity issue is subscribed pro rata by all shareholders. To account for these situations, $\Delta Equity_{j,t}$ in Equation 1 for subsidiary j owned by GUO i can take one of three values even when the ownership percentage is unchanged (i.e., $\%shares_{j,t} = \%shares_{j,t-1}$):

1. $\Delta Equity_{j,t}=0$ if $Capital_{j,t-1} \leq Capital_{j,t}$, where *Capital* is the share capital of firm j . In this case, there is no increase in the percentage of equity owned and there is no increase in the share capital.
2. $\Delta Equity_{j,t}=\%shares_{j,t-1} \times (Equity_{j,t} - Equity_{j,t-1})$ if $Capital_{j,t-1} > Capital_{j,t}$ and $Equity_{j,t} > Equity_{j,t-1}$. In this case, both the book equity and the capital of the firm increase, suggesting that there has been an equity issue.
3. $\Delta Equity_{j,t}=\%shares_{j,t-1} \times (Capital_{j,t} - Capital_{j,t-1})$ if $Capital_{j,t-1} > Capital_{j,t}$ and $Equity_{j,t} > Equity_{j,t-1}$. In this case, while the share capital of the firm increases, the value of the equity does not, suggesting that the company is struggling financially. We assume that the new equity investment of the controlling shareholder is the fraction of the increase in the share capital.

A key challenge in estimating the impact of natural disaster on controlling shareholders' equity investments is that disaster exposure occurs at different points in time for different controlling shareholders. In such staggered treatment settings, the conventional two-way fixed effects (TWFE) difference-in-differences estimator may be biased, because already-treated units are inappropriately used as controls for later-treated units and the estimator places non-convex weights on treatment effects from different cohorts (Goodman-Bacon, 2021; Baker *et al.*, 2022). Following the suggestion of Baker *et al.* (2022), we implement a stacked difference-in-differences regression approach to account for the staggered treatment timing of our events (see, e.g., Gormley and Matsa, 2011; Gormley *et al.*, 2013; Iliev and Roth, 2023).

We construct cohort samples of controlling shareholders experiencing their first disaster in year g , together with matched control firms that are not yet treated or never treated,¹¹ observed over a symmetric time window around g . We match each treated GUO i with one untreated GUO z using a propensity score matching on the basis of $\log\left(1 + \sum_{j \in i} \%shares_{j,t-1} \times Equity_{j,t-1}\right)$, the GUO's country and year.¹² We then stack all cohort samples into a single dataset and estimate the following pooled equation:

$$\Delta Equity_{i,g,t} = \alpha + \beta Disaster_{i,g,t} + \gamma_{i \times g} + \delta_{t \times g} + \theta_{c(i) \times t} + \varepsilon_{i,g,t}. \quad (2)$$

where i indexes controlling shareholders; t indexes calendar years; g indexes the cohort, defined by the GUO's first disaster year (first treatment year). $Disaster_{i,g,t}$ takes value 1 if any firm owned by GUO i in cohort g is affected by a natural disaster in year t onward. $\gamma_{i \times g}$ are GUO $\times$ cohort fixed effects, which are included to absorb the average difference in the change in equity holdings for that GUO/cohort pairing, ensuring that the treatment effect is identified purely from the time-series changes within the firm around the event. $\delta_{t \times g}$ are year $\times$ cohort fixed effects to control for any time-specific aggregate shocks that differentially affect one cohort's sample relative to another cohort's sample. We allow the firm and year fixed effects to vary by cohort, because this approach is more conservative than including simple fixed effects (Gormley and Matsa, 2011). $\theta_{c(i) \times t}$ are country $\times$ year fixed effects, where $c(i)$ denotes the country of GUO i as reported in the DataHub, to

¹¹As a robustness check, we restrict the control group to never-treated firms.

¹²Table B2 of the Online Appendix reports propensity score matching diagnostics, assuring that the level of the GUO's investment is similar in the two samples. We provide the results using alternative matching approaches in Section IV.D.

absorb cross-country differences in ownership behavior. We estimate (2) on a symmetric window $[-4, 4]$ centered on the event year. Following Gormley and Matsa (2011); Baker *et al.* (2022), we do not include additional covariates to the model as they would likely to be affected by the shock as well. Standard errors are clustered at the GUO level.

We also estimate a dynamic version of the model in (2):

$$\Delta Equity_{i,g,t} = \alpha + \sum_{k \in \mathcal{K}, k \neq -1} \beta_k \text{Disaster}_{i,g,t} + \gamma_{i \times g} + \delta_{t \times g} + \theta_{c(i) \times t} + \varepsilon_{i,g,t} \quad (3)$$

where $\mathcal{K}$ denote the set of relative years kept in the estimation window, k is equal to $t - g$, the relative year with respect to the cohort g . We omit $k = -1$ as the reference (pre) period. The coefficients β_k trace the dynamic response relative to $k = -1$. When estimating the dynamic model, we require that GUOs have non-missing $\Delta Equity_{i,g,t}$ in all the event-window years.

Finally, we explore how the GUO changes its portfolio investment at the regional level due to natural shock in the analysis of controlling shareholder-region-year. The model is the following:

$$\begin{aligned} \Delta Equity_{i,n,g,t} = & \alpha + \beta_1 \text{Disaster NUTS3}_{i,n,g,t} \\ & + \beta_2 \text{Disaster other NUTS3}_{i,M,g,t} + \gamma_{i \times n \times g} + \delta_{t \times g} + \theta_{c(n) \times t} + \varepsilon_{i,n,g,t}. \end{aligned} \quad (4)$$

$\text{Disaster NUTS3}_{i,n,g,t}$ is a dummy variable equal to 1 if a firm located in NUTS3 n in cohort g has been affected by a shock at time t onwards. $\text{Disaster other NUTS3}_{i,M,g,t}$ takes value 1 if there has been at least a shock in all the NUTS3 M with $M \neq n$ associated with the firms in the portfolio of GUO i . In this specification, we account for the different behavior of the GUO in a particular NUTS3 region.

C Descriptive statistics

Panel A of Table I presents the distribution by year. While natural disasters appear in every sample year except for 2008, the peaks are in 2007 (22 events) and 2013 (20 events). Panel B of Table I shows the country distribution of natural disasters. While natural disasters affect various countries in Europe, five countries constitute more than 80% of the sample: the United Kingdom (31.63%), France (21.43%), Germany (16.33%),

Spain (7.14%), and Italy (6.14%). Regarding controlling shareholder-year observations by country, France has more than 15% of the observations (17.05%), followed by the United Kingdom, Germany, and Spain.

Table II reports descriptive statistics for the variables used in the GUO-level analysis.¹³ Natural disasters (*Disaster*) occur in about 7.84% of controlling-shareholder-year observations. On average (median), a GUO holds equity stakes in about 7 (6) firms (calculated from N subs (log)). Furthermore, about 34.71% of controlling shareholders own more than 10 subsidiaries. The mean (median) ROE at the GUO level is 5.85% (5.70%), while the mean (median) ROA is -0.10% (2.11%). About 10.25% of controlling shareholders are non-EU, and 35.93% are family owners. As in Faccio *et al.* (2011), the portfolio diversification measure $1 - \text{HHI}$ is skewed (mean 0.406).

[Insert Table II about here]

III Empirical findings

A Main results

A.1 Baseline models

We begin by examining the effect of natural disasters on controlling shareholders' adjustments to their equity stakes. A growing methodological literature shows that two-way fixed effects estimators can combine heterogeneous treatment effects and generate bad comparisons (e.g., Callaway and Sant'Anna, 2021; Baker *et al.*, 2022; Sun and Abraham, 2021). To address these concerns, we estimate the stacked difference-in-differences model presented in Equations 2 and 3. Table III reports the corresponding results.

Column (1) estimates a specification that includes GUO-cohort, Cohort $\times$ Year, and Country-GUO fixed effects. In Column (2), our main specification, we replace Country-GUO fixed effects with Year $\times$ Country-GUO fixed effects to capture time-varying macroeconomic shocks affecting each GUO's home country. Across both specifications, the coefficient on our variable of interest, *Disaster*, is consistently negative and highly significant. The magnitude—roughly a 14% decline—is economically meaningful. These estimates indicate that natural disasters lead controlling shareholders to reduce their equity investments in portfolio firms, prompting a partial divestment of their investments.

¹³Table B1 in the Online Appendix shows the summary statistics of additional variables.

The specifications in Columns (1) and (2) do not require that the GUO be observed in every year of the event window. To address the concern that missing observations might drive the result, we re-estimate the model using only GUOs that have complete data for all years in the event window. Column (3) presents the results. The coefficient remains negative and strongly significant ($-0.097, p < 0.01$), reinforcing our baseline conclusion. Although the magnitude is slightly smaller, the effect remains substantial and continues to point toward systematic retrenchment in the aftermath of natural disasters.

[Insert Table III about here]

To evaluate pre-trends and the time profile of the effect, Column (4) estimates the dynamic model in Equation 3. Figure 1 plots the estimated coefficients with their confidence intervals. The pre-treatment leads ($t-4$ to $t-2$) are small and statistically indistinguishable from zero, providing support for the parallel trends assumption. At the time of the shock (t), the effect becomes negative and statistically significant ($-0.088, p < 0.05$). The decline deepens in the following years: between one and three years after the shock, the coefficients range from -0.124 to -0.157 (all $p < 0.01$). The effect remains sizeable even four years later ($-0.134, p < 0.01$). This pattern reveals an immediate contraction in equity investment that not only persists but intensifies over time, suggesting that natural disasters induce prolonged adjustments rather than temporary disruptions in capital allocation.

[Insert Figure 1 about here]

Taken together, these results show that natural disasters act as major shocks to the wealth and risk exposure of controlling shareholders, leading them to trim their equity investments over a multiyear horizon.

A.2 Severity of the natural disasters

In this section, we investigate whether the severity of the natural disaster shapes the controlling owner's real portfolio adjustments. Table IV reports estimates of the effect of natural disasters on changes in equity investment, $\Delta Equity_{it}$ using alternative measures of shock exposure. In addition, it examines whether the effect changes when the shock hits subsidiaries that are strategically important to the GUO. This analysis allows us to

determine whether controlling shareholders respond more aggressively when disruptions threaten core or high-value subsidiaries.

[Insert Table IV about here]

In Columns (1) and (2), the variables *Disaster loss (tot)* and *Disaster loss (max)* capture alternative ways of aggregating the economic losses from natural shocks occurring in the NUTS3 regions where GUO i operates. Each measure is constructed as the log of one plus the corresponding loss value, either summed across regions or taken at its maximum. Across all specifications, the coefficients are negative and highly significant, indicating that greater disaster-related losses are associated with larger reductions in equity investment. Economically, this suggests that as the intensity of natural disasters rises, controlling owners reduce their equity positions more sharply, possibly to mitigate exposure to future shocks.

Columns (3-7) examine whether the response varies with the strategic importance of the subsidiaries affected by the natural disaster. Controlling owners may adjust their equity positions less when the shock hits subsidiaries that are central to their portfolio, since divesting from strategically important subsidiaries could be more difficult. The variables *Disaster strategic (%Equity)* and *Disaster strategic (%TA)* indicate whether the disaster hits the subsidiary representing the largest investment in the GUO's portfolio by book equity or total assets. Across these specifications, the positive and significant interaction terms show that the overall reduction in equity investment is mitigated when key subsidiaries are affected. This indicates that controlling owners prioritize preserving or supporting strategically important firms to stabilize the portfolio in the aftermath of the shock. When the disaster affects a listed subsidiary (*Disaster strategic (Listed)*), the coefficient is small and insignificant, indicating that listed status alone does not materially influence the GUO's adjustment. However, when listed subsidiaries that also account for the largest shares of equity or total assets are affected (*Disasterd strategic (Listed %Equity)* and *Disasterd strategic (Listed %TA)*), the coefficients become positive and significant. Thus, controlling owners respond more cautiously when shocks threaten subsidiaries that are both strategically important and publicly visible.

Collectively, Table IV shows that natural disasters lead to sizable reductions in equity investment by controlling owners, but the magnitude of the adjustment depends on both

the severity of the losses and the strategic relevance of the subsidiaries affected. Larger or more widespread disaster-related losses amplify the contraction in equity holdings, indicating that the intensity of the shock plays a central role in shaping post-disaster investment behavior. At the same time, the response is less pronounced when the shock hits subsidiaries that are strategically important within the GUO’s portfolio or that combine strategic importance with public visibility. These findings suggest that controlling owners balance the need to reduce exposure following a shock with the need to sustain the portfolio’s core operations, leading to differential adjustments across subsidiaries depending on their role in the ownership portfolio.

A.3 Investment reallocation at the regional level

In this section, we study the effect of natural disasters on regional equity investment dynamics. Controlling shareholders typically operate subsidiaries across multiple regions, and a shock may affect only a subset of these areas. In such cases, the controlling owner may respond by reducing exposure to risks associated with climate change and other regional shocks, while reallocating investment toward less affected locations. Consistent with this idea, Acharya *et al.* (2023) document that firms systematically reallocate capital toward regions that are less vulnerable to climate risk, thereby preserving the stability and long-term growth of their investments. In our setting, controlling owners may, at least partially, redirect capital from disaster-affected regions to more stable areas within the portfolio, mitigating exposure to future losses and enhancing the overall resilience of their investment strategy.

To examine this conjecture, we estimate the model in Equation 4. In this specification, the coefficient of interest, *Disaster NUTS3*, captures the effect on the change in equity holdings of a natural disaster in the same NUTS3 region where the firm is located, while *Disaster other NUTS3* measures the effect of disasters occurring in the other $M \neq n$ regions within the same GUO portfolio.

We estimate the model using the stacked difference-in-differences approach in Table V. The estimated coefficients on *Disaster NUTS3* is negative and significant in most specifications, although the magnitude varies across models. In the first two columns, the effect is approximately -0.0172 , whereas in Column (3), which includes $Year \times NUTS3$ fixed effects, the coefficient becomes larger in absolute value (-0.1508) and statistically

significant at the 5% level. This reinforces the conclusion that direct exposure to natural disasters substantially reduces equity investment at the regional level. By contrast, the estimates for *Disaster other NUTS3* are small and statistically insignificant, suggesting that disasters in other regions of the GUO’s portfolio do not influence investment decisions in unaffected areas. These results imply that the adjustment is driven by local exposure, with no evidence of significant spillovers across regions within the corporate portfolio.

[Insert Table V about here]

Overall, the results show that natural disasters negatively affect local equity investment. The absence of significant effects in other regions suggests that GUOs do not reallocate capital across areas after a shock, indicating that there are no meaningful spillover effects from affected regions to non-affected ones.

B Mechanisms

Having established that natural disasters lead controlling shareholders to trim their investments in the firms they own, we next examine the mechanisms that may account for this behavior. Identifying these channels is key to understanding whether the observed responses reflect rational portfolio rebalancing, liquidity pressures, or deeper shifts in strategic priorities. We consider several—potentially overlapping—explanations. First, we assess whether buyer demand facilitates divestments, as controlling shareholders may find it easier to unwind positions when potential acquirers are more abundant. Second, we examine diversification motives, testing whether controlling shareholders with more diversified portfolios are less inclined to sell. Third, we explore underperformance and financial constraints as possible drivers, since both conditions may heighten incentives to scale back equity exposure after a shock. Fourth, we assess GUO’s personal liquidity needs, as natural disasters may impair controlling shareholders’ private wealth and induce asset liquidation. Finally, we consider external financing, as firms may shift toward greater reliance on debt financing after disasters or raise equity from new investor.

B.1 Buyer Demand

One possible explanation for the divestments observed after a natural disaster is the presence of buyers seeking distressed assets, particularly when they possess a competitive

advantage in the market. Natural disasters may create opportunities for investors pursuing long-term growth or higher returns, as disruptions can temporarily depress asset values in affected regions. Firms with strong capital reserves or abundant liquidity may, therefore, view such events as favorable entry points to expand their portfolios.

To measure buyer demand for the controlling shareholder’s equity, we construct a proxy based on the pool of potential acquirers for the firms in the controlling shareholder’s portfolio. For each portfolio firm, we identify potential buyers as either large or cash-rich industry competitors. Large (cash-rich) competitors are defined as those in the top tercile of the country’s empirical distribution of firm size (cash-to-assets) that also operate in the same NUTS3 region and industry as the portfolio firm. Because the absolute number of potential buyers depends on the size of the industry, we scale the number of potential buyers by the total number of firms in the relevant industry at either the country or NUTS3-region level. After computing buyer demand for each portfolio company, we aggregate to the GUO level by taking the maximum buyer-demand value across all subsidiaries. The resulting measures serve as our proxies for buyer demand in testing this mechanism.

[Insert Table VI about here]

Table VI reports the results. Columns (1) and (2) present the estimates using the proxy based on large competitors, while Columns (3) and (4) use the proxy based on cash-rich competitors. The findings support the view that buyer demand shapes the post-disaster adjustment in equity investments by controlling shareholders. The interaction terms— *Disaster* $\times$ *Buyer demand size* and *Disaster* $\times$ *Buyer demand cash*—are positive and highly significant across all specifications. The economic magnitudes are also meaningful: a one-standard-deviation increase in buyer demand attenuates the divestment by approximately 13.5% to 16.7%, depending on the specification. Thus, when disasters also affect potential buyers and thereby reduce buyer demand, the controlling shareholders’ ability to divest weakens substantially. In contrast, the baseline coefficients on *Buyer demand size* and *Buyer demand cash* are negative, indicating that a larger pool of potential acquirers generally facilitates equity sales. Overall, the results provide strong evidence in favor of the buyer-demand mechanism.

B.2 Controlling shareholder’s portfolio diversification

In this section, we consider controlling shareholders’ diversification across their corporate portfolios as a potential channel influencing disinvestment decisions following a natural shock. Diversification can mitigate the overall impact of the shock on the controlling owner’s portfolio by spreading exposure across multiple subsidiaries. By holding stakes in firms that are differentially affected, the owner may reduce the concentration of risk in the impacted entities (Roston, 2021). Prior research shows that portfolios diversified across uncorrelated assets experience lower volatility and recover more quickly from localized disruptions (Solnik and McLeavey, 2004). Accordingly, diversification may allow the controlling owner to offset losses in affected subsidiaries with stability or gains elsewhere, resulting in less pronounced disinvestment—if not the maintenance of investments—when the broader portfolio is resilient enough to absorb the shock. Moreover, diversification increases flexibility in reallocating resources internally, enabling owners to shift capital from affected to more stable or profitable subsidiaries, consistent with evidence on resource reallocation following natural shocks (Cavallo *et al.*, 2011).

To measure diversification, we follow Faccio *et al.* (2011) and compute the Herfindahl–Hirschman Index (HHI) as a proxy for wealth concentration within the controlling shareholder’s portfolio. As in Faccio *et al.* (2011), we use the book value of equity multiplied by the ownership stake to calculate the value of the controlling shareholder’s equity in each portfolio firm. The HHI is then obtained as the sum of squared shares of total equity wealth invested across subsidiaries. For ease of interpretation, we use $(1 - HHI)$ in our regressions, so that higher values indicate a more diversified portfolio. In addition, we construct HHI measures based on the geographical and industry distribution of the controlling shareholder’s portfolio. The results are presented in Table VII.

[Insert Table VII about here]

Across all variants of the diversification measures, Table VII shows that diversification in terms of equity investment, as well as geographic and industrial diversification, does not significantly alter the results presented in Table III. The interaction terms— $Disaster \times (1 - HHI)$, $Disaster \times (1 - HHI_{geo})$, and $Disaster \times (1 - HHI_{sector})$ —are consistently negative and statistically insignificant across all specifications.¹⁴ This

¹⁴Similar results are obtained computing $1 - HHI$ based on total assets and sales.

pattern indicates that these forms of diversification do not meaningfully moderate the adverse effect of natural disasters on changes in equity investment. These findings may reflect the fact that natural disasters generate correlated and widespread disruptions that weaken the protective value of traditional diversification. Natural shocks often spill over across regions and industries through supply-chain linkages, labor mobility, and shared infrastructure, creating systemic exposure that geographic or sectoral diversification may not be able to fully absorb. The standalone coefficients for the diversification variables are all negative and statistically significant, suggesting that more diversified controlling shareholders invest less in percentage terms, likely because they manage larger portfolios.

In Columns (4) to (6), we also consider an alternative measure of diversification: the number of subsidiaries in which the controlling shareholder holds equity across all countries in our sample (Faccio *et al.*, 2011). Unlike the HHI-based measures, the log of the number of subsidiaries, $\log(N \text{ subs})$, yields a positive and significant interaction, indicating that controlling shareholders with larger portfolios attenuate their divestment after natural disasters. To further investigate this pattern, we include indicator variables that distinguish between different ranges of portfolio size. Specifically, $N \text{ subs} < 10$ equals one when the GUO holds more than 10 subsidiaries; $N \text{ subs}[10, 25]$ equals one when the number of subsidiaries lies between 10 and 25; and $N \text{ subs} > 25$ equals one when the GUO owns more than 25 subsidiaries. The estimates from these specifications show that the mitigating effect of diversification is also important for GUOs with very large portfolios, consistent with the idea that broader portfolio offer more flexibility for internal reallocation.

Overall, the tests relating to the diversification mechanism provide only partial support for the view that diversification mitigates the impact of natural disasters. While a larger number of subsidiaries in the GUO's portfolio appears to attenuate the post-disaster reduction in equity investment, diversification based on the distribution of equity stakes does not exhibit a similar buffering effect. The same holds for diversification based on industrial or geographic dispersion. This suggests that only broad portfolio breadth—rather than the dispersion of investment across sectors or regions—offers meaningful protection against the consequences of natural shocks.

B.3 GUO's financial constraints and performance

Our baseline findings could be driven, at least in part, by the possibility that natural disasters have more pronounced effects on GUOs already experiencing financial difficulties or weak performance. Such owners face heightened vulnerability because limited liquidity and constrained financial flexibility reduce their ability to absorb and recover from shocks. As a result, controlling shareholders may attempt to limit further losses by scaling back their exposure to underperforming or financially fragile firms, either by reducing additional equity injections or by divesting altogether. This interpretation is consistent with prior evidence—for example, Lyandres *et al.* (2019)—showing that financial constraints significantly weaken firms' capacity to sustain investment.

To examine whether our main results are driven by the controlling shareholder's financial position or by the performance of their portfolio, we estimate the models reported in Table VIII. We measure performance using two portfolio-level variables: *GUO ROE* (Return on Equity) and *GUO ROA* (Return on Assets). For each controlling shareholder, we compute weighted averages of ROE and ROA in year $t - 1$, where the weights correspond to the fraction of the controlling shareholder's equity invested in each firm. ROE is defined as the portfolio firms' net income divided by the aggregate book value of equity investment, and ROA is defined analogously using total assets as denominator.¹⁵

Our results, reported in Table VIII, show that the interaction terms *Disaster* $\times$ *GUO ROE* and *Disaster* $\times$ *GUO ROA* are positive and statistically significant at the 10% level. This indicates that controlling shareholders with stronger pre-disaster portfolio performance tend to cut their equity investments less following a natural disaster. In other words, well-performing GUOs appear better positioned to absorb the shock and continue supporting their portfolio firms, which reduces their incentive to scale back equity holdings after the event.

[Insert Table VIII about here]

We also assess the role of financial constraints at the GUO level. We employ two variables. The first is the weighted average of cash reserves across the GUO's portfolio, where

¹⁵In unreported robustness checks, we also construct binary indicators, *GUO ROE* > 0 and *GUO ROA* > 0 , to identify controlling shareholders whose portfolios generate positive returns and should therefore be less prone to underperformance-driven divestments. The results are similar to those in Table VIII and are available upon request.

the weights correspond to the fraction of the controlling shareholder’s equity invested in each firm (*GUO Cash*). The second is a binary indicator equal to one if at least one bank is present among the firms owned by the controlling shareholder (*GUO with Bank*). A low value of *GUO Cash*, or a zero value of *GUO with Bank*, signals the absence of financial firms in the portfolio and serves as a proxy for tighter financial constraints. Columns (3) and (4) of Table VIII report the results. The interaction terms capturing the effect of financial constraints in the post-disaster period— $Disaster \times GUO\ Cash$ and $Disaster \times GUO\ with\ Bank$ —are statistically insignificant, indicating that financial constraints do not play a substantial role in explaining the observed reductions in equity investment.

Our findings suggest that portfolio performance, rather than financial constraints, contributes to shape controlling shareholders’ post-disaster equity investment behavior.

B.4 Owner’s Personal Liquidity Needs

One potential explanation for the baseline findings is that disasters may generate urgent liquidity needs for the controlling shareholder’s other financial or personal interests, prompting equity sales that are unrelated to the operational conditions of the affected firms. Although direct information on controlling shareholders’ personal financial assets is unavailable, cross-sectional variation in the country of origin provides a way to test this channel. Non-European controlling shareholders are exposed to natural disasters only through the firms they own in the affected regions, as they reside outside Europe. Thus, if the observed reduction in equity investment reflects personal liquidity needs unrelated to the performance of portfolio firms, we would expect the effect to be stronger for European owners, who are more likely to be directly affected by disasters occurring within Europe.

We test this conjecture in Table IX. Columns (1) and (2) present separate estimates for European and non-European controlling shareholders. In both groups, the coefficient on *Disaster* is negative and statistically significant, indicating that natural disasters lead to reduced equity investment regardless of the owner’s location. However, the magnitude is substantially larger for non-European controlling shareholders (−0.2508) than for European ones (−0.1243), offering no support for the personal-liquidity channel. Column (3) formally tests this difference by augmenting the baseline model with an interaction term,

$Disaster \times GUO\ Non-EU$, which captures the incremental effect for non-European owners. The coefficient on this interaction is negative and statistically significant at the 1% level, confirming that the reduction in equity investment is significantly stronger for non-European controlling shareholders.

Overall, the evidence does not support the view that post-disaster divestment arises from controlling shareholders' personal financial needs. Instead, the stronger response of non-European owners indicates that distance shapes post-disaster investment behavior.

[Insert Table IX about here]

B.5 External financing

Another possible explanation for our results is that controlling shareholders may reduce their equity investments while simultaneously increasing debt financing in their companies or selling shares to new equity investors, thereby keeping the overall size of their portfolios broadly stable through external financing. Under this interpretation, the observed decline in equity ownership would reflect a capital structure rebalancing rather than a true contraction in investment activity.

To examine this hypothesis, we re-estimate the baseline model using as the dependent variable the logarithm of one plus the ratio of total assets owned by the GUO at time t to total assets at time $t - 1$ (ΔTA_{it}). The results are reported in Table X.

[Insert Table X about here]

Across all specifications, the estimates show that total assets do not decline significantly following a natural disaster. This pattern is consistent with an external financing-based explanation. This suggests that the reduction in equity investment by the GUO prompts a capital structure rebalancing or the arrival of new equity investors.

IV Additional Analyses

A Family ownerships & Neighboring shocks

Column (1) of Table XI examines an additional source of heterogeneity in the response of controlling shareholders to natural disasters: family ownership. We evaluate whether

family-controlled shareholders react differently to natural disasters. Prior research shows that family owners often adopt survival-oriented strategies and display strong commitments to preserving control and long-term organizational continuity (Lins *et al.*, 2013). Consistent with this view, the coefficient on the interaction term *Disaster* $\times$ *GUO family* is positive and statistically significant at the 1% level. This result indicates that family controlling shareholders cut their equity investments significantly less than non-family owners following a natural disaster. Economically, this pattern suggests that family owners are less willing to divest in the wake of adverse shocks. Their heightened attachment to the firm and long-term orientation appear to mitigate the incentives to reduce exposure after disruptive events, aligning with the literature emphasizing the stability-focused behavior of family-controlled groups (Lins *et al.*, 2013).

[Insert Table XI about here]

It is possible that some controlling shareholders may anticipate natural disasters, particularly in regions with recurrent exposure, introducing biases in our estimates. While there is no evidence of anticipation in Table III and in Figure 1, we further explore this concern. To mitigate this issue, we exploit disasters in neighboring areas (Dessaint and Matray, 2017). We construct the variable *neighboring shocks*, capturing whether the GUO owns firms located in regions adjacent to those directly affected. Formally, *Disaster Neighbor* equals one if any firm owned by GUO j operates in a NUTS3 region m that borders a NUTS3 region n experiencing a natural disaster. The results in Column (2) of Table XI show that *Disaster Neighbor* is negative and statistically significant, indicating that controlling shareholders also reduce equity investments when their subsidiaries are located near—but not directly within—affected areas. This suggests that the perceived risks or indirect consequences of natural shocks extend beyond the immediate disaster zone, prompting precautionary divestment even among firms situated in neighboring regions.

B Never treated control group

As an additional robustness check, we re-estimate our baseline specification using a restricted sample in which the control group consists exclusively of firms located in regions that never experienced a natural disaster during the sample period. This “never-

treated” design ensures that treated firms are compared only with units that remain entirely unexposed to disaster shocks, thereby eliminating any potential contamination from repeated, partial, or indirect treatments. The results, reported in Table B3 of the Online Appendix, are virtually unchanged in sign, magnitude, and statistical significance. This confirms that our findings are not driven by the presence of regions that were treated at different points in time or by indirect exposure to disasters. Overall, this exercise strengthens the credibility of our identification strategy and supports the interpretation that the observed reduction in equity investment reflects the causal impact of natural disasters rather than sample selection or treatment misclassification.

C Alternative event windows

In this subsection, we examine the sensitivity of our results to alternative definitions of the event window. Panel A of Table B4 in the Online Appendix reports estimates using a symmetric window of three years before and after the disaster ($[-3,+3]$). Across specifications, the coefficient on *Disaster* remains negative and statistically significant, ranging from -0.099 to -0.142 depending on the fixed effects included. Model (4), which decomposes the post-disaster effect by event time, shows that the reduction in equity investment becomes statistically significant in the year of the event ($Disaster_0$) and grows in magnitude over the following years ($Disaster_{+1}$ to $Disaster_{+3}$). This pattern is consistent with a persistent downward adjustment in controlling shareholders’ equity positions once a disaster occurs.

Panel B of Table B4 extends the analysis to a wider event window ($[-5,+5]$). The results again confirm the robustness of our main finding. The estimated coefficients on *Disaster* remain negative and significant, with magnitudes between -0.083 and -0.141 . In the dynamic specification of Model (4), the coefficients on the pre-disaster leads ($Disaster_{-5}$ to $Disaster_{-2}$) are small and statistically insignificant, providing further evidence that our post-event estimates are not driven by differential pre-trends. The largest effects appear between one and three years after the shock ($Disaster_{+1}$ to $Disaster_{+3}$), after which the magnitude stabilizes.

These results demonstrate that the decline in equity investment following natural disasters is robust to alternative event-window definitions and reflects a sizable and long-lasting contraction in controlling shareholders’ capital commitments.

D Alternative matching criteria

To further assess the reliability of our findings, we replicate the baseline analysis using alternative matching procedures designed to reduce observable differences between controlling shareholders exposed to natural disasters and those that are not. The results are reported in Table B5 of the Online Appendix.

Panel A expands the matched control group by pairing each treated GUO with five untreated GUOs, rather than a single match. Panel B refines the propensity score model by adding additional conditioning variables—lagged aggregated equity holdings (in log), a family-ownership indicator, a non-European owner indicator, a large-investor dummy, and year fixed effects—to ensure more precise balance between treated and untreated groups. Panel C employs the same set of covariates as in the baseline specification but implements a coarsened exact matching (CEM) procedure, which provides a non-parametric alternative to propensity-score matching and improves covariate balance by construction.

These alternative matching strategies allow us to evaluate whether our results are sensitive to the particular method used to construct the control group. Across all panels, the estimated effects remain negative, statistically significant, and similar in magnitude to the baseline results. This confirms that our conclusions are not driven by the specific matching procedure adopted and reinforces the robustness of our main findings.

V Conclusions

In this study, we examine how natural disasters affect the investment decisions of firms' controlling shareholders. Our findings shed light on how major shocks to local economic conditions influence corporate ownership dynamics and the strategic behavior of controlling shareholders.

We document a large and statistically significant trimming in aggregate equity holdings following natural disasters. On average, controlling shareholders reduce their equity positions by roughly 14% in the years after a shock, an effect that is both economically meaningful and highly persistent. We also find no evidence that GUOs reallocate capital across the regions in which they operate. Instead, the contraction does not appear local-

ized: investment falls in disaster-affected areas without compensating increases elsewhere, suggesting limited scope for internal risk sharing across the owners' portfolio.

The magnitude of the response is strongly linked to the severity of the disaster and to the availability of potential buyers for the controlling shareholder's equity stakes. Consistent with a buyer-demand channel, controlling shareholders reduce their divestments when the pool of potential acquirers is large, whereas the equity divestment becomes sharper when buyer demand is weak. Only diversification in terms of the number of subsidiaries alleviates the decrease in equity investment. By contrast, we find no evidence that the reduction is driven by pre-existing underperformance, financial constraints, or the controlling shareholder's personal capital needs. Finally, we do not observe an offsetting decrease in the aggregate total assets of the firms under control, suggesting that controlling shareholders may use external capital to avoid reducing the assets under control.

The results prove highly robust. They hold under alternative model specifications, event windows, matching procedures, and definitions of key variables. Taken together, the evidence indicates that natural disasters significantly tighten the internal capital allocation of controlling shareholders, leading to sustained reductions in equity investment that are not mitigated by geographic diversification or reallocation strategies.

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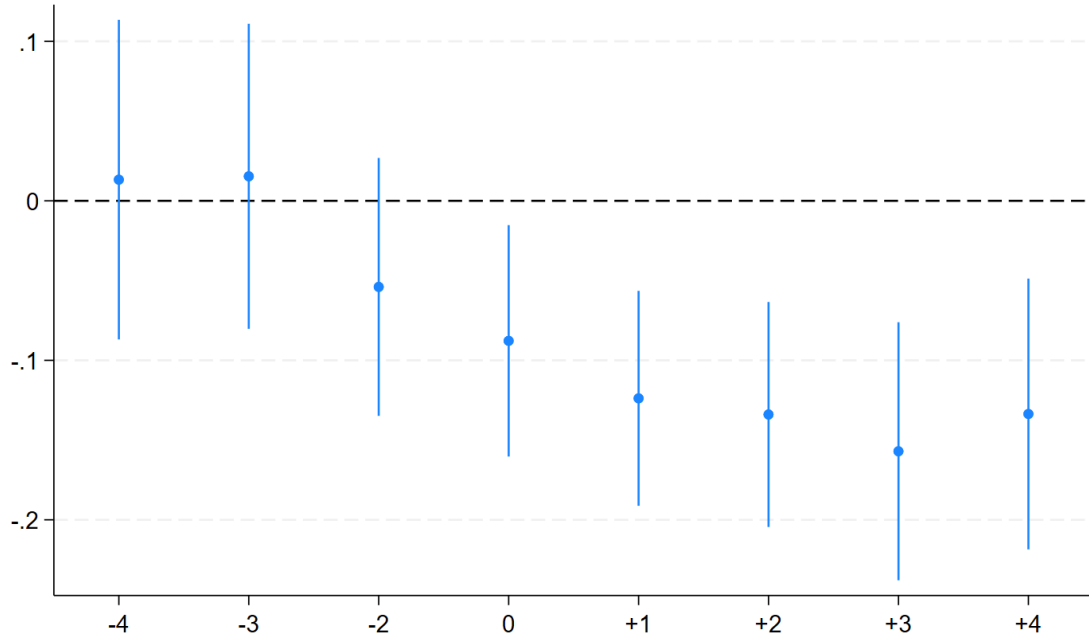
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VI Figures

Figure 1
Event Study

The graph shows the regression coefficients of the leads and lags and confidence intervals at a 95% level from a regression with GUO, Year*Country FE, GUO-cohort and Cohort*Year fixed effects (see Column 4 Table III), relative to one year before the natural disaster.



VII Tables

Table I
Descriptive statistics

The table shows the year (Panel A) and country (Panel B) distribution of event-year observations and GUO-year observations. Others includes the following countries: Algeria, Australia, the Bahamas, Brazil, Canada, the Cayman Islands, Chile, China, Curacao, Egypt, Gibraltar, Hong Kong, Iceland, India, Israel, Japan, Kazakhstan, Liechtenstein, Mexico, Monaco, Malaysia, Panama, Qatar, the Russian Federation, Singapore, South Africa, Taiwan, Thailand, Tunisia, Turkey, the United States of America, Uruguay, and Virgin Islands.

Panel A				
Year	Natural disaster distribution Freq	(%)	GUO distribution Freq	(%)
2007	22	22.4490		
2008	0	0.0000	3603	3.5557
2009	10	10.2041	5539	5.4662
2010	12	12.2449	7251	7.1557
2011	3	3.0612	8693	8.5788
2012	2	2.0408	11274	11.1259
2013	20	20.4082	10883	10.7401
2014	1	1.0204	9286	9.1641
2015	9	9.1837	8901	8.7841
2016	3	3.0612	6919	6.8281
2017	2	2.0408	8078	7.9719
2018	2	2.0408	7344	7.2475
2019	6	6.1224	5965	5.8866
2020	1	1.0204	5031	4.9649
2021	5	5.1020	2564	2.5303
Total	98		101331	

Panel B				
Country	Natural disaster distribution Freq	(%)	GUO distribution Freq	(%)
Austria	2	2.0408	1418	1.3994
Belgium	3	3.0612	1959	1.9333
Croatia			156	0.1540
Cyprus			560	0.5526
Czech Republic	1	1.0204	332	0.3276
Denmark			1657	1.6352
Estonia			34	0.0336
Finland			1514	1.4941
France	21	21.4286	17281	17.0540
Germany	16	16.3265	11842	11.6865
Greece	1	1.0204	1086	1.0717
Hungary	1	1.0204	220	0.2171
Ireland	1	1.0204	1577	1.5563
Italy	7	7.1429	9913	9.7828
Lithuania	1	1.0204	398	0.3928
Luxembourg			2864	2.8264
Malta			126	0.1243
Netherlands			2681	2.6458
Norway			1350	1.3323
Poland	3	3.0612	5080	5.0133
Portugal	2	2.0408	1109	1.0944
Romania			200	0.1974
Slovakia			160	0.1579
Slovenia			82	0.0809
Spain	7	7.1429	11285	11.1368
Sweden			3493	3.4471
Switzerland	1	1.0204	3173	3.1313
United Kingdom	31	31.6327	13914	13.7312
Others			5867	5.7899
Total	98		101331	

Table II
Summary statistics

This table shows the descriptive statistics for the main variables employed in our analysis at the GUO-year level. We describe all the variables in Appendix A.

	N	Mean	St.Dev.	Median	P.le5	P.le95	Min	Max
Dependent variables								
$\Delta Equity_{it}$	101331	0.0248	0.54	-0.00	-1.00	1.00	-1.00	2.00
ΔTA	93790	0.72	0.24	0.00	0.00	2.00	0.00	2.00
$\Delta TA(\%)$	93790	0.9385	1.19	0.24	0.00	3.00	0.00	2
Independent variables								
Disaster	101331	0.0784	0.27	0.00	0.00	1.00	0.00	1.00
Disaster loss (tot)	101331	0.0586	0.2112	0.0000	0.0000	0.6931	0.0000	4.8520
Disaster loss (max)	101331	1.5751	5.4041	0.0000	0.0000	19.5281	0.0000	22.5606
Disaster strategic (%Equity)	101331	0.0220	0.1467	0.0000	0.0000	0.0000	0.0000	1.0000
Disaster strategic (%TA)	101331	0.0224	0.1479	0.0000	0.0000	0.0000	0.0000	1.0000
Disaster strategic (Listed)	101331	0.0165	0.1274	0.0000	0.0000	0.0000	0.0000	1.0000
Disaster strategic (Listed %Equity)	101331	0.0111	0.1046	0.0000	0.0000	0.0000	0.0000	1.0000
Disaster strategic (Listed %TA)	101331	0.0112	0.1053	0.0000	0.0000	0.0000	0.0000	1.0000
Buyer demand size 1	101331	0.0710	0.0740	0.0450	0.0000	0.2250	0.0000	0.3000
Buyer demand size 2	101331	0.4593	0.2524	0.4432	0.0000	1.0000	0.0000	1.0000
Buyer demand cash 1	101331	0.0674	0.0732	0.0369	0.0000	0.2143	0.0000	0.2857
Buyer demand cash 2	101331	0.3948	0.2280	0.3754	0.0000	1.0000	0.0000	1.0000
1-HHI	93835	0.4064	0.3051	0.4537	0.0000	0.8548	0.0000	1.0000
$1 - HHI_{geo}$	93835	0.2415	0.2473	0.1677	0.0000	0.6926	0.0000	0.8217
$1 - HHI_{sector}$	93835	0.3014	0.2612	0.2909	0.0000	0.7213	0.0000	0.8140
N subs (log)	93835	1.9439	1.0633	1.7918	0.6931	3.9703	0.6931	5.3936
N subs >10	101331	0.3471	0.4760	0.0000	0.0000	1.0000	0.0000	1.0000
N subs [10,25]	101331	0.1731	0.3783	0.0000	0.0000	1.0000	0.0000	1.0000
N subs >25	101331	0.1903	0.3926	0.0000	0.0000	1.0000	0.0000	1.0000
Disaster GUO	101331	0.0031	0.0553	0.0000	0.0000	0.0000	0.0000	1.0000
Disaster only subs	101331	0.0237	0.1521	0.0000	0.0000	0.0000	0.0000	1.0000
GUO ROE	93835	5.8458	35.6397	5.6958	-35.0436	45.9330	-235.7866	154.2474
GUO ROA	93835	-0.1042	19.2179	2.1129	-25.7719	17.7646	-145.7920	42.7673
GUO Cash	93835	10.5585	14.9278	5.1619	0.1784	41.5102	-11.7408	199.9236
GUO with Bank	93835	0.0124	0.1106	0.0000	0.0000	0.0000	0.0000	1.0000
GUO Non EU	101331	0.1025	0.3034	0.0000	0.0000	1.0000	0.0000	1.0000
GUO family	101331	0.3593	0.4798	0.0000	0.0000	1.0000	0.0000	1.0000
Disaster Neighbor	101331	0.2080	0.4059	0.0000	0.0000	1.0000	0.0000	1.0000

Table III
Equity holdings and natural disasters

The table presents the estimates of the effect of a natural disaster on the change in aggregate equity holdings. The dependent variable is $\Delta Equity_{it}$. *Disaster* is a dummy variable equals 1 if any firm owned by GUO i in cohort g is affected by a natural disaster as of year t onwards. All models include GUO-cohort and Cohort $\times$ Year fixed effects. Models 2 and 3 include Country GUO $\times$ Year fixed effects. Standard errors are clustered at the GUO level and are reported in brackets. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. We provide variable definitions in Appendix A.

	$\Delta Equity_{it}$ (1)	$\Delta Equity_{it}$ (2)	$\Delta Equity_{it}$ (3)	$\Delta Equity_{it}$ (4)
Disaster	-0.1396*** (0.0138)	-0.1381*** (0.0152)	-0.0974*** (0.0249)	
Disaster ₋₄				0.0133 (0.0511)
Disaster ₋₃				0.0154 (0.0487)
Disaster ₋₂				-0.0540 (0.0412)
Disaster ₀				-0.0878** (0.0370)
Disaster ₊₁				-0.1238*** (0.0343)
Disaster ₊₂				-0.1340*** (0.0360)
Disaster ₊₃				-0.1570*** (0.0412)
Disaster ₊₄				-0.1336*** (0.0433)
Observations	101,331	101,268	27,012	27,012
R-squared	0.2567	0.2956	0.3329	0.3341
GUO-cohort FE	Yes	Yes	Yes	Yes
Cohort $\times$ Year FE	Yes	Yes	Yes	Yes
Country GUO $\times$ Year FE	No	Yes	Yes	Yes

Table IV
Severity of the natural disasters

The table presents the estimates of the effect of a natural disaster on the change in aggregate equity holdings. The dependent variable is $\Delta Equity_{it}$. *Disaster loss (tot)* is the log of one plus the total loss value across regions in the GUO's i portfolio affected by a natural disaster as of year t onwards. *Disaster strategic(%Equity)* is a dummy variable equals 1 if the largest subsidiary by equity owned by GUO i is affected by a natural disaster as of year t onwards. *Disaster strategic(%TA)* is a dummy variable equals 1 if the largest subsidiary by total assets owned by GUO i is affected by a natural disaster as of year t onwards. *Disaster strategic (Listed)* is a dummy variable equals 1 if a listed firm owned by GUO i is affected by a natural disaster as of year t onwards. *Disaster strategic (Listed %Equity)* is a dummy variable equals 1 if the largest subsidiary by equity owned by GUO i is listed firm and is affected by a natural disaster as of year t onwards. *Disaster strategic (Listed %TA)* is a dummy variable equals 1 if the largest subsidiary by total assets owned by GUO i is listed and was affected by a natural disaster as of year t onwards. All models include GUO-cohort, Cohort $\times$ Year, Country GUO $\times$ Year fixed effects. Standard errors are clustered at the GUO level and are reported in brackets. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. We provide variable definitions in Appendix A.

	$\Delta Equity_{it}$ (1)	$\Delta Equity_{it}$ (2)	$\Delta Equity_{it}$ (3)	$\Delta Equity_{it}$ (4)	$\Delta Equity_{it}$ (5)	$\Delta Equity_{it}$ (6)	$\Delta Equity_{it}$ (7)
Disaster loss (tot)	-0.1727*** (0.0196)						
Disaster loss (max)		-0.0069*** (0.0008)					
Disaster			-0.1623*** (0.0163)	-0.1644*** (0.0164)	-0.1358*** (0.0158)	-0.1503*** (0.0156)	-0.1495*** (0.0156)
Disaster strategic (%Equity)			0.0949*** (0.0262)				
Disaster strategic (%TA)				0.1021*** (0.0263)			
Disaster strategic (Listed)					-0.0118 (0.0289)		
Disaster strategic (Listed %Equity)						0.0976*** (0.0324)	
Disaster strategic (Listed %TA)							0.0911*** (0.0326)
Observations	101,268	101,268	101,268	101,268	101,268	101,268	101,268
R-squared	0.2956	0.2956	0.2958	0.2958	0.2956	0.2957	0.2957
GUO-cohort FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country GUO $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table V
Reallocation at the regional level

The table presents the estimates of the effect of a natural disaster on the change in aggregate equity holdings. The dependent variable is $\Delta Equity_{int}$. *Disaster NUTS* is a dummy variable equal to 1 if a firm located in NUTS3 n has been affected by a natural disaster at time g , 0 otherwise. *Disaster other NUTS* takes value 1 if there has been at least a shock in all the NUTS3 M with $M \neq n$ associated with the firms in the portfolio of GUO i . All models include GUO-NUTS3-cohort and Cohort $\times$ Year fixed effects. Model 3 includes NUTS3 $\times$ Year fixed effects. Standard errors are clustered at the GUO level and are reported in brackets. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. We provide variable definitions in Appendix A.

	$\Delta Equity_{int}$ (1)	$\Delta Equity_{int}$ (2)	$\Delta Equity_{int}$ (3)
Disaster NUTS3	-0.0171* (0.010)	-0.0172* (0.010)	-0.1508** (0.061)
Disaster other NUTS3		-0.0013 (0.004)	0.0029 (0.004)
Observations	1,113,375	1,113,375	1,113,354
R-squared	0.2706	0.2707	0.3506
GUO-NUTS3-cohort FE	Yes	Yes	Yes
Cohort $\times$ Year FE	Yes	Yes	Yes
NUTS3 $\times$ Year FE	No	No	Yes

Table VI
Buyer demand

The table presents the estimates of the effect of a natural disaster on the change in aggregate equity holdings. The dependent variable is $\Delta Equity_{it}$. *Disaster* is a dummy variable equals 1 if any firm owned by GUO i in cohort g is affected by a natural disaster as of year t onwards. *Buyer demand size (cash) 1* is the maximum number of firms at GUO-year level in the top tercile of size (cash) in NUTS3 n at time t in sector s over the total number of firms at time t in sector s in country c . *Buyer demand size (cash) 2* is the maximum number of firms at GUO-year level in the top tercile of size (cash) in NUTS3 n at time t in sector s over the total number of firms in NUTS3 n at time t in sector s in country c . All models include GUO-cohort, Cohort $\times$ Year, Country GUO $\times$ Year fixed effects. Standard errors are clustered at the GUO level and are reported in brackets. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. We provide variable definitions in Appendix A.

	$\Delta Equity_{it}$ (1)	$\Delta Equity_{it}$ (2)	$\Delta Equity_{it}$ (3)	$\Delta Equity_{it}$ (4)
Disaster	-0.2497*** (0.0219)	-0.4284*** (0.0289)	-0.2414*** (0.0216)	-0.4132*** (0.0264)
Buyer demand size 1	-4.5130*** (0.1508)			
Disaster $\times$ Buyer demand size 1	1.8599*** (0.1565)			
Buyer demand size 2		-1.3442*** (0.0276)		
Disaster $\times$ Buyer demand size 2		0.6599*** (0.0439)		
Buyer demand cash 1			-4.3824*** (0.1566)	
Disaster $\times$ Buyer demand cash 1			1.8386*** (0.1646)	
Buyer demand cash 2				-1.1684*** (0.0381)
Disaster $\times$ Buyer demand cash 2				0.6958*** (0.0488)
Observations	101,268	101,268	101,268	101,268
R-squared	0.3705	0.4231	0.3629	0.3911
GUO-cohort FE	Yes	Yes	Yes	Yes
Cohort $\times$ Year FE	Yes	Yes	Yes	Yes
Country GUO $\times$ Year FE	Yes	Yes	Yes	Yes

Table VII
Portfolio diversification

The table presents the estimates of the effect of a natural disaster on the change in aggregate equity holdings. The dependent variable is $\Delta Equity_{it}$. *Disaster* is a dummy variable equals 1 if any firm owned by GUO i in cohort g is affected by a natural disaster as of year t onwards. $1 - HHI$ One minus the Herfindahl–Hirschman Index obtained as the sum of squared shares of total equity of firms owned by GUO i . $1 - HHI_{geo}$ is one minus the Herfindahl–Hirschman Index obtained as the sum of squared shares of total equity by geographic area (NUTS-3) of firms owned by GUO i . $1 - HHI_{sector}$ is one minus the Herfindahl–Hirschman Index obtained as the sum of squared shares of total equity by sector (NACE Rev.2) of firms owned by GUO i . $\log(N\ subs)$ is the logarithm of the number of firms owned by a GUO in time $t-1$. $N\ subs > 10$ is a dummy variable equal to one if the number of firms owned by a GUO is greater than 10, 0 otherwise. $N\ subs[10,25]$ is a dummy variable equal to one if the number of firms owned by a GUO is between 10 and 25, 0 otherwise. $N\ subs > 25$ is a dummy variable equal to one if the number of firms owned by a GUO is greater than 25, 0 otherwise. All models include GUO-cohort, Cohort $\times$ Year, Country GUO $\times$ Year fixed effects. Standard errors are clustered at the GUO level and are reported in brackets. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. We provide variable definitions in Appendix A.

	$\Delta Equity_{it}$ (1)	$\Delta Equity_{it}$ (2)	$\Delta Equity_{it}$ (3)	$\Delta Equity_{it}$ (4)	$\Delta Equity_{it}$ (5)	$\Delta Equity_{it}$ (6)
Disaster	-0.0602** (0.0272)	-0.0494** (0.0221)	-0.0636*** (0.0240)	-0.1834*** (0.0353)	-0.0944*** (0.0193)	-0.1036*** (0.0199)
1-HHI	-0.4005*** (0.0514)					
Disaster $\times$ 1-HHI	-0.0377 (0.0421)					
1- HHI_{geo}		-0.3508*** (0.0623)				
Disaster $\times$ 1- HHI_{geo}		-0.0792 (0.0486)				
1- HHI_{sector}			-0.3636*** (0.0594)			
Disaster $\times$ 1- HHI_{sector}			-0.0412 (0.0469)			
N subs (log)				-0.2274*** (0.0174)		
Disaster $\times$ N subs (log)				0.0480*** (0.0119)		
N subs >10					-0.2590*** (0.0272)	
Disaster $\times$ N subs >10					0.0378* (0.0224)	
N subs [10,25]						-0.1985*** (0.0255)
Disaster $\times$ N subs [10,25]						0.0602** (0.0257)
N subs >25						-0.3760*** (0.0392)
Disaster $\times$ N subs >25						0.0643** (0.0291)
Observations	91,706	91,706	91,706	91,706	91,706	91,706
R-squared	0.2836	0.2793	0.2803	0.2979	0.2829	0.2842
GUO-cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
Cohort $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Country GUO $\times$ Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table VIII
Financial constraints and performance

The table presents the estimates of the effect of a natural disaster on the change in aggregate equity holdings. The dependent variable is $\Delta Equity_{it}$. *Disaster* is a dummy variable equals 1 if any firm owned by GUO i in cohort g is affected by a natural disaster as of year t onwards. *GUO ROE* (*GUO ROA*) is the weighted average of ROE (ROA) of the subsidiaries owned by GUO i , using the fraction of the aggregate equity holdings invested in each subsidiary as weight. *GUO Cash* is the weighted average of cash reserves over total assets of each firm owned by GUO i , using the fraction of the aggregate equity holdings invested in each subsidiary as weight. *GUO with bank* is a dummy variable equals 1 if at least one bank (NACE Rev.2 code 6419) is present among the firms owned by GUO i , and 0 otherwise. All models include GUO-cohort, Cohort $\times$ Year, Country GUO $\times$ Year fixed effects. Standard errors are clustered at the GUO level and are reported in brackets. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. We provide variable definitions in Appendix A.

	$\Delta Equity_{it}$ (1)	$\Delta Equity_{it}$ (2)	$\Delta Equity_{it}$ (3)	$\Delta Equity_{it}$ (4)
Disaster	-0.0836*** (0.0139)	-0.0803*** (0.0136)	-0.0920*** (0.0158)	-0.0777*** (0.0136)
GUO ROE	0.0001 (0.0003)			
Disaster $\times$ GUO ROE	0.0006* (0.0003)			
GUO ROA		0.0001 (0.0005)		
Disaster $\times$ GUO ROA		0.0011* (0.0007)		
GUO Cash			0.0012* (0.0007)	
Disaster $\times$ GUO Cash			0.0012 (0.0008)	
GUO with Bank				-0.1544 (0.1072)
Disaster $\times$ GUO with Bank				-0.0296 (0.1009)
Observations	91,706	91,706	91,706	91,706
R-squared	0.2740	0.2740	0.2744	0.2741
GUO-cohort FE	Yes	Yes	Yes	Yes
Cohort $\times$ Year FE	Yes	Yes	Yes	Yes
Country GUO $\times$ Year FE	Yes	Yes	Yes	Yes

Table IX
Controlling shareholder's liquidity needs

The table presents the estimates of the effect of a natural disaster on the change in aggregate equity holdings. The dependent variable is $\Delta Equity_{it}$. *Disaster* is a dummy variable equals 1 if any firm owned by GUO i in cohort g was affected a natural disaster as of year t onwards. *GUO Non – EU* is a dummy variable equals 1 if GUO i 's country is a non-European country, and 0 otherwise. Model 1 (2) is estimated on the sample of European (non-European) GUOs. All models include GUO-cohort, Cohort $\times$ Year, Country GUO $\times$ Year fixed effects. Standard errors are clustered at the GUO level and are reported in brackets. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. We provide variable definitions in Appendix A.

	$\Delta Equity_{it}$ EU (1)	$\Delta Equity_{it}$ Non-EU (2)	$\Delta Equity_{it}$ (3)
Disaster	-0.1243*** (0.0159)	-0.2508*** (0.0487)	-0.1241*** (0.0159)
Disaster $\times$ GUO Non-EU			-0.1301*** (0.0500)
Observations	90,931	10,337	101,268
R-squared	0.2811	0.3998	0.2958
GUO-cohort FE	Yes	Yes	Yes
Cohort $\times$ Year FE	Yes	Yes	Yes
Country GUO $\times$ Year FE	Yes	Yes	Yes

Table X
External capital

The table presents the estimates of the effect of a natural disaster on the change in aggregate total assets. The dependent variable is ΔTA_{it} . *Disaster* is a dummy variable equals 1 if any firm owned by GUO i in cohort g is affected by a natural disaster as of year t onwards. All models include GUO-cohort and Cohort $\times$ Year fixed effects. Models 2 and 3 include Country GUO $\times$ Year fixed effects. Standard errors are clustered at the GUO level and are reported in brackets. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. We provide variable definitions in Appendix A.

	ΔTA_{it} (1)	ΔTA_{it} (2)	ΔTA_{it} (3)
Disaster	0.0285* (0.0166)	0.0205 (0.0182)	
Disaster ₋₄			-0.0279 (0.0504)
Disaster ₋₃			-0.0210 (0.0440)
Disaster ₋₂			-0.0074 (0.0312)
Disaster ₀			-0.0607** (0.0282)
Disaster ₊₁			-0.0478 (0.0326)
Disaster ₊₂			-0.0155 (0.0384)
Disaster ₊₃			0.0291 (0.0472)
Disaster ₊₄			0.0563 (0.0543)
Observations	91,739	91,669	27,004
R-squared	0.8091	0.8193	0.8801
GUO-cohort FE	Yes	Yes	Yes
Cohort $\times$ Year FE	Yes	Yes	Yes
Country GUO $\times$ Year FE	No	Yes	Yes

Table XI
Additional analyses

Controlling shareholder's capital reallocation needs. The table presents the estimates of the effect of a natural disaster on the change in aggregate equity holdings. The dependent variable is $\Delta Equity_{it}$. *Disaster* is a dummy variable equals 1 if any firm owned by GUO i in cohort g is affected by a natural disaster as of year t onwards. *GUO Family* is a dummy variable equals one if GUO i is a family controlling shareholder, and 0 otherwise. *Disaster Neighbor* is a dummy variable equals one if any firm owned by GUO i , a family controlling shareholder, operates in a NUTS3 region m that borders a NUTS3 n affected by a natural disaster, and 0 otherwise. All models include GUO-cohort, Cohort $\times$ Year, Country GUO $\times$ Year fixed effects. Standard errors are clustered at the GUO level and are reported in brackets. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. We provide variable definitions in Appendix A.

	$\Delta Equity_{it}$ (1)	$\Delta Equity_{it}$ (2)
Disaster	-0.1479*** (0.0164)	-0.1393*** (0.0151)
GUO family	0.6934*** (0.0282)	
Disaster $\times$ GUO family	0.0696*** (0.0213)	
Disaster Neighbor		-0.0946*** (0.0345)
Disaster= Disaster Neighbor (p-value)		0.2386
Observations	101,268	101,268
R-squared	0.3336	0.2961
GUO-cohort FE	Yes	Yes
Cohort $\times$ Year FE	Yes	Yes
Country GUO $\times$ Year FE	Yes	Yes

Appendix

Table A1
Variable definitions

Variable	Definition
<i>Dependent variables</i>	
$\Delta Equity_{it}$	The ratio between the sum of the changes in the equity investments of the controlling shareholders across all subsidiaries in year t and the value of the controlling shareholder's equity portfolio in year $t - 1$. See Section II.B for details.
ΔTA_{it}	The ratio between the sum of changes in the total assets of the subsidiaries controlled by the controlling shareholders in year t and the sum of the total assets in year $t - 1$.
$\Delta Equity_{int}$	The ratio between the sum of the changes in the equity investments of the controlling shareholders across all subsidiaries in NUTS3 n in year t and the value of the controlling shareholder's equity portfolio in NUTS3 n in year $t - 1$.
<i>Independent variables</i>	
Disaster	Dummy variable equals 1 if any firm owned by GUO i in cohort g was affected by a natural disaster as of year t onwards.
Disaster loss (tot)	The log of one plus the total loss value across regions in the GUO's i portfolio affected by a natural disaster as of year t onwards.
Disaster loss (max)	The log of one plus the maximum loss value across regions in the GUO's i portfolio affected by a natural disaster as of year t onwards.
Disaster strategic (%Equity)	Dummy variable equals 1 if the largest subsidiary by equity owned by GUO i is affected by a natural disaster as of year t onwards.
Disaster strategic (%TA)	Dummy variable equals 1 if the largest subsidiary by total assets owned by GUO i is affected by a natural disaster as of year t onwards.
Disaster strategic (Listed)	Dummy variable equals 1 if a listed firm owned by GUO i was affected by a natural disaster as of year t onwards.
Disaster strategic (Listed %Equity)	Dummy variable equals 1 if the largest subsidiary by equity owned by GUO i is listed firm and is affected by a natural disaster as of year t onwards.
Disaster strategic (Listed %TA)	Dummy variable equals 1 if the largest subsidiary by total assets owned by GUO i is listed firm and is affected by a natural disaster as of year t onwards.
Buyer demand size 1	Max number of companies at GUO-year level in the top tercile of size in NUTS3 n at time t in industry s over the total number of firms at time t in industry s in country c
Buyer demand size 2	Max number of companies at GUO-year level in the top tercile of size in NUTS3 n at time t in industry s over the total number of firms in NUTS3 n at time t in industry s in country c
Buyer demand cash 1	Max number of companies at GUO-year level in the top tercile of cash in NUTS3 n at time t in industry s over the total number of firms at time t in industry s in country c
Buyer demand cash 2	Max number of companies at GUO-year level in the top tercile of cash in NUTS3 n at time t in industry s over the total number of firms in NUTS3 n at time t in industry s in country c
1-HHI	One minus the Herfindahl–Hirschman Index obtained as the sum of squared shares of total equity of firms owned by GUO i .
$1 - HHI_{geo}$	One minus the Herfindahl–Hirschman Index obtained as the sum of squared shares of total equity by geographic area (NUTS-3) of firms owned by GUO i .
$1 - HHI_{sector}$	One minus the Herfindahl–Hirschman Index obtained as the sum of squared shares of total equity by sector (NACE Rev.2) of firms owned by GUO i .
Log(N subs)	Logarithm of the number of firms owned by GUO i .
N subs >10 (25)	Dummy variable equals 1 if the number of firms owned by GUO i is > 10 (25), and 0 otherwise.
N subs [10, 25]	Dummy variable equals 1 if the number of firms owned by GUO i is ≥ 10 but < 25, and 0 otherwise.
GUO ROE	Weighted average of ROE of the subsidiaries owned by GUO i , using the fraction of the aggregate equity holdings invested in each subsidiary as weight.
GUO ROA	Weighted average of ROA of the subsidiaries owned by GUO i , using the fraction of the aggregate equity holdings invested in each subsidiary as weight.
GUO Cash	Weighted average of cash reserves over total assets of each firm owned by GUO i , using the fraction of the aggregate equity holdings invested in each subsidiary as weight.
GUO with Bank	Dummy variable equals 1 if at least one bank (NACE Rev.2 code 6419) is present among the firms owned by GUO i , and 0 otherwise.
GUO Non EU	Dummy variable equals 1 if GUO i 's country is a non-European Member State, and 0 otherwise.
Guo Family	Dummy variable equals one if GUO i is a family controlling shareholder, and 0 otherwise.
Disaster Neighbor	Dummy variable equals one if any firm owned by GUO i operates in a NUTS3 region m that borders a NUTS3 n affected by a natural disaster as of year t onwards.
Disaster NUTS3	Dummy variable equals 1 if any firm owned by GUO i , located in NUTS3 n , was affected by a natural disaster as of year t onwards.
Disaster other NUTS3	Dummy variable equals 1 if any firm owned by GUO i , located in NUTS3 M with $M \neq n$, was affected by a natural disaster as of year t onwards.

Appendix B

Table B1
Descriptive statistics of additional variables

Descriptive statistics at the GUO-NUTS3-level. This table shows the descriptive statistics for the main variables employed in the analysis at the GUO-NUTS3-level summary statistics. We describe all the variables in Appendix A.

	N	Mean	St.Dev.	Median	P.le5	P.le95	Min	Max
$\Delta Equity_{int}$	1113386	-0.0799	0.54	0.00	-1.00	0.53	-1.00	2.00
Disaster NUTS3	1113386	0.0086	0.09	0.00	0.00	0.00	0.00	1.00
Disaster other NUTS3	1113386	0.3355	0.47	0.00	0.00	1.00	0.00	1.00

Table B2
Propensity score matching diagnostics

This table shows the mean of the matching variables for treated GUOs and untreated GUOs in the unmatched (U) and matched (M) samples. Country of GUO and years are also included in matching procedure.

Variable	Matching	Treat	Untreat	%bias	t	p-value
$\log \left(1 + \sum_{j \in i} \%shares_{j,t-1} \cdot Equity_{j,t-1} \right)$	U	18.438	16.952	48.6	21.52	0.000
	M	18.47	18.39	1.5	0.52	0.604

Table B3
Robustness: “never treated” control group

The table presents the estimates of the effect of a natural disaster on the change in aggregate equity holdings. The dependent variable is $\Delta Equity_{it}$. *Disaster* is a dummy variable equals 1 if any firm owned by GUO i in cohort g was affected a natural disaster as of year t onwards. All models include GUO-cohort and Cohort $\times$ Year fixed effects. Models 2-4 include Country GUO $\times$ Year fixed effects. Control groups include never treated GUOs only. Standard errors are clustered at the GUO level and are reported in brackets. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. We provide variable definitions in Appendix A.

	$\Delta Equity_{it}$ (1)	$\Delta Equity_{it}$ (2)	$\Delta Equity_{it}$ (3)	$\Delta Equity_{it}$ (4)
Disaster	-0.1506*** (0.0144)	-0.1456*** (0.0157)	-0.1062*** (0.0245)	
Disaster ₋₄				0.0283 (0.0554)
Disaster ₋₃				0.0001 (0.0519)
Disaster ₋₂				-0.0474 (0.0423)
Disaster ₀				-0.0913** (0.0375)
Disaster ₊₁				-0.1327*** (0.0355)
Disaster ₊₂				-0.1320*** (0.0359)
Disaster ₊₃				-0.1540*** (0.0406)
Disaster ₊₄				-0.1426*** (0.0438)
Observations	70,619	70,494	19,504	19,504
R-squared	0.2150	0.2577	0.2781	0.2784
GUO-cohort FE	Yes	Yes	Yes	Yes
Cohort $\times$ Year FE	Yes	Yes	Yes	Yes
Country GUO $\times$ Year FE	No	Yes	Yes	Yes

Table B4
Robustness II: alternative windows

The table presents the estimates of the effect of a natural disaster on the change in aggregate equity holdings. The dependent variable is $\Delta Equity_{it}$. *Disaster* is a dummy variable equals 1 if any firm owned by GUO i in cohort g was affected a natural disaster as of year t onwards. All models include GUO-cohort and Cohort $\times$ Year fixed effects. Models 2-4 include Country GUO $\times$ Year fixed effects. In panel A the window considered is $[-3,+3]$. In Panel B the window considered is $[-5,+5]$. Standard errors are clustered at the GUO level and are reported in brackets. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. We provide variable definitions in Appendix A.

Panel A				
	$\Delta Equity_{it}$ (1)	$\Delta Equity_{it}$ (2)	$\Delta Equity_{it}$ (3)	$\Delta Equity_{it}$ (4)
Disaster	-0.1404*** (0.0141)	-0.1417*** (0.0157)	-0.0994*** (0.0207)	
Disaster ₋₃				-0.0449 (0.0387)
Disaster ₋₂				-0.0577 (0.0354)
Disaster ₀				-0.0679** (0.0313)
Disaster ₊₁				-0.1413*** (0.0298)
Disaster ₊₂				-0.1436*** (0.0299)
Disaster ₊₃				-0.1906*** (0.0342)
Observations	77,029	76,967	31,208	31,208
R-squared	0.2829	0.3208	0.3162	0.3175
GUO-cohort FE	Yes	Yes	Yes	Yes
Cohort $\times$ Year FE	Yes	Yes	Yes	Yes
Country GUO $\times$ Year FE	No	Yes	Yes	Yes

Panel B				
	$\Delta Equity_{it}$ (1)	$\Delta Equity_{it}$ (2)	$\Delta Equity_{it}$ (3)	$\Delta Equity_{it}$ (4)
Disaster	-0.1367*** (0.0138)	-0.1408*** (0.0151)	-0.0827** (0.0333)	
Disaster ₋₅				0.0012 (0.0997)
Disaster ₋₄				0.0228 (0.0666)
Disaster ₋₃				0.0082 (0.0694)
Disaster ₋₂				-0.0336 (0.0491)
Disaster ₀				-0.0699* (0.0398)
Disaster ₊₁				-0.1108** (0.0449)
Disaster ₊₂				-0.1255*** (0.0484)
Disaster ₊₃				-0.1584*** (0.0612)
Disaster ₊₄				-0.1339* (0.0702)
Disaster ₊₅				-0.0385 (0.0824)
Observations	123,910	123,844	18,873	18,873
R-squared	0.2384	0.2789	0.3616	0.3626
GUO-cohort FE	Yes	Yes	Yes	Yes
Cohort $\times$ Year FE	Yes	Yes	Yes	Yes
Country GUO $\times$ Year FE	No	Yes	Yes	Yes

Table B5

Robustness III: alternative matching procedure

The table presents the estimates of the effect of a natural disaster on the change in aggregate equity holdings. The dependent variable is $\Delta Equity_{it}$. *Disaster* is a dummy variable equals 1 if any firm owned by GUO i in cohort g was affected a natural disaster as of year t onwards. In Panel A we match each GUO in the treatment group with five untreated GUOs instead of one. In Panel B we include as control variables in the matching procedure the lagged value of aggregate equity holdings (in log), GUO family, NON-EU, Large investor, and year fixed effects. In Panel C the matching is done using the same variables of the baseline but with the coarsened exact matching procedure (CEM). Standard errors are clustered at the GUO level and are reported in brackets. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. We provide variable definitions in Appendix A.

Panel A				
	$\Delta Equity_{it}$ (1)	$\Delta Equity_{it}$ (2)	$\Delta Equity_{it}$ (3)	$\Delta Equity_{it}$ (4)
Disaster	-0.1204*** (0.0122)	-0.1013*** (0.0133)	-0.0909*** (0.0220)	
Disaster ₋₄				0.0088 (0.0501)
Disaster ₋₃				0.0187 (0.0467)
Disaster ₋₂				-0.0576 (0.0400)
Disaster ₀				-0.0815** (0.0355)
Disaster ₊₁				-0.1188*** (0.0315)
Disaster ₊₂				-0.1252*** (0.0328)
Disaster ₊₃				-0.1351*** (0.0362)
Disaster ₊₄				-0.1181*** (0.0377)
Observations	235,489	235,462	58,484	58,484
R-squared	0.2404	0.2670	0.2814	0.2822
GUO-cohort FE	Yes	Yes	Yes	Yes
Cohort×Year FE	Yes	Yes	Yes	Yes
Country GUO×Year FE	No	Yes	Yes	Yes

Panel B				
	$\Delta Equity_{it}$ (1)	$\Delta Equity_{it}$ (2)	$\Delta Equity_{it}$ (3)	$\Delta Equity_{it}$ (4)
Disaster	-0.1297*** (0.0133)	-0.1230*** (0.0159)	-0.0632** (0.0264)	
Disaster ₋₄				-0.0264 (0.0599)
Disaster ₋₃				0.0204 (0.0555)
Disaster ₋₂				-0.0378 (0.0464)
Disaster ₀				-0.0298 (0.0395)
Disaster ₊₁				-0.0964*** (0.0346)
Disaster ₊₂				-0.1100*** (0.0374)
Disaster ₊₃				-0.1059** (0.0443)
Disaster ₊₄				-0.0705 (0.0443)
Observations	104,148	104,086	31,501	31,501
R-squared	0.2271	0.2783	0.3246	0.3253
GUO-cohort FE	Yes	Yes	Yes	Yes
Cohort×Year FE	Yes	Yes	Yes	Yes

Country GUO×Year FE	No	Yes	Yes	Yes
Panel C				
	$\Delta Equity_{it}$ (1)	$\Delta Equity_{it}$ (2)	$\Delta Equity_{it}$ (3)	$\Delta Equity_{it}$ (4)
Disaster	-0.0889*** (0.0153)	-0.0408** (0.0180)	-0.1146*** (0.0409)	
Disaster ₋₄				-0.0103 (0.0631)
Disaster ₋₃				0.0082 (0.0621)
Disaster ₋₂				-0.0663 (0.0546)
Disaster ₀				-0.0621 (0.0549)
Disaster ₊₁				-0.1917*** (0.0542)
Disaster ₊₂				-0.1639*** (0.0533)
Disaster ₊₃				-0.1900*** (0.0586)
Disaster ₊₄				-0.1647*** (0.0606)
Observations	518,872	518,844	99,899	99,899
R-squared	0.2273	0.2607	0.2648	0.2654
GUO-cohort FE	Yes	Yes	Yes	Yes
Cohort×Year FE	Yes	Yes	Yes	Yes
Country GUO×Year FE	No	Yes	Yes	Yes