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Political discretion and risk: the Fukushima nuclear disaster, the distribution of global operations, and uranium company valuation

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This paper investigates the relationship between political constraint and investor perception of policy risk using an analysis of the reaction of Australian and Canadian uranium company stocks to the Fukushima nuclear disaster in 2011. Our dataset traces 933 projects of 322 uranium firms located across 36 countries and posits a U-shaped relationship between political constraint and investor perceptions of policy risk. Using an event study methodology as applied to the natural quasi-experiment arising from the event, we link heterogeneous changes in stock returns to the policy risk in the uranium project locations of the firms. The results corroborate the expected relationship and hold even after we control for home-country bias.

JEL classification: F23, G14, L5, L72, D72

1. Introduction

It is well recognized that multinational enterprises (MNEs) face policy risk with respect to their international investments (Jiménez *et al.*, 2014; Blake and Moschieri, 2017). Such policy risk incorporates the likelihood of policy changes by the host country government that can diminish the returns from an MNE's investments (e.g., adverse changes in taxes, regulations, and agreements with the host government or local partners) (Henisz, 2000; Fernández-Méndez *et al.*, 2019). Policy risk can sometimes be mitigated in the negotiation phases prior to the financial, physical, and legal commitment being made by the MNE (García-Canal and Guillén, 2008; Holburn and Bergh, 2008). However, once the investment is completed, or sunk into location-specific assets, the bargaining power shifts from the firm toward the host government (Kobrin, 1987; Ramamurti, 2001; Müllner and Puck, 2018). As a result, MNEs remain susceptible to location-specific policy change risk throughout the lifetime of their operations in the host country (Sawant, 2012; Blake and Moschieri, 2017).

The existing literature suggests that *political constraint* creates safeguards against policy changes because the lack of institutional checks and balances makes the environment more susceptible to policy change (Henisz, 2000; Jensen, 2008). The concept of *political constraint* represents a spectrum with *political discretion* on one end and *political constraint* on the other

(Henisz, 2002: 380). The literature on political constraint has disproportionately focused on the benefits of higher levels of political constraints as (generic) safeguards against adverse policy change. However, resource-rich environments, such as those targeted by the mining industry, often have low political constraints. This raises the question of how MNEs reconcile political risks with political discretion. As a result, there is a conceptual and practical gap in understanding how political discretion (i.e., the lack of constraint) influences the policy risk faced by MNEs. This research gap is particularly relevant for research on MNEs in regulated industries, given the prevalence of political governance strategies in such contexts (Menozzi *et al.*, 2011; Jiménez and Delgado-García, 2012; Terlaak and Kim, 2021).

Focusing on the *discretion* side of the political discretion–constraint domain when studying policy risk is valuable for two reasons. First, firms that make large sunk investments are not always rule-takers (Buckley *et al.*, 2020) and often apply *specialized governance strategies* to achieve favorable special treatment (Menozzi *et al.*, 2011; Zhu and Sardana, 2020). Our key argument is that higher levels of *political discretion* translate into a better environment for specialized safeguards and a lower risk of post-entry policy change for MNEs. Second, resource-seeking MNEs' location choices are often driven by the fixed location of the natural resources. As a result, such firms enter countries despite the expected political hazards as long as the expected returns are high enough to compensate for the expected abnormal risks. However, the level of expected risks is not fixed across the lifetime of MNEs' investments but is subject to possible shifts in the policy status quo (Henisz and Zelner, 2005; Blake and Moschieri, 2017). Namely, significant *unexpected* events can trigger local stakeholders' re-evaluation of the economic value of firms' existing investments, making the true risks faced by resource-seeking firms consequential.

In the present paper, we investigate this dual effect by analyzing the reaction of Australian and Canadian uranium company stocks to the Fukushima nuclear disaster in 2011. Significant events can trigger policy change (Henisz and Zelner, 2005) and provide researchers with unique opportunities to use the natural experiment created by their arising. Using an event study methodology and the quasi-experiment arising from the Fukushima nuclear event, we link heterogeneous changes in stock returns to the policy risk in the uranium project locations of the firms. We trace 933 projects of 322 uranium firms located across 36 countries. After an exogenous shock like the Fukushima nuclear disaster, the investors are forced to re-evaluate the value of MNE stocks based on the *renewed* risks of policy change in the firm's countries of operation because the incident is new information and the probability of policy change would not remain the same after the incident (Pastor and Veronesi, 2012; Blake and Moschieri, 2017).

We undertake the analysis in two stages. First, using event study methodology, we estimate the extent of the impact of the Fukushima incident on uranium stock values. Second, we attribute the heterogeneity in cumulative abnormal returns (CARs) calculated for the event window to the differences in political discretion–constraint scores of the companies' project locations in a cross-sectional analysis. The international distribution of uranium mining activity provides an appropriate testbed for contributing to international business (IB) theory. Although the IB literature on the impact of disasters and associated cascading effects is growing, the focus remains on MNEs' operations in the locations of disasters (Oh and Oetzel, 2022). By focusing on the stock prices of uranium mining companies, our study focuses on the cascading effects of a natural disaster that travel upstream along the industry value chain across borders.

We contribute to the IB and policy literature in two ways. First, our study adds to the literature on policy risk by identifying a nonlinear relationship between the level of political constraints and risk. The past literature has focused predominantly on how political constraints automatically create safeguards against political risk (Henisz, 2002; Martin *et al.*, 2010; Bucheli and Kim, 2015; Zhang *et al.*, 2016). While the literature on entry decisions suggests that political discretion can offer opportunities for effective specialized governance strategies in regulated industries (García-Canal and Guillén, 2008; Holburn and Bergh, 2008; Holburn and Zelner, 2010), the focus has been on country choice *at* entry. Therefore, we still lack an understanding of how the discretionary power of the local government would play out in terms of the consequential risk of policy change (following an exogenous shock) for MNEs already present in the country. By modeling a nonlinear effect, we reveal that the distribution of risk across the continuum of the political discretion constraint is U-shaped. This challenges the assumptions in the extant literature that the risk of policy change is concentrated at the lower end of the continuum. Instead, the highest risk levels of policy change land on firms' exposure to environments with mid-level democracies.

Second, our study contributes to the ongoing literature on the political risk that uses exogenous events such as terrorist attacks and natural disasters for testing theories in IB and policy (Oh and Oetzel, 2011; Oetzel and Oh, 2014; Dorobantu *et al.*, 2017a). While the focus in those studies has been on MNE behavior (response), our study focuses on investor perceptions as revealed by the market performance of publicly traded stocks. A unique feature of our analysis is that we focus on a single event that had a chain-reaction upstream (toward uranium mining) along the global value chain of the nuclear power industry. Country-specific shocks incorporate variations in severity (or other characteristics) of the various events, and hence, disentangling policy risk from other confounding effects is a major challenge. By focusing on the heterogeneous outcomes of a single exogenous event, our study allows reliably attributing this heterogeneity (after controlling for alternative explanations) to the project location–based political risks.

2. Review of literature and hypothesis development

2.1. Political constraint and risk

The risks faced by MNEs are distributed across the company's countries of operation, effectively subjecting them to that portfolio of location-based risks. While the institutional environment in a country often determines the base risk perceived by investors at a point in time, the likelihood of potential future policy change adds to the uncertainty with regard to future rents (Kobrin, 1979; Brewer, 1983; Huang *et al.*, 2015; Nguyen *et al.*, 2018). Policy changes that occur after an MNE commits to a country with nonrecoverable costs are the case in point. Although some institutional rules are exogenous from the perspective of a firm, a large body of research on nonmarket strategies suggests that firms employ specialized governance strategies by engaging in nonmarket practices to advance beneficial regulation or deinstitutionalize adverse regulatory constraints (Holburn and Bergh, 2008; Doh *et al.*, 2012; Sawant, 2012; Jiménez *et al.*, 2014; Dorobantu *et al.*, 2017b) while also working to formulate strategies aimed at mitigating that risk. A review of the two streams of literature provides a better understanding of the dual impact of political discretion–constraint domain on MNE market value.

2.1.1. Political constraint as a safeguard

Henisz (2000) suggests that countries vary in terms of the political discretion a ruling individual (or party) can exert on policy change. Low political discretion (high political constraint) is associated with the stability of the institutional environment (Henisz and Zelner, 2005; Getachew and Beamish, 2021). As firms optimize resource allocation for the given state of rules at the time of entry, ex-post constraints imposed by policy change or renegotiation of existing agreements may reduce the economic value of investments (e.g., increase costs of operation or restrict revenue streams)—this is particularly the case in extractive industries where sunk costs are large and alternative resource locations potentially limited. Moreover, national governments or powerful interest groups within a country often operate with a policy of resource nationalism, which broadly refers to "state control or dominance of natural resources, and the resulting potential to use this power for political and economic purposes, including relationships with foreign investors" (Click and Weiner, 2010: 784). Political risk has a direct influence on the market valuation of a company and is particularly influential on MNE investors due to their presence across multiple countries (Huang *et al.*, 2015; Zhu and Sardana, 2020). Critical events often serve as trigger points to spark stakeholder movements to generate policy change (Stevens and Newenham-Kahindi, 2017; Dorobantu *et al.*, 2017a). For instance, from the perspective of our empirical context, a nuclear disaster causes a decline in uranium prices and revenues, enticing relevant interest groups in the host country to instigate redistribution of rents (losses) or promote regulatory change to minimize the burden of losses (or foregone profits) caused by the event and its consequences. The event (and the consequent decline in revenues) is also a good opportunity for resource nationalists to re-establish, or threaten to re-establish, state control or dominance of natural resources (Click and Weiner, 2010). Uncertainty with regard to policy changes in host locations translates into a risk to the extent that the company has exposure to the policies in question (Nguyen *et al.*, 2018). Therefore, political constraint creates exogenous safeguards for MNEs; i.e., even if various interest groups instigate adverse policy change, the likelihood of their success would be limited by political constraints.

2.1.2. Political discretion as a safeguard

Firms employ policy-oriented strategies to influence the institutional environment or pre-emptively deter adverse effects (Jiménez *et al.*, 2014). Boubakri et al. (2013) show that firms' political connections with governments facilitate undertaking risky projects. Firms operating in resource- and infrastructure-related industries are inevitably embedded in pervasive regulatory institutions and rely on strategies of specialized political governance to manage the institutional contexts in which they operate (Holburn and Zelner, 2010; Sun *et al.*, 2021). García-Canal and Guillén (2008) find that firms in regulated industries prefer governments with discretionary policymaking capacities (i.e., the opposite of politically constrained governments) as they can create opportunities for the negotiation of favorable regulatory conditions. While very strong political constraint can serve as a *generic* ex-ante reassurance over the MNE's investments in the host country, the lack of such constraints creates opportunities for MNEs willing to use nonmarket strategies (Jiménez *et al.*, 2014) and establish *specialized* safeguards, both ex-ante and ex-post. Hence, from the perspective of the market value of an MNE, the impact of political constraint on firm performance can be beneficial toward the two ends of the discretion-constraint spectrum (Jiménez and Delgado-García, 2012; Fernández-Méndez *et al.*, 2019).

In environments with high political discretion, MNEs can negotiate a favorable policy environment by aligning their interests with powerful local interest groups via joint ventures (JVs) or by establishing close coalitions with the host government (García-Canal and Guillén, 2008; Jiménez *et al.*, 2014; Zhu and Sardana, 2020). Once the MNE enters the country under the negotiated conditions, the arranged terms hold so long as the interests of the MNE and the powerful coalition group remain aligned. Significant unexpected events may trigger certain third parties to initiate policy change, but the efforts bear fruit only if the alternative interest group is powerful enough to oppose the interests of the dominant group and delegitimize the policy in place (Henisz and Zelner, 2005; Stevens and Newenham-Kahindi, 2017). When the dominant interest group has vested interests in maintaining the status quo, significant shifts in policy are unlikely.

2.1.3. Examples of political safeguards in uranium mining

By definition, countries with concentrated political powers lack powerful opposing groups capable of effectively questioning the incumbent government and regulatory bureaucracy. We can see how this varies by examining the two extremes of political discretion constraint as seen in Kazakhstan and Australia. Uranium mining in Kazakhstan, the largest producer of uranium in the world, is managed by the government corporation Kazatomprom.[1] Although the Atomic Energy Agency (AEA, formerly Committee on Atomic Energy) is the regulatory body responsible for licensing and safety, both Kazatomprom and AEA, as well as other nuclear-related activities of Kazakhstan, fall under the Ministry of Energy and Mineral Resources (MEMR). Foreign MNEs entering the country and faced with this host country reality respond by establishing JVs with Kazatomprom (e.g., Canadian Cameco and Uranium One, French Areva, and Japanese Sumitomo). Establishing JVs with powerful local stakeholders is an effective method of safeguarding investments by MNEs in host countries with high political discretion (Jiménez *et al.*, 2014; Zhu and Sardana, 2020). The policy environment of uranium mining in Kazakhstan is stable, as it has no interference from outside the MEMR. Political power in the country is highly concentrated, and political opposition is virtually nonexistent[2] (same as it was at the time of the Fukushima

[1] Information on the Kazakh uranium industry and Kazatomprom is drawn from the World Nuclear Association report on Kazakhstan: https://www.world-nuclear.org/information-library/country-profiles/countries-g-n/kazakhstan.aspx (last accessed in January 2023).

[2] The country scores 0 in the POLCON metric (Henisz, 2000).

nuclear disaster in 2011) (The Economist, 2019). As a result, there is no interest group powerful enough to question the legitimacy of the status quo in the uranium industry policy.

Uranium mining policy in Australia closely reflects the partisan positions of the major political parties in the country. Generally, the Liberal Party has been supportive of uranium mining, while the Labor Party has been opposed. However, the stance of the Labor Party varies at both the state and federal levels (Ferguson and Lam, 2016). Decision-making is heavily regionalized within the federal Australian structure, and the control of various decisions will reside with the federal government, while other decisions reside with the states. This dramatically reduces the effective discretion of the bureaucracy, reflecting the role of political constraint. For example, in New South Wales, mining uranium has been prohibited since 1986, although there was recent permission approved for uranium exploration in 2012. In Victoria, exploration and mining of uranium have been prohibited since 1983. In Queensland, exploration of uranium is permitted; however, mining of uranium was banned in 1989. This ban was then overturned in 2012 by the Liberal government but subsequently banned again by the Labor government that replaced it in 2015. In Western Australia, mining of uranium was banned in 2002 under the Labor government before this ban was then overturned in 2008 by the newly elected Liberal government only to be banned again in 2017 when Labor took power again. Only in Tasmania, the Northern Territory, and South Australia, mining has always been permitted independent of the party in power. Nuclear power generation was banned in Australia in 1999 by the then Liberal federal government that made a deal with the Greens and the Australian Democrats (both left leaning) to amalgamate the Australian Radiation Laboratory and the Nuclear Safety Bureau. In summary, uranium mining policy in Australia could be described as highly politically constrained owing to the long-standing negative policy position maintained by the Labor Party. Today, with the recent closure of the Ranger Uranium Mine in the Northern Territory, there remain only two active uranium mines in Australia, both in South Australia.

This perspective establishes two opposing forces that can influence the safeguards from policy change from the perspective of an MNE: *specialized safeguards* (stemming from political discretion) on the one side and *generic safeguards* (stemming from political constraint) on the other. After establishing the baseline effect of the incident's impact on uranium stocks in hypothesis 1 in the next section, we build on the above-mentioned logic to construct our main hypothesis (H2) on the distribution of stock market political risk along the *political discretion–constraint* spectrum.

2.2. Hypotheses

2.2.1. Impact of a natural disaster on firm equity valuation: the baseline effect

From the perspective of understanding the role of political risk, after controlling for key economic factors, the remaining heterogeneity in the impact of the exogenous shock on company values will capture investors' reassessment of the risks of possible consequential changes in the locations of the companies' mines. Hence, identifying the negative impacts of the incident on uranium mining company stocks is a necessary pre-condition before we can attribute heterogeneity in these negative effects to the companies' exposure to political discretion constraints.

The recent literature on IB has emphasized the importance of cascading effects resulting from natural disasters (Oh and Oetzel, 2022). Large-scale natural disasters not only have a direct effect on firms located in the affected region (Oh and Oetzel, 2011; Dorobantu *et al*., 2017a) but also have wider cascading effects that may cross international borders via supply chains (Alexander, 2006; Altay and Ramirez, 2010). More specifically, a natural disaster that hits a specific stage in a value chain will likely disrupt supply and demand conditions with the effects traveling in both downstream and upstream directions. For instance, uranium oxide (yellowcake) is a major ingredient to the nuclear fuel cycle, and firms that are involved in the exploration and mining of uranium are likely to suffer a direct impact from a nuclear accident. A significant incident raises public concerns about the nuclear technology across the world with expectations of a fall in the demand for uranium, which directly influences the price of uranium in the global markets. The negative impact of the Fukushima nuclear disaster is assumed to result in an economic loss to upstream uranium firms due to both unforeseen changes to future revenue streams and a weaker outlook for the nuclear (and thus the upstream uranium) industry. Indeed, the event was followed by a fall in uranium spot prices, short-term futures prices, and long-term contract prices.

Prior studies of nuclear incidents focused primarily on the effects in the downstream stages. For instance, Hill and Schneeweis (1983) and Bowen et al. (1983) find evidence consistent with the market discriminating between nuclear utilities and non-nuclear utilities following the Three Mile Island (TMI) incident. Fields and Janjigian (1989) examined the stock price reaction of downstream utility firms and found significant negative abnormal returns to the utility industry following the 1986 Chernobyl nuclear accident. Several studies have also examined the effect of the Fukushima nuclear accident on stock prices of downstream energy utilities and found a significant industry-wide effect on downstream utility firms (Kawashima and Takeda, 2012; Lopatta and Kaspereit, 2014). However, we cannot directly apply the findings on the valuation of companies working in downstream stages to the valuation of companies working in upstream stages because there is an important distinction between the causal reasons for the effect. The downstream stages are affected because nuclear disasters raise public concerns about the safety of nuclear energy, whereas the upstream stages are affected because of the consequent drop in uranium prices. This distinction is important also because many countries producing uranium do not have nuclear plants, nor do they have investments in nuclear technologies that complement the use of uranium.

The focus on the upstream direction is an important context from an IB perspective because the nuclear power value chain goes from international to local; i.e., uranium is mined internationally, while supply from nuclear power plants occurs mostly at the level of local utility companies. The impact of the Fukushima nuclear disaster on energy utilities (i.e., downstream) would be subject to factors relating to re-evaluation of the risks with respect to the safety of nuclear plants (public perceptions in this regard and responses of politicians). Uranium mining, on the other hand, would be affected primarily by economic factors via changes in the expected future demand for uranium.[3] Therefore, we postulate our baseline effect as follows:

H1 (baseline effect): *Markets exhibit a negative reaction toward uranium resource firms following a nuclear disaster*

2.2.2. The role of local political discretion and constraint

The literature on institutional change suggests that relevant interest groups can use significant events to challenge the legitimacy of the status quo and trigger policy change (Henisz and Zelner, 2005; Stevens *et al.*, 2016). However, institutional environments with high political constraint can be characterized by dispersed powers across the various interest groups, where the preferences of a single interest group are less likely to make their way through to meaningful policy change. Multiple bodies with veto power create rigidity in policy changes, thus reinforcing the status quo. Hence, even if the relevant authority in the country intends to make policy changes, multiple checks and balances and veto points that the regulating body must face can effectively prevent significant amendments (Jensen, 2008; Fernández-Méndez *et al.*, 2019; Buckley *et al.*, 2020). Consequently, we can expect that firms that operate in countries with high levels of political constraint face less risk of adverse regulatory change compared to firms operating with large commitments in countries with low political constraints.

On the other hand, high political discretion can often reflect the potential political risk for foreign investment that would be incorporated into the stock price at the time of entry or project announcement (Henisz, 2000; Henisz and Zelner, 2005). However, companies' political strategies in such environments can be used effectively to prevent adverse regulatory change and reduce the associated uncertainty as to the value of the investment (Bonardi *et al.*, 2006; Holburn and Bergh, 2008; Sawant, 2012). By erecting firm-specific safeguards, firms can establish discretionary constraint, the constraint to policy change that remains at the discretion of the ruling executive or group. It is an outcome of political discretion and can be an effective tool for preventing policy change when the foreign investor can achieve alignment of the interests of the ruling executive

[3] That is, many countries involved in uranium mining do not have nuclear power plants; hence, the effect on the uranium industry is an economic effect cascading via lower demand for uranium.

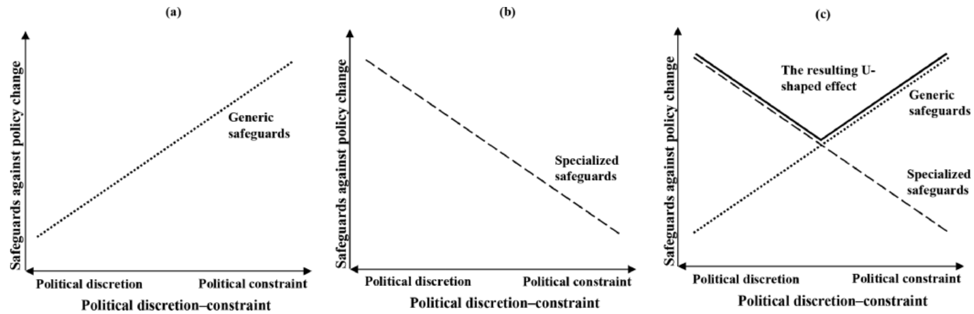

Figure 1. Constraints on policy change: (a) generic safeguards, (b) specialized safeguards, and (c) the combination of both

(or party/group) with its own (Bucheli and Kim, 2015; Bucheli and Salvaj, 2018). Therefore, political discretion can increase the effectiveness of political strategies to build *specialized safeguards* (Fernández-Méndez *et al.*, 2018, 2019). As a result, coalitions or partnerships with the group(s) holding the controlling power can suffice for effectively preventing adverse policy change (Jiménez *et al.*, 2014; Zhu and Sardana, 2020). The decline in political discretion disperses power to multiple interest groups, thus decreasing certainty in the effectiveness of *specialized safeguards*.

Firms can choose between *generalized governance strategies* and *specialized governance strategies*, but their relative effectiveness is contingent on the institutional environment (Henisz and Zelner, 2004; Sun *et al.*, 2012; Dorobantu *et al.*, 2017b; Fernández-Méndez *et al.*, 2018). Generic safeguards stem from exogenous rules in the environment resulting from political constraints and, in this context, translate primarily into compliance with the existing rules (Jensen, 2008). Specialized safeguards, on the other hand, are an outcome of the firms' specialized governance strategies where firms seek to create specialized favorable conditions[4] (Sidki Darendeli and Hill, 2016; Dorobantu *et al.*, 2017b) that are bespoke to the context and conditions being faced with respect to the needs of the various stakeholders who can make discretionary decisions that influence the value of the investment.

To demonstrate our logic visually, we depicted the model in Figure 1(a)–(c). Our approach to constructing the U-shaped relationship is consistent with the recommendations of Haans et al. (2016) and corresponds to the U-shaped relationship resulting from "multiplicative combination" of two latent mechanisms, *generic* and *specialized* safeguards. The upward-sloping dotted line in Figure 1(a) represents increasing *generic* constraints on policy change with an increase in political constraints. As argued earlier, generic constraints stem from the exogenous constraints to changes in the institutional environment. Therefore, the stronger are political constraints, the stronger are safeguards against policy change. Figure 1(a) represents the standard conclusion from the literature on policy risk.

The downward-sloping dashed line in Figure 1(b) represents *specialized safeguards* against policy change, which declines along with increase in political constraint. To achieve specialized safeguards, firms build coalitions with interest groups capable of delivering favorable outcomes and/or preventing adverse policy change. However, the effectiveness of specialized governance strategies is conditional on the discretion available to the local coalition partner. At lower levels of political constraint, generic safeguards are too weak for firms to rely on them, while the resulting political discretion is favorable for creating specialized safeguards. At higher levels of political constraint, there is little political discretion of any one interest group, and hence, specialized safeguards would bear little fruit, making generic safeguards more effective. Therefore, the overall impact of political constraint on the amount of risk faced by the firm is a combination

[4] Dorobantu et al. (2017b) review strategic options for firms faced with weak institutions. Related strategies include political donations, firm or industry lobbying for favorable regulatory change, social initiatives, maintaining close relations with powerful stakeholders, etc. For instance, Sidki Darendeli and Hill (2016) demonstrate how important it was for MNEs in Libya to not only maintain connections with the Qadhafi family but also engage in social projects with local tribes and their leaders who often held administrative positions in local governments.

of the two latent mechanisms (safeguards) forming a U-shaped relationship (Haans *et al.*, 2016) represented by the solid line in Figure 1(c). The solid line shows declining safeguards (against policy change) between low and moderate levels of political constraint and increasing safeguards between moderate and high levels of political constraint. We expect this effect to project to the heterogeneous change in the values of uranium-related stocks following the Fukushima incident. Accordingly, we postulate H2 as follows:

H2: *The negative market reaction of uranium resource firms (following a nuclear disaster) will have a U-shaped form with respect to the firm exposure to political discretion constraint.*

3. Methodology

The fundamental challenge of empirically capturing the impact of institutions on the economic value of embedded investments is that MNEs evaluate the potential political hazards prior to making investment decisions. Hence, there is inherent pre-selection in the country composition of MNE project portfolios based upon the company's tolerance for risk and uncertainty and their strategy for managing such factors. However, an exogenous shock (like the Fukushima nuclear disaster) will increase the likelihood of the downside risk associated with political hazard to materializing and will do so for all firms at the same moment in time.

The anticipated market reaction of uranium company stocks to the Fukushima nuclear disaster can be thought of as comprising three elements: (I) a shock to the economic fundamentals, (II) the market's sentiment (or fear) in response to the nuclear mishap, and (III) a reassessment of the probability of an adverse policy change toward uranium mining and production in the country of operation. By and large, firms with different project locations are subject to, on average, the same economic shock to the industry (such as changes in uranium prices and demand) driving investors to revise stock prices. Within each of Australia's and Canada's stock markets, all firms, regardless of the location of their projects, are subject to the same market sentiment affecting investors' investment decisions. In this regard, holding the economic fundamentals and market sentiment constant, any systematic difference in observed abnormal returns would reflect the market's assessment of the differential probability of an adverse change in the project locations. Hence, the analysis of the levels of the firm's exposure to political discretion and constraint in the countries of project location permits a direct examination of the effect of the likelihood of policy change on the extent of the market reaction following the significant incident at Fukushima.

3.1. The "event" and its impact on uranium company stocks

On March 11, 2011, the east coast of Japan was struck by a magnitude 9.0 earthquake and the tsunami that ensued caused serious damage to the Fukushima Daiichi Nuclear Power Plant owned by Tokyo Electric Power Company (TEPCO). Three of the six nuclear reactors operating at the time went into automatic shutdown in response to the earthquake that struck at 2:46 p.m. on Friday, March 11, 2011 (Japan local time). Seismic damage caused a loss of power from external sources, resulting in the plant's dependency on emergency generators to support the critical cooling process required post shutdown. The first tsunami wave arrived 41 minutes after the quake and a second 8 minutes later. The extent of these waves varied along the east coast of Japan, reaching a height of 15 m in the Fukushima prefecture. Tsunami waves damaged and inundated the plant's backup power supply, resulting in a complete loss of power to reactors 1–4 at the plant by 3:42 p.m. Incapacitated to manage the overheating reactor cores, TEPCO made its first emergency report to the government. Naoto Kan, the then Japanese Prime Minister, declared a nuclear emergency at 7:03 p.m. that evening, ordering an evacuation zone within a 2-km radius of the plant. The accident at Fukushima Daiichi Nuclear Power Plant received a level-7 crisis ranking on the International Nuclear and Radiological Event Scale (INES), placing the radiation implications on par with the April 26, 1986, Chernobyl nuclear accident in Ukraine.

Conde and Kallis (2012) recognize a considerable shift in mining investment from countries such as Australia and Canada to Kazakhstan and Africa. For example, the uranium industry in African countries has experienced rapid expansion, issuing 66 exploration licenses since 2005 and the likely development of three to four new mines. This shift has occurred despite appreciably lower-quality ore grades in these countries, accompanied by less economically favorable extraction conditions compared with Australian and Canadian uranium deposits. Conde and Kallis (2012) suggest that the more rigorous environmental regulation and enforcement in Australia and Canada, in combination with effective social resistance and lengthy legal challenges, are likely to have contributed to the expansion of the uranium industry in other parts of the world. Investments by the uranium mining firms into overseas projects in countries with diverse institutional settings provide an appropriate empirical context for testing our main hypothesis.

3.2. Sample

We conduct our event study analysis at the firm level. The sample comprises all pre-production mining and exploration firms listed on the Australian Stock Exchange (ASX), Toronto Stock Exchange (TSX), and TSX Venture Exchange (TSXV) engaged in at least one uranium-related project over the sample period[5]. A firm's involvement in the exploration or development of uranium was determined via a number of processes. Qualifying search firms include all firms classified as belonging to either the materials or energy sectors under the Global Industry Classification Standard (GICS) and the mining sector under the North American Industry Classification System (NAICS) for Australian and Canadian firms, respectively.

We conducted a keyword search of company announcements pertaining to a firm's participation in uranium through Morningstar's DatAnalysis database for Australian firms and via the annual reports of Canadian firms in conjunction with the SEDAR database. We performed a further comprehensive search on Factiva to identify additional firms with uranium interests falling outside the above classification schemes or firms that were delisted before the start of the sample identification date. This process identified 384 Australian and 349 Canadian firms with a present or historical involvement in uranium. The sample criteria imposed require firms to have a continual engagement in uranium throughout the sample period, verified through their 2010 fourth-quarter and 2012 first-quarter activity reports. We further impose a threshold materiality level of 20% direct or indirect equity interest in at least one uranium-related project, excluding firms with small royalty interests in uranium projects. The final sample consists of 181 ASX-listed and 141 TSX/V-listed uranium firms (Table 1).

3.3. Data

We obtained daily adjusted closing stock prices and market capitalization (as a proxy for firm size) for the Australian and Canadian sample firms from Thomson Reuters' Datastream. The Carhart's (1997) four factors for both Australia and Canada for estimating the expected returns of sample firms are downloaded from the website of AQR Capital Management, LLC.[6]

Firm- and project-level variables obtained for the purposes of conducting cross-sectional analysis include project development milestones, project location, and uranium sector focus. We manually collect information on project milestones, uranium "focus," and project location from each firm's annual disclosure, including annual reports of Australian firms and the Management's Discussion and Analysis (MD&A) in conjunction with the financial statements of Canadian firms. The information contained in the Australian and Canadian annual reports is cross-checked using a search of the company's disclosure on DatAnalysis (ASX-listed firms) and SEDAR (TSX/V-listed

[5] According to Mining Feeds™ (https://miningfeeds.com/uranium-mining-report-all-countries/), Canada and Australia are at the center of the world mining industry. Out of a total of 669 mining company listings documented on Mining Feeds™ with a market capitalization exceeding CAD10 million, Australia accounted for 263 listings or 39.3%, while Canada accounted for 326 or 48.7%. Together, Canada and Australia accounted for 88% of global mining company listings. This market share could, in reality, be even higher on the basis that listings in the UK and the United States are frequently cross-listings from other countries. Australia and Canada have well-developed capital markets in relation to operational disclosure, meaning that data are available for the study.

[6] Research data on daily global factors are maintained and updated by Andrea Frazzini and available for download at http://www.aqr.com/library/data-sets/quality-minus-junk-factors-daily/data. The portfolio construction follows Fama and French (1992, 1993, 1996), Asness and Frazzini (2013), and Asness et al. (2019).

Table 1. Sample selection

Step	Identification process/filter	Number of firms ASX	TSX/V
1	ASX-listed firms classified as Energy (code 10) or Materials (code 15) sector under the GICS and TSX/V-listed firms classified as Mining (code 212) sector under the NAICS	1040	1674
2	Factiva searches for mining and exploration firms outside the above industry classification and/or firms delisted prior to August 1, 2012	1063	1737
3	Keyword search performed on firms' historical disclosure for uranium project involvement	384	349
4	Firms are listed on the stock exchange for the entire sample period	353	278
5	Firms with uranium project interest verified in their 2011 annual report	224	186
6	Firms with a continuous material interest in at least one uranium-related project over the sample period	191	169
7	Firms with no missing data for any of the variables used	181	141
	Total number of sample firms	322	

ASX, Australian Stock Exchange; GICS, Global Industry Classification Standard; TSX/V, Toronto Stock Exchange/Venture Exchange; NAICS, North American Industry Classification System.

firms) around the event date to ensure only information known to the market at the time of the Fukushima nuclear accident is contained in the project-level measures.

3.4. Measurement of political constraint

To assess the level of *political constraint*, we use the *POLCON(V)*[7] measure of political constraint developed by Henisz (2000), which is updated annually and made accessible for researchers. It is one of the widest used measures of political constraint and risk in IB literature (e.g., García-Canal and Guillén, 2008; Henisz *et al.*, 2014; Müllner, 2016; Albino-Pimentel et al. 2018; Clegg *et al.*, 2018; Getachew and Beamish, 2021). *POLCON* measures the feasibility of policy change due to the preferences of any one actor. More specifically, the measure focuses on two elements characterizing the structure of the political system: "… the number of independent veto points over policy outcomes and the distribution of preferences of the actors that inhibit them" (Henisz, 2000: 5). "This variable is calculated as (1 – the level of political discretion). Discretion is operationalised as the expected range of policies for which all political actors with veto power can agree upon a change in the status quo" (Henisz, 2002: 380). We use the 2011 scores as they show the condition of the political constraint in each country as of January 1 of that year. Because several of the sample firms have uranium projects in multiple countries, *POLCON* is calculated for each firm as a measure of "exposure to political constraint", depending on the project locations of the firm. Firm-specific *POLCON* is calculated as the average *POLCON* score of countries where the firm's uranium projects are located (including both domestic and foreign projects). Countries where the firm has its flagship[8] project are assigned double weight. For example, consider a firm with uranium projects in three countries, the country where the flagship project is located is assigned a weight of 0.5, and the two countries with non-flagship projects are assigned a weight of 0.25 each. For a firm with projects in two countries, a weight of 0.67 (0.33) is assigned to the

[7] POLCON(V) is an upgraded version of POLCON(III). The only difference is that POLCON(V) includes two additional veto points, the judiciary and sub-federal entities (Henisz, 2000). We conducted a robustness check with respect to POLCON(III) by redoing the analysis with this measure. The pattern of results remained unchanged in terms of coefficient signs and statistical significance.

[8] We used multiple sources in identifying flagship projects. For Canada, the exploration and development expenditure is disclosed in the quarterly MD&A filings, which means that we are able to assign the flagship project based on investment size (i.e., the amount of expenditure incurred on the most important project). In Australia, there is no such expenditure disclosure for individual mining projects. Therefore, for Australian firms, we reviewed the annual report of the firm and the quarterly activities report and identify the flagship project based on the first project profiled in these reports. While mining exploration and development companies do have multiple projects in their exploration portfolios, the flagship project is readily identifiable on the basis that these (exploration and development) firms are severely cash-constrained (Bui *et al.*, 2021) and technically do not have enough resources to pursue the development of multiple projects simultaneously. "Highlights" in the quarterly activities report are typically associated with this flagship project.

country with the flagship (non-flagship) project. Overall, 933 projects are distributed across 380 firm–country combinations of 322 firms. On average, this makes 2.90 projects per firm and 1.18 unique countries per firm.

3.5. Control variables

First, following the studies of uranium company stock price performance, we controlled for the mine lifecycle milestone stages. Namely, we adopted the coding approach similar to that used by Ferguson and Lam (2021). We first summarized project development milestones into 10 different stages: (I) project/tenement acquisition, (II) grass-root exploration, (III) mineral discovery, (IV) resource definition, (V) scoping study, (VI) pre-feasibility study, (VII) bankable feasibility study, (VIII) project financing, (IX) mine construction, and (X) production. Based on the mining lifecycle activity identified in the firm's disclosure, we group milestones I–III as grass-root explorers, IV–VI as advanced explorers, and VII–IX as potential producers. We define *GRT, ADV*, and *POT* as dummy variables taking the value of 1 if the firm is a grass-root explorer, advanced explorer, and potential producer, respectively, and 0 otherwise. The project milestone recorded is based on the firm's most advanced uranium project, either advanced by the firm itself or acquired at a certain stage in the mining lifecycle.[9] Second, the focus variable (*FOCUS*) attempts to gauge a firm's operational focus on uranium projects, recognizing the polymetallic nature of many resource projects.[10] A firm's uranium orientation is estimated by considering the entire portfolio of projects held by a firm, calculated as the proportion of uranium projects to total firm projects. This portfolio measure allows the level of uranium emphasis to vary across firms. Third, we created a dummy variable PRD to control for firms that are uranium producers, as their much larger size and abundant cash flows from operations tend to make them different from the rest of the sample (e.g., BHP Billiton, Rio Tinto). Fourth, we control for firm size by including market capitalization (*MCAP*), measured as the log of the market value of equity. Fifth, to control for home-country effects, we included a dummy variable (*CAN*) that equals 1 for Canadian-traded firms and 0 for Australian-traded firms. Finally, risks of adverse regulatory change in a country may also depend on the significance of uranium revenues for its economy. This may be particularly the case for countries whose economies rely heavily on commodity exports. Therefore, we calculate a ratio of uranium export revenue per thousand dollars of gross domestic product (GDP) for each country and construct a project-weighted measure of exposure to country uranium dependence (*EUD*) using the same weights used for *POLCON*.

3.6. Event study methodology

We assess the wealth effect on upstream uranium firms in response to the Fukushima accident using an event study methodology (Ball and Brown, 1968; Fama *et al.*, 1969). Given the assumption of market efficiency and the unanticipated nature of the event, observing price changes following the event will provide an unbiased estimation of the resulting wealth implications (Fama, 1965; Fama *et al.*, 1969). We calculate abnormal returns as prediction errors over the event window, with expected returns estimated using the four-factor model of Fama and French (1992, 1993) and Carhart (1997).

We adopt an estimation window from day −290 to day −11 to estimate the factor model parameters. Because of the lingering uncertainty surrounding the extent of the damage, the primary event window includes a second trading day to capture any residual reaction to the event. The 2-day event window (from day 0 to day +1) for ASX-listed firms covers March 14 and 15, 2011, and for TSX/V-listed firms, the corresponding calendar dates are March 11 and 14, 2011.[11] The difference in calendar date occurs due to time differences between the two countries, with the earthquake itself occurring on Friday 4:46 p.m. Sydney time after the market closed and

[9] In the case of polymetallic projects, the uranium status of the project is recorded regardless of further advancement in non-uranium minerals.

[10] Although there is some specialization on commodity lines, mining companies will always contemplate economic deposits irrespective of commodity type.

[11] Given the unpredicted nature of this event, this study is devoid of any anticipation effects possibly detracting from the power of the event study approach. Due to the event's unexpected nature, the inclusion of the day prior to the accident is not meaningful for this particular event.

12:46 a.m. Toronto time before the market opened on March 11, 2011. We aggregate the daily abnormal returns for the first two trading days to obtain the CAR[0,+1] over the event window.

Studies involving events such as the Fukushima nuclear accident are prone to problems of event day and industry clustering and this study is no exception. To address this problem, we use the adjusted-BMP (Boehmer, Musumeci, and Poulsen) statistic developed by Kolari and Pynnönen (2010) to take into account the cross-sectional correlation of abnormal returns among the sample firms. The original BMP statistic is a *t*-statistic based on standardized abnormal returns, which accounts for potential problems of event-induced volatility and autocorrelation of returns (Boehmer *et al.*, 1991). The adjusted-BMP statistic can also be used to test CARs across the event windows (Kolari and Pynnönen, 2010).

3.7. Cross-sectional analysis

To assess the differential wealth impact of the Fukushima accident on uranium firms, we perform a cross-sectional analysis. The influence of these characteristics on the magnitude of CAR is estimated by pooling all sample firms together in the following cross-sectional regression.

$$CAR[0,+1]_i = \alpha_0 + \alpha_1 POLCON_i + \alpha_2 POLCON_i^2 + \alpha_3 MCAP_i + \alpha_4 FOCUS_i + \alpha_5 ADV_i + \alpha_6 POT_i + \alpha_7 PRD_i + \alpha_8 CAN_i + \alpha_9 EUD_i + \varepsilon_i \quad (1)$$

We expect the above explanatory variables to be associated with the cross-sectional variation in abnormal returns. In particular, if the U-shaped relation between political constraint and CAR as postulated in H2 is borne out empirically, we expect to observe significantly negative and positive coefficients for $POLCON$ and $POLCON^2$, respectively.

4. Empirical results

4.1. Sample characteristics

Table 2 reports the descriptive statistics for the sample firms. Uranium firms listed in both countries are reasonably similar in size in terms of mean and median market capitalization. In terms of

Table 2. Sample characteristics

Market capitalization	*N*	Mean	Median	Std. dev.	Min	Max
Australian firms (AUD million)	181	1064.01	22.85	11,630.71	1.69	155,621.40
Canadian firms (CAD million)	141	223.20	21.37	1406.72	0.80	15,578.34
Focus measure	*N*	Mean	Median	Std. dev.	Min	Max
All firms	322	0.51	0.48	0.32	0.03	1.00
Australian firms	181	0.51	0.50	0.31	0.03	1.00
Canadian firms	141	0.50	0.43	0.34	0.03	1.00
Project location	*N*	OVS	AFR	SA	OTH	
All firms	322	80	47	20	54	
Australian firms	181	38	34	4	20	
Canadian firms	141	42	13	16	34	
Project milestone	*N*	GRT	ADV	POT	PRD	
All firms	322	274	24	16	8	
Australian firms	181	153	13	11	4	
Canadian firms	141	121	11	5	4	

This table reports the characteristics of the sample firms. Market capitalization is a measure of firm size. Focus measure is a proxy for a firm's operational focus on uranium. The project location variable OVS stands for firms with all of their uranium projects located overseas, while AFR, SA, and OTH stand for Africa, South America, and other offshore regions, respectively. The project milestone variables of GRT, ADV, POT, and PRD stand for grass-root explorers, advanced explorers, potential producers, and producers, respectively.

Table 3. Distribution of uranium projects by country

Project country	Australian firms	Canadian firms	Total projects
Angola	1		1
Argentina	3	21	24
Australia	347	23	370
Botswana	3		3
Burkina Faso	2	1	3
Cameroon	1	1	2
Canada	1	303	304
Chile	2	1	3
Columbia		1	1
Finland	1	3	4
Greenland	2	1	3
Guinea	3		3
Guyana	1	2	3
Hungary	1		1
Italy	2		2
Kazakhstan		7	7
Kenya	1		1
Kyrgyz Republic	2	4	6
Malawi	6		6
Mali	2	1	3
Mauritania	4		4
Mongolia		8	8
Morocco		1	1
Mozambique	1		1
Namibia	13	5	18
Niger	2	3	5
Peru	2	14	16
Slovakia	3	3	6
South Africa	5	2	7
South Korea	3	1	4
Spain	1		1
Sweden	11	2	13
Tanzania	7		7
Turkey	2		2
USA	19	65	84
Zambia	4	2	6
All countries	458	475	933

uranium operational focus, both countries are very similar, with a mean (median) focus of 0.51 (0.50) for Australian firms and 0.49 (0.40) for Canadian firms.

We consider firm subsamples in partitions based on overseas locations. Eighty firms in the sample have all of their projects located overseas only (OVS), 30 firms have both domestic and overseas projects, and 212 have all their projects located domestically. Henceforth, we refer to the sample consisting of the latter 242 as DOM. Looking at the OVS partition is important because these firms are fully exposed to the institutions of their host country locations.

The Canadian sample has relatively more firms with uranium project portfolios located entirely overseas (40 out of 141 firms or 28.4%), notably in South America. In comparison, a total of 38 out of 181 firms (21%) in the Australian sample have purely overseas project portfolios. An examination of the development milestone achieved by the most advanced uranium project of sample firms confirms the dominance of grass-root explorers (86.4% and 88.3% for Australian and Canadian firms, respectively).

Table 3 reports a breakdown of projects by country. Out of the total 933 projects, 458 (49%) belong to Australian firms and 475 (51%) to Canadian firms. Overall, 650 (69.67%) of uranium projects are located domestically with 283 projects located overseas (31.33%). The dispersion of overseas projects across countries with diverse institutional systems provides the opportunity

Table 4. Average abnormal returns and cumulative abnormal returns for the first 25 trading days after the Fukushima nuclear event

Event window	Full ($N=322$)	AUS ($N=181$)	CAN ($N=141$)
–1	–0.0142**	–0.0113	–0.0179*
0	–0.0320**	–0.0510***	–0.0076
1	–0.0901***	–0.0742***	–0.1105***
2	–0.0111	0.0297**	–0.0634***
3	–0.0076	–0.0232*	0.0125
4	0.0175*	0.0251**	0.0077
5	0.0341***	0.0258**	0.0448***
6	0.0185*	0.0032	0.0382**
7	–0.0016	0.0069	–0.0124
8	–0.0044	0.0022	–0.0128
9	–0.0062	0.0025	–0.0173
10	0.0013	–0.0058	0.0104
11	–0.0179**	–0.0122	–0.0254*
12	–0.0090	–0.0031	–0.0166
13	–0.0022	–0.0020	–0.0024
14	–0.0006	–0.0007	–0.0004
15	0.0034	0.0031	0.0038
16	0.0034	0.0067	–0.0008
17	–0.0163**	–0.0152	–0.0176**
18	–0.0028	–0.0027	–0.0028
19	–0.0031	–0.0092	0.0047
20	–0.0014	0.0089	–0.0147
21	–0.0068	–0.0075	–0.0058
22	–0.0135*	–0.0105	–0.0173*
23	0.0031	0.0022	0.0042
24	0.0077	0.0111	0.0034
CAR[0,+1]	–0.1221***	–0.1252***	–0.1181***
CAR[0,+4]	–0.1233***	–0.0936***	–0.1614***
CAR[0,+9]	–0.0827***	–0.0530***	–0.1208***
CAR[0,+14]	–0.1112***	–0.0769***	–0.1552***
CAR[0,+19]	–0.1265***	–0.0943***	–0.1679***
CAR[0,+24]	–0.1374***	–0.0901***	–0.1981***

The average daily abnormal returns and CARs across the Fukushima event window [–1,+24] for various sample partitions. "Full" stands for the full sample. AUS and CAN stand for firms that are listed on the ASX and TSX/V, respectively.
***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively. Statistical significance is assessed based on the adjusted-BMP *t*-statistic, which accounts for potential problems of event-induced volatility, autocorrelations of returns, and cross-correlation of abnormal returns (see Kolari and Pynnönen, 2010).

to analyze the link between the variation in the firms' exposure to political discretion–constraint and associated risks.

4.2. Market reaction to the Fukushima nuclear event

Table 4 presents average abnormal returns (AARs) for the first 25 trading days after the Fukushima event.[12] The results show an overall strong market reaction to the nuclear disaster, with 76.1% of the full sample experiencing negative abnormal returns during the 2-day event window (from day 0 to day +1). The AAR for day 0 and day +1 is –3.20% and –9.01%, respectively. These abnormal returns are highly significant (at $P<0.01$) based on the adjusted-BMP *t*-statistic (Kolari and Pynnönen, 2010). This is followed by a reversal at around day +4, +5, and +6 before dropping further. The cumulative AARs computed across various window lengths

[12] These abnormal returns and the adjusted-BMP statistics are estimated using the Stata module 'eventstudy2' contributed by Kaspereit (2020).

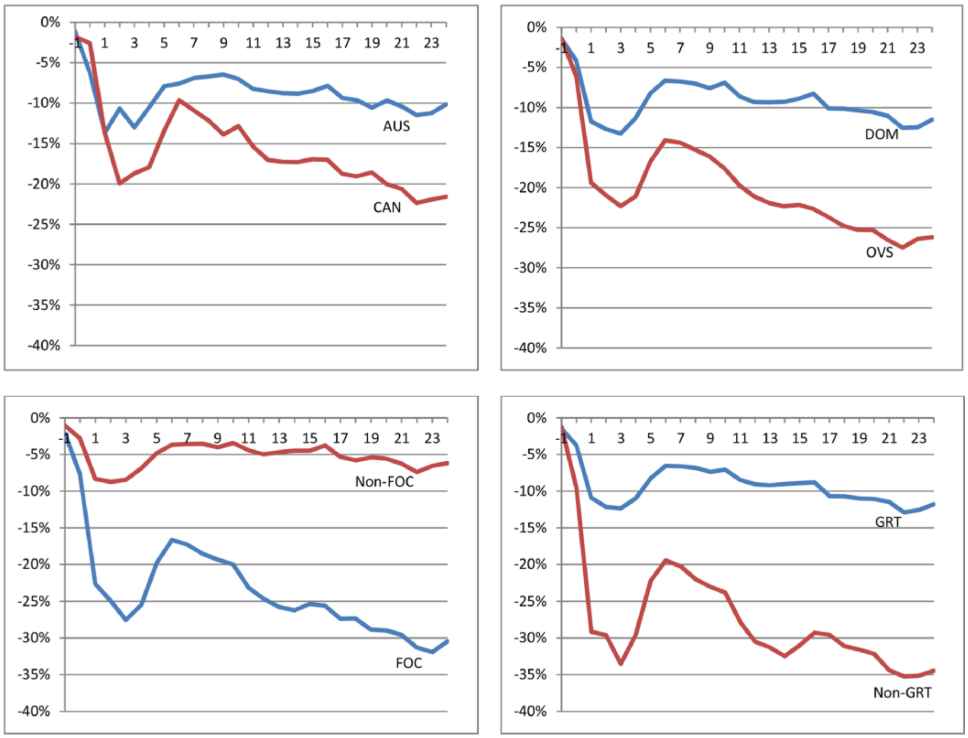

Figure 2. Cumulative average abnormal returns for the first 25 trading days after Fukushima nuclear event. AUS and CAN stand for firms that are listed on the ASX and TSX/V, respectively. OVS stands for firms with all of their uranium projects located overseas and DOM for otherwise. FOC stands for firms with a uranium focus measure greater than 50% and Non-FOC for otherwise. GRT and Non-GRT stand for firms that are grass-root explorers and advanced explorers or potential producers, respectively

confirm that uranium firms experienced strong negative market reactions to the disaster, with CAR[0,+24] equal to −13.74% (at $P < 0.01$).

We further partition the sample based on various attributes to gauge the reactions across Australian and Canadian subsamples. A comparison between AUS and CAN reveals Canadian firms barely responded to the disaster on day 0 (−0.76%, not significant), which is in sharp contrast to the day 0 abnormal return of −5.10% (at $P < 0.01$) for Australian firms. However, at day +1, the pattern is completely reversed with Canadian firms suffering an abnormal return of −11.05% (at $P < 0.01$) versus −7.42% (at $P < 0.01$) for the Australian subsample. Over the 2-day event window, both subsamples experienced roughly the same negative CAR. The lack of market response on day 0 and enhanced response on day +1 for Canadian firms may be explained by the difference in calendar time between Japan, Australia, and Canada. The Fukushima nuclear accident occurred on March 11 (Friday), with the first trading day in Australia after the accident being March 14 (Monday), giving Australian investors the whole weekend (March 12 and 13) to receive and process additional information before the commencement of trading on Monday morning. On the other hand, the first trading day in Canada is March 11 (Friday), with relatively little information on the extent of damage and potential policy ramifications known to Canadian investors and thus the initial lack of market response. The much stronger Canadian reaction at day +1 indicates the delayed arrival of more actionable information. Overall, the evidence in Table 4 strongly supports hypothesis H1 asserting that uranium firms experienced a negative market reaction following the Fukushima nuclear accident. We plot the cumulative average abnormal returns over the full event window [0,+24] in Figure 2, showing a general pattern of declining CAR.

Table 5. Summary statistiSummary statistics and correlation matrix of cross-sectionalross-sectional variables

Panel A: summary statistics						
	N	Mean	Median	Std. dev.	Min	Max
CAR[0,+1]	322	−0.1221	−0.0900	0.1578	−0.6443	0.1891
POLCON	322	0.7636	0.8396	0.1755	0.0000	0.8542
MCAP	322	3.3521	3.0692	1.5958	−0.2231	11.9552
FOCUS	322	0.5074	0.4750	0.3245	0.0256	1.0000
ADV	322	0.0745	0	0.2630	0	1
POT	322	0.0497	0	0.2176	0	1
PRD	322	0.0248	0	0.1559	0	1
CAN	322	0.4379	0	0.4967	0	1
EUD	322	0.8153	0.0221	1.3522	0.0000	14.1709

Panel B: correlation matrix								
	CAR	*POLCON*	*MCAP*	*FOCUS*	*ADV*	*POT*	*PRD*	*CAN*
CAR[0,+1]								
POLCON	0.0955							
MCAP	−0.2247*	−0.1477						
FOCUS	−0.4043*	−0.1299	0.1036					
ADV	−0.3029*	−0.0981	0.2022*	0.2623*				
POT	−0.2760*	−0.1128	0.2492*	0.1778	−0.0649			
PRD	−0.0589	−0.1208	0.5202*	0.1273	−0.0453	−0.0365		
CAN	0.0224	−0.0039	−0.0505	−0.0135	0.0117	−0.0578	0.0200	
EUD	0.0440	0.1473	0.0058	−0.0508	−0.0878	−0.1177	0.2564*	0.6484*

This table reports the summary statistics and correlation coefficients for the variables used in the cross-sectional analysis. *POLCON* is firm-specific exposure to political constraint. *MCAP* is the natural log of the market value of equity. *FOCUS* is the firm's operational focus on uranium. *ADV* is a dummy variable for advanced explorers. *POT* is a dummy variable for potential producers. *PRD* is a dummy variable for producers. *CAN* is a dummy variable for Canadian-listed firms. *EUD* is firm-specific country exposure to uranium dependence.
*indicates significance at the 1% level.

4.3. Cross-sectional analysis

Univariate results in confirm that OVS firms suffered more negative abnormal returns than DOM firms, suggesting that market reactions to the incident may be related to the location (domicile) of uranium projects across sample firms.

Table 5 presents summary statistics and correlation coefficients on the variables used in the cross-sectional model (equation 1). In panel A, the vast difference observed between the mean (0.8153) and median (0.0221) measure of *EUD* suggests that the majority of sample firms are engaged with uranium projects in countries where reliance on uranium export revenue is relatively low. The correlation matrix in panel B indicates that *EUD* is positively correlated with *POLCON* and *CAN*, while *MCAP* is positively correlated with *ADV* and *POT*. The particularly high correlation between *EUD* and *CAN* (0.7557) may pose a problem when both variables are included in the regression. For robustness tests, we rerun the cross-sectional regressions in Table 6 by dropping either *CAN* or *EUD* from the model with results (unreported) qualitatively the same.

Table 6 reports the results of the ordinary least squares (OLS) cross-sectional analysis.[13] As a baseline model, we first present results for the regression of CAR[0,+1] on the control variables, which show highly negative and significant coefficients (at $P < 0.01$) for the variables *FOCUS, ADV*, and *POT* (column 1). The signs of the coefficients suggest a negative impact of uranium focus, project development, and involvement in uranium production on CAR.

We next present regression results with *POLCON* and its squared term in the model. Models 2 and 3 incorporate POLCON and its square term sequentially, without the control variables,

[13] Due to potential concerns of heteroscedasticity, we report *t*-statistics and significance levels using robust standard errors of White (1980).

Table 6. Cross-sectional analysis of political constraint and market reaction to the Fukushima nuclear accident

	Dependent variable = CAR[0,+1]				
	(1)	(2)	(3)	(4)	(5)
Constant	0.0059	−0.1876***	−0.0118	0.0024	0.0944**
	(0.23)	(−4.58)	(−0.21)	(0.05)	(2.02)
POLCON		0.0858*	−0.8132***	0.0043	−0.5044***
		(1.67)	(−3.34)	(0.10)	(−2.74)
$POLCON^2$			0.8319***		0.4777***
			(3.66)		(2.65)
MCAP	−0.0109*			−0.0109*	−0.0105*
	(−1.85)			(−1.84)	(−1.77)
FOCUS	−0.1477***			−0.1476***	−0.1456***
	(−5.38)			(−5.36)	(−5.31)
ADV	−0.1302***			−0.1301***	−0.1237***
	(−4.14)			(−4.12)	(−3.96)
POT	−0.1527***			−0.1524***	−0.1432***
	(−3.54)			(−3.55)	(−3.33)
PRD	0.0301			0.0309	0.0535
	(0.62)			(0.63)	(1.04)
CAN	0.0092			0.0095	0.0114
	(0.50)			(0.51)	(0.61)
EUD	−0.0048			−0.0050	−0.0066
	(−0.86)			(−0.87)	(−1.21)
Observations	322	322	322	322	322
F-statistic	18.24	2.79	7.37	15.95	15.16
Prob > *F*	0.0000	0.0957	0.0007	0.0000	0.0000
R^2	0.2687	0.0091	0.0474	0.2687	0.2804

This table reports ordinary least squares (OLS) cross-sectional regressions of CAR[0,+1] on *POLCON* and other firm-level control variables. *POLCON* is firm-specific exposure to political constraint. *MCAP* is the natural log of the market value of equity. *FOCUS* is the firm's operational focus on uranium. *ADV* is a dummy variable for advanced explorers. *POT* is a dummy variable for potential producers. *PRD* is a dummy variable for producers. *CAN* is a dummy variable for Canadian-listed firms. *EUD* is firm-specific country exposure to uranium dependence. *t*-statistics (in parentheses) are computed using robust standard errors of White (1980).
***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.

and models 4 and 5 with the control variables. When POLCON alone is included with the control variables in the regression, model 4 shows that it is not significant but *FOCUS*, *ADV*, and *POT* continue to be so. Results in model 5 show the U-shaped relationship between abnormal returns.

Following Haans et al. (2016) and Lind and Mehlum (2010), we ran the test of the presence of a U shape. The test returned the *t*-value of 2.44 with the *P*-value of 0.008, confirming the statistical significance of the U shape. The inflection point calculated from the coefficients is 0.53 (i.e., 0.5044/(2*0.4777)) (Haans *et al.*, 2016). The 95% Fieller's interval for the inflection point was [0.432; 0.696]; i.e., both lower and upper bounds are within the POLCON range in our sample between 0 and 0.854. Following the tests, we can conclude that the cross-sectional results support the hypothesized (H2) U-shaped relationship between *POLCON* and abnormal returns to uranium firms as a result of the Fukushima incident. This result implies disasters like the Fukushima accident result in investors revising expectations regarding possible policy changes, incorporating political discretion–constraint levels of the jurisdictions in which the uranium projects are located. In particular, market participants consider the trade-off between political constraint and political discretion, resulting in a U-shaped relation with abnormal returns.

The strength of this relationship can be seen in the depiction of the estimated model in Figure 3. The figure presents the predicted relationship between *POLCON* (i.e., a firm's exposure to it) on the horizontal axis and CARs on the vertical axis. For ease of attributing specific project location countries to their corresponding *POLCON* scores, we flagged their locations across the axis, thereby making it clear which countries fall into which political discretion categories. The graphs show that the negative impact of *POLCON* on heterogeneous CARs is weaker for firms exposed to high levels of *political discretion* (low *POLCON*). This negative impact strengthens

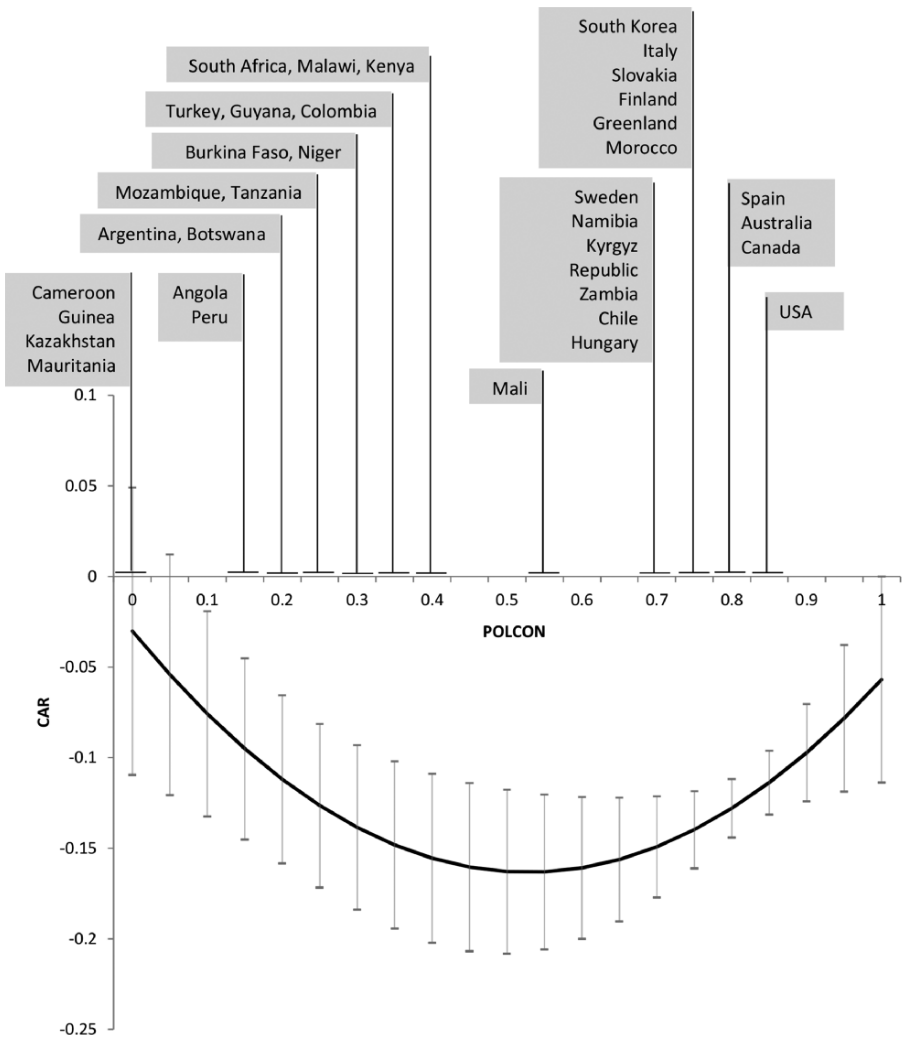

Figure 3. The impact of firm exposure to political constraints on cumulative abnormal returns as a result of the Fukushima nuclear incident

as we move rightwards. Moving from moderate to high levels of *POLCON*, the negative impact weakens again. The figure also shows that the effect sizes are substantial, as at the lowest and highest levels of POLCON, the CARs are around −0.03, but declining down to as low as −0.16 at the moderate levels. This relationship holds independent of whether one examines the results at the level of operations individually or aggregated as a country—which reveals that the results are not skewed by over- or underrepresentation of operations in one country relative to another.

5. Additional analysis

5.1. Robustness to alternative estimation window

We have tested the robustness of our results to an alternative event window. Namely, we have rerun the AARs and CARs using an estimation window of [−140, −1], as opposed to the estimation window of [−290, −11] used in the main results. The new estimation window not only cuts the window in half (140 versus 280 days) but also shifts it closer to the event (if there were doubts regarding the exogeneity of the event, choosing a window very close to the event would pick up pre-event anticipation). The results (both of the estimates of the returns and those of cross-sectional analysis) are strengthened with the new event window in terms of the size of the effects and statistical significance levels, indicating that our original estimation window used in the paper is a conservatively selected window.

In further analysis, we consider the impact of flight-home effects caused by the Fukushima nuclear disaster as an alternative explanation for the cross-sectional variation in market reaction that we observed. For instance, French and Poterba (1991) find that US investors allocate nearly 94% of funds domestically, despite the US market comprising less than 48% of global market capitalization. In the context of our study, this flight-home effect can be thought of as investors with home-country bias favoring firms with domestic uranium projects over those with projects located overseas. It is also consistent with studies examining the behavior of multinational corporations in local disasters (Oh and Oetzel, 2011). To examine the possibility of uranium investor flight-home effects, we first determine the geographic co-ordinates for each uranium project in the portfolio of Australian and Canadian sample participants, obtained from the SNL Metals and Mining database. The geographic distance measure is the linear distance from the firm's flagship uranium project to the firm's headquarters in the home country (Australia or Canada). This measure is calculated using the "geodist" package in Stata. We then define a variable *GEODIST* as the natural logarithm of the geographic distance measure obtained. Although we found a negative association between abnormal returns and geographic distance, the inclusion of *GEODIST* in the cross-sectional model did not subsume the U-shaped relationship between the market reaction and *POLCON*. In other words, the flight-home effect appears unlikely to be an alternative explanation for the political constraint proxy results.

6. Summary and conclusions

Environments with high political constraints may, other things equal, offer a less risky setting for MNEs. However, other things are rarely equal, and MNEs do not choose their locations based on political constraints only but make their investment decisions based on a balance of a myriad of factors. For resource-seeking MNEs, a necessary condition of location selection is the availability of resources, a fact even more clearly demonstrated for natural resource MNEs. Firms may enter high-risk locations *despite* the risk if economic returns are high enough to compensate for the expected risk, particularly if the focal resources are very location-bound and limited in terms of global availability. As a result, the investigation of political risk cannot be separated from observing firms' endogenous choices of locations alone.

In this paper, we develop an empirical response to a puzzle in the previous literature on the implications of political discretion constraint for firms in regulated sectors. The literature on policy risk in IB suggests that the concentration of political power in the hands of the ruling executive (or party) poses the risk of policy change for foreign firms with investments in those countries (Henisz, 2000; Henisz and Zelner, 2005). At the same time, another stream of work suggests that, other things equal, MNEs operating in regulated industries often prefer countries with high political discretion, due to better outcomes of negotiating and sustaining favorable conditions in the host country (Holburn and Bergh, 2008; Holburn and Zelner, 2010; Jiménez *et al.*, 2014; Zhu and Sardana, 2020). While the preference for political discretion is logical, political risk-based implications of such preferences for the companies remained unstudied.

In the case invested in this research, we demonstrate that the distribution of risk across the continuum of the political discretion constraint is nonlinear. High levels of political discretion (i.e., low levels of political constraint) facilitate creating *specialized safeguards* in dealing with the host country government and preventing adverse policy changes. At high levels of political constraints, *generic safeguards* reduce the risk of policy change. As a result, the moderate/intermediate level on the political discretion–constraint continuum becomes the range with the highest risk of policy change. To corroborate our logic, we investigated the relationship between heterogeneity in stock market reactions of uranium company stocks to the Fukushima nuclear disaster and the companies' exposure to overseas policy risk. We found that, first, uranium stocks in Australian and Canadian equities markets experienced significant losses in the 2-day window associated with the nuclear disaster. This finding shows how a disaster in the nuclear plant caused a reaction upstream along the value chain and a reassessment of firm value. As a result, the international distribution of uranium mining created an international natural experimental context for testing the impact of political risk on the heterogeneity of the effect across firms. Consequently, we attributed the heterogeneity in CARs to the levels of policy constraint in uranium project locations. Our cross-sectional results provide evidence in support of the U-shaped relationship between the value of the portfolio of projects in a firm and the distribution of those projects on the political discretion–constraint continuum, and this effect remains intact and material even when alternative model specifications are examined.

Our work contributes to the literature in several ways. First, the prior literature on policy risk focused on how political *constraints* provide generic safeguards against the risk of policy change in host locations (Henisz, 2002; Martin *et al.*, 2010; Bucheli and Kim, 2015; Zhang *et al.*, 2016). The prior literature on entry decisions reveals the importance of specialized safeguards (Henisz and Zelner, 2004; García-Canal and Guillén, 2008; Holburn and Zelner, 2010; Menozzi *et al.*, 2011; Zhu and Sardana, 2020) but does not explain the post-entry effect of political discretion on MNEs. We fill this gap by hypothesizing and documenting a U-shaped investor-perceived consequential risk across the *political discretion–constraint* spectrum, following a significant event. Second, most studies of cross-country institutional variations examine distinct regulatory regimes rather than the mixture of regimes (Jiménez *et al.*, 2014; Buckley *et al.*, 2020). The Fukushima nuclear disaster created a natural experimental structure in which we were able to examine the effects on differentially domiciled firms operating with assets dispersed across regulatory regimes. The strength of our results shows that such dispersion matters and can add significantly to the impact of natural events. The literature has used exogenous events for testing IB theories but has done so by focusing on location-specific events (Oh and Oetzel, 2011; Oetzel and Oh, 2014; Dorobantu *et al.*, 2017a). Unlike those studies, we focus on a single event that had a chain-reaction upstream along the global value chain of the nuclear power industry. This approach allows disentangling event-specific consequential expectations of policy changes from other location-specific characteristics of host countries.

The findings provide implications for both MNE strategy and risk management in stock market investments. There is increasing evidence that following the rise in recent years in mining companies' move into higher-risk locations to mine new deposits, companies are facing a resurgence in resource nationalism and other political hazards (Mordant and Taylor, 2017; Aquino and Cambero, 2021; Blanco and Machado, 2021). Although mining firms take political risk into account either by selecting more stable and safer locations or via proactive measures to lower potential risks at the time of entry decisions (Jiménez *et al.*, 2014; Oh *et al.*, 2020), such approaches are not always guaranteed to be effective. Our findings indicate that mid-level democracies may create a regulatory environment where both generic and specialized safeguards are at their moderate strength, creating both opportunities and risks for firms. In these circumstances, while firms may lack some effective generic safeguards against adverse policy changes, those companies confident in their political capabilities might possess advantages that allow them to adjust effectively via specialized governance mechanisms.

Second, our study has implications for managing risk not only at the project level but also at the project portfolio and stock market portfolio levels. Although much of the extant literature focuses on the risks of political discretion, our research shows that in regulated industries the risk implications of political discretion can be reversed. Furthermore, our findings imply that generic safeguards and specialized safeguards are substitutes, rather than complements. If mid-level democracies create an environment lacking both generic and specialized safeguards, such risk will have to be managed at the firm (i.e., project portfolio) level, by balancing between low-risk-low-return and high-risk-high-return projects. In making location choices, firms must compare countries not only in terms of high versus low political discretion but also in terms of whether or not firms can erect specialized safeguards in environments that lack generic safeguards. This implication can also be extended to stock market portfolio investors. The largest stock market risk levels for these investors land not on the firm's exposure to environments with low levels of political constraint (as the literature on political risk would suggest) but on the stocks of companies exposed to mid-level democracies. Therefore, our findings add precision to the risk management tools for investors intending to diversify the level of policy risk in their stock portfolios.

6.1. Limitations and future research

We would like to highlight two points with regard to the limitations of the present study and avenues for future research. First, our sample is based on uranium firms, due to the focal event being nuclear related. However, the distribution of policy risk in other industries may be different from that in uranium mining and production. For example, the regulatory conditions in the electric power generation are different from those in the mining industry (Holburn and Zelner, 2010). Hence, industry-specific conditions may influence the dynamic of relationships with the host government. Therefore, the findings drawn from a sample of uranium companies should be generalized to other industries with due consideration of industry-specific conditions. This limitation also opens avenues for future research. For example, a multi-industry analysis identifying industry-specific conditions that can moderate the impact of political discretion constraint on political risk can uncover industry-specific contingency effects.

Second, we did not measure the MNEs' political capabilities or related experiences explicitly but followed past studies, suggesting that firms in regulated industries inevitably rely on such capabilities (García-Canal and Guillén, 2008; Jiménez *et al.*, 2014). As the next step of understanding the impact of political constraint on stock valuations, future studies can measure political capabilities explicitly and investigate whether the impact of political discretion constraint on investor returns varies with the firm-specific level of political capability. In addition, understanding whether the firm and its managers have had experience with similar or related types of disasters/events would prove illuminating, as this has been found to be the case with respect to some natural disasters in the United States (Oetzel and Oh, 2021). The U-shaped effect may become shallower for some firms and deeper for others, depending on their political capabilities or preparedness for managing unexpected developments (Jiménez *et al.*, 2014; Oetzel and Oh, 2014; Zhu and Sardana, 2020). We trust that further research in this stream can uncover new theoretical and managerial implications.

Related to the above, firms also vary in the types of capabilities they have. Firms that invest in high political discretion countries may have higher relational capabilities, whereas those that invest in countries with high political constraints may have stronger legal and community engagement capabilities. In other words, firms in our sample chose countries that match their political risk management capabilities (Henisz and Zelner, 2004; Holburn and Zelner, 2010). In the full population of firms and investment opportunities, firms with one sort of capability may do relatively better in one environment and those with another set of capabilities better in another. While this point does not change the implications of our analysis for investors in companies already present in the location (because we focus on consequential risk for existing firms), it does alter the implications for managers assessing a potential investment opportunity because investment decisions should take into account the firm's capabilities and tolerance for risk.

Finally, we must acknowledge the geographic coverage of the home countries of the companies in the empirical section, as our dataset covers only Australian and Canadian firms Although this sample covers 88% of global listings, including firms from other home countries can help address more nuanced questions with respect to potential home-country effects and associated implications for MNEs' ability to manage political risk.

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