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Multinational enterprises' R&D commitments in Chinese provinces: A configurational approach

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ABSTRACT

Multinational enterprises (MNEs) are increasingly off-shoring some of their R&D to emerging markets, including China. Much of the extant literature on MNEs' investments in R&D facilities abroad analyses technological and institutional factors at the national level, typically using regressions to examine how host-country institutions influence foreign MNEs' outlays. It, therefore, tends to downplay the importance of sub-national and non-technology-related institutions, and how configurations of home- and host-country institutions interact to influence R&D commitments abroad. Drawing on the global factory model and the Varieties of Capitalism approach, we identify five causal conditions that may influence MNEs' R&D commitments abroad. Conducting an abductive fuzzy-set qualitative comparative analysis, we find four combinations of causal conditions are sufficient to explain substantial R&D commitments in different Chinese provinces. The combination of local corruption and provincial R&D intensity is important, as are the MNE's home-country stock-market capitalization to GDP ratio and minority investor protection. We contribute to the literature on MNEs' investments abroad by extending the importance of sub-national institutions to include those not directly related to technology. We also reveal how combinations of institutions (rather than individual ones acting independently) from the MNE's home and host contexts explain MNEs' R&D commitments in Chinese provinces.

1. Introduction

Multinational enterprises (MNEs) are increasingly off-shoring some of their R&D to emerging markets, including China (Buckley et al., 2020; Mavroudi et al., 2023; Papanastassiou et al., 2020). Research has long examined R&D off-shoring (Kuemmerle, 1999; Nachum, 2003; Papanastassiou et al., 2020; Xu et al., 2021), often analysing national-level institutions and investments (Lehrer et al., 2011; Mavroudi et al., 2023; Lewin et al., 2009). By doing so, such work overlooks how institutions and technological capabilities vary within countries, especially large ones, such as China (Zhang and Peck, 2016).

Although some research emphasizes the importance of sub-national institutional differences to explain firms' innovation strategies (Allen, 2013; Cantwell and Piscitello, 2002; Onuklu et al., 2021; Yang, 2018; see also, more broadly, Saittakari et al., 2023), including their decisions to invest abroad (Hu et al., 2021; McDonald et al., 2018; Monaghan et al., 2014), it often relies, as the nationally focused

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work does (Demirbag and Glaister, 2010; Hong et al., 2019; Mavroudi et al., 2023), on quantitative, regression-based models. By doing so, it downplays how institutions interact in complex ways to influence firms' strategies (Belderbos, 2003; Belderbos et al., 2023; Xu et al., 2021), and overlooks the possibility that more complex causal pathways exist that combine different institutional conditions.

In addition, empirical analyses frequently use measures and variables that are narrowly related to R&D rather than broader ones that capture firms' institutional contexts, neglecting, for instance, how home-country institutions shape company priorities and behaviour (Belderbos et al., 2023; Marano et al., 2016; Xu et al., 2021), as well as the influence of broader host-country factors (Papanastassiou et al., 2020). Despite advances, then, the causal conditions that influence MNEs' off-shored R&D investments require further scrutiny (Buckley et al., 2020; Xu et al., 2021).

To address this gap, we propose a nuanced research approach involving 1) a sub-national focus that captures host-country, inter-provincial institutional variation (Onuklu et al., 2021); 2) the incorporation of the role of home-country institutions in regulating and constituting actors, such as MNEs (Whitley, 2007); 3) an examination of the interplay between the institutional contexts of the MNE's home country and its sub-national, host-country investment location; and 4) a configurational approach (Furnari et al., 2021; Misangyi et al., 2017; Ragin, 2000; Ragin and Fiss, 2008).

We integrate insights from two transaction cost economics-based approaches, Buckley's global factory model and the 'Varieties of Capitalism' perspective. These two approaches have commonalities: both, for instance, discuss how institutions shape actor opportunism (Buckley, 2009a, 2009b, 2007; Hall and Soskice, 2001). They also, however, differ: while the 'global factory' focuses primarily on the internalization-externalization decision, the VoC approach highlights how configurations of casual conditions influence firm behaviour (Allen, 2004). Synthesizing these two approaches enables us to identify the causal conditions that are likely to influence MNEs' R&D commitments in different Chinese provinces.

We examine the degree of commitment in R&D facilities in Chinese provinces by MNEs from diverse institutional settings. China's provinces exhibit, for example, varying levels of corruption, R&D expenditure, and technological capabilities (Demir et al., 2022; Zhang and Peck, 2016), influencing the attractiveness of particular provinces to foreign firms (Zhao and Zhang, 2007). MNEs from distinct institutional contexts respond differently to these host contexts, highlighting the importance of both home and host institutional contexts in explaining variations in R&D commitments (Whitley, 2012, 2005, 2001).

Using a configurational approach, we 1) formulate new propositions and 2) provide greater theoretical precision about the associated causal links between institutions and off-shored R&D. Our approach offers new theoretical insights, and presents novel configurations of non-competing causal conditions, demonstrating the versatility and value that configurational analyses can bring to topics that have long been the focus of IB research and that have typically adopted a 'net effects' perspective. Our findings underscore how the conjunction of home and host institutions shape MNEs' R&D commitments in Chinese provinces, revealing, for example, the significance of combinations of provincial corruption levels, local R&D intensity, and home-country stock-market capitalization.

Drawing on Furnari et al. (2021), we structure the remainder of the paper as follows. First, we draw on relevant theories and studies to 'scope' the attributes, or potential causal conditions (Furnari et al., 2021). We then show how some of these causal conditions can be 'linked' together to form possible causal combinations. In the section that then follows, we set out our methods and data. The penultimate section discusses our results, and puts forward some propositions based on our findings (Furnari et al., 2021). Finally, we conclude.

2. 'Scoping'

2.1. Previous studies' explanations of MNEs' R&D commitments abroad

Buckley's global factory offers a unique perspective on MNEs' R&D investments abroad. When combined with insights from the VoC perspective, the global factory model can help to shift analytical attention away from the current 1) focus on national factors; 2) concentration on technology- or market-related conditions, such as the availability of skilled employees; and 3) use of regression models (Demirbag and Glaister, 2010; Hong et al., 2019; Kuemmerle, 1999; Lehrer et al., 2011; Lewin et al., 2009), which rely on 'net effects' thinking (Ragin and Fiss, 2008).

Research on MNEs' R&D abroad, which initially focused on developed-economy investments, often examines the influence of economic development, human capital and local R&D expenditure, aggregated at the host-country level (Hong et al., 2019; Kuemmerle, 1999; Mavroudi et al., 2023). Similarly, the first studies that analysed MNEs' emerging-economy investments assessed the influence of a range of national-level factors, such as wage differentials between the two countries as well as country-level risk and human capital (Demirbag and Glaister, 2010; Lewin et al., 2009; Papanastassiou et al., 2020).

The focus on national-level factors downplays how sub-national institutional variation shapes firms' innovation strategies (Allen, 2013; Cantwell and Piscitello, 2002; Onuklu et al., 2021; Yang, 2018). Although international-business research increasingly considers important sub-national factors to explain, inter alia, variation in FDI (Hu et al., 2021; McDonald et al., 2018; Monaghan et al., 2014; Saittakari et al., 2023), it overlooks the influence of sub-national institutions on R&D commitments. For instance, recent work highlights how 'peripheral' cities' proximity to a 'core' city in China influences the amount of FDI they receive. Although peripheral cities obtain less than core ones, the difference is smaller for peripheral cities closer to core cities (McDonald et al., 2018). Such results underscore the influence of sub-national geographical space on FDI (see also Fu, 2008). However, it disregards R&D investments and corruption; the latter is, in China, generally high (Transparency International, 2012), and varies considerably between provinces (Demir et al., 2022).

Other research examines how an MNE's home-country status as either a developed or emerging economy influences the company's strategies to acquire high-tech competencies abroad (De Beule et al., 2014). However, it often overlooks how different owners of MNEs

in the firm's country of origin influence its strategic priorities (Coveri and Zanfei, 2023); existing research, therefore, neglects how institutions regulate and constitute firms and other actors (Whitley, 2007).

Similarly, work that focuses on how an MNE's home country influences its knowledge-related investment decisions abroad examines the role of home-country factor and market conditions, such as skilled-labour availability (Contractor et al., 2021; Demirbag and Glaister, 2010; Nachum, 2003); it does not analyse how institutional contexts both at home and abroad interact to influence MNEs' R&D commitments overseas. Moreover, existing work typically relies on regression models (Belderbos, 2003; Belderbos et al., 2023; Demirbag and Glaister, 2010; Hong et al., 2019; Lewin et al., 2009; Mavroudi et al., 2023; Xu et al., 2021), downplaying how institutions interact in complex ways to influence firms' strategies.

2.2. Synthesizing the 'global factory' and varieties of capitalism approaches: identifying potential causal conditions

To apply Buckley's global factory model to MNEs' R&D commitments in China, we propose combining it with the cognate VoC approach. We detail how the global factory relates to R&D investments abroad before setting out how we can integrate it with a VoC approach.

The global factory model emphasizes three conditions that influence MNEs' decisions to invest in R&D abroad: the lead MNE's power in the emerging economy; the prevalence of high, host-country transaction costs; and the relative importance of financial returns to individual MNEs (Buckley, 2009a, 2009b; Buckley et al., 2020). Transaction-cost economics underpins Buckley's (2004, 2007, 2009a, 2009b) conceptualization of the global factory (Narula, 2019; Narula and Verbeke, 2015) and the model's implications for MNEs' R&D commitments abroad. It is a more direct descendent of the former than the 'Varieties of Capitalism' approach that infuses other strands of thinking, most notably regulation theory and neocorporatist analysis (Allen, 2004; Hall and Soskice, 2001).

Consistent with transaction-cost economics, Buckley, (2009a, p. 135) emphasizes that, within the global factory, 'Products which should not be outsourced include those where protection of intellectual property is crucial, [and] those [...] with high technology content or performance requirements [...]'. Similarly, Buckley, (2009b, p. 233) has contended: "The general adage that 'you don't have to own something to control it' applies increasingly to physical assets but emphatically not to intangible assets such as brands and to knowledge."

Lead MNEs within global factories, by internalizing knowledge, such as R&D, and externalizing other activities, can maintain their control over the value chain, allowing them to extract rents along the value chain (Buckley and Strange, 2015, p. 244). Indeed, lead firms' internalization of knowledge within the global value chain, in part, underpins their power within host economies. As Buckley (2009a, p.137) argues: 'This [MNEs' emerging-economy strength] is allied to control of internalised technology and research skills that provide state-of-the-art products and a pipeline of future products.'

2.2.1. Host-location corruption

The emphasis on the internalization of knowledge-related activities as a source of MNE strength implies that lead MNEs in global factories may avoid investing in knowledge-related activities in provinces abroad with high actor opportunism or corruption (Li and Kozhikode, 2009). As Buckley (2009a, p. 141) has noted: 'In addition, developmental states have been riddled with corruption. Moves away from market-based rewards provide opportunities for opportunism.' Relatedly, poorly defined and enforced property rights increase the costs of contracting (La Porta et al., 1999); corruption heightens the costs of dealing with government entities (Uhlenbruck et al., 2006), inhibiting the establishment of new facilities (Buckley, 2009a; Buckley et al., 2020).

2.2.2. Knowledge spillovers, R&D expenditure, and absorptive capacity

The emphasis on knowledge internalization raises the prospect of knowledge spilling over from an R&D facility abroad to local organizations. Spillovers, the non-contractual diffusion of knowledge from one organization to another, can negatively impact investing MNEs (Buckley et al., 2020; Li and Kozhikode, 2009; Meyer, 2004, p. 260), potentially reducing their willingness to commit R&D resources (Buckley et al., 2020; Crespo and Fontoura, 2007; Teece, 1986).

When local organizations have high levels of absorptive capacity, driven by investments in R&D, the risk of knowledge spilling over increases (Buckley, 2009a; Cohen and Levinthal, 1990). Consistent with the global factory's logic, areas with local organizations exhibiting high R&D spending and absorptive capacity are likely to discourage MNEs from investing in R&D facilities there.

2.2.3. MNE size

The global factory model implies that powerful foreign firms face less jeopardy from local opportunism. The strength of MNEs in emerging economies relies heavily on their internalized knowledge assets and resources, and the current and future products that they support (Buckley, 2009a, p.137). Similarly, Chen et al., (2010, p. 527) argue, host governments face greater risks expropriating R&D assets from larger foreign firms, given their prominence and potential future investments. Therefore, firm size is likely to play a role in conditioning MNEs' investments in R&D facilities abroad, with larger firms being more likely to have greater R&D commitments abroad.

2.2.4. The varieties of capitalism framework, and the relative importance of institutional investors in the MNE's home country

The VoC framework complements the global factory in three important ways. First, it considers corporate-governance issues, including ownership, control, and minority-shareholder protection, which impact companies' strategic priorities and links to other firms. Second, it emphasizes a configurational approach to analyse how combinations of causal conditions shape companies' decisions. Finally, it considers the institutional specificity of sub-national locations in examining firms' R&D activities (Allen, 2013; Casper et al.,

2023), which contrasts with the global factory's tendency to downplay this aspect.

The global factory model posits that OECD multinationals externalize activities to boost shareholder returns. As Buckley and Strange (2015, p. 245) argue: 'There are thus substantial potential gains from externalization to the shareholders of the lead firms, whom we assume reside primarily in the advanced economies, over and above the profits to be made from internalizing production through FDI.' While multinationals from countries with stock markets that play an important role in financing firms often prioritize financial objectives, those from countries where institutional investors play a lesser role also invest in emerging economies (Belderbos et al., 2023; Coveri and Zanfei, 2023), and short-term financial returns alone often do not drive the latter.

The VoC framework emphasizes how company ownership and control influence strategic behaviour (Hall and Soskice, 2001; Jackson and Deeg, 2019, 2008), providing a theoretical basis for diverse firm objectives beyond short-term financial results (Allen, 2004; Fainshmidt et al., 2020; Hall and Soskice, 2001; Judge et al., 2014). It most closely associates a focus on short-term financial metrics with ownership by dispersed groups of institutional investors, typical of US and UK firms (Hall and Soskice, 2001).

Moreover, variation in company ownership and control influences firm behaviour beyond their relative focus on financial metrics. Companies from countries in which stock markets play a prominent role in financing companies are more likely to invest in R&D abroad than are MNEs from countries in which stock markets play less of a role (Whitley, 2012, 2005, 2001). The former often develop knowledge assets and resources relatively autarkically (Allen, 2013), enabling investment in foreign research (Whitley, 2012, 2001), and avoiding spillovers to local organizations (Oh and Yoo, 2022). Conversely, firms from countries in which the stock market plays a less prominent role in financing companies often rely on other domestic organizations to develop key knowledge resources (Whitley, 2007), constraining R&D investment abroad (Whitley, 2012, 2005). The relative importance of stock markets in owning and controlling firms in the MNEs' home country will influence their R&D commitments abroad (Morgan and Whitley, 2003; Whitley, 2007).

2.2.5. *Minority-investor protection*

It is not just firm funding that is a probable and important condition that influences MNEs' R&D commitments abroad: minority-investor protection is also crucial (Whitley, 2005), as it shapes senior managers' willingness to make risky investments (Whitley, 1999). In some countries, large shareholders or pyramid share-ownership structures may weaken minority shareholders' rights (La Porta et al., 1999), resulting in a lack of independent oversight of directors' decisions and actions. Countries that have greater protection for minority-shareholders' rights enable greater scrutiny of companies' major decisions (Kim et al., 2007; van Essen et al., 2015), influencing R&D commitments in emerging economies, with stronger minority-shareholder rights being associated with greater scrutiny, and levels, of investment in relatively high-risk locations.

2.2.6. *Diversity in Chinese capitalism*

The VoC literature highlights how institutions are never completely aligned and tightly coupled; in specific varieties of capitalism, regional and sectoral diversity exists (Allen, 2013), even if certain norms and practices prevail (Lane and Wood, 2009). This tendency is particularly pronounced in China, where there is much disparity between regions, inter alia, in the nature and extent of local and regional government involvement in economic activity (Lim, 2014; Zhang and Peck, 2016). Relatedly, network ties between local government and firms vary according to province, influencing the opportunities for, and level of, corruption (Chen et al., 2018; Zhang and Peck, 2016); some provinces are more proactive in deepening local R&D by, for example, creating university-centred knowledge districts (Zhang and Peck, 2016).

This review or 'scoping' of the literature suggests that five casual conditions are likely to be particularly important influences on MNEs' R&D commitments abroad. They are: 1) provincial-level corruption; 2) provincial-level R&D investments; 3) MNE size and, hence, power; 4) the significance of institutional investors in the MNEs' country of origin; and 5) minority-investor protection in the MNE's home country.

3. 'Linking' causal conditions: a configurational approach

The global factory model and the VoC approach diverge in their treatment of causal conditions as either discrete or interacting. The former assumes independent influences, where one condition's effect is unrelated to others. Suggesting, for example, that the level of IP protection independently influences MNEs' R&D investments, Buckley et al. (2020, p. 84) note: 'There is evidence that IP protection has improved over time in many emerging economies, and that this improvement has led to greater inflows of [knowledge-related] FDI.' In contrast, the VoC approach emphasizes how configurations of causal conditions collectively shape outcomes, highlighting the interplay among potential causes (Whitley, 2007; Cui et al., 2017). The VoC perspective, therefore, recognizes the complexity of relationships among conditions, and offers a holistic analytical approach.

Evidence from previous studies suggests the influence of each of the conditions we have identified depends on one or more of the others. For instance, more corrupt provinces are likely to pose a threat to MNEs' abilities to retain the knowledge that underpins their competitiveness (Meyer and Sinani, 2009); however, this threat may be lower if local firms in the region do not invest in R&D, and, consequently, have a limited absorptive capacity (Cohen and Levinthal, 1990; Crespo and Fortuna, 2007). Similarly, strong home-country minority-investor protection may facilitate greater scrutiny of R&D investments abroad, enabling investment even in relatively corrupt provinces.

The possibility of causal conditions acting as configurations raises issues of equifinality and asymmetry (Cui et al., 2017). Equifinality refers to how various 'causal pathways' lead to the same outcome (Aguilera et al., 2015; Misangyi et al., 2017): different firms may have high levels of R&D commitments in Chinese provinces for varying reasons. The asymmetry of causal explanations highlights how the conditions that lead to an outcome are not the inverse of those leading to its absence (Allen and Aldred, 2011; Campbell et al.,

2016). For instance, greater local corruption may impede MNEs' R&D investments; however, the 'absence' of provincial corruption does not guarantee high MNE R&D commitments.

A configurational approach also raises the issues of 'necessary' and 'sufficient' conditions. Strictly, a necessary condition is one that must be present for an outcome to occur, but its presence does not mean the outcome will occur, i.e., if X is a necessary condition, it should be present each time the outcome occurs. By contrast, the outcome can occur without the presence of a sufficient condition, but the outcome would be expected every time a sufficient condition is present (Ragin, 2000, p. 91–2).

Building on this discussion and our theoretical considerations, we argue that each of the five potential causal conditions we have identified may act either independently or conjunctively, in their presence or absence, with one or more of the other causal conditions, necessitating a configurational approach to unravel instances of equifinality, causal asymmetry and conjunctural causation.

In line with many configurational analyses (Campbell et al., 2016; Hong et al., 2019; Misangyi et al., 2017), we theorize (Mantere and Ketokivi, 2013), adopting an abductive approach (Park et al., 2020), and emphasizing observed data to formulate explanations (Mantere and Ketokivi, 2013). Our analytical framework identifies potential causal conditions and highlights potential complex causation based on their interactions; we seek to generate a mid-range theory by examining the relationships between those causal conditions and MNEs' R&D commitments in Chinese provinces. We do not set out formal hypotheses, but anticipate conjunctive influences of the identified conditions on MNEs' R&D commitments, using the empirical evidence to generate theory (Mantere and Ketokivi, 2013; Misangyi et al., 2017).

4. Methods and data

4.1. Methods

As we intend to build theory, and as the framework that we draw on does not specify how particular combinations of causal conditions influence the outcome, we use fuzzy-set qualitative comparative analysis (fsQCA) abductively (Campbell et al., 2016; Misangyi et al., 2017; Park et al., 2020). Our causal conditions are complex and configurational; they are conjunctural (Fainshmidt et al., 2020; Rihoux, 2006), making the use of fsQCA rather than a net effects-based regression appropriate (Fainshmidt et al., 2020; Meuer and Fiss, 2020; Ragin, 2008, 2000; Schneider and Wagemann, 2012).

Typically, fsQCA relies on purposive sampling methods, requiring the identification of the outcome of interest and a sample of firms to study (Greckhamer et al., 2013, p. 58; Meuer and Fiss, 2020). The sample size for fsQCA analysis depends on the model's number of causal conditions (Fainshmidt et al., 2020; Rihoux and Ragin, 2009); our model has five causal conditions, requiring at least 15 cases in our sample size (Marx, 2006). Our dataset, with 60 cases (after excluding some cases because of missing data), comfortably exceeds that, and represents a relatively large fsQCA sample (Cui et al., 2017; Park et al., 2020).

4.2. Proxies, data sources, and calibration

We compiled 2012 data on MNEs' R&D commitments in Chinese provinces from the Financial Times' fDI Markets database. We chose this year due to data availability and to avoid the influence of Chinese government policies launched in 2016 to attract investment in selected technologies, such as robotics and new energy (CSET, 2019).

The fDI Markets dataset systematically records announced and realized R&D FDI projects. Past studies have used this dataset to analyse off-shoring decisions (Demirbag and Glaister, 2010; Doh et al., 2009; Hahn et al., 2009). It provides comprehensive details on each project, including invested capital, investing MNE's identity and origin, host country, sub-national province, and project launch date. We measured the MNE's R&D commitments in China by the capital investment as a percentage of revenues. We anchored thresholds for full membership, two thirds, one third, and non-membership of the set of firms with a high R&D commitment, respectively, at 1 % or more; more than 0.5, but less than 1 %; more than zero, but less than 0.5 %; and 0 at 0 % of the firm's revenue.

We used the fDI Markets database to assess MNE power, measuring it as the MNE's total (global) revenues. The direct method of calibration was applied to calibrate firms' revenues for the sample of firms selected, with anchors being established at 1 for firms with revenues of 40 billion USD and above, and 0 for firms with revenues of 1 billion USD or less. The cross-over point (0.5) was set at 15 billion USD.

To evaluate short-term financial pressures on MNEs, and in line with related studies (Judge et al., 2014; Gupta et al., 2020), we use the home-country stock-market capitalization to GDP ratio. We draw on data from Federal Reserve Bank of St. Louis Economic Data (<https://fred.stlouisfed.org>) (or Federal Reserve Economic Data). There is one exception: for Taiwan, we use the *Taiwan Stock Exchange Fact Book* (2013), as the Federal Reserve Economic Data do not cover Taiwan. Both databases use the same formula for calculating this ratio (total value of companies listed on the home country's stock market divided by the country's GDP). We use the direct method of calibration to assign fuzzy-set values to firms' stock-market capitalization, setting anchors at 1 for 130 %, 0.5 for 65 %, and 0 at 10 %.

Our data on minority-investor protection come from the World Bank Doing Business publication (<https://www.worldbank.org/en/programs/business-enabling-environment/doing-business-legacy>); in line with previous studies (Witt et al., 2018), it captures the average of three indicators that assess minority investor protection: the extent of disclosure, the extent of directors' liability, and the ease with which shareholders can take legal action against the company (World Bank Group, 2022). We again use the direct method of calibration for the fsQCA values: 1 for investor protection scores of 100, a value of 0 for the minimal investor protection score of 0, and 0.5 when the investor protection score is 50.

As our proxy for provincial corruption in China, we use data from Chen et al. (2018). They use a 'multiple indicators and multiple

causes' (MIMIC) model to estimate corruption in all Chinese provinces. We use a four-set fsQCA scale to calibrate the corruption index. We assign a value of 1 to provinces with a score of 5 or above on [Chen et al.'s \(2018\)](#) index; a value of 0.67 for provinces with a score above 2.5, but below 5; a score of 0.33 for provinces with a score above 0, but below 2.5; and 0 for provinces with a score of 0.

To proxy local organizations' absorptive capacity at the provincial level, we, as related studies do ([Fu, 2008](#)), use data on provincial-level R&D intensity from the Chinese [National Bureau of Statistics \(2013\)](#). R&D intensity, expressed as a percentage of the province's gross product, captures actual spending on basic and applied research, along with experimental development, including personnel fees and material costs. We use a four-set fsQCA scale to calibrate the level of absorptive capacity in Chinese provinces: a score of 1 covers provinces with an R&D intensity of 5 % or more; 0.67 for scores of 2.5 % and above, but below 5 %; 0.33 for scores above 0 %, but below 2.5 %; and 0 for scores of 0 %. [Table 1](#) summarizes how we calibrated the 'raw' data for our analysis, our data sources, and other studies that have used the same proxies. We used publicly available data to provide illustrative cases in each recipe.

As our research is innovative and exploratory, and because the presence or absence of specific causal conditions could lead to the outcome, we argue that specifying assumptions for logical remainders is not appropriate at this stage. Following recommendations to choose the most appropriate solution(s) for the analysis ([Schneider and Wagemann, 2012](#)), we select the complex solution. Hence, only empirical cases inform our results; we do not consider counterfactual cases. We, therefore, assume that all counterfactual cases, if they existed, would be negative (i.e. would not be associated with high R&D commitments) ([Soda and Furnari, 2012](#)). We justify this assumption because 1) our analysis is abductive (and, hence, observable, rather than counterfactual, evidence seems most appropriate when formulating theory) ([Misangyi et al., 2017](#)), p. 268, and 2) our fsQCA sample is relatively large (60 cases) ([Cui et al., 2017](#); [Park](#)

Table 1
Calibration table.

Causal Conditions, and Outcome	Causal Conditions and Outcome Capture ...	Calibration Scale	Source and previous studies that have used the same database
<i>Outcome</i>			
Capital investment in R&D facility as a percentage of the firm's total revenue	The firm's commitment to R&D investments in China.	Four-value fuzzy set: 1 = fully in (if R&D investment in China is 1 % or more of the firm's total revenue) 0.67 = more in than out (0.5 % and above, but below 1) 0.33 = more out than in (above 0, but below 0.5) 0 = fully out (equal to 0)	Financial Times' fDI Markets Demirbag and Glaister, 2010 ; Doh et al., 2009 ; Coveri and Zanfei, 2023 ; Hahn et al., 2009 , who used the forerunner to the fDI Markets database, LOCOMonitor
<i>Causal Conditions</i>			
Firm Revenue (USD m)	The power of the MNE in the emerging economy – the higher the total global revenue for the MNE, the more powerful the MNE.	Direct Method of Calibration Anchors: 1–40,000 USD m 0.5–15,000 USD m 0–1000 USD m	Financial Times' fDI Markets
Stock Market Capitalization as a % of GDP	The importance of short-term profitability to the MNE – the higher the percentage, the more short-term MNEs from that country are likely to be.	Direct Method of Calibration Anchors: 1–130 % or more 0.5–65 % 0–10 %	Federal Reserve Bank of St. Louis Economic Data Allen and Aldred (2011) , Judge et al. (2014) , Gupta et al. (2020) , Schneider et al. (2010) , Schneider and Paunescu (2012) .
Minority-Investor Protection	The pressure on managers from minority shareholder to protect the firm from risky investments.	Direct Method of Calibration Anchors: 1–100 0.5–49 0–0	World Bank measure Witt et al. (2018)
Destination Province Corruption Score	The risk of expropriation in the province where the investment is made.	Four-value fuzzy set: 1 = fully in (equal to, or above, above 5) 0.67 = more in than out (above 2.5 but below 5) 0.33 = more out than in (above 0, but below 2.5) 0 = fully out (equal to 0)	Measured developed by: Chen et al. (2018)
Input intensity of R&D funds (%)	The importance of R&D to the province's economy	Four-value fuzzy set: 1 = fully in (equal to, or above, 5 %) 0.67 = more in than out (above 2.5 %, but below 5 %) 0.33 = more out than in (above 0 %, but below 2.5 %) 0 = fully out (equal to 0 %)	Financial Times' fDI Markets

et al., 2020).

5. Results

5.1. Configurational solutions

We first assessed whether any of our causal conditions is 'necessary' for the outcome to occur. The results shown in Table 2 reveal that none of the individual conditions exceed the recommended 0.90 threshold of consistency for necessary conditions (Schneider et al., 2010; Schneider and Wagemann, 2012, p. 143).

Table 3 provides the results of our fuzzy-set analysis of the linkages between configurations of our causal conditions and high R&D commitments in China. Black circles (●) indicate the presence of a condition; white circles (○), its absence. We excluded the logical remainders generated in the truth table. Blank spaces in Table 3 mean that the relevant causal condition may be either present or absent, and does not play a role in the causal configuration. Our fsQCA resulted in the identification of four causal solutions or recipes (R1, R2, R3, and R4 in Table 3).

We adopted a consistency threshold of 0.85 to classify causal conditions as sufficient (Fainshmidt et al., 2020; Schneider and Wagemann, 2012, p. 129). The proportional reduction in inconsistency (PRI) measure captures how much a given configuration is not only a subset of the outcome of interest (Y), but also a subset of 'not Y' (Schneider, 2016). We adopt a PRI consistency threshold of 0.70 (Greckhamer et al., 2018), which avoids simultaneous subset relations of combinations in both the outcome and its absence.

We find four combinations of causal conditions that are sufficient to explain significant MNE R&D commitments in China. In all four of these causal conditions, MNEs are likely to have high R&D commitments in Chinese provinces if they are relatively small in terms of global sales revenues. In all four causal 'recipes', either local R&D intensity is low and local corruption high, or local R&D intensity is high and local corruption high.

Recipe 1 (R1 in Table 3) covers those MNEs that come from countries that have high stock-market capitalization to GDP ratios, that invest in Chinese provinces that have a high R&D intensity and low levels of corruption, and that are relatively small. An example is Highjump Software, which specializes in supply-chain software and which is now part of the Körber Group. In 2012, it was a relatively small MNE with global sales of 36.5 million USD, and was headquartered in the United States, which had a high stock-market capitalization to GDP ratio. Leveraging the province's high R&D intensity and low corruption levels, and relying on local skilled graduates, Highjump invested in Shanghai in 2012 to continue its expansion and enhance product development to boost revenues and profits (MMH Staff, 2012). Although the company did recruit highly skilled employees whose availability provincial institutions conditioned (local R&D intensity), it did not partner with local organizations; instead, it acted autarkically.

Recipe 2 (R2) captures relatively small MNEs from countries with high stock-market capitalization to GDP ratios that invest in Chinese provinces with low R&D intensity and high levels of corruption, and that are relatively small. Maxxis International exemplifies these conditions. A wholly owned subsidiary of Taiwan's stock-market listed Cheng Shin Rubber Industry Co Ltd., Maxxis sells tyres, and had global sales of just under 3.5 billion USD in 2012, making it a relatively small company. In 2012, Taiwan's stock-market capitalization stood at approximately 150 % of its GDP, making Taiwan a full member of the countries in which the stock market plays an important role in financing companies. To demonstrate product quality and gain market share in an industry dominated globally by three large companies, Maxxis built a tyre-testing and research track in Jiangsu province. Although it liaised with other foreign companies, such as car companies, to determine the track specifications, it did not collaborate closely with any local firms (Wu, 2014), suggesting that the firm operated independently from Chinese companies and did not require local knowledge-intensive resources, and may have been wary of knowledge spillovers in a province characterized by high corruption levels.

Recipe 3 (R3) relates to MNEs from countries with strong minority-investor protection, that invest in Chinese provinces with high R&D intensities and low levels of corruption, and that are relatively small. Aromatech, which is a small Canadian fragrance specialist, exemplifies this recipe through its joint venture with Apple Flavor and Fragrance, which is headquartered in Shanghai. The joint venture includes an R&D laboratory in Shanghai that combines Aromatech's technical expertise with its partner's production know-how (Culliney, 2012). Local R&D seems, therefore, to have played a role in attracting Aromatech's investment, which aims to increase the firm's sales in China and other Asian countries. Minority-investor protection in Canada is high.

Recipe 4 (R4) covers MNEs that come from countries with strong minority-investor protection, that invest in provinces with low

Table 2
Analysis of necessary conditions for outcome (high R&D commitments).

Causal conditions	Consistency	Coverage
High Destination Province Corruption	0.708346	0.7005220
~ High Destination Province Corruption	0.650015	0.764320
Input intensity of R&D funds	0.783121	0.756821
~ Input intensity of R&D funds	0.626435	0.757598
Stock Market Capitalization as a % of GDP	0.859758	0.677506
~ Stock Market Capitalization as a % of GDP	0.395284	0.667016
High Firm Revenue	0.377288	0.434441
~High Firm Revenue	0.762644	0.767885
High Investor Protection	0.873720	0.646465
~ High Investor Protection	0.423829	0.830900

Table 3
Analysis of sufficient conditions for high R&D commitments in Chinese Provinces.

Configuration - causal conditions	Presence or absence of causal condition*			
	R1	R2	R3	R4
Stock-market capitalization as a % of GDP	●	●		
Minority investor protection			●	●
Destination state corruption score	○	●	○	●
Input intensity of R&D funds (%)	●	○	●	○
Firm Revenue (USD m)	○	○	○	○
Solution Consistency	0.839			
Solution Coverage	0.610			
Consistency	0.959	0.860	0.921	0.864
Raw Coverage	0.432	0.407	0.444	0.437
Unique Coverage	0.011	0.006	0.008	0.021

* ● Presence of a condition, ○ Absence of a condition.

R&D intensities and high corruption levels, and that are relatively small. The RTP company illustrates these conditions. RTP, which was a relatively small thermoplastics compounding firm (USD 64 million sales in 2012) headquartered in the United States, opened a technical centre in Shenzhen, Guangdong province, in 2012. While working closely with its customers, RTP does not collaborate with local thermoplastics-compounding firms (RTP, 2012), suggesting it may be wary of knowledge spillovers to competitors, especially as it operates in a province with high corruption levels.

5.2. Interpretation of results, and propositions

The presence of a high home-country stock-market capitalization to GDP ratio in two of the four causal recipes indicates that companies from countries with higher levels of stock-market capitalization as a percentage of GDP may typically develop their capabilities largely independently from other firms in both home and host countries, making them more likely to invest in R&D facilities abroad. Based on our findings and drawing on our two relevant illustrative cases (Highjump and Maxxis), we propose:

Proposition 1. In combination with other conditions, MNEs from countries with high stock-market capitalization to GDP ratios are likely to have higher R&D commitments in Chinese provinces.

The presence of relatively high levels of minority-investor protection in two of the four causal recipes also draws attention to conditions in the MNE's home country. Higher levels of investor protection are likely to be associated with greater scrutiny of investment decisions. Such scrutiny may, paradoxically, facilitate higher R&D commitments by foreign MNEs in Chinese provinces. Drawing this finding and our two relevant illustrative cases (Aromatech and RTP), we propose that:

Proposition 2. In combination with other conditions, MNEs from countries with high levels of minority-investor protection are likely to have higher R&D commitments in Chinese provinces.

The combination of high local R&D intensity and low local corruption in two recipes suggests that, while MNEs may be wary of knowledge spilling over to local organizations, they will invest in areas with high levels of local R&D. Indeed, as our illustrative cases (Highjump and Aromatech) demonstrate, foreign MNEs will invest in provinces in which local firms potentially have high absorptive capacities to benefit either from Chinese firms' expertise in areas related to, but distinct from, the MNE's capabilities or from the relative abundance of highly skilled employees; both are institutionally conditioned by high local R&D intensity. We, therefore, propose that:

Proposition 3. In combination with other conditions, institutionally conditioned local knowledge-intensive resources that do not pose a direct knowledge-spillover risk to MNEs are likely to attract greater R&D commitments from MNEs.

The combination of low local R&D intensity and high local corruption in two recipes suggests that foreign MNEs will invest in provinces with such characteristics; however, our illustrative cases of MNEs that invest in such regions (Maxxis and RTP) do not collaborate with local firms and do not rely extensively on local, institutionally conditioned resources. This suggests that MNEs may limit the possibility of knowledge spillovers by having independent or 'free standing' R&D commitments in such provinces. We propose:

Proposition 4. In combination with other conditions, regions that lack institutionally conditioned local knowledge-intensive resources and that have high levels of local corruption are likely to attract 'free-standing' R&D commitments from foreign MNEs.

5.3. Assessment of the 'negated outcome'

We performed analyses of necessity and sufficiency for the negated outcome, investigating the causal conditions that lead to lower R&D commitments in China. We used the same calibration measures and analytical process for generating the necessary and sufficient conditions for the negated outcome i.e. without any logical remainders or simplifying assumptions. Table 4 provides the results of the

necessary analysis; Table 5, the sufficiency analysis.

While high minority-investor protection has high consistency and coverage scores, the consistency score is not above the 0.90 threshold for necessary conditions (Greckhamer et al., 2018; Schneider and Wagemann, 2012). We uncover one sufficiency recipe for the negated outcome (lower R&D commitments) with a solution consistency of 0.96 and a solution coverage of 0.48. The sufficient recipe for low R&D commitments combines high firm revenues and home-country investor protection with low levels of provincial corruption and high local R&D intensity.

Interestingly, the absence recipe (\sim R1) differs from R3 only with regards to firm revenue (which is low in R3, but high in \sim R1). This suggests that small firms (measured by global revenues) are more inclined to make significant R&D commitments in China than their larger counterparts. This challenges concerns regarding corruption and intellectual asset expropriation in the global factory model, as, despite their relative lack of size-related power, smaller MNEs and not larger ones have greater R&D commitments. Both the absence recipe (\sim R1) and the relevant outcome recipe (R3) indicate that a combination of high local R&D intensity and low provincial corruption may either mitigate expropriation risks or offer sufficient benefits to investing MNEs to outweigh any expropriation risks.

The presence of high minority-investor protection in both the outcome and absence recipes potentially reflects our dataset's composition, with investment primarily originating from advanced economies, such as Germany and the United States, where such protection is common. While this preponderance of advanced-economy MNEs in R&D FDI reflects global patterns (Coveri and Zanfei, 2023), our findings prompt an analysis of the countries that MNEs from developing countries, which often lack strong minority-investor protection, invest their R&D resources.

6. Conclusion

Our research contributes to the literature and has implications for practice that we discuss below; however, it also has some limitations. Focusing on MNEs' R&D investments in Chinese provinces in 2012 may limit some of our findings. Notably, our research reveals that small firms are – alongside other causal conditions – likely to exhibit higher R&D commitments in Chinese provinces, deviating from the global factory model's expectations of larger – and hence more powerful – firms dominating. This result may stem from our outcome measure (capturing R&D commitments as a percentage of global revenues), which, while capturing relative investment size, might favour smaller firms due to the potential fixed costs of establishing Chinese R&D facilities. In addition, China's 2016 reform prioritizing domestic and foreign investment in specific sectors, such as renewable energy, may render 2012 investments an anomaly. Finally, as we use quantitative and secondary data, we lack insights into how MNE managers interpret conditions, such as the combination of province-level corruption and innovation, that influence their R&D commitments. Future research could, therefore, examine different years, consider the stock of R&D commitments, analyse decisions qualitatively, and delve into the nuanced configurational dynamics influencing MNEs' R&D investments beyond one year's flow.

Despite these limitations, our research has practical implications. Understanding why specific firms commit R&D resources to particular Chinese provinces aids policy makers to make targeted policy adjustments. Our illustrative cases highlight how provinces with high R&D intensities attract MNEs seeking to benefit from institutionally conditioned knowledge resources, suggesting that provincial governments could boost inward R&D FDI by encouraging local R&D expenditure. Our finding that MNEs from countries with higher stock-market capitalization to GDP ratios are likely to invest in Chinese provinces is consistent with the VoC expectation that these companies are likely to develop their innovative capabilities relatively independently both at home and abroad, making it easier for them to invest abroad, but hindering inter-organizational knowledge transfer. Policy makers could foster learning and collaboration between foreign and domestic firms through schemes, such as research consortia, tax incentives, or innovation hubs.

Our research contributes theoretically and analytically. First, our results demonstrate the value of explicitly extending global factory model arguments. While the model mentions the lead MNE's nationality as a potential influence on the MNE's out-sourcing and off-shoring decision making, it lacks detailed theoretical underpinnings. By drawing on the VoC perspective, we can elucidate why MNE ownership and control matter, emphasizing the stock-market's role in financing MNE in their home country as well as the regulations that protect minority investors (cf. Coveri and Zanfei, 2023). High levels of both, as identified in separate recipes, provide a nuanced understanding of MNEs' high R&D commitments abroad. This insight emphasizes the significance of conditions, such as firm financing and investor protection, in shaping MNE behaviour beyond the global factory model's original considerations. In addition, the global factory model emphasizes the risk of the expropriation of intellectual assets; however, our results highlight the importance

Table 4
Analysis of necessary conditions for negated outcome (low R&D commitments).

Causal conditions	Consistency	Coverage
High Destination Province Corruption	0.767375	0.653882
\sim High Destination Province Corruption	0.648542	0.657059
Input intensity of R&D funds	0.767375	0.638980
\sim Input intensity of R&D funds	0.707958	0.737711
Stock Market Capitalization as a % of GDP	0.770976	0.523472
\sim Stock Market Capitalization as a % of GDP	0.525027	0.763351
High Firm Revenue	0.732445	0.726688
\sim High Firm Revenue	0.429960	0.373009
High Investor Protection	0.899892	0.573691
\sim High Investor Protection	0.445445	0.752433

Table 5
Analysis of sufficient conditions for low R&D commitments in Chinese Provinces.

Configuration - causal conditions	Presence or absence of causal condition ^a
Stock-market capitalization as a % of GDP	(~R1)
Minority-investor protection	●
Destination state corruption score	○
Input intensity of R&D funds (%)	●
Firm revenue (USD m)	●
Solution Consistency	0.960
Solution Coverage	0.484

^a ● Presence of a condition, ○ Absence of a condition.

of local R&D intensity in some of our causal recipes, indicating that institutionally conditioned knowledge resources may, in certain conditions, attract MNE investments.

Our second contribution challenges the prevalent international business literature on R&D investments abroad, which often treats causal conditions independently, with each having its own separate influence. Instead, our results underscore the importance of a configurational approach, illustrating how different combinations of causal conditions collectively influence MNEs' decision to invest in R&D facilities abroad. No single causal condition alone proves necessary or sufficient; rather, outcomes result from the interplay of various conditions. In particular, we identified four sufficient causal solutions to higher R&D commitments by MNEs in Chinese provinces. This challenges the common net-effects perspective in many previous studies (Demirbag and Glaister, 2010; Hong et al., 2019; Lewin et al., 2009; Mavroudi et al., 2023).

Finally, our results contribute to the broader literature on MNEs' R&D investments abroad; Prior research has predominantly focused on either subsidiary roles (Hong et al., 2019; Kuemmerle, 1999; Liu and Li, 2022) or country-level factors (Demirbag and Glaister, 2010; Nachum, 2003), overlooking the influence of the interactions between home- and host-economy institutional conditions and the effects of sub-national variations in institutions and practice (McNally, 2019). For example, previous studies downplay how MNE home-country regulations influence their R&D investments abroad. Similarly, many previous studies neglect sub-national influences on R&D, such as the combined influence of province-level corruption and R&D expenditure. Although some studies highlight important provincial differences in R&D expenditure (Zhang and Peck, 2016), they do not typically explore the relationship between R&D spending and corruption at the provincial level. Instead, they often focus on illustrative evidence, rather than adopt a configurational analysis that the present study embodies.

CRedit authorship contribution statement

Matthew M.C. Allen: Conceptualization, Writing – original draft, Writing – review & editing. **Mehmet Demirbag:** Data curation, Formal analysis, Resources, Writing – review & editing. **Maria L. Allen:** Conceptualization, Methodology, Writing – original draft, Writing – review & editing. **Shabneez Bhankaraully:** Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Geoff Wood:** Conceptualization, Writing – original draft, Writing – review & editing.

Data availability

Data will be made available on request.

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