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Geographic Diversification of Firm Resources and Cash Holdings

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Abstract

This study examines the intersection of multinational enterprise (MNE) strategy and international financial management, focusing on how the geographic diversification of tangible assets, intangible assets, and growth opportunities is associated with MNEs' cash holdings, an important component of their financial strategy. Panel regression models were estimated using data from 576 MNEs headquartered in 28 countries. The findings suggest that the geographic diversification of intangible assets and growth opportunities attenuates the positive associations of these assets with cash holdings. In contrast, the geographic diversification of tangible assets attenuates the negative association between tangible assets and cash holdings. Overall, the findings suggest that MNEs' cash holdings cannot be fully understood by examining only firm-level determinants, such as growth opportunities and multinationality, but also by considering the geographic diversification of different types of assets.

Keywords: cash holdings; geographic diversification; multinationality; multinational enterprises; resources; intangible assets; tangible assets; growth opportunities; real options

1. Introduction

Adequate cash holdings are essential not only for a firm's daily operations (Meltzer, 1963) and survival (John, 1993), but also for financing future growth opportunities. If a firm faces cash flow shocks or investment opportunities while being unable to access cash through borrowing, equity issuance, dividend reduction, or asset sales, sufficient cash holdings become a prerequisite for the firm's survival and growth (Opler et al., 1999). However, excessive cash holdings can be also negatively associated with firm value (Banjade & Diltz, 2022). Several studies have documented an increase in firms' cash holdings among both domestic firms and multinational enterprises (MNEs) across numerous countries over an extended period (e.g., Bates et al., 2009; Dao & Maggi, 2018; Inaba, 2021; Kim et al., 2023; X. Li & Luo, 2020). With respect to MNEs, these firms appear to have primarily expanded their foreign cash holdings (Faulkender et al., 2019). Taken together, exploring the factors associated with higher and lower levels of cash holdings is important given the role of cash holdings in firms' operations, survival, growth, and value creation.

The study examines the intersection of MNE strategy and international financial management. MNEs operate across multiple countries, resulting in geographically diversified business activities. Such diversification constitutes a defining characteristic of MNEs and a key source of their competitive advantage over domestic firms. At the same time, geographic diversification may also be associated with distinct liquidity requirements because operating across different countries exposes firms to heterogeneous risk exposures, investment opportunities, and potential diversification benefits. These implications may vary

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across tangible assets, intangible assets, and growth opportunities. Although prior research has investigated different determinants of MNE cash holdings, how the geographic diversification of different types of assets relates to cash holdings has received limited empirical attention. The aim of this study is therefore to examine whether and how the geographic diversification of tangible assets, intangible assets, and growth opportunities is associated with MNEs' cash holdings as a component of their liquidity and financial strategy.

Prior research on MNEs' cash holdings primarily focuses on determinants such as growth opportunities (e.g., Benkraiem et al., 2020; Hanlon et al., 2017; F. Li & Lin, 2022; Manoel & da Costa Moraes, 2022; Ramírez & Tadesse, 2009), innovation and knowledge transfer (Beuselinck & Du, 2017; Fernandes & Gonenc, 2016; Hanlon et al., 2017; F. Li & Lin, 2022; Pinkowitz et al., 2016), governance mechanisms such as subsidiary monitoring (Beuselinck & Du, 2017), formal and informal institutions (Y. Chang et al., 2024; Chen, 2011; Fernandes & Gonenc, 2016; F. Li & Lin, 2022; Manoel & da Costa Moraes, 2022; Ramírez & Tadesse, 2009), cultural heterogeneity (So & Zhang, 2022), cash-flow uncertainty (firm risk) (Foley et al., 2007; Hanlon et al., 2017), taxes (De Simone et al., 2019; Faulkender et al., 2019; Foley et al., 2007; Gu, 2017; Guenther et al., 2020; Hanlon et al., 2017; F. Li & Lin, 2022; Xing, 2018), financial constraints (Guenther et al., 2020; Hanlon et al., 2017), and multinationality (Fernandes & Gonenc, 2016; Manoel & da Costa Moraes, 2022). Although these studies focus on different determinants of MNEs' cash holdings, they largely do not address geographic diversification, and none examines how the relationship between an MNE's asset composition and its cash holdings is conditional on the geographic diversification of foreign subsidiaries across countries.

Among the determinants examined in prior research, multinationality is particularly relevant to this study because commonly used measures of multinationality may capture firms' geographic diversification to different extents. However, geographic diversification and multinationality are distinct constructs because an MNE with substantial foreign activity may still concentrate its investments in a limited number of foreign countries and therefore exhibit low geographic diversification despite a high degree of multinationality. Consequently, multinationality proxies may not adequately reflect country-level geographic diversification.

Additionally, empirical studies examining the relationship between multinationality and MNEs' cash holdings have yielded mixed findings. Some studies report that higher levels of multinationality are associated with higher cash holdings (Manoel & da Costa Moraes, 2022; Ramírez & Tadesse, 2009), whereas others report the opposite relationship (Fernandes & Gonenc, 2016), particularly during non-crisis periods (Benkraiem et al., 2020). In these studies, all authors used foreign sales to total sales as a proxy for the degree of multinationality, except for Fernandes and Gonenc (2016), who additionally considered the number of reported geographic regions in financial reports and the Herfindahl Index based on sales in those regions. It is also worth noting that, according to accounting standards, MNEs have the discretion to define geographic regions. Consequently, a reported region can vary from a single country to multiple countries or even continents. For example, Europe, Africa, and the Middle East are sometimes defined as a single region. Therefore, relying on proxies based on total foreign sales or reported regions may prove inadequate for investigating country-level geographic diversification and its association with cash holdings. Although such proxies capture the extent of foreign business activity, they may not adequately reflect the degree of country-level geographic diversification. Furthermore, companies possess different types of resources. For example, some firms may have a high proportion of tangible assets, whereas others may have a higher proportion of growth opportunities. Consequently, the geographic diversification of these resource types may be associated with cash holdings in different ways. However, existing research has not

investigated whether the association between geographic diversification and cash holdings differs across resource types, leaving our understanding of these relationships limited.

The present study contributes to the literature in several ways by examining how the geographic portfolio diversification of firm resources relates to cash holdings. First, it expands the current body of knowledge on MNE cash holdings by shifting the focus from general multinationality to country-level geographic diversification. Second, it introduces country-level measures of geographic diversification based on the number of countries in which MNEs maintain majority foreign-owned subsidiaries (MFOSs) in each year of the observation period. Specifically, the subsidiary network is traced up to the tenth ownership level to avoid excluding countries in which subsidiaries are located several ownership levels below the first-tier subsidiary. For example, a first-tier subsidiary of a French MNE located in France may own multiple lower-tier subsidiaries located in South America. In contrast, commonly used measures based on subsidiaries or geographic regions reported in financial statements would fail to capture such subsidiaries and, consequently, the countries in which they operate. Third, it focuses on the geographic diversification of different types of assets, as the association between geographic diversification and cash holdings may vary across asset types. This distinction is particularly relevant because tangible assets, intangible assets, and growth opportunities differ in characteristics such as risk, irreversibility, redeployability, collateral value, and cross-country transferability. For instance, the geographic diversification of tangible assets may reduce cash-flow volatility and, consequently, business risk. However, this risk-mitigation mechanism may be offset by additional risks associated with operating across multiple countries. Although intangible assets may be positively associated with cash holdings because they are difficult to collateralize, their geographic diversification may create valuable cross-border real options that reduce firm risk and, consequently, the need to hold cash. Similarly, while prior studies suggest that growth opportunities are positively associated with cash holdings (Cunha & Pollet, 2020), the effect of the geographic diversification of growth opportunities remains unknown, despite evidence that growth opportunities can represent a substantial portion of firm value (Crain et al., 2021; Kester, 1984; Myers, 1977). Overall, little is known about how the geographic diversification of different types of firm resources is associated with cash holdings.

Specifically, the paper contributes in two ways. First, it examines whether the association between firm resources and cash holdings differs across MNEs with different degrees of geographic diversification. MNEs have different asset structures, and these differences, combined with geographic diversification, may be associated with cash holdings in different ways. For example, geographic diversification may weaken the association between growth opportunities and cash holdings, while strengthening the association between tangible assets and cash holdings. Examining geographic diversification without distinguishing between asset types would leave these differences unobserved. Such differences may be relevant to practitioners such as corporate treasurers and financial analysts when assessing an MNE's liquidity or making decisions about its cash holdings. Second, the study measures geographic diversification based on the number of countries in which an MNE maintains subsidiaries, as geographic diversification concerns the spread of an MNE's operations across countries. This measure captures geographic spread more directly than the measures of multinationality commonly used in the cash holdings literature, such as the ratio of foreign sales to total sales or diversification measures based on the number of geographic regions. In the first case, the spread across countries is not captured, whereas in the second case, geographic diversification is measured only across broad regions. To the best of my knowledge, no study has investigated how the interaction between geographic diversification and different types of assets is associated with cash holdings.

The sample consists of 576 publicly traded manufacturing MNEs reporting according to International Financial Reporting Standards (IFRS) from 28 countries across Europe, Canada, New Zealand, and Australia, comprising 2719 firm-year observations. Financial data on MNEs were collected from Bloomberg and Refinitiv Workspace, subsidiary-level data from Orbis, and data on divested subsidiaries from Zephyr. These data are analyzed using panel regression models. The findings suggest that specific asset types are associated with cash holdings and that the geographic diversification of these assets moderates the strength and, in some cases, the direction of these associations, underscoring the importance of considering both asset composition and the geographic diversification of each asset type when explaining MNEs' cash-holding policies. These findings remain consistent across robustness tests. Overall, the findings suggest that MNEs' cash holdings cannot be fully understood by examining only traditional determinants, such as growth opportunities or multinationality, but also require consideration of the geographic distribution of different types of assets.

This study investigates associations rather than causal effects. Specifically, it examines whether the associations between different types of assets and cash holdings differ according to the level of geographic diversification, without seeking to establish whether these associations are causal. Consequently, the estimates should be interpreted as conditional associations and not as causal effects; potential endogeneity is discussed in Section 4.

This study is organized as follows. The next section reviews the literature on the associations of growth opportunities, intangible assets, and tangible assets with cash holdings and develops the hypotheses. The methodology section then outlines the data, variable operationalizations, and model specification. This is followed by the presentation of the results and robustness tests, and by a discussion of the findings and the study's limitations. Finally, the study concludes by summarizing the findings, discussing the implications for practice and policy, and outlining avenues for future research.

2. Literature Review

2.1. Geographic Diversification

This subsection examines how geographic diversification relates to MNEs' cash holdings through taxes and working capital management, and considers whether differing operationalizations explain the mixed findings in prior research. MNEs may hold more cash in foreign affiliates to avoid repatriation taxes. Consistent with Foley et al. (2007), this pattern is likely to be more pronounced among firms with substantial intangibles and high profit margins, such as technology firms, because they can use production-location choices, transfer pricing, and royalty payments to shift taxable income and retain cash in lower-tax jurisdictions. Building on this logic, Faulkender et al. (2019) argue that intangibles, such as intellectual property, are inherently more difficult to value, which expands MNEs' discretion in setting intra-firm prices through transfer pricing and complicates tax enforcement because authorities face greater challenges in verifying arm's-length valuations. Moreover, they further note that intangibles (e.g., patents and know-how) are more readily redeployed across subsidiaries than tangible assets, which can be further enabled by tax provisions. Taken together, the valuation opacity and mobility of intangibles, along with enforcement constraints, facilitate income shifting to lower-tax jurisdictions (Faulkender et al., 2019). Accordingly, Foley et al. (2007) point out that cash accumulation cannot be explained solely by precautionary motives[1] but is also driven by tax motives.

In line with this reasoning, several empirical studies provide evidence that MNEs increase cash holdings to reduce tax burdens and that intangibles facilitate this process. In particular, prior research documents that MNEs increase foreign cash holdings, and thus total cash, to reduce tax costs (Faulkender et al., 2019; Foley et al., 2007; Hanlon et al., 2017),

particularly when firms expect lower future repatriation taxes (De Simone et al., 2019). More recently, Campbell et al. (2025) replicate the study by Foley et al. (2007) and report, in an untabulated test, a negative association between the median tax rates of foreign countries and cash balances held in those countries. Consistent with these findings, Xing (2018) documents that Japanese MNEs reduced foreign cash holdings following a reform that lowered repatriation taxes, reinforcing the view that repatriation taxes are related to both the level and geographic location of cash holdings. Faulkender et al. (2019) further find that higher foreign cash holdings are associated with greater levels of intangibles, opportunities for income shifting arising from tax rules, and higher volumes of related-party sales within the MNE's internal network of subsidiaries, consistent with transfer pricing-based income shifting. Additionally, in the context of profit shifting among subsidiaries, Alghamdi et al. (2024) find that non-arm's-length transactions and the presence of offshore financial centers are associated with higher cash holdings. Similarly, Gu (2017) finds that MNEs with substantial intangibles tend to have a presence in lower-tax countries and to hold higher foreign cash balances. These findings indicate that tax motives are an important determinant of cash holdings (Faulkender et al., 2019).

However, taxes may increase cash holdings not only by discouraging repatriation of earnings when repatriation is tax costly but also by creating tax-related uncertainty arising from potential disputes with tax authorities, which leads firms to hold precautionary domestic and foreign cash balances, consistent with the arguments and evidence in Hanlon et al. (2017). In line with this tax-uncertainty logic, Guenther et al. (2020) find that MNEs retain tax savings generated by shifting taxable income to lower-tax jurisdictions and delaying repatriation in the form of cash balances and marketable securities, suggesting that these holdings function as a precautionary buffer to mitigate the risk that firms will be required to repay the tax savings to tax authorities, potentially with interest and penalties.

Empirical evidence from Desai et al. (2006) suggests that greater international activity among MNEs is associated with a higher likelihood of establishing tax haven subsidiaries, particularly within the same region. Building on this logic and related evidence documenting a positive relationship between repatriation taxes and cash holdings, greater geographic diversification of an MNE's subsidiary network is expected to be associated with greater ability to optimize tax payments. A broader international network expands opportunities for income shifting and for establishing affiliates in nearby low-tax jurisdictions, thereby potentially reducing the repatriation of foreign earnings and increasing total cash holdings.

Additionally, the association between geographic diversification and cash holdings may be related to working capital management, risk, and uncertainty. Kang and Kim's (2024) findings suggest that home-country uncertainty is positively associated with cash holdings in foreign subsidiaries. MNEs may have more extensive operating cycles and higher risks related to working capital management stemming from factors such as longer credit terms, higher credit risk exposure, and longer inventory days outstanding (Ramírez & Tadesse, 2009). Studies by Manoel and da Costa Moraes (2022) and Ramírez and Tadesse (2009) find a positive relationship between multinationality and cash holdings. Consistent with these findings, Latin American MNEs hold more cash than domestic firms, although this difference is statistically present only after the 2008 financial crisis (Melgarejo Duran & Stephen, 2025). Conversely, Benkraiem et al. (2020) and Fernandes and Gonenc (2016) find a negative relationship between multinationality and cash holdings. Similarly, Hong and Liu (2023) find a negative relationship between geographic diversification across U.S. states and cash holdings, with this association concentrated in financially constrained firms and firms that make active use of their internal capital markets. In the context of this study, the relevant limitation is that their analysis examines geographic diversification

within the United States rather than across countries. Taken together, these studies provide mixed evidence on the relationship between multinationality and cash holdings.

The mixed evidence on the relationship between geographic diversification and cash holdings may also be the consequence of different operationalizations of geographic diversification. In this literature, prior studies operationalize multinationality using foreign sales to total sales, except for Fernandes and Gonenc (2016), who additionally considered the number of reported geographic regions in financial reports and the Herfindahl Index based on sales in those regions. Because this study focuses on geographic diversification, defined as the dispersion of operations across countries, it is also worth noting that, according to accounting standards, MNEs have the discretion to define geographic regions. Accordingly, a reported region can vary from a single country to multiple countries or even continents. For example, Europe, Africa, and the Middle East are sometimes defined as a single region. Consequently, proxies based on total foreign sales or reported regions may not fully capture geographic diversification. So and Zhang (2022) measure geographic spread using the number of foreign countries in which a firm holds subsidiaries, based on Orbis data, which provides a useful point of comparison for this study. The present study extends their approach by counting the number of countries in which the MNE holds MFOSs, which, unlike joint ventures and minority holdings, are more directly under MNE control, by tracing ownership chains consisting exclusively of MFOSs up to ten ownership levels in each year of the observation period, and by incorporating previously divested subsidiaries identified through the Zephyr database over the observation period. This extension is important because Orbis reflects the current status of subsidiaries, whereas Zephyr helps capture subsidiaries that were divested during the period of analysis. Accordingly, geographic diversification is operationalized as the number of countries in which the firm holds MFOSs.

In sum, although geographic diversification may be negatively associated with cash holdings through the use of internal capital markets, particularly for financially constrained firms, as documented for domestic firms diversified across U.S. states (Hong & Liu, 2023), or through the risk-diversification benefits of a portfolio of investments across countries (Rugman, 1976), these effects may be offset by mechanisms that increase cash holdings, including tax optimization, higher working capital requirements, and greater risks associated with foreign working capital (Ramírez & Tadesse, 2009). Working capital requirements and risks increase with each additional country in which an MNE operates and add to the complexity of managing working capital. The tax advantages of retaining earnings abroad likewise increase with the number of countries in which the MNE operates. Risk diversification, by contrast, requires a sufficient number of imperfectly correlated investments with adequate variability, while the use of internal capital markets requires the ability to transfer cash across countries. Because the first set of mechanisms operates with each additional country entered, whereas the other two depend on conditions that may be only partially met, the net association is expected to be positive. This leads to the following hypothesis:

Hypothesis 1. *The geographic diversification of MNEs' operations is positively related to their cash holdings.*

2.2. Tangible Assets

This subsection examines why tangible assets are generally negatively related to MNEs' cash holdings and how geographic diversification moderates that relationship. Asset tangibility may increase borrowing capacity in two ways. First, tangible assets can serve as collateral (Almeida & Campello, 2007), thereby enhancing access to external financing. Second, tangible assets can be liquidated when firms need cash (Falato et al., 2022; Lei et al., 2018). This, in turn, reduces the need to hold precautionary cash balances. Several studies

find that asset tangibility is negatively related to corporate cash holdings (Elyasiani & Movaghari, 2022; Lei et al., 2018), indicating that such firms are less financially constrained in accessing external funds (Alves et al., 2022). This negative association also holds in service industries, such as legacy airline carriers (Kiracı & Vasigh, 2024). However, these studies did not specifically investigate MNEs, although MNEs may have been included in their samples. Building on this collateral and liquidation logic, asset tangibility is expected to relax financing constraints by increasing debt capacity, thereby reducing the need for precautionary cash holdings among MNEs. This leads to the following hypothesis:

Hypothesis 2. *The level of asset tangibility is negatively related to MNEs' cash holdings.*

MNEs may face greater risk exposure than domestic firms because they are exposed to a broader range of market and nonmarket risks. In particular, MNEs face political risks that can negatively influence financial performance, such as expropriation and regulatory changes (Campisi & Caprioni, 2017; Kobrin, 1979), as well as macroeconomic risks, such as exchange-rate shocks and foreign-currency depreciation (Cavusgil et al., 2020). Additionally, MNEs face nonmarket risks, such as natural disasters, technological disasters (e.g., technological failures and hazardous materials incidents), political conflicts (e.g., civil wars and terrorist attacks), and social conflicts, such as civil society activism targeting firm practices (Oh & Oetzel, 2022).

Beyond these risks, MNEs may also incur additional costs of doing business abroad because of the liability of foreignness in host countries. These costs stem from distance-related challenges (e.g., coordinating geographically dispersed units), unfamiliarity with the local environment (e.g., local business practices), discrimination against foreign firms (e.g., lack of legitimacy and preferential treatment of domestic firms), and home-country restrictions (e.g., constraints on the sale of certain products or technologies) (Zaheer, 1995). These challenges can be amplified by volatile and complex global environments, which complicate strategy formulation and implementation abroad (Sethi & Guisinger, 2002). These aspects of the liability of foreignness can give rise to three groups of hazards: unfamiliarity hazards, discrimination hazards, and relational hazards (e.g., challenges in managing relationships among stakeholders, including employees) (Eden & Miller, 2004). Additionally, An (2025) finds that MNEs face cognitive liabilities (e.g., negative stereotypes about foreign MNEs), normative liabilities (e.g., higher expected standards for MNEs than for domestic firms), and regulative liabilities of foreignness (e.g., additional bureaucratic burdens, lawsuits, and higher compliance costs).

Overall, heightened risk exposure and the liability of foreignness suggest that the cross-border deployment of tangible resources may be particularly exposed to such risks because these investments are more difficult to reverse. In line with this view, resources transferred across countries might not perform similarly across contexts, and although geographic diversification can benefit MNEs by transferring firm-specific resources and acquiring local resources, the risks associated with this diversification can offset these benefits (Mammen et al., 2021). Supporting this risk-exposure argument, geographic diversification is associated with higher systematic risk (Olibe et al., 2008; Reeb et al., 1998). This concern is especially relevant for geographically dispersed tangible assets, which are often difficult to redeploy once in place and can lock firms into host countries when adverse shocks materialize (e.g., expropriation). Limited redeployability of tangible assets is important because it reduces the ability to liquidate them if conditions in a country deteriorate or when a firm needs liquidity, which in turn reduces their collateral value and the firm's ability to raise funds. In this setting, holding precautionary cash can help MNEs absorb country-specific shocks without relying on costly external finance or abandoning valuable projects. Consistent with this logic, Zheng (2019) provides evidence that risk

exposure plays a stronger role in shaping precautionary cash holdings for MNEs than for domestic firms and that multinationals' higher cash holdings cannot be explained solely by tax motives. Accordingly, these arguments suggest that the capacity of tangible assets to reduce the need for cash holdings is weaker when those assets are geographically dispersed, leading to the following hypothesis:

Hypothesis 3. *The negative relationship between the value of tangible assets and MNEs' cash holdings is positively moderated by the geographic diversification of tangible assets.*

2.3. Intangible Assets in Place

This subsection examines how intangible assets in place relate to cash holdings through debt and equity financing, profitability, and risk, and how geographic diversification moderates that relationship. Firms can hold different types of intangibles, such as brands, know-how, and growth opportunities. The latter represent potential future investments. Myers (1977) distinguishes between assets in place and growth opportunities. Following this logic, this study distinguishes between two types of intangible assets: intangible assets in place and growth opportunities. Intangible assets in place can take many forms, such as marketing intangibles (e.g., trademarks and product image) (Guilding & Pike, 1990) and brand (Seetharaman et al., 2001), trade secrets (e.g., know-how and confidential information), networks (e.g., internal employee networks and external networks with suppliers and customers), patents (Hall, 1992), organizational capital (e.g., distinctive processes, structures, and systems) (Miles & van Clieaf, 2017), and digital intangibles (Zhang et al., 2026).

However, because intangible assets are difficult to pledge as collateral, they are associated with lower borrowing capacity and higher cash holdings. Lenders are often unable to evaluate intangibles and cannot seize them (e.g., employee knowledge) if the borrower defaults, making intangibles unsuitable as collateral (Falato et al., 2022). The more intangibles a firm has, the less pledgeable collateral it can offer to lenders, resulting in lower borrowing capacity. This mechanism works in the opposite direction to the collateral mechanism for tangible assets. While asset tangibility reduces financing constraints and, consequently, the need to hold cash, intangibility does not provide comparable collateral value that would enhance a firm's ability to obtain financing when needed. As a result, firms may rely more on equity financing, which can be costly when external finance is needed. To mitigate these costs, firms may raise equity in excess of immediate cash needs during favorable market conditions in anticipation of future financing needs and to avoid the large fixed costs of repeated small equity issuances, resulting in higher cash holdings (Huang & Ritter, 2021; McLean, 2011).

Two further mechanisms concern the risk and return characteristics of intangible assets. The first operates through profitability. Intangible assets are associated with higher subsidiary profitability (Contractor et al., 2016), which may generate higher cash flows. King et al. (2024) argue that intangibles generate cash flows through synergies with tangible assets and find that different types of identifiable intangibles are positively related to equity value. Consequently, given the potentially high costs of raising equity, firms with higher profitability driven by intangible assets may retain a portion of these cash flows as cash holdings. The second operates through risk. Intangibles are associated with greater risk, such as earnings volatility (Elkemali, 2024) and stock price crash risk (Wu & Lai, 2020), and, in turn, higher risk is associated with higher cash holdings (Bates et al., 2009). Taken together, these mechanisms suggest that higher levels of intangible assets in place are associated with higher cash holdings, leading to the following hypothesis:

Hypothesis 4. *The value of intangible assets in place is positively related to MNEs' cash holdings.*

Extending this risk-based argument, geographic diversification of MNEs' operations can negatively moderate the relationship between intangible assets in place and risk through two mechanisms: passive portfolio diversification and the flexibility conferred by real options. In the first mechanism, risk may be reduced by passively holding a geographic portfolio of intangibles. In the second, risk may be reduced by actively managing a geographic portfolio of investments and activities through the exercise of real options.

The passive portfolio mechanism reduces risk through geographic diversification, as predicted by portfolio theory in finance. Portfolio theory predicts that investing in less-than-perfectly correlated investments reduces an investor's risk (Markowitz, 1952; Sharpe, 1995). This logic has been extended to MNEs' international investments (Rugman, 1976), suggesting that MNEs can reduce risk by geographically diversifying investments and passively holding them without actively managing the portfolio (Ioulianou et al., 2021). Applied to intangible assets, when MNEs hold intangibles across multiple geographic locations, the variability of the cash flows generated by these assets is likely to be reduced. Consequently, lower cash-flow volatility may reduce the need for precautionary cash holdings.

Beyond passive diversification, an international network may benefit firms not only through geographic risk diversification but also through the real options embedded in the network (Brouthers et al., 2008; S.-H. Lee & Makhija, 2009a, 2009b). Such real options can be conceptualized as intangible assets that, together with tangible assets, comprise a firm's total assets (Myers, 1977). More generally, real options grant managers the right, but not the obligation, to invest or divest in the future (Kogut & Kulatilaka, 1994; S. H. Lee & Chung, 2007; Tong & Reuer, 2007b).

In the international business context, real options are often divided into within-country options, which are available to both domestic firms and MNEs, and across-country options, which are unique to MNEs (Kogut & Kulatilaka, 1994). For example, unlike domestic firms, MNEs may not only refrain from divesting subsidiaries in crisis-stricken countries but may even shift operations to those countries in order to exploit lower labor costs, according to real options theory (S. H. Lee & Chung, 2007). With the exception of growth opportunities, these types of options represent intangible assets in place.

Across-country options also include options to exploit arbitrage opportunities through production shifting, tax arbitrage, financial market arbitrage, and information arbitrage (e.g., knowledge transfer) (Kogut, 1985). These options may have important implications for cash holdings, particularly switching options, because they allow MNEs to reallocate value chain activities across borders in ways that reduce risk and enhance profitability, cash flows, and firm value. Such options include the ability to shift manufacturing locations and other value chain activities across borders (Kogut, 1985, 1990; Tong & Reuer, 2007a). This flexibility may reduce exposure to risks such as exchange rate fluctuations and input cost uncertainty, thereby limiting downside risk (Belderbos et al., 2014; Driouchi & Bennett, 2011; Huchzermeier & Cohen, 1996; Miller, 1998; Miller & Reuer, 1998; Reuer & Leiblein, 2000).

Moreover, a multinational network can also confer options to transfer resources and capabilities across borders, including innovations (Kogut, 1985), know-how, information, skills, and brand names (Kogut, 1990), which can generate super-additive payoffs and reduce cash-flow volatility. Resources and capabilities can also confer options to acquire new resources and capabilities, or even new options (Sanchez, 1993). These options can lead to portfolio super-additivity, because resources and capabilities can be redeployed to acquire new ones at diminishing costs (Vassolo et al., 2004), which reduces exercise costs and, in turn, increases the value of subsequent options. Consistent with this logic, Sun and Govind (2018) provide evidence that MNEs' capability to deploy resources across countries reduces cash-flow volatility not only through the passive portfolio effect but also through the ability to exploit resources such as knowledge and brand image across countries.

Overall, MNEs possess intangibles in the form of across-country real options that can reduce risk by providing operational flexibility, such as switching production locations. Building on this logic, this study hypothesizes that greater geographic diversification increases the availability of across-country real options that reduce risk and, consequently, cash holdings for precautionary reasons, leading to the following hypothesis:

Hypothesis 5. *The positive relationship between intangible assets in place and MNEs' cash holdings is negatively moderated by geographic diversification.*

2.4. Growth Opportunities

Drawing on real options and pecking order theory, this subsection examines how growth opportunities relate to MNEs' cash holdings through information asymmetry and equity underpricing, and how geographic diversification moderates that relationship. Growth opportunities translate into firm growth through investment that constitutes the exercise of growth options, as conceptualized by real options theory (see, e.g., Y. Li et al., 2007; Smit & Trigeorgis, 2004). However, firms can exercise these growth options only if they hold sufficient cash to undertake such investments. When internal funds are insufficient, firms may need to obtain external financing by issuing shares. In this context, the firm, as the equity issuer, has more information about its future prospects than investors, as buyers, thereby creating information asymmetry (Myers & Majluf, 1984).

In the seminal work on information asymmetry, Akerlof (1970) illustrates the consequences of information asymmetry through an analogy to the used car market, where the seller of a used car knows better than the buyer whether the car is of poor quality, thereby exposing buyers to the risk of purchasing a "lemon." Consequently, buyers are willing to pay a lower price to compensate for this risk, which also reduces the price of high-quality used cars, thereby leading to their underpricing, because buyers have difficulty distinguishing good cars from bad ones. As a result, sellers avoid selling good cars at lower prices but remain willing to sell low-quality cars, leading to the problem of adverse selection (Akerlof, 1970).

Similarly, when firms issue shares, information asymmetry can lead to share underpricing, which in turn may discourage management from issuing new shares to finance growth opportunities (Myers & Majluf, 1984). In addition, information asymmetry is generally even greater when firms have more growth opportunities (Harris & Raviv, 2017). Consequently, firms may maintain greater financial slack, reflected in higher cash holdings and unused borrowing capacity, to fund investments that exercise growth options (Myers & Majluf, 1984). Among the components of financial slack, this study focuses on cash holdings as a source of such financing. Consistent with this argument, empirical studies document a positive association between growth opportunities and cash holdings (e.g., Benkraiem et al., 2020; Gonenc et al., 2022; Manoel & da Costa Moraes, 2022). In sum, because growth opportunities increase information asymmetry, which in turn leads to equity underpricing, firms tend to hold more cash to avoid issuing underpriced shares when they seek to invest. Accordingly, this reasoning leads to the following hypothesis:

Hypothesis 6. *The value of growth opportunities is positively associated with MNEs' cash holdings.*

Geographic diversification may reduce the cash needed to exercise growth opportunities because it lowers the correlation in the value and exercise timing of growth opportunities across countries. Within a single country, a firm may face a situation in which many unrelated growth opportunities need to be exercised during the same period. In other words, both the value of these growth opportunities and their exercise timing may be correlated. This correlation increases the need for cash to ensure that all growth options that

are in the money in the same period can be exercised. However, if a firm is geographically diversified, growth opportunities are less correlated, resulting in their exercise being spread across multiple years and reducing cash needs for exercising them in any given year. This diversification mechanism leads to the following hypothesis:

Hypothesis 7. *The positive relationship between growth opportunities and MNEs' cash holdings is negatively moderated by the geographic diversification of growth opportunities.*

3. Methods

To test the hypotheses, panel regression models were estimated using data from a sample of listed MNEs reporting under IFRS. Multiple databases were employed to collect information on the MNEs and their subsidiaries worldwide. The databases included the Bloomberg Terminal, Refinitiv Workspace (LSEG, previously Thomson Reuters), and two Bureau van Dijk products (a Moody's Analytics company), Orbis and Zephyr.

The initial sample of MNEs was drawn from the Orbis database based on several criteria. Eligible firms had to be active listed corporations with at least one MFOS, publish consolidated financial statements under IFRS, and be classified in manufacturing industries, defined as primary codes 31–33 in the North American Industry Classification System (NAICS 2017) and section C—Manufacturing in the Statistical Classification of Economic Activities in the European Community (NACE Rev. 2). For a subsidiary to be considered an MFOS, the parent must hold a stake of more than 50%, which includes wholly owned subsidiaries. The network of subsidiaries was traced by searching the subsidiaries of each identified MFOS in turn, level by level, until no further lower-level MFOSs were found or the tenth level was reached. This step was necessary to avoid excluding countries in which MFOSs are located several ownership levels below the first-tier subsidiary, because a standard Orbis search returns lower-level MFOSs only incompletely. In addition, the network is reconstructed for each year of the observation period, because Orbis reports only subsidiaries held at the time of retrieval. Subsidiaries divested during the observation period were therefore identified through Zephyr. In addition, firms had to be headquartered in Europe, Australia, New Zealand, or Canada. Industry codes were also manually screened to exclude non-manufacturing MNEs.

Three aspects of the sample selection require further explanation. First, most of the variables are constructed from MNEs' consolidated financial statements, for which recognition and measurement rules differ across national accounting frameworks. Including MNEs reporting under different accounting standards could therefore introduce measurement error into the variables. However, given the countries included in the sample, this requirement has relatively limited implications for sample coverage. IFRS is mandatory for the consolidated financial statements of companies admitted to trading on regulated markets in the EU or EEA, covering 23 of the 28 countries in the sample, including the United Kingdom throughout the sample period. Listed companies in Australia, Canada, New Zealand, and Ukraine report under IFRS or national standards converged with IFRS, and most listed companies in Switzerland report under IFRS. Second, samples of manufacturing firms are common in international business research (e.g., Zhao et al., 2020), especially in research on real options (e.g., Song, 2023), with real options representing an important construct in this study. Additionally, restricting the sample to manufacturing firms reduces the possibility that the results are driven by sectoral differences.

Third, samples focusing on MNEs are also common in international business research. Moreover, because domestic firms do not have foreign subsidiaries, they do not exhibit the cross-country geographic diversification examined in this study. The sample also

excludes emerging-market MNEs because they are relatively heterogeneous and differ from developed-market MNEs (see, e.g., Zhu et al., 2022).

Since MNEs need to actively manage their operations to exercise real options in their global networks, firms functioning primarily as holding companies or those engaged in consulting, support, or financial services were excluded. MNEs with missing country-level information or incomplete financial data were also excluded, as were small and medium-sized enterprises (SMEs).

To define SMEs, the financial criteria of the European Commission recommendation were applied (European Commission, 2003). Accordingly, firms with revenues of €50 million or less or total assets of €43 million or less were excluded. Lastly, MNEs with missing financial data in Bloomberg were eliminated. The final sample consists of 576 MNEs, yielding 2719 firm-year observations for the period 2015–2019.

Financial data on MNEs were obtained from the Bloomberg Terminal and Refinitiv Workspace (e.g., expected net income, stock prices, betas, expected inflation, market returns, and financial statements), subsidiary-level data from Orbis, and information on divested subsidiaries from Zephyr (based on mergers and acquisitions transactions). The Orbis database provides financial and ownership data for public and private firms worldwide at specific points in time and is generally regarded as the most comprehensive commercially available source of such data. However, because it was not possible to export MNEs' historical subsidiary networks from Orbis, the database was combined with Zephyr to obtain information on divested subsidiaries. The integration of both databases enabled the reconstruction of historical ownership structures of MNEs up to ten ownership levels deep for the period 2015–2019. This approach produced a unique historical dataset that cannot be derived from a single source.

The newly developed dataset contains MNEs, their financial data, and their foreign subsidiaries. To the author's knowledge, no comparable dataset is commercially available. Moreover, analyzing foreign subsidiaries up to ten ownership levels deep, information that cannot be extracted from firms' annual reports, addresses the issue of "omitted" subsidiaries. For instance, a French MNE may list a first-level subsidiary in France, but this subsidiary may in fact manage operations in Latin America and hold subsidiaries in that region. Relying solely on annual reports would therefore overlook the subsidiaries in Latin America.

Another important consideration concerns the choice of proxy. *Tobin's Q* is commonly measured as the ratio of the market value of a firm's assets to its book value, serving as a proxy for replacement value (e.g., Glova & Panko, 2025). The excess of the market value of assets over their replacement value reflects intangible assets in place and growth opportunities. However, intangible assets in place (e.g., brand equity) and growth opportunities are distinct asset types. Using proxies such as *Tobin's Q* precludes the separate examination of the associations between these two asset types and cash holdings. Therefore, this study measures intangible assets in place and growth opportunities separately, allowing their respective associations with cash holdings to be examined independently.

All variables were standardized prior to estimation. The model includes cash holdings as the dependent variable. It was operationalized using the following formula:

$$CH_{i,t} = LN\left(\frac{CCE_{i,t}}{TA_{i,t}}\right) \quad (1)$$

where:

- $CH_{i,t} \equiv$ Cash holdings for firm i in year t
- $CCE_{i,t} \equiv$ Cash and cash equivalents for firm i in year t
- $TA_{i,t} \equiv$ Book value of total assets for firm i in year t

The independent variables included growth opportunities, intangible assets, tangible assets, and geographic diversification. Growth opportunities (options) were scaled by debt and equity capital invested. They were operationalized as follows:

$$GO_{i,t} = \frac{GOV_{i,t}}{E_{i,t} + D_{i,t}} \quad (2)$$

where:

- $GO_{i,t} \equiv$ Proportion of growth opportunities in capital for firm i in year t
- $GOV_{i,t} \equiv$ Growth opportunities value for firm i in year t
- $E_{i,t} \equiv$ Market value of equity for firm i in year t
- $D_{i,t} \equiv$ Book value of total debt for firm i in year t

Growth opportunities are often operationalized using the market-to-book ratio (e.g., Hanlon et al., 2017). However, this ratio also includes intangible assets. To separate growth opportunities from other intangible assets, the value of growth opportunities was estimated using the following formula:

$$GOV_{i,t} = E_{i,t} - EIP_{i,t} \quad (3)$$

where:

- $GOV_{i,t} \equiv$ Growth opportunities value for firm i in year t
- $E_{i,t} \equiv$ Market value of equity for firm i in year t
- $EIP_{i,t} \equiv$ Market value of equity without growth option value for firm i in year t

In Equation (3), the market value of equity was defined as market capitalization plus preferred equity and minority interest. Additionally, *EIP* represents the portion of equity that finances assets in place and was estimated using the following formula:

$$EIP_{i,t} = \frac{ENI_{i,t+1}}{r_{Ei,t} - g} \quad (4)$$

where:

- $EIP_{i,t} \equiv$ Market value of equity without growth option value for firm i in year t
- $ENI_{i,t+1} \equiv$ Estimated net income for firm i in year $t + 1$
- $r_{Ei,t} \equiv$ Cost of equity for firm i in year t
- $g \equiv$ Net income average long-run growth rate

In Equation (4), the market value of equity without growth option value was estimated as a growing perpetuity. A long-run net income growth rate of 2 percent was used as g, approximated by the average annual dividend growth rate of about 2 percent (Golez & Koudijs, 2018). If *EIP* was negative, it was set to zero, and if *EIP* exceeded the market value of equity, it was set equal to the market value of equity.

The value of growth opportunities cannot be directly observed and hence every proxy unavoidably contains measurement error. Conceptually, the estimation is grounded in the division of firm value into the value of assets in place and the present value of growth opportunities (Myers, 1977), and specifically in the measurement of the value of growth opportunities as the market value of equity less the capitalized value of estimated net income, where the capitalized value represents the value of equity without the contribution of growth opportunities (Brealey et al., 2022), an approach conceptually similar to empirical implementations in the literature (e.g., Cao et al., 2008; Trigeorgis & Lambertides, 2014). Because the market value of equity moves with changing market expectations, the *GO* proxy captures market fluctuations in addition to changes in the underlying growth opportunities. This is reflected in the lower persistence of *GO* relative to the proportion of tangible assets in total assets (based on book values) and geographic diversification (Table A2 in Appendix A).

To the extent that this error is random, it attenuates the estimated associations of *GO*, including its interaction with geographic diversification, toward zero, thereby making the reported estimates more conservative. These concerns are mitigated to some extent by additional robustness checks. For example, the winsorized specification yields comparable results (Table A1 in Appendix A), and the specification with year fixed effects absorbs fluctuations in equity values common to all firms in a year (Section 4.2).

In a broad sense, intangible assets consist of growth opportunities and intangible assets in place, such as knowledge. This study focuses on intangible assets excluding growth opportunities and refers to them simply as intangible assets. For this purpose, the variable *INT* measures intangible assets excluding growth opportunities as well as recognized intangibles reported on the balance sheet. They were scaled by the market value of invested equity and debt capital and were operationalized as follows:

$$INT_{i,t} = \frac{IA_{i,t}}{E_{i,t} + D_{i,t}} \quad (5)$$

where:

- $INT_{i,t} \equiv$ Proportion of intangible assets in capital for firm i in year t
- $IA_{i,t} \equiv$ Intangible assets excluding growth opportunities for firm i in year t
- $E_{i,t} \equiv$ Market value of equity for firm i in year t
- $D_{i,t} \equiv$ Book value of total debt for firm i in year t

Intangible assets excluding growth opportunities in Equation (5) were calculated using Equation (6). Total liabilities and the market value of equity without growth option value in Equation (6) were used as proxies for the market value of assets without growth opportunities. If *IA* was less than zero, it was set to zero. In this case, it was assumed that the firm did not possess any *IA*. Additionally, for firm-year observations in which the initial *GOV* was estimated to be negative, the *IA* was also set to zero.

$$IA_{i,t} = TL_{i,t} + EIP_{i,t} - TA_{i,t} \quad (6)$$

where:

- $IA_{i,t} \equiv$ Intangible assets excluding growth opportunities for firm i in year t
- $TL_{i,t} \equiv$ Total liabilities for firm i in year t
- $EIP_{i,t} \equiv$ Market value of equity without growth option value for firm i in year t
- $TA_{i,t} \equiv$ Book value of total assets for firm i in year t

The proportion of tangible assets is often operationalized as property, plant, and equipment scaled by total assets (see e.g., Leary & Roberts, 2005). Some manufacturing MNEs also have financial operations. Their value was approximated using Bloomberg's enterprise value adjustment (*EV_Adj*), which consists of debt for financial services (e.g., financial subsidiaries) reduced by cash, cash equivalents, and marketable securities for financial services. The resulting net debt for financial services was used as a proxy for the assets of those operations. The proportion of tangible assets in total assets was estimated using the following formula:

$$TAN_{i,t} = \frac{PPE_{i,t}}{TA_{i,t} - EV_Adj_{i,t}} \quad (7)$$

where:

- $TAN_{i,t} \equiv$ Proportion of tangible assets in total assets for firm i in year t
- $PPE_{i,t} \equiv$ Property, plant, and equipment book value for firm i in year t
- $TA_{i,t} \equiv$ Book value of total assets for firm i in year t

- $EV_Adj \equiv$ Bloomberg's enterprise value adjustment for firm i in year t

Similar to the approach of Allen and Pantzalis (1996) and S.-H. Lee and Makhija (2009b), the number of countries with at least one MFOS was used to estimate the breadth of the international network, which represents the geographic diversification (*GEOD*) of an MNE. *GEOD* can also be viewed as a measure of multinationality (Driouchi & Bennett, 2011; Tong & Reuer, 2007a). Geographic diversification was operationalized as follows:

$$GEOD_{i,t} = N_Countries_{i,t} \tag{8}$$

where:

- $GEOD_{i,t} \equiv$ Geographic diversification of firm i in year t
- $N_Countries_{i,t} \equiv$ Number of countries with at least one MFOS of firm i in year t

Financial leverage serves as a control variable in the cash holdings model. Hanlon et al. (2017) found a negative relationship between leverage and cash holdings in their sample of MNEs. Therefore, a negative relationship for leverage as a control variable is also expected in the sample of MNEs in this study.

$$LEV_{i,t} = LN\left(\frac{TL_{i,t}}{(E_{i,t} + TL_{i,t})}\right) \tag{9}$$

where:

- $LEV_{i,t} \equiv$ Financial leverage for firm i in year t
- $TL_{i,t} \equiv$ Total liabilities for firm i in year t
- $E_{i,t} \equiv$ Market value of equity for firm i in year t

Firm size, operationalized as the logarithm of total assets, is often used as a control variable (see e.g., Song et al., 2014). Although prior research reports mixed results regarding the relationship between size and cash holdings for MNEs, a positive relationship may be expected in particular for foreign-held cash (Faulkender et al., 2019), as larger MNEs are more likely to accumulate substantial foreign cash holdings. The control variable size was quantified using the following equation:

$$SIZE_{i,t} = LN(TAEUR_{i,t}) \tag{10}$$

where:

- $SIZE_{i,t} \equiv$ Size of firm i in year t
- $TAEUR_{i,t} \equiv$ Book value of total assets in euros for firm i in year t

To test the hypotheses, a model including independent and control variables as well as interactions was developed. The model is specified below:

$$\begin{aligned} CH_{i,t} = \alpha + \beta_1 \times \; & SIZE_{i,t} + \beta_2 \times LEV_{i,t} + \beta_3 \times GO_{i,t} + \beta_4 \times INT_{i,t} \\ & + \beta_5 \times TAN_{i,t} + \beta_6 \times GEOD_{i,t} + \beta_7 \times (GEOD_{i,t} \times GO_{i,t}) \\ & + \beta_8 \times (GEOD_{i,t} \times INT_{i,t}) + \beta_9 \times (GEOD_{i,t} \times TAN_{i,t}) \\ & + \epsilon_{i,t} \end{aligned} \tag{11}$$

Since the dataset consists of yearly observations for 576 MNEs with 2719 firm-year observations, it represents an unbalanced panel. Accordingly, panel regression was employed for the analysis.

When deciding whether to use a random-effects model, several aspects were considered. The Hausman test was not significant for the main model ($p > 0.05$). Geographic diversification is a stock accumulated over the life of a firm and hence exhibits limited changes over the analysis period. The standard deviation of year-to-year within-firm

changes is 9% of the standard deviation of the levels across all firm-year observations, and 58% of consecutive firm-year pairs show no change in the number of countries (Table A2 in Appendix A). Additionally, 99.2% of the total variance of geographic diversification is attributable to differences between firms. A fixed-effects estimator would discard this between-firm variation and would estimate coefficients from a small portion of the overall sample variation, which does not align with the focus of the study on differences between less and more broadly diversified firms. In contrast, the random-effects model exploits the between-firm variation that is central to the analysis. Moreover, this study investigates whether the associations differ according to the level of geographic diversification rather than whether they are causal, and a random-effects model accounts for these between-firm differences, such as those between narrowly and broadly diversified MNEs. Based on these considerations, a random-effects model was applied.

The Breusch–Godfrey test indicates serial correlation ($p < 0.05$). The studentized Breusch–Pagan test indicates heteroskedasticity ($p < 0.05$). The Breusch–Pagan Lagrange multiplier test indicates cross-sectional dependence ($p < 0.05$). Accordingly, Driscoll–Kraay standard errors were employed.

4. Results

4.1. Descriptive Statistics and Main Results

The following subsections present the empirical analysis. Table 1 presents the home countries of the MNEs and the total number of MNEs from each country. The sample consists of 576 MNEs from 28 home countries. Of these, 501 are from 25 European countries, while the remaining 75 are from Australia, Canada, and New Zealand.

Table 1. Home countries of MNEs.

No.	Home Country	Total MNEs	No.	Home Country	Total MNEs
1	United Kingdom	92	15	Austria	15
2	Germany	72	16	Norway	9
3	Sweden	56	17	New Zealand	8
4	France	51	18	Croatia	4
5	Canada	39	19	Ireland	4
6	Finland	34	20	Greece	3
7	Switzerland	31	21	Ukraine	3
8	Australia	28	22	Luxembourg	2
9	Italy	25	23	Estonia	1
10	Netherlands	21	24	Hungary	1
11	Denmark	19	25	Iceland	1
12	Poland	19	26	Latvia	1
13	Spain	18	27	Portugal	1
14	Belgium	17	28	Slovenia	1

Table 2 presents the summary statistics of MNE characteristics. Total assets range from €44 million to €488 billion, with an average of €8.5 billion. Financial leverage, measured as total liabilities divided by total liabilities plus the market value of equity, ranges from 0.01 to 0.96, with an average of 0.37. Total assets and financial leverage also represent the control variables *SIZE* and *LEV*, respectively, in non-transformed form. The number of MFOSs ranges from 1 to 2760, with an average of 92.

Table 2. Descriptive statistics of MNE sample characteristics.

Statistic	Total Assets (Million EUR)	Number of MFOSs	Financial Leverage
Mean	8516	92	0.37
SD	30,542	179	0.19
Min	44	1	0.01
Max	488,071	2760	0.96

Note: SD denotes standard deviation.

Table 3 presents the descriptive statistics of the variables of interest used in the three models, reported in non-transformed form. MNEs have MFOSs in between 1 and 124 countries, with an average of approximately 22 countries (*GEOD*). *GO* ranges from 0 to 1, with an average of 0.16, while *INT* ranges from 0 to 1.18, with an average of 0.29. *TAN* ranges from 0.01 to 0.85, with an average of 0.25.

Table 3. Descriptive statistics for model variables of interest.

Statistic	*GO*	*INT*	*TAN*	*GEOD*
Mean	0.16	0.29	0.25	21.81
SD	0.21	0.23	0.15	21.05
Min	0.00	0.00	0.01	1.00
Max	1.00	1.18	0.85	124.00

Note: *SIZE* denotes firm size, *LEV* financial leverage, *GO* growth opportunities, *INT* intangible assets, *TAN* tangible assets, and *GEOD* geographic diversification; variable definitions are provided in Section 3.

Table 4 presents the generalized variance inflation factor (GVIF) and correlation matrix of the independent and control variables. Most Pearson coefficients suggest a low probability of multicollinearity. One relationship, between *LEV* and *INT*, shows moderately higher negative correlation (−0.51), but this value is generally not considered problematic. By contrast, the correlation of 0.78 between *GEOD* and *SIZE* is relatively high but still below the thresholds of 0.8 or 0.9. This high correlation is also understandable, since an MNE operating in more countries is likely to have more assets; however, having more assets does not necessarily imply a presence in more countries. Although pairwise correlations can be a useful diagnostic tool for multicollinearity, they should be interpreted with caution. A strong correlation coefficient (e.g., above 0.8 or 0.9) may suggest multicollinearity, but correlation alone is neither a necessary nor sufficient condition for identifying multicollinearity.

Table 4. Correlation matrix and GVIF.

Variable	*LEV*	*GO*	*INT*	*TAN*	*GEOD*	GVIF
SIZE	0.19	0.05	−0.10	0.07	0.78	1.05
LEV		−0.33	−0.51	0.17	0.08	1.50
GO			−0.30	−0.10	0.06	1.44
INT				−0.17	0.02	1.50
TAN					−0.16	1.32
GEOD						1.05

Note: *SIZE* denotes firm size, *LEV* financial leverage, *GO* growth opportunities, *INT* intangible assets, *TAN* tangible assets, and *GEOD* geographic diversification; variable definitions are provided in Section 3. GVIF denotes the generalized variance inflation factor.

A more reliable approach than pairwise correlations is to consider the variance inflation factor (VIF). Different VIF thresholds have been suggested as indicators of multicollinearity, most commonly 5 or 10. The lower the threshold, the more conservative the test is. Additionally, when interaction terms are included, GVIF is more appropriate. In the last column of Table 4 are provided GVIFs for all variables. As shown in the table, all GVIF values are below 2, well under the conservative threshold of 3, suggesting that multicollinearity is not present in the model.

Table 5 presents the stepwise (hierarchical) specification of models with firm cash holdings (*CH*) as the dependent variable. The coefficients on *GEOD* are positive but not statistically significant ($p > 0.05$), thus failing to support Hypothesis 1, which posits that geographic diversification is positively related to the cash holdings of MNEs.

Table 5. Stepwise (hierarchical) panel regression analysis of cash holdings.

Variable	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		Model 7		Model 8		Model 9	
Intercept	−2.673	***	−2.664	***	−2.664	***	−2.664	***	−2.663	***	−2.663	***	−2.660	***	−2.658	***	−2.645	***
	(0.078)		(0.043)		(0.046)		(0.041)		(0.034)		(0.035)		(0.035)		(0.036)		(0.036)	
SIZE	−0.005		0.056	**	0.049	*	0.046	*	0.060	**	0.020		0.020		0.019		0.018	
	(0.021)		(0.020)		(0.022)		(0.022)		(0.019)		(0.055)		(0.053)		(0.051)		(0.052)	
LEV			−0.265	***	−0.248	***	−0.191	***	−0.158	***	−0.159	***	−0.165	***	−0.164	***	−0.161	***
			(0.028)		(0.026)		(0.028)		(0.026)		(0.027)		(0.027)		(0.026)		(0.025)	
GO					0.062	***	0.105	***	0.098	***	0.096	***	0.087	***	0.084	***	0.086	***
					(0.010)		(0.023)		(0.019)		(0.019)		(0.017)		(0.018)		(0.019)	
INT							0.078	*	0.065	*	0.063	*	0.059	†	0.053	†	0.055	†
							(0.031)		(0.029)		(0.029)		(0.028)		(0.029)		(0.030)	
TAN									−0.254	***	−0.246	***	−0.245	***	−0.243	***	−0.224	***
									(0.025)		(0.036)		(0.035)		(0.036)		(0.039)	
GEOD											0.052		0.051		0.051		0.070	
											(0.086)		(0.083)		(0.069)		(0.072)	
GEOD × *GO*													−0.041	***	−0.063	***	−0.059	***
													(0.012)		(0.016)		(0.015)	
GEOD × *INT*															−0.054	***	−0.049	***
															(0.012)		(0.010)	
GEOD × *TAN*																	0.078	***
																	(0.019)	
No. of obs.	2719		2719		2719		2719		2719		2719		2719		2719		2719	
R^2	0.016		0.036		0.038		0.039		0.053		0.053		0.054		0.055		0.056	
Adj. R^2	0.015		0.035		0.037		0.037		0.051		0.051		0.051		0.052		0.053	

Notes: *SIZE* denotes firm size, *LEV* financial leverage, *GO* growth opportunities, *INT* intangible assets, *TAN* tangible assets, and *GEOD* geographic diversification; variable definitions are provided in Section 3. Standard errors are reported in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, † $p < 0.10$.

TAN exhibits a negative and highly significant coefficient across all models ($p < 0.001$), supporting Hypothesis 2. MNEs with higher levels of tangible assets hold lower levels of cash. The interaction coefficient of *GEOD* and *TAN* is positive and significant ($p < 0.001$), providing strong evidence for Hypothesis 3. Figure 1 illustrates the interaction between *TAN* and *GEOD* on *CH*. The negative relationship between *TAN* and *CH* is positively moderated by *GEOD*. These findings suggest that geographic diversification weakens the negative association of higher tangible assets with cash holdings, providing further support for Hypothesis 3.

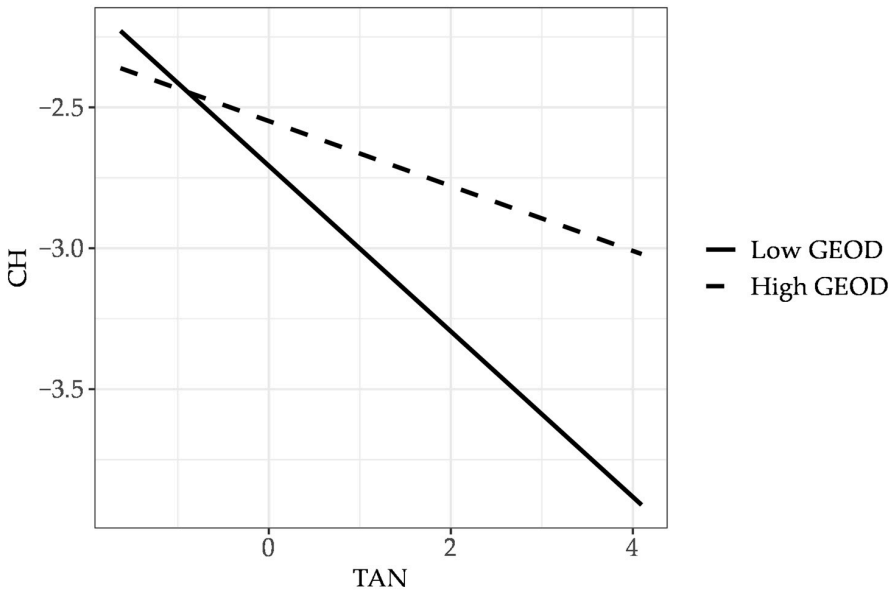


Figure 1. Interaction of *TAN* and *GEOD* on *CH*.

The coefficient of *INT* is positive in all models but not significant in the last two models ($p > 0.05$). In these models, however, the coefficient is marginally significant ($p = 0.07$ and $p = 0.06$, respectively), providing modest support for Hypothesis 4. By contrast, the coefficient of the interaction term *GEOD* × *INT* is negative and highly significant ($p < 0.001$), providing empirical evidence for Hypothesis 5, which posits that the positive relationship between *INT* and *CH* is negatively moderated by *GEOD*. Figure 2 illustrates this interaction, showing that *CH* increases as *INT* increases when MNEs have lower *GEOD*. However, the relationship becomes slightly negative under high *GEOD*, indicating that the level of geographic diversification negatively moderates the positive relationship between intangibles and cash holdings. Given the marginal significance of *INT* at the 0.1 level and the non-significance of *GEOD*, these results suggest that the relationship between intangibles and cash holdings is conditional on the level of geographic diversification and provide support for Hypothesis 5.

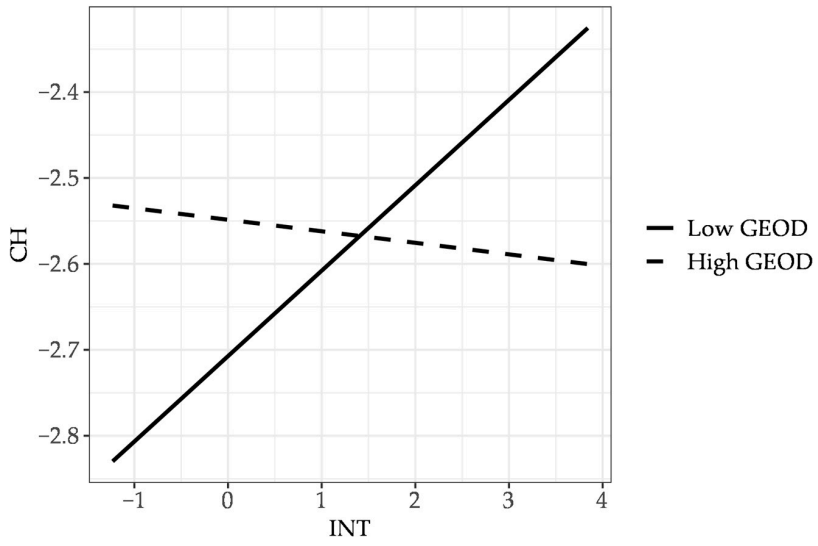


Figure 2. Interaction of *INT* and *GEOD* on *CH*.

The coefficient on *GO* is positive and highly significant across all models in which it is included ($p < 0.001$), providing strong support for Hypothesis 6. This finding indicates that MNEs with greater growth opportunities hold more cash to finance future investments. The interaction term *GO* × *GEOD* was added to the model to test Hypothesis 7, which states that the positive relationship between available growth opportunities and cash holdings should be weakened by the level of geographic diversification. In other words, geographically diversified MNEs with the same amount of growth opportunities are expected to hold lower levels of cash than less diversified MNEs. Consistent with Hypothesis 7, the interaction coefficient between *GO* and *GEOD* is negative and highly significant across all models ($p < 0.001$), providing strong support for Hypothesis 7. Figure 3 illustrates this interaction, showing that the higher the *GO*, the higher the *CH* level for MNEs with low *GEOD*. By contrast, the positive relationship between *GO* and *CH* is weakened when MNEs have higher *GEOD*, confirming Hypothesis 7.

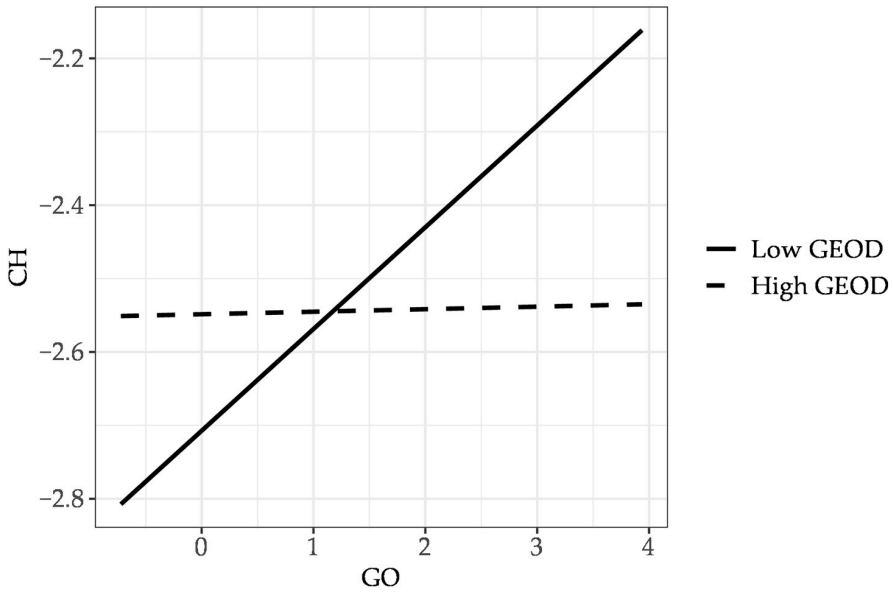


Figure 3. Interaction of *GO* and *GEOD* on *CH*.

The control variable *SIZE* is positive in all models except the first, but it is significant in only four models. This result provides weak evidence that larger MNEs hold more cash, possibly because they are in the mature phase of their life cycle, where cash flows are higher and repatriation of cash may be delayed due to taxation. Consistent with the findings of Hanlon et al. (2017), the control variable *LEV* is negative and highly significant in all models.

Taken together, these findings suggest that all three types of assets are associated with the level of cash holdings held by MNEs, but in different directions. Both growth opportunities and intangible assets are positively associated with cash holdings, indicating that MNEs with valuable intangible assets or growth opportunities hold more cash, although the evidence for intangible assets is moderate and weaker than that for growth opportunities. In contrast, tangible assets are negatively associated with cash holdings, consistent with the view that tangible assets enhance financial flexibility through greater borrowing capacity (Almeida & Campello, 2007; Alves et al., 2022). Overall, the results suggest that the composition of assets is importantly associated with the level of cash holdings.

The expectation that geographic diversification alone would be related to cash holdings was not supported (Hypothesis 1). However, geographic diversification moderates the association between each type of asset and cash holdings. While tangible assets are generally associated with lower cash holdings (Hypothesis 2), this negative relationship is

weakened in the presence of greater geographic diversification (Hypothesis 3). Specifically, MNEs with a broader international network and high levels of tangible assets hold more cash than those with a smaller network but comparable levels of tangible assets, all else being equal. One possible explanation is that the international diversification of tangible assets increases firm risk and cash flow variability, thereby raising the need for larger precautionary cash balances. These risks may arise from factors such as country-specific economic, political, or social conditions, as well as supply chain disruptions stemming from events such as natural disasters, pandemics, or military conflicts. The existing literature primarily examines the relationship between tangible assets and cash holdings, typically emphasizing a negative association, as tangible assets can serve as collateral and thereby enhance borrowing capacity (Almeida & Campello, 2007; Alves et al., 2022). This study extends the literature by examining whether the association between tangible assets and cash holdings differs according to the level of geographic diversification, an aspect that has been largely overlooked in prior research.

The analysis indicates that geographic diversification negatively moderates the positive relationship between intangible assets and cash holdings. While the results provide only moderate support for a positive association between intangible assets and cash holdings (Hypothesis 4), they show strong support for the interaction between intangible assets and geographic diversification (Hypothesis 5). These findings suggest that the association between intangibles and cash holdings is contingent on the level of geographic diversification. When geographic diversification is low, the relationship between intangibles and cash holdings is positive. However, as diversification increases, the relationship progressively weakens and eventually turns negative. In contrast to MNEs with low geographic diversification, the relationship between intangibles and cash holdings for MNEs with high geographic diversification is negative. This suggests a mechanism whereby firms with substantial intangible assets, such as knowledge, and extensive geographic diversification may hold lower cash holdings, as they can benefit from higher profitability in foreign subsidiaries (Contractor et al., 2016) or from a portfolio effect of intangible assets that may lower risk and stabilize cash flows. Prior studies support a positive relationship between intangibles and cash holdings (e.g., Falato et al., 2022), but they have not considered whether the association between intangibles and cash holdings differs according to the level of geographic diversification.

The analysis provides support for the view that, similar to the case of intangible assets, the positive relationship between growth opportunities and cash holdings (Hypothesis 6) is moderated by geographic diversification (Hypothesis 7). However, in the case of growth opportunities, the relationship is weakened but does not turn negative. Among MNEs with broader geographic diversification, higher values of growth opportunities are associated with only slightly higher cash holdings than among less diversified MNEs. This finding is noteworthy because it is consistent with a portfolio effect of growth opportunities, whose values are expected to be less correlated for MNEs operating in a larger number of countries. The more correlated the value of growth opportunities, the greater the need for cash holdings, since multiple opportunities are likely to become exercisable at the same time. Conversely, when growth opportunities are less correlated, fewer of them will be exercised simultaneously and they will instead be exercised more evenly across periods. With fewer opportunities requiring exercise in the same period, MNEs need less cash on hand, which reduces their speculative cash holdings.

Studies examining the relationship between growth opportunities and cash holdings have also documented a positive association (Benkraiem et al., 2020; Fernandes & Gonenc, 2016; Manoel & da Costa Moraes, 2022), particularly when growth opportunities are driven by innovation or knowledge (Beuselinck & Du, 2017; Hanlon et al., 2017; F. Li & Lin, 2022;

Pinkowitz et al., 2016). Nevertheless, these studies did not consider the role of geographic diversification in shaping the relationship between growth opportunities and cash holdings. This study extends the literature by addressing this gap and examining how geographic diversification moderates the growth opportunities–cash holdings relationship.

Overall, the association of each type of asset with cash holdings aligns with expectations. Intangible assets and growth opportunities are positively associated with cash holdings, whereas tangible assets are negatively associated with cash holdings. Comparing the interaction terms of asset types with geographic diversification, the results indicate that the geographic diversification of intangible assets and of growth opportunities is associated with lower cash holdings, consistent with diversification benefits, while the geographic diversification of tangible assets shows the opposite pattern. MNEs with more geographically diversified tangible assets hold more cash than MNEs with the same level of tangible assets but less diversification.

As the explanatory variables are standardized, the estimated coefficients in Model 9 (Table 5) represent the difference in the dependent variable associated with a one-standard-deviation difference in the respective explanatory variable. At the mean level of geographic diversification, there is a positive association between *GO* and *CH* ($\beta = 0.086$), which is weakened by approximately two-thirds (to 0.027) at one standard deviation of *GEOD* above the mean (*GO* × *GEOD*: $\beta = -0.059$). The negative association between *TAN* and *CH* ($\beta = -0.224$) is weakened by approximately one-third (to −0.146) at one standard deviation of *GEOD* above the mean (*TAN* × *GEOD*: $\beta = 0.078$). The positive, marginally significant association between *INT* and *CH* ($\beta = 0.055$) is weakened by approximately 90% (to 0.006) at one standard deviation of *GEOD* above the mean (*INT* × *GEOD*: $\beta = -0.049$). One standard deviation of *GEOD* corresponds to approximately 21 countries (Table 3). These associations do not describe changes in cash holdings resulting from changes in geographic diversification, but rather differences in the conditional associations between the respective assets and cash holdings at different levels of geographic diversification.

Additionally, although the R-square values are generally low, similarly low R-square values have also been reported in other studies (e.g., Da et al., 2011; Hsu & Cohen, 2020; Thia & Ong Lopez, 2023). One possible explanation is the substantial firm-specific heterogeneity among MNEs from 28 different home countries, which increases the relative importance of cross-sectional variation in the data (Q. Chang & Devine, 2019). Such heterogeneity may arise from factors such as managerial competence, firm strategy, competitive advantage, and organizational culture. While a high R-square is generally important for predictive purposes, the primary objective of this study is hypothesis testing rather than prediction. Furthermore, several estimated coefficients are statistically significant, and the Wald χ^2 test indicates that the explanatory variables are jointly statistically significant ($p < 0.001$).

4.2. Robustness Checks

To assess the robustness of the primary findings, several additional analyses were conducted. Table 6 reports robustness tests estimated using year fixed effects and alternative variable operationalizations. First, year fixed effects were added to the baseline model to address concerns that the results may be driven by unobserved time-specific heterogeneity, such as macroeconomic shocks common across firms. As reported in Column 1 of Table 6, the coefficients for *LEV*, *GO*, *TAN*, *GEOD* × *GO*, *GEOD* × *INT*, and *GEOD* × *TAN* remain statistically significant and retain the same signs and broadly similar magnitudes relative to Model 9 in Table 5. The only exception among the main explanatory variables is *INT*, which retains a similar magnitude but becomes statistically insignificant ($p = 0.13$), whereas it

was marginally significant in Model 9 of Table 5 ($p = 0.06$). The main findings are therefore robust to the inclusion of year fixed effects.

Table 6. Robustness tests using year fixed effects and alternative variable operationalizations.

	Baseline + Year FE		Alternative Operationalization		Alternative Operationalization + Year FE	
Intercept	−2.649	***	−1.607	***	−1.631	***
	(0.005)		(0.082)		(0.087)	
SIZE	0.017		−0.020		−0.020	
	(0.049)		(0.036)		(0.035)	
LEV	−0.167	***	−0.175	***	−0.180	***
	(0.021)		(0.028)		(0.034)	
GO	0.091	***				
	(0.022)					
INT	0.052					
	(0.034)					
Tobin's Q			0.048	***	0.052	***
			(0.011)		(0.011)	
TAN	−0.219	***	−2.340	***	−2.320	***
	(0.041)		(0.167)		(0.176)	
GEOD	0.076		−0.260	***	−0.256	***
	(0.069)		(0.054)		(0.053)	
GEOD × *GO*	−0.057	***				
	(0.015)					
GEOD × *INT*	−0.050	***				
	(0.011)					
GEOD × *Tobin's Q*			−0.057	**	−0.056	**
			(0.021)		(0.021)	
GEOD × *TAN*	0.078	***	1.040	***	1.035	***
	(0.020)		(0.089)		(0.090)	
Year FE	Yes		No		Yes	
No. of obs.	2719		2719		2719	
R^2	0.058		0.099		0.101	
Adj. R^2	0.053		0.097		0.097	

Notes: *SIZE* denotes firm size, *LEV* financial leverage, *GO* growth opportunities, *INT* intangible assets, *TAN* tangible assets, and *GEOD* geographic diversification; variable definitions are provided in Section 3. Standard errors are reported in parentheses. *** $p < 0.001$, ** $p < 0.01$.

Second, to assess the sensitivity of the results to alternative variable operationalizations, an alternative operationalization was constructed by replacing *GO* and *INT* with *Tobin's Q* and by employing alternative measures of *TAN* and *CH*. In this study, *GO* approximates growth opportunities, whereas *INT* captures intangible assets other than growth opportunities. Consequently, the sum of *GO* and *INT* should be positively associated with the excess of the market value of assets over the book value of assets. Accordingly, these two variables were replaced by *Tobin's Q*, which is generally operationalized as the market valuation of firms' assets relative to the book value of their assets as a proxy for replacement value (e.g., Glova & Panko, 2025). Therefore, *Tobin's Q* is expected to exhibit a positive coefficient, whereas its interaction with *GEOD* is expected to be negative, consistent with the corresponding *GO* and *INT* coefficients and their interactions with *GEOD* in Table 5. In the alternative operationalization, *TAN* was alternatively measured by including inventory in addition to property, plant, and equipment. Furthermore, *CH* was alternatively measured as the natural logarithm of cash and cash equivalents scaled by operating assets rather than total assets, where operating assets were defined as total assets minus cash and cash equivalents, following Papanastasopoulos and Tsiritakis (2015).

Column 2 of Table 6 reports the model using the alternative variable operationalization, whereas Column 3 reports the same operationalization with year fixed effects. Because these specifications use alternative measures for several variables, the comparison with Column 1 and Model 9 of Table 5 focuses primarily on coefficient signs and statistical significance rather than coefficient magnitudes. The signs and statistical significance of the key coefficients, especially the hypothesized interaction terms, remain broadly consistent with the baseline findings. *LEV* remains negative and highly significant, *TAN* remains negative and highly significant, and the interaction between *TAN* and *GEOD* remains positive and highly significant. Although *GEOD* becomes negative and statistically significant in the alternative specifications, the coefficients of the interaction terms central to the hypotheses remain consistent. *Tobin's Q* exhibits a positive and significant coefficient, whereas its interaction with *GEOD* is negative and significant. This pattern is consistent with the positive and statistically significant coefficient for *GO*, the marginally significant positive coefficient for *INT*, and the negative and significant coefficients for their interactions with *GEOD* in Table 5. Adding year fixed effects to the model using the alternative variable operationalization in Column 3 does not change the signs or statistical significance of the key coefficients reported in Column 2. Overall, the results suggest that the main findings, particularly the hypothesized interaction terms, are robust to alternative variable operationalizations and to unobserved time-specific heterogeneity captured by year fixed effects.

Third, the first three columns of Table A1 in Appendix A report specifications that assess whether the baseline results depend on extreme observations or on the operationalization of the variables. The first specification winsorizes all continuous explanatory variables at the 1st and 99th percentiles except for *GEOD*, as it is a count variable representing the number of countries. The results are largely consistent with those of the baseline specification. All coefficients retain comparable magnitudes, signs, and significance levels, with *INT* remaining marginally significant and *GEOD* remaining positive and insignificant.

The second column uses an alternative measure of the dependent variable, the natural logarithm of cash scaled by operating assets, operationalized in the same way as in the second and third columns of Table 6. There, however, this measure was applied together with alternative measures of the explanatory variables, whereas here it is reported in isolation. The signs of all explanatory variables remain the same, and all coefficients that were significant in the main model remain significant and retain similar magnitudes. *INT*, which was marginally significant in the main model, is insignificant in this specification. Most importantly, all three interaction terms retain very similar magnitudes, have the same signs, and remain significant at $p < 0.001$.

The third column uses an alternative measure of *GEOD*, defined as the number of MFOSs. As the distribution of the number of MFOSs is right-skewed, with the maximum value lying approximately 15 standard deviations above the mean, it was log-transformed. All explanatory variables that were significant in the main model retain the same signs and remain significant. The interaction coefficients for *GO* and *INT* increase in magnitude, whereas the interaction coefficient for *TAN* decreases. The coefficient of *INT* changes from marginally significant to insignificant but remains positive. The coefficient for the number of MFOSs is negative and highly significant, whereas the coefficient for *GEOD* is positive and insignificant.

Fourth, the timing of measurement is examined. Table A2 in Appendix A shows the within-firm first-order autocorrelation and the share of total variance attributable to differences between firms for each variable of interest. When interpreting the lagged specification in the fourth column of Table A1 in Appendix A, it should be considered that these variables differ in the extent to which they change over time. While *GEOD* and *TAN* are relatively stable over time ($\varrho = 0.996$ and 0.958, respectively), *INT* and *GO* exhibit

greater variation (ϱ = 0.826 and 0.772, respectively). These differences arise by construction because *GEOD* is a count of countries that changes only through the firm's own entries and exits, and *TAN* is derived from book values, accumulated over the years through investment net of depreciation, whereas *GO* and *INT* are derived from market values that move with changing expectations. Consequently, the lagged values of *GEOD* and *TAN* are more similar to their respective contemporaneous values than are the lagged values of *INT* and *GO*.

In the fourth column of Table A1 in Appendix A, the interaction coefficient for *GEOD* × *TAN* retains the same sign and a similar magnitude and remains significant, whereas the coefficients for *GEOD* × *INT* and *GEOD* × *GO* are no longer distinguishable from zero. These results are consistent with the differences in year-to-year variation reported in Table A2. The dependent variable, *CH*, also varies more over time (ϱ = 0.766), similarly to *INT* and *GO*, suggesting that MNEs can adjust their cash holdings faster than their tangible assets. Model 9 in Table 5, in which all variables are measured contemporaneously, therefore remains the primary specification because the hypotheses concern how cash holdings and asset composition are related at the same point in time rather than whether asset composition in one year predicts cash holdings in the next.

Fifth, a subsample analysis is reported in Table A3 in Appendix A. In the first two columns, MNEs are grouped by industry capital intensity into low- and high-intensity groups based on the NACE statistical classification of economic activities. The split is based on the median ratio of property, plant, and equipment to total assets for each two-digit NACE division. The divisions with medians above the overall median are categorized as the high-intensity group, whereas those below the overall median are categorized as the low-intensity group. Since the classification is based on division-level medians, the level of tangible assets of an individual MNE does not determine the group to which it belongs, allowing for variation in tangible asset intensity within each group. For the low-intensity group, all three interactions retain their signs and remain significant. For the high-intensity group, the interactions involving *GO* and *INT* retain their signs, but only the interaction involving *INT* remains significant, and the interaction involving *TAN* is not distinguishable from zero. The high-intensity group also has approximately half the explanatory power of the low-intensity group.

In the third and fourth columns, MNEs are grouped by financial system into market-based and bank-based systems, following Demirgüç-Kunt and Levine (2001), with the classification further supported by information from the International Monetary Fund (2024) and the European Investment Bank (2022) for Eastern European countries and Luxembourg. The interactions retain their signs in both groups. All three are significant at $p < 0.001$ for MNEs in market-based systems, whereas for MNEs in bank-based systems only the interaction involving *TAN* remains significant. The split is also informative regarding the standalone *GEOD* coefficient, which is positive and significant for the market-based group (0.263) and negative and significant for the bank-based group (−0.169).

The fifth and sixth columns of Table A3 present the subsample analysis based on firm size. MNEs are classified once, using the mean of their logarithmic total assets across all observed years, and split at the median across firms, so that no MNE changes group between years. The interaction coefficients for the large-firm group retain their hypothesized signs, but only the interaction involving *TAN* remains significant. For the small-firm group, the interactions involving *GO* and *INT* retain their hypothesized signs and are significant, whereas the interaction involving *TAN* is not distinguishable from zero. These two interactions exhibit the largest magnitudes among the interaction terms estimated in this study (−0.262 and −0.288, respectively, both $p < 0.001$), while the coefficients for *GO* and *INT* are negative, with *INT* significant and *GO* marginally significant. The negative associations of

GO and *INT* may be related to the greater financial constraints of smaller firms, for which high growth-option and intangible-asset intensity may coincide with cash being used to finance investment rather than being accumulated in anticipation of future investment.

Sixth, Table A4 in Appendix A reports cross-sectional ordinary least squares (OLS) regressions estimated separately for each year. As these regressions do not account for the panel structure of the data and use approximately 540 observations per year, compared with 2719 observations in the main panel model, their estimates are less precise. Therefore, consistency in coefficient signs is more informative than statistical significance within any single year. On this basis, all 35 coefficients for the variables of interest retain the hypothesized signs, including 20 standalone associations and 15 interaction terms.

In sum, the robustness check specifications support the interaction results of the main full-sample model. Across the 12 panel specifications, there are 36 interaction estimates, of which 27 retain the hypothesized sign and are statistically significant, while none of the remaining estimates is significant with a sign opposite to that hypothesized. This count includes the specification with year fixed effects reported in Column 1 of Table 6, but excludes the two specifications in Columns 2 and 3, which combine the *GO* and *INT* measures into *Tobin's Q* as a single measure capturing both. Those two specifications nevertheless also support the results of the main model. The *GEOD* × *TAN* interaction retains the hypothesized sign and is significant in 10 out of 12 specifications, the *GEOD* × *INT* interaction in 9, and the *GEOD* × *GO* interaction in 8. The interactions that are not significant either retain the hypothesized sign or are indistinguishable from zero. The only two variables of interest whose results differ from those in the main model are *GO* and *INT* in the small-firm subsample, where the association is negative and significant for *INT* and marginally significant for *GO*. These results limit the generalizability of the standalone associations for *GO* and *INT* and identify a boundary condition for these associations, rather than for the interaction coefficients, which are the focal point of this study.

4.3. Interpretation of the Estimates and Potential Endogeneity

There are a few considerations when interpreting the coefficients, each of which relates to potential endogeneity in the relationships examined, particularly the possibility of reverse causality between geographic diversification, asset composition, and cash holdings. First, firms need cash to exercise their growth opportunities through investments in tangible and intangible assets, which in turn increases the stock of these investments and geographic diversification when the investment is made in a new country. Such investment represents a change in the stock of assets and geographic diversification, whereas the measures used in this study represent their accumulated stocks. Therefore, investments and the levels of tangible assets, intangible assets, and geographic diversification are conceptually distinct constructs. The stocks reflect the accumulated outcome of past investment decisions over the life of a firm. In sum, although cash levels generally precede new investments, this mechanism is not automatically present for the accumulated stock of investments and geographic diversification.

Second, since intangible assets, tangible assets, and geographic diversification represent stocks accumulated through past investments over the life of a firm, a reverse-causality account would require past rather than current cash holdings to have driven those investments. Current cash levels would then serve as a reasonable proxy for past cash levels only if cash holdings were highly persistent over the lifespan of a firm. However, even during the period of analysis, cash holdings were less persistent ($\varrho = 0.766$) than geographic diversification and tangible assets ($\varrho = 0.996$ and 0.958, respectively), as shown in Table A2. The lower persistence of cash holdings substantially reduces the reliability of current cash holdings as a proxy for past cash holdings.

Third, growth opportunities generally stem from firm- and market-specific factors (e.g., increases in demand for a firm's products), whereas cash enables the exercise of growth opportunities through investments. Growth opportunities are therefore a distinct construct from the investments that exercise them, and the ordering implied by the mechanism developed in Section 2 is growth opportunities, then cash, then investment.

Fourth, the interaction terms are less susceptible to reverse-causality concerns than the standalone coefficients. Since geographic diversification is a stock accumulated over the life of a firm and changes little during the period of analysis, such a mechanism is unlikely to operate through this variable. Therefore, a reverse-causality interpretation would require cash holdings to influence growth opportunities, intangible assets, and tangible assets differently depending on the number of countries in which the MNE operates, with cash holdings affecting tangible and intangible assets in opposite directions.

Fifth, in the lagged specification (fourth column of Table A1 in Appendix A), the explanatory variables are measured in the previous year and therefore cannot be influenced by unanticipated changes in cash holdings in the observation year. In that specification, the *GEOD* × *TAN* interaction retains its sign, its significance, and a similar magnitude, whereas the *GEOD* × *GO* and *GEOD* × *INT* interactions are close to zero in magnitude and statistically indistinguishable from zero. This attenuation is expected given the lower persistence of *GO* and *INT* relative to *TAN* (Table A2 in Appendix A), which stems from the derivation of *GO* and *INT* from market values, which are forward-looking, whereas *TAN* is based on book values that accumulate over time and are therefore backward-looking. Considering that the hypotheses concern the contemporaneous association between different types of assets and cash holdings, the contemporaneous specification remains primary.

Lastly, instrumental-variable and dynamic generalized method of moments (GMM) estimation were considered but not adopted. For each explanatory variable of interest, a valid instrumental variable would need to shift that variable while influencing cash holdings only through that channel. Because geographic diversification is included in the interaction terms that constitute the main variables of interest, instrumenting an asset variable alone would leave its interaction unidentified, and identification would therefore require a valid instrument for geographic diversification itself; however, no generally accepted instrument for a firm's degree of geographic diversification exists (Hong & Liu, 2023), and an instrument proposed for diversification within a single country does not extend to MNEs operating across many countries. Dynamic GMM uses lagged values of the variables as internal instruments and exploits within-firm variation for identification. In this particular study, as shown in Table A2 in Appendix A, geographic diversification has very limited within-firm variation, and such internal instruments would therefore be weak in this setting (Bun & Windmeijer, 2010). Moreover, the hypotheses concern the levels of geographic diversification and asset composition, which are stocks accumulated over many years, rather than their year-to-year changes. Accordingly, coefficients identified primarily from within-firm changes would capture short-run variation rather than the associations addressed by the hypotheses.

In sum, although the possibility of reverse causality cannot be excluded, these six considerations constrain the mechanisms through which it could operate, and because two-way causality requires reverse causality to be present, they also constrain that possibility. The estimates are accordingly interpreted as conditional associations rather than as causal effects.

5. Discussion

This study investigates how the geographic diversification of tangible assets, intangible assets, and growth opportunities is associated with MNEs' cash holdings as a key component of their financial strategy. With the exception of two hypotheses, all hypotheses were supported. As the first exception, the hypothesis that intangible assets are positively associated with cash holdings received only weak support. The second exception is the hypothesis that geographic diversification on its own is related to cash holdings, which was not supported. However, the findings suggest that the geographic diversification of specific asset types is associated with the level of cash holdings.

Taken together, both intangible assets and growth opportunities appear to be positively associated with cash holdings, although the evidence for intangibles is weaker. Furthermore, the findings suggest that the geographic diversification of intangibles and growth opportunities weakens the positive association of these assets with cash holdings. In the case of intangibles, high levels of geographic diversification may even reverse the relationship, turning it into a negative association with cash holdings. This change in direction at higher levels of diversification may explain why the hypothesis that intangibles are positively associated with cash holdings received only weak support, since this association was tested in isolation without accounting for geographic diversification. By contrast, tangible assets show the opposite pattern. They are negatively associated with cash holdings overall, while their geographic diversification weakens this negative association.

Economically, these associations are consistent with the mechanisms presented in Section 2. The portfolio diversification of growth opportunities across countries and, in the case of intangible assets, both portfolio diversification and the operational flexibility conferred by across-country real options may reduce risk and thereby the associated need for cash holdings. In turn, the geographic diversification of tangible assets appears to weaken their role as collateral and as a potential source of liquidity, and to increase firms' exposure to country-specific risks.

No statistically significant association was found between standalone geographic diversification and cash holdings. This is consistent with the mixed findings of previous studies. One possible explanation is that the association varies across institutional environments. In the subsample analysis, the association is positive in market-based systems and negative but of comparable magnitude in bank-based systems; because these associations have opposite signs, they may offset each other to some extent in the main sample. The findings further indicate that the association may depend on the asset composition of the MNEs. Geographic diversification therefore does not appear to have a stable or unconditional association with cash holdings.

This study is subject to several assumptions and limitations. Generally, investment diversification is expected to capture both risk reduction effects and additional upside benefits. In this context, it is assumed that geographic diversification reflects various risks and environmental aspects, such as formal and informal institutional factors (e.g., culture), environmental risks, and political risks. Consequently, specific risks and institutional aspects were not examined directly.

Due to data restrictions, the study assumes that a broad network of countries in which MFOSs are located sufficiently captures the geographic diversification effect. This assumption introduces four further limitations. First, only the network of MFOSs was investigated, while investments in joint ventures and minority interests were excluded from the analysis. Second, geographic diversification does not account for the amount invested in each country and the correlation between these investments, thereby limiting the ability to fully assess diversification effects. Unfortunately, information on investments across countries is often unavailable, and restricting the analysis to subsidiaries for which such

information is available would reduce the number of subsidiaries and, consequently, the number of countries included in the study. Furthermore, even relatively small investments may contribute to geographic diversification because they can serve as springboards for future investments, consistent with real options theory (Belderbos et al., 2019). Consequently, excluding countries for which investment data are unavailable could omit potentially important diversification effects arising from such real options. Third, the study does not measure tangible assets, intangible assets, and growth opportunities at the country level, but instead assumes that a broader international network implies that these assets are more widely diversified than in the case of a narrower network. Fourth, the role of subsidiary type, such as sales, R&D, and manufacturing subsidiaries, was not examined. Considering the focus on MFOSs, which are majority-controlled by MNEs, the exclusion of other forms of investment, such as joint ventures and minority interests, may understate the breadth of some networks. Coupled with treating all countries equally regardless of investment size, this measurement approach may introduce measurement error. To the extent that this error is random, it attenuates the estimated coefficient of *GEOD* and the coefficients of its interactions toward zero, thereby making the reported estimates conservative in this respect. Consistent with this, the results are also robust to an alternative operationalization of *GEOD* based on the number of MFOSs (Table A1 in Appendix A).

Additionally, the observation period from 2015 to 2019 does not include events such as COVID-19 or the policy rate hikes in 2022. Due to this constraint, extreme macroeconomic shocks cannot be identified. The COVID-19 shock may produce different levels of precautionary cash balances, and interest rate spikes may change the opportunity cost of capital. Extending the panel data in a single specification may therefore create a risk of conflating distinct cash-holding regimes, and would instead indicate the need for a research design tailored to this purpose.

Despite these limitations, this study extends the literature by combining multiple databases to overcome data constraints faced by prior research and by enabling the analysis of several hundred MNEs from 28 countries with subsidiaries operating in most parts of the world. In doing so, this study further extends the literature by providing a more comprehensive understanding of the associations between the geographic diversification of different asset types and MNEs' cash-holding policies.

In sum, to the best of my knowledge, the relationship between diversification of different types of assets and cash holdings has not been researched so far. This study seeks to address this gap by providing insights into how geographic portfolio effects of these assets may shape key aspects of the financial and strategic decisions of MNEs.

Overall, this study extends the literature by showing that the strategy of MNEs is shaped not only by the structure of assets but also by the distinct portfolio effects of each asset type. In addition, it examines unrecognized intangible assets separately from growth opportunities and employs the number of countries, rather than the broad regions typically reported in accounting reports that may even extend across continents, as a proxy for diversification.

6. Conclusions

This study, positioned at the intersection of MNE strategy and international financial management, examined whether the associations of growth opportunities, intangible assets, and tangible assets with MNEs' cash holdings differ according to the level of geographic diversification. Based on a sample of 576 manufacturing MNEs from 28 home countries, comprising European countries as well as Australia, Canada, and New Zealand, with majority foreign-owned subsidiaries in up to 124 countries, over the period 2015–2019, the study finds that the positive associations of growth opportunities and, less robustly,

intangible assets with cash holdings weaken with broader geographic diversification. Similarly, the negative association of tangible assets with cash holdings weakens with broader diversification. However, standalone geographic diversification does not show a stable or unconditional association with cash holdings. These patterns are consistent with geographic portfolio effects that differ across asset types.

The implications for managers, corporate treasurers, and financial analysts, as well as for the financial policies of MNEs, are that the cash holdings associated with a firm's asset structure differ with the breadth of its network of countries. MNEs with broader networks of countries hold lower cash levels per unit of growth opportunities and, less robustly, intangible assets than less geographically diversified MNEs, while the negative association between tangible assets and cash holdings is weaker among them, so tangible assets appear to substitute for cash less strongly. When benchmarking cash holdings against peers, or when planning liquidity in the context of international expansion, managers, corporate treasurers, and financial analysts can derive more informative insights if they consider geographic diversification alongside asset composition. Because this study examines associations rather than causal effects, these implications concern expected cash levels and benchmarking rather than the consequences of changes in geographic diversification.

The data constraints encountered in this study also carry an implication for policymakers and standard-setting bodies, which could consider more detailed disclosure requirements regarding foreign investments at the subsidiary or country level (e.g., asset values, revenues, and profits). Such disclosures would allow financial analysts, creditors, and investors to assess firms' liquidity positions more accurately.

Since the study provides evidence on associations, future research could seek to establish causal effects, for example, by identifying a valid instrument for geographic diversification, such as exposure to exogenous changes that affect the geographic networks of some firms but not others. Future research could further refine the measurement of geographic diversification by incorporating investment size, returns, and correlations across country-level investments, for instance, by examining a sample of MNEs for which country-level investment data are available. Additionally, the scope of the analysis could be expanded to include other forms of investment, such as joint ventures and minority holdings, potentially using ownership-weighted counts. The study suggests portfolio effects of different asset types, and future research could further explore how different types of intangible assets (e.g., knowledge or brand equity) and their geographic diversification may be associated with the financial strategy of MNEs, and how these intangible assets relate to cash-flow volatility, risk, and cash holdings of MNEs.

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Abbreviations

The following abbreviations are used in this manuscript:

GMM	Generalized method of moments
MNE	Multinational enterprise
MFOS	Majority foreign-owned subsidiary
OLS	Ordinary least squares
IFRS	International Financial Reporting Standards
GVIF	Generalized variance inflation factor
VIF	Variance inflation factor

Appendix A

Table A1. Robustness checks: alternative specifications.

Variable	Winsorized		Cash/ Net Assets		MFOS Count (log)		Lagged (t − 1)	
Intercept	−2.646	***	−2.512	***	−2.660	***	−2.660	***
	(0.036)		(0.031)		(0.030)		(0.065)	
SIZE	0.016		0.037		0.173	***	−0.113	*
	(0.051)		(0.047)		(0.039)		(0.053)	
LEV	−0.166	***	−0.197	***	−0.158	***	−0.033	
	(0.026)		(0.020)		(0.025)		(0.031)	
GO	0.084	***	0.079	***	0.085	***	0.045	†
	(0.020)		(0.020)		(0.022)		(0.025)	
INT	0.052	†	0.040		0.041		0.066	***
	(0.031)		(0.026)		(0.038)		(0.019)	
TAN	−0.225	***	−0.273	***	−0.260	***	−0.143	***
	(0.039)		(0.041)		(0.027)		(0.014)	
DIV	0.072		0.032		−0.145	***	0.176	*
	(0.071)		(0.062)		(0.041)		(0.081)	
DIV × *GO*	−0.061	***	−0.059	***	−0.083	***	0.014	
	(0.016)		(0.016)		(0.011)		(0.045)	
DIV × *INT*	−0.050	***	−0.048	***	−0.113	***	0.003	
	(0.011)		(0.010)		(0.019)		(0.014)	
DIV × *TAN*	0.079	***	0.088	***	0.031	*	0.090	**
	(0.019)		(0.022)		(0.013)		(0.033)	
No. of obs.	2719		2719		2719		2128	
R^2	0.056		0.070		0.060		0.038	
Adj. R^2	0.053		0.067		0.057		0.034	

Notes: *SIZE* denotes firm size, *LEV* financial leverage, *GO* growth opportunities, *INT* intangible assets, *TAN* tangible assets, and *GEOD* geographic diversification; variable definitions are provided in Section 3. *MFOS* denotes majority foreign-owned subsidiaries. *DIV* denotes the measure of geographic diversification, which is *GEOD* in Columns 1, 2, and 4 and the logarithm of the number of MFOSs in Column 3. Column 1 winsorizes all continuous explanatory variables at the 1st and 99th percentiles. Column 2 uses the logarithm of cash scaled by operating assets as the dependent variable, where operating assets are defined as total assets minus cash and cash equivalents. Column 4 lags all explanatory variables by one year. In each column, all variables not described above are measured as in the main model. Standard errors are reported in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, † $p < 0.10$.

Table A2. Within-firm autocorrelation and share of variance between firms.

Variable	$\varrho\ (X_t, X_{t-1})$	SD(ΔX)/SD(X)	Share of Variance Between Firms
CH	0.766	0.751	0.716
GEOD	0.996	0.090	0.992
TAN	0.958	0.290	0.943
INT	0.826	0.590	0.773
GO	0.772	0.675	0.744

Notes: *CH* denotes cash holdings, *GEOD* geographic diversification, *TAN* tangible assets, *INT* intangible assets, and *GO* growth opportunities; variable definitions are provided in Section 3. The first column of the table reports the within-firm first-order autocorrelation, computed over 2128 consecutive one-year pairs. SD(ΔX)/SD(X) in the second column represents the standard deviation of year-to-year within-firm changes ($\Delta X = X_t - X_{t-1}$) divided by the standard deviation of the levels of X; lower values indicate lower year-to-year variability relative to the overall variation in X. The third column reports the share of total variance attributable to differences between firms. For *GEOD*, 58% of the consecutive firm-year pairs record no change in the number of countries, 24% record a change of one country, and 18% a change of more than one country.

Table A3. Subsample analyses.

Variable	Low Capital Intensity		High Capital Intensity		Market-Based		Bank-Based		Small Firms		Large Firms	
Intercept	−2.552	***	−2.853	***	−2.886	***	−2.441	***	−2.497	***	−2.625	***
	(0.028)		(0.067)		(0.087)		(0.046)		(0.089)		(0.048)	
SIZE	0.004		0.093		−0.086		0.158	**	−0.133		0.014	
	(0.033)		(0.148)		(0.113)		(0.056)		(0.103)		(0.080)	
LEV	−0.214	***	−0.090	†	−0.311	***	−0.071	***	−0.299	***	−0.049	*
	(0.050)		(0.051)		(0.052)		(0.018)		(0.062)		(0.020)	
GO	0.087	***	0.063	†	0.084	**	0.086	*	−0.092	†	0.105	***
	(0.020)		(0.037)		(0.031)		(0.035)		(0.048)		(0.011)	
INT	0.062	***	0.026		0.071	†	0.054		−0.163	**	0.078	**
	(0.016)		(0.064)		(0.039)		(0.036)		(0.062)		(0.025)	
TAN	−0.239	***	−0.163	***	−0.182	***	−0.297	***	−0.253	**	−0.269	***
	(0.040)		(0.041)		(0.048)		(0.023)		(0.080)		(0.018)	
GEOD	0.013		0.105		0.263	*	−0.169	***	0.537	***	0.015	
	(0.018)		(0.133)		(0.129)		(0.038)		(0.124)		(0.079)	
GEOD × *GO*	−0.037	***	−0.091		−0.099	***	−0.021		−0.262	***	−0.024	
	(0.008)		(0.060)		(0.024)		(0.022)		(0.075)		(0.023)	
GEOD × *INT*	−0.030	***	−0.102	**	−0.065	***	−0.048		−0.288	***	−0.011	
	(0.005)		(0.036)		(0.016)		(0.032)		(0.074)		(0.015)	
GEOD × *TAN*	0.086	***	−0.004		0.088	***	0.065	**	−0.026		0.089	**
	(0.020)		(0.038)		(0.025)		(0.025)		(0.050)		(0.033)	
No. of obs.	1465		1254		1348		1371		1293		1426	
R^2	0.076		0.039		0.060		0.099		0.075		0.039	
Adj. R^2	0.070		0.032		0.054		0.093		0.069		0.033	

Notes: *SIZE* denotes firm size, *LEV* financial leverage, *GO* growth opportunities, *INT* intangible assets, *TAN* tangible assets, and *GEOD* geographic diversification; variable definitions are provided in Section 3. Standard errors are reported in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, † $p < 0.10$.

Table A4. Yearly cross-sectional OLS regressions of cash holdings.

Variable	2015		2016		2017		2018		2019	
Intercept	−2.649	***	−2.575	***	−2.706	***	−2.613	***	−2.679	***
	(0.060)		(0.039)		(0.071)		(0.059)		(0.071)	
SIZE	−0.084		−0.027		−0.019		−0.120		−0.100	
	(0.069)		(0.065)		(0.076)		(0.105)		(0.106)	
LEV	−0.077		−0.082		−0.091		−0.076		−0.141	
	(0.079)		(0.063)		(0.082)		(0.069)		(0.104)	
GO	0.126		0.140	*	0.200	*	0.203	***	0.152	*
	(0.093)		(0.060)		(0.087)		(0.058)		(0.070)	
INT	0.033		0.066		0.206	*	0.150	*	0.081	
	(0.063)		(0.059)		(0.094)		(0.069)		(0.103)	
TAN	−0.157	**	−0.190	***	−0.144	*	−0.141	*	−0.078	
	(0.050)		(0.043)		(0.056)		(0.056)		(0.067)	
GEOD	0.152		0.060		0.139		0.172		0.199	†
	(0.093)		(0.068)		(0.099)		(0.127)		(0.117)	
GEOD × *GO*	−0.077		−0.116	*	−0.114		−0.101		−0.092	
	(0.106)		(0.058)		(0.083)		(0.063)		(0.056)	
GEOD × *INT*	−0.110	*	−0.083	†	−0.145	*	−0.046		−0.093	
	(0.048)		(0.043)		(0.073)		(0.074)		(0.058)	
GEOD × *TAN*	0.015		0.047		0.047		0.068		0.084	
	(0.052)		(0.042)		(0.055)		(0.058)		(0.068)	
No. of obs.	544		545		538		542		550	
R^2	0.054		0.116		0.074		0.077		0.067	
Adj. R^2	0.038		0.101		0.058		0.061		0.052	

Notes: *SIZE* denotes firm size, *LEV* financial leverage, *GO* growth opportunities, *INT* intangible assets, *TAN* tangible assets, and *GEOD* geographic diversification; variable definitions are provided in Section 3. Standard errors are reported in parentheses. *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, † $p < 0.10$.

Note

[1] In this context, precautionary motives refer to holding cash to finance growth opportunities and to buffer against cash-flow volatility (Opler et al., 1999).

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