Multinationals and Uncertainty: The Role of Internal Capital Markets*

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Abstract

Multinational enterprises (MNEs) borrow capital globally and reallocate it internally. This paper studies how external lenders at the parent and subsidiary levels of an MNE interact through its internal capital market (ICM). Due to agency problems faced by MNEs and their external lenders, I show that an MNE can allocate an optimal portion of its external debt at the subsidiary level for delegated monitoring when local lenders have information advantages over the (foreign) shareholders of a subsidiary. Given the debt structure, I then study how the parent- and subsidiary-level external debt interacts via the ICM in response to local country-level shocks both theoretically and empirically. Using the rise of uncertainty in the UK during an early period of Brexit as a natural experiment, I provide evidence that MNEs can lower the portion of external debt allocated at the subsidiary level when facing local shocks that enhance the monitoring incentive of subsidiary-level external lenders. Thus, MNEs respond by raising parent-level external debt for their affected subsidiaries, which tends to be cheaper. Meanwhile, the subsidiaries lower their external borrowing in exchange for new capital provided internally via the ICM. Such substitution of external debt across the ICM improves the debt structure of MNEs and can stabilize the deleveraging pressure caused by a local country-level shock.

Keywords: multinational enterprises, internal capital markets, debt structure, uncertainty shocks, Brexit

JEL Codes: F23, F34, D81, G30

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1 Introduction

How do multinational enterprises (MNEs) connect external lenders through their internal capital markets (ICMs)? ICMs play a vital role in the interaction of MNEs with external capital markets. They allow MNEs to borrow globally with the support of cash flows from their subsidiaries and enable the reallocation of capital internally to substitute external debt. Understanding how the ICMs connect different external lenders of MNEs is important as such linkage affects the capacity of MNEs to finance their activities as a prominent force in the global economy.[1]

Despite its importance, how MNEs interact with different external lenders through their ICMs has not been fully understood. The existing literature has studied whether domestic business groups use their ICMs to allocate assets efficiently (e.g., Santioni, Schiantarelli, and Strahan 2020), how MNEs respond to global credit supply shocks binding the borrowing constraint of the entire business group (Biermann and Huber 2023), and how MNEs utilize ICMs to improve the performance of their subsidiaries in emerging markets (e.g., Kalemli-Ozcan et al. 2016) or to maximize tax benefits (e.g., Goldbach et al. 2021). So far, little attention has been paid to the interconnection of external lenders through the ICMs of MNEs, especially among developed countries. My paper fills this gap by studying how the external lenders at the parent (group) level interact with those at the subsidiary level, and the unique role of subsidiary-level external lenders in the response of MNEs to local shocks.

Compared with domestic firms, multinational parents have a financing advantage since an MNE's cash flows in different countries are exposed to different shocks. Such international diversification can allow the parent company to use cross-subsidization across countries to lower its default risk and the overall volatility of cash flows (Erel, Jang, and Weisbach 2020). While the diversification benefit grants a financing advantage to multinational parents, MNEs

[1] Multinational parents and their subsidiaries account for around 1/3 of the global output, 50% of the international trade, and 25% of the global employment (Cadestin et al. 2018). In the US, MNEs account for about half of the publicly traded firms and 57% of the market value of the equity market as of 2017, with the foreign sales of the average MNE representing 40% of its aggregate sales (Erel, Jang, and Weisbach 2020). In the EU, intra-group debt accounts for about one-third of non-financial corporate debt, while the intra-group debt-to-GDP ratio was 47% in 2020 and is trending upwards, according to national account data from the OECD.

still use a substantial amount subsidiary-level external debt without a parent-level guarantee (Chowdhry and Nanda 1994).[2] In fact, the significant usage of subsidiary-level external debt is the case even among domestic subsidiaries (Kolasinski 2009). Existing studies have largely purpose that subsidiary-level external debt can serve as a device to mitigate agency problems between a parent company and its subsidiaries.[3]

Given the reasons for borrowing external debt at both parent and subsidiary levels, the first contribution of my paper is to derive the optimal mix of parent- and subsidiary-level external debt, which can help explain how MNEs respond to local country-level shocks. Specifically, subsidiary-level external lenders are important to the debt structure of an MNE for at least two reasons. First, as local lenders, they can have advantages in monitoring subsidiaries over (foreign) shareholders. Thus, an MNE can use them for delegated monitoring to lower the risk premium of parent-level external debt because the delegated monitoring can act as a commitment device to discipline the behavior of subsidiaries. Secondly, to convince the parent-level external lenders that the subsidiary-level external lenders will monitor and discipline the subsidiaries ex post, an MNE needs to give the subsidiary-level external lenders enough skin in the game. Effectively, MNEs can use subsidiary-level external debt as informed capital, following Holmstrom and Tirole (1997). The informed capital is expensive due to monitoring cost and, in this context, the standalone default risk. As a result, if an MNE opts to use the informed capital, it is optimal to allocate a minimum portion of their external debt at the subsidiary level to incentivize the delegated monitoring. Then the parent company can utilize its diversification benefit and finance the rest of the subsidiary using uninformed capital at the parent level, including parent-level external debt.

With the optimal debt structure in equilibrium, the second contribution of my paper is to demonstrate how the parent- and subsidiary-level external debt of MNEs interconnect through the ICM when facing local country-level shocks. A key insight of my arguments is that subsidiary-level informed capital providers are important. When a local shock enhances

[2]Henceforth, subsidiary-level external debt refers to the standalone external debt of a subsidiary.

[3]For example, firms can use subsidiary-level external debt as a commitment device to reduce rent-seeking and inefficient cash flow diversification among subsidiaries (Jensen 1986; Scharfstein and Stein 2000; Rajan et al. 2000), or to prevent subsidiary-level excessive risk-taking (Flannery et al. 1993; Kahn and Winton 2004). See Kolasinski (2009) for empirical evidence supporting these arguments.

the monitoring incentive of subsidiary-level external lenders, MNEs will have an incentive to activate their ICMs and use additional parent-level external debt to stabilize the impact of the shock. For example, following a country-level increase in uncertainty, lenders can have a stronger incentive to monitor their borrowers in the country, as the misbehavior of the latter can lead to a higher increase in the probability of default.[4] As a result, a MNE can afford to lower the portion of external debt allocated at the subsidiary level without destroying the lenders' incentive to monitor. This effectively allows an MNE to substitute external debt at the subsidiary level with that at the parent level, which lowers the overall cost of funds by improving the debt structure, as a multinational parent enjoys a financing advantage due to its diversification benefit.

Without the usage of subsidiary-level informed capital, a contractionary shock that lowers a firm's expected return will cause it to deleverage, as a firm would borrow until its expected marginal return equals its marginal cost of funds in equilibrium. This point applies to MNEs in that a local contractionary shock will create deleveraging pressure on both the unconsolidated balance sheet of a subsidiary and the consolidated balance sheet of the parent company. Admittedly, compared with independent firms, the deleveraging pressure for subsidiaries of MNEs in the same country can be smaller as MNEs can divert cash flows through their ICMs to support the subsidiaries. However, asides from the reallocation of cash flows, there is little reason for a MNE to increase parent-level external debt so that the *consolidated* leverage of the business group remains stable. After all, a negative shock to a subsidiary is a negative shock to its parent company since the latter is the shareholder of the former.

While MNEs can have incentives to substitute external debt across ICMs following local country-level shocks, whether such substitution can significantly affect their debt structure and mitigate any deleveraging pressure is fundamentally an empirical question. The third contribution of my paper is to answer this question. To do this, I perform two Difference-in-Differences (DID) analyses, based on the consolidated financial statements of US MNEs and the unconsolidated financial statements of their UK subsidiaries, using the uncertainty

[4]Following an uncertainty shock, a borrower can also have a higher probability of earning greater profits, though this will benefit the shareholders, not the lenders who receive fixed interest rate payments.

shock during the Brexit interregnum as a natural experiment.

There are several reasons why I investigate the substitution of external debt through the lens of uncertainty shocks. First, uncertainty shocks are a natural candidate for studying shocks that change the monitoring incentive of external lenders, especially in a non-crisis environment. Intuitively, given any default threshold and the distribution of a borrower's returns ex ante, a lender has incentives to monitor the borrower ex post if the misbehavior of the latter can sufficiently increase the default probability by deteriorating the return distribution. A positive uncertainty shock enhances the monitoring incentive because it redistributes probability density towards the tails of the distribution, making any deterioration caused by the misbehavior more costly.

Secondly, the study of uncertainty shocks is important as uncertainty has been at the forefront of discussions among policymakers, academics, and investors for at least the past two decades.[5] Understanding how uncertainty shocks interconnect external lenders through the ICMs of MNEs adds a novel channel through which uncertainty can impact the economy and financial markets, especially internationally.

Thirdly, uncertainty shocks are relevant in both crisis and non-crisis environments. The existing literature tends to focus on the role of ICMs during crises (Desai, Foley, and Forbes 2008; Kalemli-Ozcan et al. 2016; Santioni, Schiantarelli, and Strahan 2020). However, just like monetary policy shocks, uncertainty shocks are also applicable in a non-crisis environment. As uncertainty shocks can affect the monitoring incentive that drives the portion of external debt allocated at the subsidiary level, they allow me to investigate the substitution of external debt by MNEs across ICMs in a more generalized context.

To identify a country-level uncertainty shock, I use the period between the announcement of the Brexit vote and the first Brexit proposal made by the UK government as a natural experiment. This period, which I call the Brexit interregnum (6/23/2016-12/31/2018), offers a valuable natural experiment to me for at least three reasons. First of all, there has been a

[5]The Federal Open Market Committee (FOMC) minutes repeatedly highlighted uncertainty as a crucial factor in every recession since 2000. Recent macroeconomics and finance research studies the role of policy uncertainty in business cycles and its effect on financial markets (Pastor and Veronesi 2012; Baker, Bloom, and Davis 2016; Ozdagli and Wang 2024).

large, broad, and persistent rise of uncertainty in the UK during the interregnum, following the unexpected Brexit vote, with relatively little other change (Bloom et al. 2019). Notably, the UK remained inside the EU during the interregnum, meaning no real changes caused by the actual Brexit had occurred. Bloom et al. (2019) use detailed surveys to show that, except for the strong initial reaction after the Brexit vote for a few months, the interregnum was dominated by a severe degree of uncertainty about the Brexit negotiations, while the expected Brexit outcome was a soft Brexit.[6] Hassan et al. (2024) confirm that the Brexit shock predominantly affects firms through uncertainty, as opposed to sentiment, although firms generally have a negative sentiment, especially after the rejection of a soft Brexit. To minimize the impact of a negative expectation shock, I therefore stop my sample at the end of 2018, before the first soft Brexit proposal made by the UK government was rejected and a no-deal Brexit started to become a real concern.[7]

The second reason why the Brexit interregnum is a valuable natural experiment to me is that the credit supply in the UK was well stabilized by the Bank of England (Broadbent 2017; BoE 2017; BoE 2018). The interregnum thus offers me an opportunity to identify a country-level uncertainty shock, without a credit supply shock, which usually tangles with uncertainty shocks, especially during crises. The stable credit market in the UK also helps rule out the possibility that MNEs were substituting external debt across ICMs due to a local credit stress.

The third reason why the natural experiment is appealing is that the UK is influential for the activities of MNEs. It is one of the top 5 countries that hosts inward production of foreign MNEs' majority-owned subsidiaries (Cadestin et al. 2018). It is also one of the most important countries for US MNEs in terms of the output and value added by their majority-owned foreign subsidiaries (BEA 2021). As a result, the Brexit uncertainty shock

[6] A soft Brexit means the UK's relationship with the EU would be as close as possible to what it was before Brexit.

[7] Admittedly, it is not realistic for me to assume a zero expectation shock during the interregnum. However, the substitution of external debt across the ICMs of MNEs requires only an uncertainty shock in the country of a subsidiary that changes the monitoring incentive of subsidiary-level external lenders. A rise in uncertainty also tends to create a deleveraging pressure for an MNE. A negative expectation shock together with a rise in uncertainty will make the deleveraging pressure stronger, which will make it more difficult for the MNE to stabilize its leverage, at least at the consolidated level, through the substitution of external debt .

has the potential to impose material impacts on MNEs, including US MNEs.

Using the rise of uncertainty in the UK during the Brexit interregnum as a natural experiment, I perform my first DID analysis at the parent level, taking advantage of the detailed information on the *consolidated* capital and debt structures that publicly traded US MNEs are required to disclose. Based on the data from Capital IQ and Compustat, together with the complete ownership structure from Orbis, I examine how US non-financial MNEs with non-financial subsidiaries in the UK react to the Brexit uncertainty shock differently, compared with those without a UK subsidiary.[8] I find that US MNEs with UK subsidiaries raise more parent-level external debt, where the lenders are less informed about the operations of their subsidiaries, during the Brexit interregnum. Meanwhile, the *consolidated* book leverage (total external debt over total assets) of the affected MNEs remains stable relative to the other group. Thus, the increase in the parent-level external debt reflects a change in the debt structure, conditioning on the book leverage. This change is also significant. On the *consolidated* balance sheet, I estimate that the affected US MNEs raise the ratio of parent-level external debt to total assets by 1.8 percentage points, or 9 percent, on average relative to the US MNEs without a UK subsidiary. These findings are consistent with the argument that MNEs can substitute external debt to stabilize their book leverage when a country-level uncertainty shock allows them to lower the portion of external debt allocated at the subsidiary level as informed capital.

To further check if the substitution of external debt can be observed among the UK subsidiaries, I perform my second DID analysis at the subsidiary level, taking advantage of the information on the *unconsolidated* balance sheets that UK firms are required to report. Based on the regulatory data from the UK Companies House and the same ownership mapping from Orbis, I examine how the non-financial UK subsidiaries of US MNEs react differently during the Brexit interregnum, compared with the non-financial UK subsidiaries of UK business groups. As US multinational parents should be less affected by the rise of uncertainty in the UK, their substitution of external debt across ICMs should be stronger.

[8] As will be explained in detail later, I compare the US MNEs with non-financial UK subsidiaries with non-financial US business groups without a UK subsidiary in general, non-financial US domestic business groups, and non-financial US MNEs without a UK subsidiary separately. The results from these analyses are almost the same.

In line with this argument, I find that the UK subsidiaries of US MNEs lower the ratio of external debt to total assets by about 7 percentage points on average on their *unconsolidated* balance sheets. Meanwhile, the decline in the external debt is offset by an almost equivalent increase in the ratio of internal debt to total assets. Thus, consistent with the results at the parent level, there is a corresponding change in the debt structure at the subsidiary level, conditioning on leverage.

The findings from both of my DID analyses hold after a battery of robustness tests. For the parent-level analysis, my results are robust after controlling for various characteristics of the business groups, such as measures of their size, growth opportunities, and liquidity. The results cannot be explained by time-varying trends at the industry level. A placebo test conducted during the period leading to the Brexit interregnum also confirms that there are no pre-trends. To rule out alternative explanations, I perform several additional analyses. To begin with, the parent-level results are not driven by developments unique to the international nature of US MNEs in general, as a placebo test between US MNEs without a UK subsidiary and US domestic business groups yields no time-varying differences. Secondly, the results cannot be explained by changes in the European Union without the UK, since using US MNEs with non-financial subsidiaries in the EU27, but no subsidiaries in the UK, as a placebo treatment group generates no significant results. Thirdly, my results remain virtually unchanged after dropping the MNEs qualified for the corporate bond purchase programs of the Bank of England and European Central Bank. Last but not least, my results are robust, if not stronger, after matching the US MNEs with UK subsidiaries with both the US business groups without a UK subsidiary and the US MNEs without a UK subsidiary in various ways.

Similar to those of my parent-level analysis, my subsidiary-level results are robust after controlling for firm-level characteristics on the *unconsolidated* balance sheet, such as size and accounting leverage (total liabilities over total assets). The results also cannot be explained by time-varying trends at the industry level. A placebo test conducted during the period leading to the Brexit interregnum further confirms that there are no pre-trends. Just like US multinational parents, foreign multinational parents in general should be less affected by the rise of uncertainty in the UK, compared with the parent companies of UK business groups. In line with this argument, I find a consistently significant substitution of external debt with internal debt on the subsidiary-level *unconsolidated* balance sheet when switching my treatment group from the UK subsidiaries of US MNEs to those of foreign MNEs.[9] Overall, my empirical findings provide evidence that there are important interactions between parent- and subsidiary-level external debt through the ICMs of MNEs in response to local country-level shocks. When facing local shocks that can increase the monitoring incentive of subsidiary-level external lenders, MNEs can improve their debt structure by substituting external debt across ICMs, which can stabilize their *consolidated* book leverage.

The rest of my paper is organized as follows: Section 2 outlines the related literature. Section 3 describes the model that derives the optimal mix of parent- and subsidiary-level external debt of an MNE, given its ICM, and shows how the MNE would respond to local shocks. Sections 4 and 5 present the empirical evidence of my parent- and subsidiary-level analysis, respectively. Section 6 concludes.

2 Related Literature

My paper relates to several strands of the literature, beginning with the one studying the asset reallocation within the ICMs of business groups. There are multiple papers that show domestic business groups can use their ICMs efficiently to reallocate assets when facing external credit stress, especially during crises. For example, Santioni, Schiantarelli, and Strahan (2020), Kim et al. (2020), Almeida et al. (2015), Gopalan et al. (2007). Recently, Biermann and Huber (2023) document consistent evidence for German MNEs that faced a binding borrowing constraint during the 2008 financial crisis. Buchuk et al. (2020) further demonstrates that the asset allocation within ICMs is coordinated by ownership, not by other linkages, such as input-output linkages. My paper contributes to the literature by showing that when MNEs substitute subsidiary-level external debt with internal capital, the internal capital can be financed by parent-level external debt. Thus, the reallocation within the ICMs of MNEs can reflect significant interactions across external capital markets, even in a non-crisis environment.

[9] Due to data limitations, I unfortunately cannot confirm if the decrease in external debt at the subsidiary level for foreign MNEs in general is accompanied by a corresponding rise in parent-level external debt on the *consolidated* balance sheet with a stable book leverage.

Consistent with the efficient usage of ICMs, a branch of research has shown that MNEs can benefit from ICMs by supporting their subsidiaries during financial crises, especially in emerging markets. For instance, Kalemli-Ozcan et al. (2016) find that foreign-owned firms in Latin American countries outperform domestically-owned firms in investments when there is a banking crisis, while they do not find a differential performance when there is a pure currency crisis. Desai, Foley, and Forbes (2008) document similar findings and conclude that ICMs can help foreign subsidiaries of US MNEs overcome financial constraints in emerging markets. Another branch of research emphasizes that MNEs can benefit from ICMs through maximizing tax benefits (e.g., Chowdhry and Nanda 1994; Desai et al. 2006; Egger et al. 2014, 2010; Goldbach et al. 2021). My paper adds to this line of research by providing evidence that MNEs can benefit from ICMs through a substitution of external debt when facing local country-level shocks, such as uncertainty shocks, even for their subsidiaries in developed countries.

My paper also relates to the literature studying uncertainty shocks. Many existing works in the literature have found that higher uncertainty can generate countercyclical credit spreads, procyclical leverage, and depress output, consumption, and investment, among other impacts (e.g., Bloom 2009; Julio and Yook 2012; Christiano et al. 2014; Gilchrist et al. 2014; Basu and Bundick 2017; Bloom et al. 2018; Arellano et al 2019). Fernandez-Villaverde and Guerron-Quintana (2020) highlight the role of agency problems and financial frictions in the transmission of uncertainty shocks. My paper contributes to this literature by showing that uncertainty shocks can transmit internationally through the ICMs of MNEs as they interconnect external lenders in different capital markets due to frictions faced by MNEs caused by agency problems. In addition, since a local uncertainty shock can prompt MNEs to improve their debt structure by substituting subsidiary-level external debt with parent-level external debt, my paper provides evidence that the ICMs of MNEs can stabilize the deleveraging pressure of uncertainty shocks, at least among firms owned by MNEs.

Last but not least, my paper pertains to the literature underlining the important role of external lenders as informed capital providers. Holmstrom and Tirole (1997) demonstrate that external lenders can be used as informed capital providers for delegated monitoring to mitigate agency problems of firms. A rich body of research has shown that external lenders, in particular banks, can specialize in monitoring (e.g., Stiglitz and Weiss 1983; Diamond 1984, 1991; Fama 1985; Rajan 1992; Hoshi et al. 1993; Denis and Mihov 2003; Mehran and Thakor 2011; Lin et al. 2013). My paper expands this literature to the usage of subsidiary-level external debt by MNEs for delegated monitoring, since local lenders, such as local banks, can have advantages in monitoring subsidiaries over (foreign) shareholders. Generally speaking, this is consistent with the evidence that subsidiary-level external debt can be used to mitigate agency problems faced by business groups (e.g., Jensen 1986; Scharfstein and Stein 2000; Rajan et al. 2000; Kahn and Winton 2004; Kolasinski 2009). My paper is different with the existing studies in that I highlight delegated monitoring as a reason why subsidiary-level external debt can benefit MNEs, instead of investigating the different types of agency problems that can be prevented with the presence of subsidiary-level external lenders. In addition, I provide evidence that the usage of subsidiary-level external debt by MNEs transmits local shocks internationally because subsidiary-level informed lenders are connected with parent-level uninformed lenders in different capital markets through the ICMs. Furthermore, my finding that MNEs can stabilize the deleveraging pressure of uncertainty shocks by substituting subsidiary-level informed capital with parent-level uninformed capital adds to the evidence that banks can play a special role in damping the negative impact of uncertainty shocks (Ozdagli and Wang 2024).

3 Model

3.1 Setup

Consider a world with two countries: Home and Foreign. There is a representative MNE consisting of a parent company in Home that owns a subsidiary by majority in Foreign.[10] The parent company and foreign subsidiary each manage a project in their country for the parent company to invest. All investments are made at time t, and returns are realized at $t+1$. At time t, the expected returns of the home and foreign projects are $E_t(\omega_{t+1})I_tR_t$ and $E_t(\omega^*_{t+1})I^*_tR^*_t$, respectively. I_t and I^*_t are the parent company's home and foreign investments, denominated accordingly in each country's currency. R_t and R^*_t are country-specific

[10] The parent company can be empirically interpreted as either the ultimate parent or an intermediate holding company.

technologies with constant returns to scale that are publicly known at t. At the beginning of $t+1$, the parent company and foreign subsidiary independently observe a private productivity draw, ω_{t+1} and ω^*_{t+1}. That is, ω_{t+1} is private to the parent company and ω^*_{t+1} is private to the foreign subsidiary. The productivity draws are the sources of uncertainty at time t as they will be embedded with the public components of the returns, I_tR_t and $I^*_tR^*_t$, to form the realized returns, $\omega_{t+1}I_tR_t$ and $\omega^*_{t+1}I^*_tR^*_t$, at the end of $t+1$. I assume ω_{t+1} and ω^*_{t+1} are independent draws from log-normal distributions with:

$$E_t(\omega_{t+1}) = e^{\mu_t+\frac{1}{2}\sigma_t^2} = 1 \tag{1}$$

and:

$$E_t(\omega^*_{t+1}) = e^{\mu^*_t+\frac{1}{2}\sigma_t^{*2}} = 1, \tag{2}$$

where μ_t, σ_t, μ^*_t, and σ^*_t are country-level parameters, publicly known at t. The distributions can be normalized to have a unit mean by the country-specific technologies R_t and R^*_t. The assumption that productivity draws are independent and log normally distributed is common in the literature (e.g., Bernanke, Gertler, and Gilchrist 1999, henceforth, BGG; Christiano, Motto, and Rostagno 2014; Akinci 2021).[11] Assuming the independence between ω_{t+1} and ω^*_{t+1} is also suitable to study the effect of an exogenous, country-level uncertainty shock. A foreign uncertainty shock at time t, which affects the MNE's investment decisions, can be described as an exogenous, mean-preserving shock to σ^*_t with $E_t(\omega^*_{t+1}) = 1$, following Dorofeenko, Lee, and Salyer (2008) and Akinci (2021).[12]

With the home and foreign projects, the parent company maximizes its expected profits at time t, $E_t(\Phi_{t+1})$, by choosing its home and foreign investments, I_t and I^*_t, and debt

[11] I can generalize the log-normal distribution to any distribution with a continuous and once-differentiable cumulative distribution function (CDF) over a non-negative support. In this case, I would assume that ω_{t+1} and ω^*_{t+1} come from the same distribution with potentially different distribution parameters, and that the distribution satisfies the regularity condition $\partial\left(\omega_{t+1}h(\omega_{t+1})\right)/\partial\omega_{t+1} > 0$ and $\partial\left(\omega^*_{t+1}h(\omega^*_{t+1})\right)/\partial\omega^*_{t+1} > 0$, where the hazard rate $h(\omega_{t+1}) \equiv f(\omega_{t+1})/\left(1-F(\omega_{t+1})\right)$ and $h(\omega^*_{t+1}) \equiv f(\omega^*_{t+1})/\left(1-F(\omega^*_{t+1})\right)$, consistent with BGG (1999). $f(\omega_{t+1})$ and $f(\omega^*_{t+1})$ denote the probability density functions (PDFs). $F(\omega_{t+1})$ and $F(\omega^*_{t+1})$ denote the CDFs. I adopt the log-normal distribution for simplicity and by convention.

[12] A mean-shifting shock to σ^*_t can represent a combination of two shocks: An uncertainty shock to σ^*_t with $E_t(\omega^*_{t+1}) = 1$ and a first moment shock that shifts R^*_t.

structure, D_t and D_t^*. D_t is the external debt issued by the parent company. D_t^* denotes the stand-alone external debt of the foreign subsidiary. The parent company can use the foreign subsidiary's equity at $t+1$ to serve D_t by ownership. For simplicity and without loss of generality, I assume the parent company fully owns the foreign subsidiary in the model so that the parent company can claim the entirety of the foreign subsidiary's equity.[13]

Since the focus of this paper is leveraged MNEs, I assume that the parent company is capital constrained but can raise external funds from a home lender, who faces the risk-free interest rate in Home, $1 + r_t^{rf}$, as his/her opportunity cost. The MNE can also raise subsidiary-level debt from a foreign lender, who faces the risk-free interest rate in Foreign, $1 + r_t^{rf*}$, as his/her opportunity cost. I further assume a version of the CIP holds to prevent risk-free arbitrage:

$$(1 + r_t^{rf}) = \frac{F_{t+1}}{S_t}(1 + r_t^{rf*}). \tag{3}$$

S_t is the spot exchange rate in units of Foreign's currency per unit of Home's currency. F_{t+1} is the (risk-adjusted) forward exchange rate quoted in the same manner. Equation 3 implies that the home and foreign lenders face equivalent opportunity costs in the same currency.[14] As a result, when the parent company issues the parent-level debt through the foreign subsidiary, the lender can be effectively represented by the home lender in terms of both the opportunity cost and credit risk. Section 3.2.1 will expand this point with details.

Let $A_t > 0$ be the limited capital endowment of the MNE. The budget constraint of the parent company is:

$$D_t + A_t \geq I_t + T_t. \tag{4}$$

[13]US MNEs wholly own more than 80% of their subsidiaries according to the BEA annual survey (Desai, Foley, and Forbes 2008).

[14]The CIP assumption is consistent with the literature of the ICMs of global banks (e.g., Brauning and Ivashina 2020).

The budget constraint of the foreign subsidiary is:

$$D_t^* + \frac{T_t}{S_t} \geq I_t^*. \tag{5}$$

T_t represents an intra-firm transfer through the ICM of the MNE. When $T_t > 0$, the parent company is providing internal funds for I_t^*.[15] Though my framework includes the possibility of $T_t \leq 0$, it will be optimal for the parent company to have $T_t > 0$ when both the home and foreign projects are productive enough. The main intuition lies in the parent company's ability to lower its risk premium by internationally diversifying its investments, while the subsidiary-level debt carries a standalone default risk. The following sections expand this point in details.[16]

3.2 Agency Problems and Debt Contracts

Based on the setup, I now introduce agency problems that characterize the MNE's debt contracts. The agency problems aim to capture two realistic features: 1) MNEs have costly defaults and borrow with risk premia. 2) Business groups with complex operations, such as MNEs, face limited internal monitoring capacity and have operational risk (e.g., Jorion 2007, Chernobai, Jorion, and Yu 2011, Chernobai, Ozdagli, and Wang 2021, etc.). Before discussing the limited internal monitoring capacity MNEs, it is useful to explain the structure of the debt

[15] $T_t > 0$ can be interpreted as an equity transfer or an intra-firm loan given that the parent company is the shareholder of the foreign subsidiary. In the absence of any corporate income tax differential between Home and Foreign, which will be discussed later, the two concepts are equivalent (Chowdhry and Nanda 1994, Chowdhry and Coval 1998, Eiteman, Stonehill, and Moffet 2016, Shapiro and Hanouna 2019, etc.). $T_t > 0$ can also represent the external debt of the foreign subsidiary guaranteed by the parent company since external debt guaranteed by the parent company is tantamount to intra-firm debt from the parent company (Chowdhry and Coval 1998). One way to see this in my framework is that the parent company can guarantee T_t/S_t units of external debt for the foreign subsidiary by issuing $D_t/S_t = T_t/S_t$ units of parent-level debt through the foreign subsidiary at time t and transferring the funds to the balance sheet of the foreign subsidiary simultaneously via the ICM.

[16] I endow the initial capital, $A_t > 0$, to the parent company for convenience and exposition purposes. Writing the initial capital of the parent company and foreign subsidiary separately yields the same results. In fact, the parent company can receive the initial capital of the foreign subsidiary at time t via either an equity transfer or an intra-firm loan, bypassing concerns associated with a cross-border corporate income tax differential. A tax differential at time $t + 1$ will change the relative size of home and foreign projects in equilibrium as it may discount the foreign return received by the parent company. Yet, the discount can be incorporated in R_t^* without changing the main conclusions of the paper. How cross-border tax differentials affect the equilibrium capital allocation of MNEs is an important topic. It is, however, beyond the scope of this paper given that my focus is how the ICMs of MNEs respond to country-level uncertainty shocks from non-tax-related origins.

contracts without any agency problem between the parent company and foreign subsidiary.

3.2.1 Costly Defaults and Parent-Level Debt

To generate financial frictions associated with costly defaults that make external funds more expensive than internal funds, I introduce moral hazard between the MNE and its external lenders ex-post the realization of ω_{t+1} and ω^*_{t+1}. The moral hazard takes a form similar to the costly state verification (CSV) problem proposed by Townsend (1979), following Bernanke and Gertler (1989), BGG (1999), Christiano, Motto, and Rostagno (2014), etc.[17] The difference is the MNE's ability to transfer the foreign subsidiary's return to the parent company ex-post the realization of ω^*_{t+1}. Since the parent company seeks to maximize profits from its own balance sheet, a standard Townsend CSV formulation can be applied at the parent level.

Let $\bar{\omega}^*_{t+1}$ be a contractual threshold enforceable by the foreign lender. Without any agency problem between the parent company and foreign subsidiary, the foreign subsidiary will send $\left(\omega^*_{t+1} - \bar{\omega}^*_{t+1}\right) \mathbf{1}(\omega^*_{t+1} \geq \bar{\omega}^*_{t+1}) I^*_t R^*_t$ to the parent company at the end of $t+1$. The parent company may choose to untruthfully report the total return it has received at the end of $t+1$ to the home lender. In response, the home lender may choose to audit the balance sheet of the parent company at the end of $t+1$, but ν portion of the return would be lost during the audit process, consistent with the canonical financial accelerator model (BGG 1999). The audit cost can be interpreted as the cost of default.

Given the ownership structure of the MNE, the optimal contract for the parent company is a two-dimensional debt contract involving a combination of $(\omega_{t+1}, \omega^*_{t+1})$. Appendix A.1 details the proof of the optimal contract. The structure of the optimal contract can be described as follows.

Let r_{t+1} be the risky interest rate, a non-default threshold $\hat{\omega}_{t+1}$ for ω_{t+1} can be decided

[17] Other related work with a similar implementation includes Gale and Hellwig (1985), Williamson (1987), Carlstrom and Fuerst (1997), Fisher (1999), Christiano, Motto, and Rostagno (2003), Arellano, Bai, and Kehoe (2012), and Jermann and Quadrini (2012), among others.

at time t such that:

$$\hat{\omega}_{t+1} I_t R_t = D_t(1 + r_t). \tag{6}$$

When $\omega_{t+1} \geq \hat{\omega}_{t+1}$, the return from the home project is enough to serve D_t, regardless ω^*_{t+1}.

Similarly, a non-default threshold $\hat{\omega}^*_{t+1}$ for ω^*_{t+1} can be decided at time t such that:

$$F_{t+1} \left(\hat{\omega}^*_{t+1} - \bar{\omega}^*_{t+1}\right) I^*_t R^*_t = D_t(1 + r_t). \tag{7}$$

When $\omega^*_{t+1} \geq \hat{\omega}^*_{t+1}$, the return from the foreign project is enough to serve D_t, regardless ω_{t+1}.

To convert the foreign return to Home's currency, I assume the MNE can use foreign exchange (FX) swaps to cover $\left(\hat{\omega}^*_{t+1} - \bar{\omega}^*_{t+1}\right) I^*_t R^*_t$. The parent company then uses the spot exchange rate, S_{t+1}, to receive the surplus from the foreign subsidiary if $\omega^*_{t+1} > \hat{\omega}^*_{t+1}$ with $E_t(S_{t+1}) = F_{t+1}$. The assumption that the MNE uses FX swaps to serve D_t is consistent with the heavy usage of the FX or cross-currency (XCCY) swaps by non-financial MNEs in debt issuance.[18] The purpose of this assumption is for convenience. It simplifies the contract so that the contractual thresholds are not contingent on the realization of S_{t+1}. The key mechanism of the model and my empirical predictions do not depend on this assumption, as will be clear in Section 3.4.

In addition to the non-default thresholds, a default threshold $\bar{\omega}_{t+1}$ for ω_{t+1}, contingent on the realization of ω^*_{t+1}, can be decided at time t such that:

$$\bar{\omega}_{t+1} I_t R_t + F_{t+1} \left(\omega^*_{t+1} - \bar{\omega}^*_{t+1}\right) \mathbf{1}(\omega^*_{t+1} \geq \bar{\omega}^*_{t+1}) I^*_t R^*_t = D_t(1 + r_t), \forall \omega^*_{t+1} < \hat{\omega}^*_{t+1} \tag{8}$$

$$\iff \bar{\omega}_{t+1} = \hat{\omega}_{t+1} \left[1 - \frac{(\omega^*_{t+1} - \bar{\omega}^*_{t+1})}{(\hat{\omega}^*_{t+1} - \bar{\omega}^*_{t+1})} \mathbf{1}(\omega^*_{t+1} \geq \bar{\omega}^*_{t+1})\right], \forall \omega^*_{t+1} < \hat{\omega}^*_{t+1}. \tag{9}$$

When $\omega^*_{t+1} \in (0, \hat{\omega}^*_{t+1})$ and $\omega_{t+1} \in [\bar{\omega}_{t+1}, \hat{\omega}_{t+1})$, the total return is enough to serve D_t. When $\omega^*_{t+1} \in (0, \hat{\omega}^*_{t+1})$ and $\omega_{t+1} \in (0, \bar{\omega}_{t+1})$, the parent company will default and the home lender

[18] For instance, the BNP Paribas 2014 FX/XCCY Swap Market Overview shows that non-financial corporates are as important as banks in the market of FX/XCCY swaps for debt issuance with 2 year and above maturities. Both non-financial corporates and banks are dominant players in the FX/XCCY market for debt issuance. Other important players include hedge funds and supra-nationals and agencies (BNP Paribas 2014).

receives $(1-\nu)\left[\omega_{t+1}I_tR_t + F_{t+1}\left(\omega^*_{t+1} - \bar{\omega}^*_{t+1}\right)\mathbf{1}(\omega^*_{t+1} \geq \bar{\omega}^*_{t+1})I^*_tR^*_t\right]$ after auditing or taking over the parent company's balance sheet.[19]

Figure 1 provides a visual representation of the parent-level debt contract. The blue dashed lines mark the non-default thresholds, $\hat{\omega}_{t+1}$ and $\hat{\omega}^*_{t+1}$. The red solid line describes the state-contingent default threshold, $\bar{\omega}_{t+1}$. ND and D depict the non-default and default regions of the parent company for any combination of $(\omega_{t+1}, \omega^*_{t+1})$ when $I_t > 0$ and $I^*_t > 0$.[20] The black dashed line shows the contractual threshold of the foreign lender, $\bar{\omega}^*_{t+1}$. When $\bar{\omega}^*_{t+1} > 0$, the MNE faces a "double debt curve," where the parent-level debt is stacked upon subsidiary-level debt. Section 3.2.2 explains when it can be optimal for the MNE to use subsidiary-level debt.

The existence of the state-contingent default threshold, along with the two non-default thresholds, indicates a cross-border cash-flow diversification benefit: The parent company can use the equity of the foreign subsidiary to serve its debt by ownership if needed, not vice versa. Because of the diversification benefit, the parent-level debt will always be used when the MNE can also have subsidiary-level debt under a standard contract supported by the return of the foreign project, ceteris paribus. I defer the discussion on the potential differences in default cost and tax environment in Section 3.2.2 when the usage of subsidiary-level debt is introduced. Appendix A.2 explains the proof.

Let $\Omega^h_t = \Omega^h(\hat{\omega}_{t+1}, \hat{\omega}^*_{t+1}, \bar{\omega}^*_{t+1})$ and $\Omega^f_t = \Omega^f(\hat{\omega}_{t+1}, \hat{\omega}^*_{t+1}, \bar{\omega}^*_{t+1})$ denote the expected share of I_tR_t and $F_{t+1}I^*_tR^*_t$ respectively for the home lender. The home lender's participation constraint in equilibrium is:

$$D_t(1 + r^{rf}_t) = \Omega^h_t I_t R_t + \Omega^f_t F_{t+1} I^*_t R^*_t. \tag{10}$$

The detailed expressions of Ω^h_t and Ω^f_t with associated explanations are shown in Appendix A.3.

[19]Writing the default threshold for ω^*_{t+1} contingent on the realization of ω_{t+1} is equivalent to writing the default threshold according to Equation 9. The two ways of writing the same state-contingent default threshold describes the identical set of $(\omega_{t+1}, \omega^*_{t+1})$ where the parent company will default, as can be seen in Figure 1.

[20]The optimal debt contract converges to a standard debt contract when $I_t = 0$ or $I^*_t = 0$.

For the moral hazard between the foreign subsidiary and foreign lender, an implicit assumption of the CSV technology is that the lender does not need additional technologies to prevent the borrower from shrinking its balance sheet before a potential audit. In other words, there is no other agency problems except for the untruthful reporting from the borrower. If this is true, the CSV problem between the foreign subsidiary and foreign lender is equivalent to the CSV setup in BGG (1999). The optimal contract for the subsidiary-level debt is therefore a standard debt contract. However, the foreign subsidiary may shrink its balance sheet by transferring its return to the parent company in general. The foreign lender thus need additional technologies to ensure their seniority on the foreign return over both the parent company and home lender.[21] Without additional assumptions, I take the stance that the foreign lender would not participate in a debt contract unless they can audit the parent company and effectively become a home lender.[22]

Although subsidiaries of MNEs rely heavily on debt and equity from parent companies for financing needs, especially when faced with adverse conditions in local capital markets, subsidiaries do have external debt (e.g., Chowdhry and Coval 1998, Desai, Foley, and Forbes 2008, etc.). Existing evidence from domestic business groups suggests that operating subsidiaries tend to use bank debt and rarely issue bonds (e.g., Santioni, Schiantarelli, and Strahan 2020, Kim, Wilcox, and Yasuda 2020, etc.). While external debt of subsidiaries can still be parent-level debt in my framework through parent-level guarantees, and there is a general lack of data to observe how much of the external debt of subsidiaries is guaranteed by their parent companies, it is normal for MNEs to have subsidiary-level defaults due to underperformance, suggesting the usage of stand-alone debt at the subsidiary level.[23]

[21] In the case of a parent company default, the home lender will become the shareholder of the parent company and foreign subsidiary by their debt contract.

[22] If lenders with different per-unit audit cost are willing to participate the parent-level debt contract, the home lender is the one with the lowest per-unit audit cost.

[23] Some recent examples include the bankruptcy of the US subsidiary of Italy's cosmetics chain Kiko SpA due to "extremely high operating costs and continually depressed profits in recent years": https://www.reuters.com/article/bankruptcy-kiko/cosmetics-chain-kiko-files-for-bankruptcy-to-close-most-stores-idUSL1N1P7284, the recent bankruptcy of Talen Energy Supply, a subsidiary of Talen Energy owned by the US's Riverstone Holdings, due to exposures to market price volatility: https://www.datacenterdynamics.com/en/news/talen-energy-subsidiary-files-for-bankruptcy-company-still-plans-nuclear-data-center/, and the bankruptcy of US and Canada subsidiaries of UK's IWG group due to "Covid-19-adjusted market realities": https://www.bloomberg.com/graphics/2020-us-bankruptcies-coronavirus/.

A popular explanation on why MNEs use subsidiary-level debt is the exploitation of cross-border corporate income tax differentials when foreign subsidiaries are located in high tax regimes (e.g., Chowdhry and Nanda 1994, Desai, Foley, and Hines 2004, etc.). Though local tax rates are clearly important for the choice of capital structure, it is more difficult to apply this rationality to MNEs with foreign subsidiaries in low tax regimes, such as the European subsidiaries of US MNEs, or to domestic business groups. Without imposing restrictions on a cross-border tax differential, the next section offers explanations on why MNEs can find it optimal to use subsidiary-level debt due to agency problems. The usage of the subsidiary-level debt can yield important implications when interacting with the parent-level debt in the presence of a country-level uncertainty shock.

3.2.2 Limited Internal Monitoring Capacity and Subsidiary-Level Debt

While parent companies of MNEs enjoy the benefit of a cross-border cash-flow diversification, the diversification usually comes with complex operations that limit the internal monitoring capacity of a parent company. The complexity faced by MNEs includes at least three dimensions. First, MNEs have organizational complexity. A parent company usually has multiple layers of subsidiaries. The records of subsidiary-level activities can be complicated by intermediate holding companies that own a network of subsidiaries, which can own other subsidiaries at a lower level. The accounting of subsidiary-level activities can be further clouded by the usage of tax heavens and special purpose vehicles. When there are agency problems between a parent company and its subsidiaries, it can be difficult for the parent company to judge if the underperformance of a front-line operation is due to local managerial misbehavior or bad luck. Secondly, a MNE faces geographical complexity, where each country of its operations can have a different set of rules and regulations. The best practice of a proprietary technology in the parent company's country may violate regulations in another country and thus need to be adjusted in a way foreign to the parent company. Without detailed local knowledge, a parent company may not be able to monitor its foreign subsidiaries effectively. Thirdly, MNEs can be confronted with business complexity. As a MNE expands across industries, the parent company will inevitably need to manage subsidiaries from less familiar business lines. This can further reduce the power of monitoring from the parent company. When the three dimensions of complexity compound, parent companies can have a limited internal monitoring capacity and suffer losses from subsidiary-level managerial misbehavior, including frauds, the materialization of other operational risk, bad business decisions, or a lack of due diligence.

The significance of the limited internal monitoring capacity, together with the associated losses, has been documented by the growing literature of operational risk. For instance, recent studies have pointed out the importance of operational losses due to managerial misbehavior among US bank holding companies as complex financial MNEs (Cetorelli and Goldberg 2014, Chernobai, Ozdagli, and Wang 2021, Berger et al. 2022). MNEs with complex intra-group transfers also face a higher group-level risk premium due to concerns over weak corporate governance and low managerial ability (Richardson, Taylor, and Obaydin 2020). The limited internal monitoring capacity is further consistent with studies that argue internal agency problems related with ICMs can destroy values (Lamont 1997, Whited 2001, Schoar 2002, Villalonga 2004).

I model the agency problem between the parent company and foreign subsidiary as moral hazard ex-ante the realization of ω^*_{t+1}. While the parent company maximizes its expected profits at time t by choosing the investments and debt structure, the objective of the foreign subsidiary, as the manager of the foreign project, is to maximize its private benefit at the end of $t+1$. Concretely, the foreign subsidiary can privately choose to behave or not after observing the private productivity draw ω^*_{t+1} at the beginning of $t+1$. If the foreign subsidiary behaves, it will receive a private benefit of 0 and its return will be fully realized as $\omega^*_{t+1}I^*_tR^*_t$. If the foreign subsidiary does not behave, it can shrink the productivity draw to $(1-\psi^*)\omega^*_{t+1}$ for a private benefit of $\psi^*\omega^*_{t+1}I^*_tR^*_t$ with $\psi^* \in [0,1]$. In this case, the foreign subsidiary's return will only be partially realized as $(1-\psi^*)\omega^*_{t+1}I^*_tR^*_t$. Finally, I make the tie-breaking assumption that the foreign subsidiary always behaves with a 0 private benefit.

The private benefit can be interpreted as the opportunity cost for the foreign subsidiary to be diligent. Broadly speaking, it can reflect any loss of the foreign return that won't be received by the parent company due to its limited internal monitoring capacity. Examples of such loss include losses from the materialization of operational risk (e.g., frauds and embezzlement), tunneling activities by managers or shareholders, consequences of poor business decisions (e.g., overborrowing), or additional compensations the parent company has to offer to the foreign subsidiary to prevent a larger shrinkage.[24] I assume the private benefit equals $\psi^*\omega^*_{t+1}I^*_t R^*_t$ for simplicity. In general, it can take any form that rises with ψ^* to induce the shrinkage of the productivity draw to $(1-\psi^*)\omega^*_{t+1}$. I also assume only a fraction of foreign productivity draw can be lost with $\psi^* \in [0,1]$ by limited liability.[25] The magnitude of ψ^* reflects the internal monitoring capacity of the parent company. When the parent company has a perfect internal monitoring capacity, it can eliminate the private benefit with $\psi^* \to 0$. When the parent company has no internal monitoring capacity, it will lose the foreign return entirely with $\psi^* \to 1$, in which case the parent company behaves as if it only has the home project at time t.

With a limited internal monitoring capacity, $\psi^* > 0$ and the parent company can find it optimal to reduce ψ^* with additional resources. Consistent with the seminal work of Holmstrom and Tirole (1997), which captures the critical role of monitoring in understanding financial intermediation, I assume that the parent company can use subsidiary-level debt as informed capital for local delegated monitoring. Specifically, both the home and foreign lenders can provide lending as uninformed capital with only the CSV technology. They can also provide lending as informed capital with monitoring in an attempt to reduce the shrinkage of a firm's productivity draw by lowering the firm's private benefit. When lending informed capital to the foreign subsidiary, the foreign lender has a comparative advantage in accessing local private information and monitoring efficiency, making him/her the cheapest and most effective informed capital supplier that can further decrease ψ^*.

For simplicity and without loss of generality, I assume the parent company always behaves when managing the home project. Since an informed lender monitors the firm they will take over in default by the debt contract, the parent company will only demand informed capital at the subsidiary level. The difference between a lender providing uninformed and informed capital can be interpreted as a bank investing corporate bonds (uninformed capital) vs.

[24] "Regular" compensations for managing I^*_t, such as wages, are included in the technology R^*_t.

[25] If $\psi^* > 1$, it is possible for the parent company to experience a net loss as a result of the foreign subsidiary's actions, such as legal expenses of a subsidiary-level fraud.

granting bank loans with detailed collateral and covenant requirements (informed capital). This interpretation is consistent with the literature on the comparative advantage of banks in accessing private information as insiders and preventing moral hazard via monitoring.[26]

To formalize the monitoring incentive of the foreign lender as an informed lender, I propose that the foreign lender can take two actions at time $t+1$ after signing a subsidiary-level debt contract at t: Monitoring the foreign subsidiary properly or only securing its share of the return without lowering the private benefit of the foreign subsidiary. To begin with, the foreign lender can reduce the private benefit of the foreign subsidiary through proper monitoring with a per-unit monitoring cost $c^* + s^* > 0$. The per-unit monitoring cost captures the idea that monitoring is privately costly in the same way of Holmstrom and Tirole (1997). The total monitoring cost is therefore $(c^* + s^*)\, I_t^*$. When the foreign lender properly monitors, I assume that ψ^* can be diminished to 0 so that the foreign subsidiary will behave.

Instead of proper monitoring, the foreign lender can shirk themselves to only secure their share of the return from the debt contract with a per-unit cost $s^* \geq 0$ without lowering the private benefit of the foreign subsidiary. In this case, the foreign subsidiary will misbehave and the productivity draw will shrink to $(1-\psi^*)\omega_{t+1}^*$. The per-unit cost $s^* \geq 0$ is paid to ensure the foreign lender's seniority on the foreign return due to the moral hazard between the MNE and its lenders in the case of a subsidiary-level default, which allows a transfer of the foreign return to the parent company before the CSV. After paying the per-unit cost $s^* \geq 0$, the optimal contract for the foreign subsidiary is the standard debt contract, as explained in Section 3.2.1.

Let $\bar{\omega}_{t+1}^*$ be the default threshold of the standard debt contract. The participation constraint for the foreign lender with proper monitoring in equilibrium is:

$$D_t^*(1+r_t^{m*}) = \left(\int_{\bar{\omega}_{t+1}^*}^{+\infty} \bar{\omega}_{t+1}^* F(\omega_{t+1}^*) + \int_0^{\bar{\omega}_{t+1}^*} (1-\nu^*)\omega_{t+1}^* F(\omega_{t+1}^*) \right) I_t^* R_t^*, \tag{11}$$

where ν^* is the per-unit default cost of the foreign lender and $1 + r_t^{m*}$ is the required rate of

[26] See, for instance, Stiglitz and Weiss (1983), Diamond (1984, 1991), Fama (1985), Rajan (1992), Hoshi et al. (1993), Denis and Mihov (2003), Mehran and Thakor (2011), Lin et al. (2013).

return of the informed capital D_t^* with:

$$D_t^*(1+r_t^{m*}) = D_t^*(1+r_t^{rf*}) + (c^*+s^*)I_t^* > D_t^*(1+r_t^{rf*}). \tag{12}$$

To sustain proper monitoring, the incentive constraint for the foreign lender satisfies:

$$\begin{aligned} &\left(\int_{\bar{\omega}_{t+1}^*}^{+\infty} \bar{\omega}_{t+1}^* F(\omega_{t+1}^*) + \int_0^{\bar{\omega}_{t+1}^*} (1-\nu^*)\omega_{t+1}^* F(\omega_{t+1}^*)\right) I_t^* R_t^* \\ &\geq \left(\int_{\frac{\bar{\omega}_{t+1}^*}{1-\psi^*}}^{+\infty} \bar{\omega}_{t+1}^* F(\omega_{t+1}^*) + \int_0^{\frac{\bar{\omega}_{t+1}^*}{1-\psi^*}} (1-\nu^*)(1-\psi^*)\omega_{t+1}^* F(\omega_{t+1}^*)\right) I_t^* R_t^* + c^* I_t^*. \end{aligned} \tag{13}$$

Note that the productivity draw must be $\omega_{t+1}^* = \bar{\omega}_{t+1}^* / (1-\psi^*)$ for the realized productivity to meet $\bar{\omega}_{t+1}^*$ when the foreign subsidiary misbehaves.

Because proper monitoring is expensive, it follows that the foreign lender requires a minimum share of R_t^* in expectation to sustain the incentive constraint.[27] The optimal way to use the informed capital with proper monitoring is thus to borrow just enough so that the incentive constraint binds and finance the rest of I_t^* via funds with a cheaper required rate of return. Whether the leverage for the rest of I_t^* is made of the parent-level debt depends on the frictions associated with the subsidiary-level debt, notably s^*. When s^* is sufficiently high, only the parent-level debt will be used to externally fund I_t^*, conditioning on the usage of the informed capital with proper monitoring. When s^* and other frictions are low, the parent company might even use the subsidiary-level informed capital without proper monitoring to further decrease the risk-premium of the parent-level debt by making it more state contingent.[28] This gives the parent company another incentive to raise uninformed debt and internally finance the foreign subsidiary with $T_t > 0$.

[27] Appendix B.1 details the proof.

[28] The subtle reason for this improvement is that the expected default loss of the parent-level debt could be reduced by allowing the possibility of a parent-level default after the subsidiary-level lender getting paid in full, where the home lender can know from the informed subsidiary-level lender that the realized foreign productivity draw is at least above $\bar{\omega}_{t+1}^*$. When the reduction of the expected default loss from the greater state contingency is larger than the additional stand-alone default risk of the subsidiary-level debt, it is optimal to use the additional informed capital to reduce the risk-premium of the parent-level debt. See Appendix B.2 for details.

Since the usage of the informed capital without proper monitoring reinforces the parent company's incentives to active the ICM with $T_t > 0$, while it does not affect the private benefit of the foreign subsidiary, the additional informed capital helps form the mechanism of the model associated with $T_t > 0$, but is not required for this cause. To underline the full mechanism of the model in a simple setup, I make the simplifying assumption that the frictions associated with the subsidiary-level debt is large enough so that the local informed capital will be used with proper monitoring (i.e., s^* is large enough). The simplifying assumption is convenient without giving up generality for my purpose because adding the additional informed capital leads to the same empirical predictions, as will be explained in Section 3.4. The simplifying assumption is also consistent with the literature on informed capital that emphasizes the role of monitoring in reducing the private benefit associated with managerial misbehavior (e.g., Holmstrom and Tirole 1997, Antras, Desai, and Foley 2009, Mehran and Thakor 2011, etc.). The details of the simplifying assumption, along with the usage of the additional informed capital, are described in Appendix B.2.

Given the international setup of the model, it is also helpful to discuss the potential differences between the home and foreign default costs, ν and ν^*, and the two countries' tax environments. To start with, the empirical focus of this paper is US MNEs with subsidiaries in developed economies, especially the UK, where the financial industries share a similar degree of development. I therefore assume that $\nu = \nu^*$ to reflect the similar institutional background.[29] For US MNEs in general with subsidiaries that face a less developed financial industry, one can assume there is $\nu \leq \nu^*$ (e.g., Desai, Foley, and Forbes, 2008). Such setup will additionally enhance a parent company's incentives to borrow for their subsidiaries due to the lower default cost.

As the focus of this paper is how the ICMs of MNEs respond to country-level uncertainty shocks from non-tax-related origins, I abstract any cross-border corporate income tax differential from my framework and assume that the tax environment remains stable during time t and $t + 1$, when a foreign uncertainty shock occurs at time t. For my empirical analysis that examines the UK subsidiaries of US MNE before and after the the Brexit referendum,

[29]The frictions associated with the nature of a subsidiary-level debt is captured by the per-unit cost s^*.

the corporate income tax is higher in the US. This can provide the US parents with further incentives to borrow for their UK subsidiaries as interest expenses are tax deductible.

3.3 Equilibrium

At time t, the objective of the parent company is to maximize its expected profits, $E_t(\Phi_{t+1})$, by choosing its home and foreign investments, I_t and I_t^*, and debt structure, D_t and D_t^*, given the endogenously decided lending rates, r_t and r_t^*. Let $\Upsilon_t^h = \Upsilon^h(\hat{\omega}_{t+1}, \hat{\omega}^*_{t+1}, \bar{\omega}^*_{t+1})$ and $\Upsilon_t^f = \Upsilon^f(\hat{\omega}_{t+1}, \hat{\omega}^*_{t+1}, \bar{\omega}^*_{t+1})$ denote the parent company's expected share of $I_t R_t$ and $F_{t+1} I_t^* R_t^*$, respectively, from the optimal contract.[30] The optimization problem is:

$$\max_{\{I_t, T_t, I_t^*, r_t, r_t^*\}} E_t(\Phi_{t+1}) = \max_{\{I_t, T_t, I_t^*, r_t, r_t^*\}} \Upsilon_t^h I_t R_t + \Upsilon_t^f F_{t+1} I_t^* R_t^*,$$

subjecting to:

$$\bar{\omega}^*_{t+1} = \frac{D_t^*(1+r_t^*)}{I_t^* R_t^*}, \tag{14}$$

$$\hat{\omega}_{t+1} = \frac{D_t(1+r_t)}{I_t R_t}, \tag{15}$$

$$\hat{\omega}^*_{t+1} = \frac{D_t(1+r_t)}{F_{t+1} I_t^* R_t^*} + \bar{\omega}^*_{t+1}, \tag{16}$$

$$\bar{\omega}_{t+1} = \hat{\omega}_{t+1}\left[1 - \frac{(\omega^*_{t+1} - \bar{\omega}^*_{t+1})}{(\hat{\omega}^*_{t+1} - \bar{\omega}^*_{t+1})}\mathbf{1}(\omega^*_{t+1} \geq \bar{\omega}^*_{t+1})\right], \forall \omega^*_{t+1} < \hat{\omega}^*_{t+1}, \tag{17}$$

$$\int_{\bar{\omega}^*_{t+1}}^{\frac{\bar{\omega}^*_{t+1}}{1-\psi^*}} \left[\bar{\omega}^*_{t+1} - (1-\nu^*)(1-\psi^*)\omega^*_{t+1}\right] dF(\omega^*_{t+1}) + \int_0^{\bar{\omega}^*_{t+1}} (1-\nu^*)\psi^* \omega^*_{t+1} dF(\omega^*_{t+1}) = \frac{c^*}{R_t^*}, \tag{18}$$

$$D_t^*(1+r_t^{m*}) = \left(\int_{\bar{\omega}^*_{t+1}}^{+\infty} \bar{\omega}^*_{t+1} F(\omega^*_{t+1}) + \int_0^{\bar{\omega}^*_{t+1}} (1-\nu^*)\omega^*_{t+1} F(\omega^*_{t+1})\right) I_t^* R_t^*, \tag{19}$$

$$D_t(1+r_t^{rf}) = \Omega_t^h I_t R_t + \Omega_t^f F_{t+1} I_t^* R_t^*. \tag{20}$$

Condition 14 describes the default threshold of the subsidiary-level debt contract. Conditions 15-17 define the contractual thresholds of the parent-level debt contract. Condition 18 is the binding incentive constraint for the foreign lender to reduce the private benefit of the foreign

[30]See Appendix A.3 for details on Υ_t^h and Υ_t^f.

subsidiary via local monitoring when providing informed capital. Conditions 19 and 20 are the participation constraints for the foreign and home lenders, correspondingly, to break even with their cost of funds.

To decide whether the subsidiary-level deb, D_t^*, should be used as local informed capital in equilibrium, the parent company solves the optimization problem with and without D_t^* before choosing the equilibrium debt structure that yields the highest expected profits, $E_t(\Phi_{t+1})$. Without D_t^* in equilibrium, $\bar{\omega}_{t+1}^* = 0$. Conditions 14, 18, and 19 are dropped from the optimization, while the foreign productivity draw, ω_{t+1}^*, shrinks to $(1-\psi^*)\omega_{t+1}^*$ as the foreign subsidiary pursues its private benefit.

With D_t^* in equilibrium, all foreign variables except for I_t^* are solved through Conditions 14, 18, and 19. Let $M(\bar{\omega}_{t+1}^*)$ denote the expected payoff to the foreign lender per unit of I_t^* from reducing the private benefit of the foreign subsidiary through monitoring (the left hand side of Condition 18):

$$M(\bar{\omega}_{t+1}^*) = \int_{\bar{\omega}_{t+1}^*}^{\frac{\bar{\omega}_{t+1}^*}{1-\psi^*}} \left[\bar{\omega}_{t+1}^* - (1-\nu^*)(1-\psi^*)\omega_{t+1}^*\right] dF(\omega_{t+1}^*) + \int_0^{\bar{\omega}_{t+1}^*} (1-\nu^*)\psi^*\omega_{t+1}^* dF(\omega_{t+1}^*). \quad (21)$$

The incentive constraint (Condition 18) determines the minimum $\bar{\omega}_{t+1}^*$ in equilibrium given the distribution of ω_{t+1}^*:

$$M(\bar{\omega}_{t+1}^*) = \frac{c^*}{R_t^*}. \quad (22)$$

The foreign contractual threshold, $\bar{\omega}_{t+1}^*$, regulates the minimum portion of I_t^* that needs to be funded by D_t^* in equilibrium, D_t^*/I_t^*, to sustain the incentive constraint for monitoring through Condition 19. By deciding D_t^*/I_t^*, $\bar{\omega}_{t+1}^*$ also solves the foreign lending rate r_t^* through the optimal contract, Condition 14. Substituting Condition 14 to the budget constraint in equilibrium:

$$D_t^* + \frac{T_t}{S_t} = I_t^*, \quad (23)$$

I_t^* becomes a function of the internal transfer T_t with:

$$I_t^* = \frac{T_t}{S_t \Lambda\left(\bar{\omega}_{t+1}^*\right)} \Longleftrightarrow T_t = S_t I_t^* \Lambda\left(\bar{\omega}_{t+1}^*\right), \quad (24)$$

where $\Lambda\left(\bar{\omega}_{t+1}^*\right)$ denotes the share of I_t^* that can be financed by funds cheaper than the local informed capital, D_t^*, with:

$$\Lambda\left(\bar{\omega}_{t+1}^*\right) = 1 - \frac{\bar{\omega}_{t+1}^* R_t^*}{1 + r_t^*\left(\bar{\omega}_{t+1}^*\right)}. \tag{25}$$

Conditions 22 and 24 illustrate an important interaction between the local capital market in Foreign and the international capital market in Home. Each unit of the internal funding, T_t, which is leveraged by the parent-level debt, D_t, needs to be blended with a minimum share of the local informed capital, D_t^*, to sustain the incentive constraint for monitoring. This mixture exists as long as the parent company wants to complement its limited internal monitoring capacity with local monitoring from the foreign lender to reduce the private benefit of the foreign subsidiary. If a rise in foreign uncertainty improves the incentive of the foreign lender to monitor the foreign subsidiary, the minimum share of D_t^*/I_t^* can be reduced for each unit of I_t^* without destroying the foreign lender's incentive constraint for monitoring. As a result, the parent company can effectively lower the cost of funds by financing the same level of I_t^* with additional parent-level debt, which is cheaper since the parent-level debt is backed by a diversified cash flow. In this way, the existence of D_t^* in the equilibrium debt structure can induce an inflow of capital, or external debt, from Home to Foreign when the uncertainty in Foreign becomes higher. The inflow of international capital through the ICM can offset at least some of the negative effect from the rise in foreign uncertainty. Intuitively, while the parent company experiences an increase in the cost of funds because the foreign subsidiary becomes riskier, the parent company can also decrease the cost of funds by improving its debt structure with a smaller minimum share of D_t^*/I_t^* for each unit of I_t^*. The intuition that the existence of D_t^* in the equilibrium debt structure can act as stabilizer for foreign uncertainty shocks via a change in the debt structure forms a keystone for my empirical results, which will be elaborated in the next section.

With the equilibrium conditions of the foreign variables, the lending rate of the parent-level debt, r_t, together with the parent company's decision rules on I_t and T_t, are determined by the following three equations:

$$\lambda = -\frac{\Upsilon^h_{\hat{\omega}_{t+1}} + \Upsilon^h_{\hat{\omega}^*_{t+1}} \frac{I_t R_t}{F_{t+1} I^*_t R^*_t} + \Upsilon^f_{\hat{\omega}_{t+1}} \frac{F_{t+1} I^*_t R^*_t}{I_t R_t} + \Upsilon^f_{\hat{\omega}^*_{t+1}}}{\Omega^h_{\hat{\omega}_{t+1}} + \Omega^h_{\hat{\omega}^*_{t+1}} \frac{I_t R_t}{F_{t+1} I^*_t R^*_t} + \Omega^f_{\hat{\omega}_{t+1}} \frac{F_{t+1} I^*_t R^*_t}{I_t R_t} + \Omega^f_{\hat{\omega}^*_{t+1}}} > 1, \tag{26}$$

$$\Upsilon^h_t R_t + \delta^I_t = \lambda \left[(1 + r^{rf}_t) - \Omega^h_t R_t \right], \tag{27}$$

$$\Upsilon^f_t \frac{F_{t+1}}{S_t \Lambda \left(\bar{\omega}^*_{t+1} \right)} R^*_t + \delta^T_t = \lambda \left[(1 + r^{rf}_t) - \Omega^f_t \frac{F_{t+1}}{S_t \Lambda \left(\bar{\omega}^*_{t+1} \right)} R^*_t \right]. \tag{28}$$

Appendix C.1 provides the details of their derivations.

λ is the Lagrange multiplier associated with r_t. Consistent with BGG (1999), λ reflects the risk premium generated by the costly default with $\nu > 0$. It prescribes the additional shares of the returns the parent company needs to compensate the home lender in the optimal contract to cover their expected default loss. Appendix C.1 demonstrates this point in details.

Conditions 27 and 28 are the equilibrium conditions for I_t and T_t, where δ^I_t and δ^T_t capture a diversification effect from a marginal increase in I_t and T_t, respectively. Though a marginal increase in I_t or T_t affects the expected default loss through both changing the relative size of the projects (the diversification effect) and lifting the leverage, Appendix C.2 shows that the marginal impact of any diversification benefit diminishes as the parent company's leverage rises. Thus, by keeping building up the leverage, a marginal increase in I_t or T_t eventually raises the cost of funds because of the costly default. Appendix C.2 documents the details on how a marginal increase in I_t or T_t affects the expected default loss.

When $T_t \to 0$, the equilibrium converges to an one-project equilibrium similar to that of BGG (1999) with:

$$\lambda = -\frac{\Upsilon^h_{\hat{\omega}_{t+1}}}{\Omega^h_{\hat{\omega}_{t+1}}} = -\frac{\Upsilon^h_{\bar{\omega}_{t+1}}}{\Omega^h_{\bar{\omega}_{t+1}}} = \frac{1 - F(\bar{\omega}_{t+1})}{1 - F(\bar{\omega}_{t+1}) - \nu \bar{\omega}_{t+1} f(\bar{\omega}_{t+1})}, \tag{29}$$

$$\Upsilon^h_t R_t = \lambda \left[(1 + r^{rf}_t) - \Omega^h_t R_t \right]. \tag{30}$$

In this case, Appendix C.3 proves that it is optimal for the parent company to have $T_t > 0$

when the foreign project has a large enough R_t^*:

$$\int_{\bar{\omega}_{t+1}^*}^{+\infty} (\omega_{t+1}^* - \bar{\omega}_{t+1}^*) dF(\omega_{t+1}^*) \frac{F_{t+1}}{S_t \Lambda\left(\bar{\omega}_{t+1}^*\right)} R_t^* > \frac{(1 + r_t^{rf})}{1 - \nu F(\hat{\omega}_{t+1}) - \nu \hat{\omega}_{t+1} f(\hat{\omega}_{t+1})}. \tag{31}$$

Similarly, when $I_t \to 0$, the equilibrium converges to an one-project equilibrium close to that of BGG (1999), conditioning on the potential usage of the local informed capital, with:

$$\lambda = -\frac{\Upsilon^f_{\hat{\omega}^*_{t+1}}}{\Omega^f_{\hat{\omega}^*_{t+1}}} = \frac{1 - F(\hat{\omega}^*_{t+1})}{1 - F(\hat{\omega}^*_{t+1}) - \nu\left(\hat{\omega}^*_{t+1} - \bar{\omega}^*_{t+1}\right) f(\hat{\omega}^*_{t+1})}, \tag{32}$$

$$\Upsilon^f_t \frac{F_{t+1}}{S_t \Lambda\left(\bar{\omega}^*_{t+1}\right)} R_t^* = \lambda \left[(1 + r_t^{rf}) - \Omega^f_t \frac{F_{t+1}}{S_t \Lambda\left(\bar{\omega}^*_{t+1}\right)} R_t^*\right]. \tag{33}$$

In this case, Appendix C.3 proves that it is optimal for the parent company to have $I_t > 0$ when the home project has a large enough R_t:

$$R_t > \frac{(1 + r_t^{rf})}{1 - \nu F(\hat{\omega}^*_{t+1}) - \nu(\hat{\omega}^*_{t+1} - \bar{\omega}^*_{t+1}) f(\hat{\omega}^*_{t+1})}. \tag{34}$$

3.4 Local Uncertainty Shocks and International Debt Substitution

The theoretical framework has so far characterized how the MNE utilizes the ICM in equilibrium with two main features: 1) The parent company has a comparative advantage in raising uninformed debt due to the benefit of a cross-border cash-flow diversification by the virtue of ownership. 2) The local informed capital can be used at the foreign subsidiary for delegated monitoring. The local informed capital can complement the parent company's internal monitoring capacity due to the local lender's comparative advantage in addressing agency problems locally. Such comparative advantage can be especially helpful when the parent company faces a limited capacity in preventing the managerial misbehavior of the foreign subsidiary because of the MNE's operational, geographical, or business complexity.

Based on the framework, this section discusses how a foreign uncertainty shock affects the MNE's borrowing decisions globally by interacting with the ICM. Admittedly, a surge of uncertainty in Foreign can yield negative spillovers through the ICM as the uncertainty shock can raise the risk premium of any debt supported by the foreign return. However, the debt structure of the MNE matters during periods of heightened uncertainty. A key mechanism of my framework is that local informed capital, such as local bank debt, can play a special role in stabilizing uncertainty shocks through monitoring. A surge of foreign uncertainty can enhance the local lender's incentives for proper monitoring to protect their own returns from the foreign project. As a result, when the local informed capital is used in equilibrium, the parent company can raise additional parent-level debt globally to substitute the more expensive local informed capital without destroying the incentive constraint for monitoring. Such cross-border external debt substitution improves the debt structure of the MNE, which offsets the negative impact of the uncertainty shock at least partially. The usage of the local informed capital can therefore help anchor foreign capital in an economy during periods of heightened uncertainty via the ICMs of MNEs. I now explain these mechanisms in details with testable predictions.

3.4.1 The Impact of a Foreign Uncertainty Shock on $\bar{\omega}^*_{t+1}$

To highlight the role of the debt structure in response to local uncertainty shocks, I start by examining the impact of a foreign uncertainty shock on the foreign contractual threshold, $\bar{\omega}^*_{t+1}$. $\bar{\omega}^*_{t+1}$ plays a central role in the debt structure of the MNE since it regulates the usage of the local informed capital in equilibrium. As established in Section 3.1, a foreign uncertainty shock at time t, which affects the MNE's investment decisions, can be described as an exogenous, mean-preserving shock to σ^*_t, consistent with Dorofeenko, Lee, and Salyer (2008) and Akinci (2021).[31] Because the incentive constraint for monitoring (Condition 22) determines $\bar{\omega}^*_{t+1}$ in equilibrium, a starting point to investigate the effect of the uncertainty shock is:

$$\frac{dM\left(\bar{\omega}^*_{t+1}, \sigma^*_t\right)}{d\sigma^*_t} = 0 \tag{35}$$

following Condition 22.

Equation 35 holds because the per-unit expected payoff to the home lender from proper

[31] A mean-shifting shock to σ^*_t can represent a combination of two shocks: An uncertainty shock to σ^*_t with $E_t(\omega^*_{t+1}) = 1$ and a first moment shock that shifts R^*_t.

monitoring, $M(\bar{\omega}^*_{t+1})$, is pinned down by the cost of the monitoring technology, c^*, and the country-specific technology, R^*_t. Both c^* and R^*_t are independent with the foreign uncertainty shock. I write $M\left(\bar{\omega}^*_{t+1}\right) = M\left(\bar{\omega}^*_{t+1}, \sigma^*_t\right)$ to indicate that the distribution of the foreign productivity draw, ω^*_{t+1}, depends on the parameter σ^*_t. Applying the definition of $M(\bar{\omega}^*_{t+1})$ according to Equation 21, Equation 35 implies:

$$\frac{\partial M(\bar{\omega}^*_{t+1},\sigma^*_t)}{\partial F(\bar{\omega}^*_{t+1},\sigma^*_t)}\frac{\partial F(\bar{\omega}^*_{t+1},\sigma^*_t)}{\partial \sigma^*_t}+\frac{\partial M(\bar{\omega}^*_{t+1},\sigma^*_t)}{\partial\left(F(\frac{\bar{\omega}^*_{t+1}}{1-\psi^*},\sigma^*_t)-F(\bar{\omega}^*_{t+1},\sigma^*_t)\right)}\frac{\partial\left(F(\frac{\bar{\omega}^*_{t+1}}{1-\psi^*},\sigma^*_t)-F(\bar{\omega}^*_{t+1},\sigma^*_t)\right)}{\partial \sigma^*_t}$$
$$= -\frac{\partial M(\bar{\omega}^*_{t+1},\sigma^*_t)}{\partial \bar{\omega}^*_{t+1}}\frac{\partial \bar{\omega}^*_{t+1}}{\partial \sigma^*_t}. \tag{36}$$

Consider an exogenous, mean-preserving shock to σ^*_t that raises the default probability of the foreign subsidiary with $\partial F(\bar{\omega}^*_{t+1},\sigma^*_t)/\partial\sigma^*_t > 0$, and that the due diligence of the foreign subsidiary will not worsen the increase, $\partial F(\bar{\omega}^*_{t+1},\sigma^*_t)/\partial\sigma^*_t \leq \partial F(\frac{\bar{\omega}^*_{t+1}}{1-\psi^*},\sigma^*_t)/\partial\sigma^*_t$. There will be:

$$\frac{\partial M(\bar{\omega}^*_{t+1},\sigma^*_t)}{\partial \bar{\omega}^*_{t+1}}\frac{\partial \bar{\omega}^*_{t+1}}{\partial \sigma^*_t} < 0 \tag{37}$$

since $\partial M(\bar{\omega}^*_{t+1},\sigma^*_t)/\partial F(\bar{\omega}^*_{t+1},\sigma^*_t) > 0$ and $\partial M(\bar{\omega}^*_{t+1},\sigma^*_t)/\partial\left(F(\frac{\bar{\omega}^*_{t+1}}{1-\psi^*},\sigma^*_t)-F(\bar{\omega}^*_{t+1},\sigma^*_t)\right) > 0$ following Equation 21. The impact of the foreign uncertainty shock on $\bar{\omega}^*_{t+1}$ can then be signed as:

$$\frac{\partial \bar{\omega}^*_{t+1}}{\partial \sigma^*_t} < 0 \tag{38}$$

due to $\partial M(\bar{\omega}^*_{t+1})/\partial\bar{\omega}^*_{t+1} > 0$, as proved by Appendix B.1.

The condition $\partial F(\bar{\omega}^*_{t+1},\sigma^*_t)/\partial\sigma^*_t > 0$ implies the foreign uncertainty shock is contractionary. It is consistent with the theoretical and empirical evidence from Bloom et al. (2018), Christiano, Motto, and Rostagno (2014), Julio and Yook (2012), Fernandez-Villaverde et al. (2011), Bloom (2009), etc. It is true in my model when R^*_t is not extremely low so that $\bar{\omega}^*_{t+1}$ is not extremely high. The fact that $\bar{\omega}^*_{t+1}$ decreases in R^*_t can be seen from Condition 22 in the equilibrium with $\partial M(\bar{\omega}^*_{t+1})/\partial\bar{\omega}^*_{t+1} > 0$. It should also be noted that $\bar{\omega}^*_{t+1}$ cannot be extraordinarily high. This is because if R^*_t is too low, a $\bar{\omega}^*_{t+1}$ does not exist in the equilibrium as the foreign lender cannot meet their participation constraint. Appendix B.1 explains the concavity of the expected payoff to the foreign lender with respect to $\bar{\omega}^*_{t+1}$ in details, which tracks the framework of BGG (1999).

Though it is reasonable to assume that the increase in the default probability rises with the managerial misbehavior, whether, and to what extend, $\partial F(\bar{\omega}^*_{t+1}, \sigma^*_t)/\partial\sigma^*_t \leq \partial F(\frac{\bar{\omega}^*_{t+1}}{1-\psi^*}, \sigma^*_t)/\partial\sigma^*_t$ is an empirical question since the answer depends on the value of ψ^* for a given R^*_t. If there is somehow $\partial F(\bar{\omega}^*_{t+1}, \sigma^*_t)/\partial\sigma^*_t > F(\frac{\bar{\omega}^*_{t+1}}{1-\psi^*}, \sigma^*_t)/\partial\sigma^*_t$, the value of $\partial\bar{\omega}^*_{t+1}/\partial\sigma^*_t$ will grow toward being positive based on Equation 36. This will work against me in finding any empirical result associated with $\partial\bar{\omega}^*_{t+1}/\partial\sigma^*_t < 0$.[32] The same argument goes if the exogenous shock to σ^*_t has a mean-shifting component that depresses R^*_t, which will make the value of $\partial M(\bar{\omega}^*_{t+1})/\partial\bar{\omega}^*_{t+1}$ grow toward being negative following Condition 22.

Condition 38 reveals that the usage of the local informed capital, D^*_t, in the equilibrium debt structure can act as a stabilizer during periods of heightened uncertainty. Intuitively, the foreign lender is incentivized to reduce the private benefit of the foreign subsidiary via local monitoring in order to avoid the default state, in which the foreign subsidiary misbehaves. When a rise in foreign uncertainty makes it easier for the foreign subsidiary to default with the managerial misbehavior, the foreign lender's incentive to monitor becomes stronger, which relaxes their incentive constraint for monitoring with $\partial\bar{\omega}^*_{t+1}/\partial\sigma^*_t < 0$. As explained in Section 3.3, the foreign contractual threshold, $\bar{\omega}^*_{t+1}$, regulates the minimum share of D^*_t/I^*_t to sustain the incentive constraint for monitoring. The relaxed incentive constraint thus allows the parent company to improve its debt structure by funding each unit of I^*_t with additional parent-level debt, which is cheaper due to the diversification benefit, without losing the local

[32]Empirically speaking, however, $\partial F(\frac{\bar{\omega}^*_{t+1}}{1-\psi^*}, \sigma^*_t)/\partial\sigma^*_t \geq \partial F(\bar{\omega}^*_{t+1}, \sigma^*_t)/\partial\sigma^*_t > 0$ is almost always true even if R^*_t is low and ψ^* is substantially large. Using the sample period of 2016-2018 of my Brexit natural experiment as an example for back-of-the-envelope calculations. The subsidiary-level debt ratio in the UK, D^*_t/I^*_t, can be estimated as around 0.3 according to Table 1. Approximating the local risky lending rate, r^*_t, using the effective interest rate of bank loans with a fixed rate to UK private non-financial corporations according to the BoE, $1 + r^*_t = 1.045$ (https://www.bankofengland.co.uk/statistics/visual-summaries/effective-interest-rates). $1 + r^*_t$ is around 1.03 for the bank loans with a floating rate or 1.04 based on the yield of the UK non-investment-grade corporate bonds from Capital IQ. Approximating the MNE's country-specific technology R^*_t using the UK GDP growth, $R^*_t = 1.015$. The value is likely to be an underestimation if the UK subsidiaries of non-UK, non-financial MNEs tend to be more productive. With $\bar{\omega}^*_{t+1} = 0.31$, $\partial F(\frac{\bar{\omega}^*_{t+1}}{1-\psi^*}, \sigma^*_t)/\partial\sigma^*_t \geq \partial F(\bar{\omega}^*_{t+1}, \sigma^*_t)/\partial\sigma^*_t > 0$ is true even if ψ^* is as large as 0.5, meaning half of ω^*_{t+1} would be lost due to managerial misbehavior. See Figure 2 for a demonstration of this example.

monitoring of the foreign lender. As a result, while the rise in foreign uncertainty can increase the cost of funds since the foreign subsidiary is riskier, the substitution of parent-level debt for subsidiary-level debt as local informed capital can also decrease the cost of funds via improving the debt structure.

The external debt substitution between the parent company and foreign subsidiary and the associated stabilization effect can be summarized by the following empirical predictions:

> **Prediction 1:** Given a higher country-level uncertainty, if MNEs with foreign subsidiaries operating in the country respond with a substitution of external debt between the foreign subsidiaries and their parent companies, there should be an increase in the ratio of parent-level debt to total assets, conditioning on the ratio of total debt to total assets, in the consolidated financial statements of the MNEs.

> **Prediction 2:** If the improvement of the debt structure through the external debt substitution can substantially offset the contractionary impact of the uncertainty shock, there should not be a significant decrease in the ratio of total debt to total assets in the consolidated financial statements of the MNEs.

With the predictions about the external debt substitution between the parent company and foreign subsidiary based on the consolidated financial statements, the next section discusses the detailed effects of the country-level uncertainty shock on the unconsolidated balance sheet of the foreign subsidiary.

3.4.2 The Impact of a Foreign Uncertainty Shock on D_t^*/I_t^*

Because $\partial\bar{\omega}_{t+1}^*/\partial\sigma_t^* < 0$, the foreign uncertainty shock will decrease the ratio of subsidiary-level debt to total assets, D_t^*/I_t^*, through two forces that affect I_t^* in the opposite directions. Combining the participation constraint for the foreign lender (Condition 19) with the foreign contractual threshold (Condition 14), D_t^*/I_t^* in equilibrium is:

$$\frac{D_t^*}{I_t^*} = \frac{\Omega^*(\bar{\omega}_{t+1}^*)R_t^*}{1 + r_t^{rf*}} - \frac{c^* + s^*}{1 + r_t^{rf*}}, \tag{39}$$

where $\Omega^*(\bar{\omega}^*_{t+1}) = \Omega^*(\bar{\omega}^*_{t+1}, \sigma^*_t)$ denotes the expected share of $I^*_t R^*_t$ for the foreign lender from the subsidiary-level debt contract.

For the mean-preserving shock to σ^*_t, there is:

$$\frac{d(D^*_t/I^*_t)}{d\sigma^*_t} = \frac{R^*_t}{1+r^{rf*}_t}\left[\frac{\partial\Omega^*(\bar{\omega}^*_{t+1},\sigma^*_t)}{\partial\bar{\omega}^*_{t+1}}\frac{\partial\bar{\omega}^*_{t+1}}{\partial\sigma^*_t} + \frac{\partial\Omega^*(\bar{\omega}^*_{t+1},\sigma^*_t)}{\partial F(\bar{\omega}^*_{t+1},\sigma^*_t)}\frac{\partial F(\bar{\omega}^*_{t+1},\sigma^*_t)}{\partial\sigma^*_t}\right]. \tag{40}$$

The first term in the squared brackets, $\left(\partial\Omega^*(\bar{\omega}^*_{t+1},\sigma^*_t)/\partial\bar{\omega}^*_{t+1}\right)\left(\partial\bar{\omega}^*_{t+1}/\partial\sigma^*_t\right) < 0$, represents the expansionary impact from the relaxation of the incentive constraint for monitoring. It enables the MNE to improve its debt structure via the external debt substitution, as explained in the previous section. The term is negative since $\partial\bar{\omega}^*_{t+1}/\partial\sigma^*_t < 0$ and $\partial\Omega^*(\bar{\omega}^*_{t+1},\sigma^*_t)/\partial\bar{\omega}^*_{t+1} > 0$. Appendix B.1 provides the details on $\partial\Omega^*(\bar{\omega}^*_{t+1},\sigma^*_t)/\partial\bar{\omega}^*_{t+1} > 0$.

The second term in the squared brackets, $\left(\partial\Omega^*(\bar{\omega}^*_{t+1},\sigma^*_t)/\partial F(\bar{\omega}^*_{t+1},\sigma^*_t)\right)\left(\partial F(\bar{\omega}^*_{t+1},\sigma^*_t)/\partial\sigma^*_t\right) < 0$, represents the contractionary impact from the higher default probability of the foreign subsidiary. It creates an upward pressure in the risk premium of the MNE and, consequently, a downward pressure in I^*_t through deleveraging (i.e., a fall in the debt-to-equity ratio, conditioning on the debt structure, of the MNE). The term is negative since $\partial F(\bar{\omega}^*_{t+1},\sigma^*_t)/\partial\sigma^*_t > 0$ and $\partial\Omega^*(\bar{\omega}^*_{t+1},\sigma^*_t)/\partial F(\bar{\omega}^*_{t+1},\sigma^*_t) < 0$.[33]

Without the relaxation of the incentive constraint for monitoring, the foreign uncertainty shock would only be contractionary for any subsidiary-level debt used in equilibrium due to the higher default probability.[34] With the relaxation of the incentive constraint, however, the external debt substitution can lower the subsidiary-level debt ratio, D^*_t/I^*_t, without decreasing I^*_t as the substitution reduces the cost of funds for the MNE by improving its debt structure. When the expansionary impact of the external debt substitution substantially

[33] $\partial\Omega^*(\bar{\omega}^*_{t+1})/\partial F(\bar{\omega}^*_{t+1}) < 0$ due to $\Omega^*(\bar{\omega}^*_{t+1}) = \bar{\omega}^*_{t+1}\left(1 - F(\bar{\omega}^*_{t+1})\right) + \int_0^{\bar{\omega}^*_{t+1}}(1-\nu^*)\omega^*_{t+1}dF(\omega^*_{t+1})$ and $(1-\nu^*)\omega^*_{t+1} < \bar{\omega}^*_{t+1}\forall\omega^*_{t+1} \in [0, \bar{\omega}^*_{t+1}]$.

[34] I have assumed that the exogenous foreign uncertainty shock does not affect the local risk-free interest rate, r^{rf*}_t. If the uncertainty shock additionally raises r^{rf*}_t, the contractionary impact will be amplified due to a larger opportunity cost of the foreign lender. The rise in r^{rf*}_t, along with the contractionary impact from the higher default probability of the foreign subsidiary, can be answered by the foreign central bank, at least partially, via lowering r^{rf*}_t. The movements in the risk-free interest rate do not affect my empirical predictions about the external debt substitution originated from $\partial\bar{\omega}^*_{t+1}/\partial\sigma^*_t < 0$. This is because $\bar{\omega}^*_{t+1}$ is determined by the incentive constraint for monitoring, which is independent with r^{rf*}_t, as shown by Condition 22. As a result, $\partial\bar{\omega}^*_{t+1}/\partial\sigma^*_t$ does not rely on r^{rf*}_t, following Equation 36.

offsets the contractionary impact of the foreign uncertainty shock, it is possible for D_t^*/I_t^* to decline, while I_t^* remains relatively stable. As a result, the effect of the external debt substitution on the subsidiary-level unconsolidated balance sheet can be summarized by the following empirical predictions:

> **Prediction 3:** Given a higher country-level uncertainty, if MNEs with foreign subsidiaries operating in the country respond with a substitution of external debt between the foreign subsidiaries and their parent companies, there should be a decrease in the ratio of external debt to total assets in exchange for an increase in the ratio of internal debt to total assets, conditioning on I_t^*, on the unconsolidated balance sheet of the foreign subsidiaries.

> **Prediction 4:** If the expansionary impact of the external debt substitution can substantially offset the contractionary impact of the uncertainty shock, the ratio of total debt to total assets should remain relatively stable on the unconsolidated balance sheet of the foreign subsidiaries.

3.4.3 The Impact of a Foreign Uncertainty Shock on the Parent Company

Consistent with the contractionary impact on I_t^* through the subsidiary-level debt, the foreign uncertainty shock would yield a downward pressure on the parent company's global investments, I_t and T_t, via $\partial F(\bar{\omega}_{t+1}^*, \sigma_t^*)/\partial \sigma_t^* > 0$. The downward pressure exists because the higher default probability of the foreign subsidiary reduces the expected payoff to the home lender from the parent-level debt contract, ceteris paribus. Specifically, the higher default probability decreases the expected return of the home lender from the foreign project, $\Omega_t^f F_t I_t^* R_t^*$, as $\Omega_t^f = 0 \; \forall \omega_{t+1}^* \leq \bar{\omega}_{t+1}^*$. It also lowers the home lender's expected return from the home project, $\Omega_t^h I_t R_t$, by increasing the probability density of the states $\int_0^{\bar{\omega}_{t+1}^*} 0 dF(\omega_{t+1}^*) I_t R_t$ and $\int_0^{\bar{\omega}_{t+1}^*} \int_0^{\hat{\omega}_{t+1}} (1-\nu)\omega_{t+1} dF(\omega_{t+1}) dF(\omega_{t+1}^*) I_t R_t$. See Equations A.15 and A.12 for the definitions of Ω_t^f and Ω_t^h, respectively, from Appendix A.3. Overall, the reduced expected payoff to the home lender from the parent-level debt contract raises the risk premium of the parent-level debt. This creates a downward pressure in the leverage of the parent company,

$D_t / (I_t + T_t)$, given the minimum share of D_t^* / I_t^* determined by the foreign contractual threshold, $\bar{\omega}_{t+1}^*$.

It is worth noting that the deleverage pressure exists whenever the subsidiary-level debt is used in equilibrium to support the parent-level debt. When the subsidiary-level debt is used without the incentive constraint for monitoring, the uncertainty shock only generates deleverage pressures through the subsidiary- and parent-level debt. When the local informed capital is used with the incentive constraint for monitoring, the expansionary impact from the external debt substitution can offset the deleverage pressures at least partially. Whether, and to what extent, MNEs perform the external debt substitution to stabilize a country-level uncertainty shock so that Predictions 2 and 4 hold is an empirical question explored in Sections 4 and 5.

In the equilibrium where only the parent-level debt is used, $\bar{\omega}_{t+1}^* = 0$. The foreign uncertainty shock would operate entirely through the leverage of the parent company without triggering adjustments in the debt structure by construction. Similar to the case of $\partial F(\bar{\omega}_{t+1}^*, \sigma_t^*) / \partial \sigma_t^* > 0$, the uncertainty shock will still contract the parent company's global investments, I_t and T_t, via deleveraging with $\partial F(\hat{\omega}_{t+1}^*, \sigma_t^*) / \partial \sigma_t^* > 0$. The conclusions associated with $\bar{\omega}_{t+1}^* = 0$ cannot be supported by my empirical findings, however, as will be clear in Sections 4 and 5. The lack of subsidiary-level debt in equilibrium is also not consistent with the existing evidence that subsidiaries have external debt (e.g., Desai, Foley, and Forbes 2008, Santioni, Schiantarelli, and Strahan 2020, Kim, Wilcox, and Yasuda 2020, etc.), and that it is normal for MNEs to have subsidiary-level defaults (e.g., Chowdhry and Coval 1998). Section 3.2.1 provides more recent examples on subsidiary-level defaults due to underperformance.[35]

[35] Though not the focus of this project, my framework incorporates the possibility that the parent company funds the foreign subsidiary internally without primarily using it for the diversification benefit. An example can be the parent company establishes the foreign subsidiary for risky R&D activities. The foreign non-default threshold, $\hat{\omega}_{t+1}^*$, can be high under such circumstance as the foreign return is not meant to serve the parent-level debt in the first place. With $\bar{\omega}_{t+1}^* = 0$, it is then possible that a mean-preserving increase in σ_t^* benefits the parent company via an improved upside potential, $\partial F(\hat{\omega}_{t+1}^*, \sigma_t^*) / \partial \sigma_t^* < 0$. This will lead to an expansion of the parent company's global investments with a rise in its leverage, $D_t / (I_t + T_t)$. Such conclusion cannot be supported by my empirical findings either. The scenario is also more applicable for activities of individual subsidiaries, but less so for activities of MNEs at the country level, especially when the country hosts significant non-financial subsidiaries' activities for the MNEs. The latter case is the focus of my theoretical framework with the representative MNE.

3.4.4 The Role of the Exchange Rate

Though my framework highlights the interaction between the local informed capital and parent-level debt in response to a foreign uncertainty shock per se, it is useful to understand how the uncertainty shock may affect the MNE via the spot and forward exchange rates. To begin with, the key mechanism of my framework does not depend on the exchange rate. Specifically, the impact of the foreign uncertainty shock on the incentive constraint for monitoring and subsidiary-level debt ratio, D_t^*/I_t^*, does not depend on the exchange rate. This is because the incentive constraint for monitoring is decided entirely by the local parameters in Foreign, as shown by Condition 22. Since the incentive constraint pins down the foreign contractual threshold, $\bar{\omega}_{t+1}^*$, while $\bar{\omega}_{t+1}^*$ regulates D_t^*/I_t^* in the equilibrium, the responses of both $\bar{\omega}_{t+1}^*$ and D_t^*/I_t^* to the foreign uncertainty shock are independent with the exchange rate without additional assumptions, following Equations 36 and 40.

Furthermore, the ratio of parent-level debt to total assets on the consolidated balance sheet, $D_t/\left(I_t + S_t I_t^*\right)$, is not affected by the spot exchange rate per se in equilibrium because:

$$S_t I_t^* = \frac{T_t}{\Lambda\left(\bar{\omega}_{t+1}^*\right)} \tag{41}$$

by Condition 24. This theoretical outcome is consistent with my empirical findings in Section 4, where I observe a persistently higher $D_t/\left(I_t + S_t I_t^*\right)$ during periods of heightened foreign uncertainty, even when there is a depreciation of the Home's currency (i.e., S_t rises).

The parent company's investments, I_t and T_t, are connected with the forward premium $F_{t+1}/S_t = (1+r_t^{rf})/(1+r_t^{rf*})$ through Condition 28 and the CIP in equilibrium, where F_{t+1} is the risk-adjusted forward exchange rate. Therefore, movements in the risk-free interest rates can amplify or dampen the impact of the foreign uncertainty shock on the leverage of the parent company, $D_t/\left(I_t + T_t\right)$, via F_{t+1}/S_t. However, movements in the risk-free interest rates do not affect my empirical predictions about the external debt substitution originated from $\partial\bar{\omega}_{t+1}^*/\partial\sigma_t^* < 0$, which improves the MNE's debt structure by lowering the minimum share of D_t^*/I_t^*, as explained in Section 3.4.2. If the forward exchange rate is not risk adjusted, while the country-level uncertainty shock in Foreign induces a CIP deviation with a foreign risk premium, the contractionary impact of the uncertainty shock on the leverage of the parent company will be amplified through a decline in F_{t+1}/S_t. This will increase the challenge in finding empirical evidence consistent with Prediction 2.[36]

4 Empirical Analysis: Parent-Level Evidence

My theoretical framework predicts that the usage of subsidiary-level debt can allow MNEs to improve their debt structure by substituting subsidiary-level debt with parent-level debt in response to a rise in country-level uncertainty. Whether, and to what extent, the external debt substitution takes place is ultimately an empirical question. The following sections empirically test my predictions based on the parent-level consolidated financial statements (Predictions 1 and 2) and subsidiary-level unconsolidated balance sheet (Predictions 3 and 4) using the Brexit interregnum as a natural experiment.

4.1 The Brexit Interregnum as a Natural Experiment

My empirical analysis starts with the identification of exogenous uncertainty shocks that can affect the debt structure of MNEs by a substitution of external debt through their ICMs. Such identification is challenging because major uncertainty shocks tend to concur with other shocks driving business cycles (e.g., Bloom et al. 2019, Christiano, Motto, and Rostagno 2014, etc.). To address this challenge, I take advantage of the Brexit interregnum (6/23/2016-12/31/2018) as a natural experiment. To be precise, I define the interregnum as the period between the vote for Brexit on June 23, 2016 and the first Brexit proposal made by the UK government at the end of 2018 signaling a "soft" Brexit, in which Britain could maintain most its existing relationships with the EU.

The Brexit interregnum is a suitable natural experiment for my purpose due to three reasons. To begin with, the vote for Brexit was mostly unexpected. Meanwhile, it generated a large, broad, and persistent rise in uncertainty within the UK regarding the Brexit process

[36] When the parent company optimizes in period t with $E_t(S_{t+1})$, instead of using the forward contract, its investments are similarly connected with the exchange rate. In this case, movements in the risk-free interest rates can interact with the impact of the foreign uncertainty shock on the leverage of the parent company in an equivalent manner via the UIP, $E_t(S_{t+1})/S_t = (1 + r_t^{rf})/(1 + r_t^{rf*})$. The contractionary impact of the foreign uncertainty shock on the leverage of the parent company will also be amplified through a decline in $E_t(S_{t+1})/S_t$ when the country-level uncertainty shock induces an UIP deviation with a foreign risk premium.

and its consequences, accompanied by little other change (Bloom et al. 2019). In specific, the UK remained inside the EU during the interregnum, meaning the supply side condition of the country remained largely unchanged. The stable supply side condition was paired with a remarkably stable demand in the UK during the interregnum, as suggested by numerous reports from the Bank of England (e.g., Broadbent 2017, BoE 2017, BoE 2018, etc.). Although the vote had caused a strong reaction consistent with a negative first moment shock in the first few months, the response was soon replaced by a lack of clarity on the Brexit process and its consequences, together with a general hope for a "soft" Brexit. For instance, an average UK firm in late 2017 and early 2018 reported a more than 50% probability that the eventual Brexit outcome would have a non-negative impact on their sales. At the same time, an average UK firm in late 2017 and early 2018 assigned a 15% probability that Brexit would never be materialized and a more than 70% probability that the eventual Brexit would take a form of "soft" Brexit (Bloom et al. 2019).[37] I define the interregnum with a stop at the end of 2018 to focus on the period when there was a high uncertainty and a relatively high hope for a "soft" Brexit within the UK.[38] Admittedly, assuming a zero first moment shock in the UK during the interregnum is unrealistic. However, existing evidence supports the argument that the uncertainty shock was large and dominating in the country during the interregnum. In addition, a negative first moment shock will work against me in finding an external debt substitution through the ICMs of MNEs without a significant decline in leverage (i.e., total debt over total assets) at both the parent and subsidiary level, as explained in Section 3.4.

The second reason the Brexit interregnum is a suitable natural experiment is that the BoE stabilized the UK credit environment during this period (BoE 2017, BoE 2018). The stabilized credit environment allows me to disentangle the response of ICMs to uncertainty shocks from the response to credit supply shocks, which often accompany with uncertainty shocks during financial crises. In fact, it is difficult to explain internal capital flows toward the UK during the interregnum as a reallocation of equity capital or cash flows via the ICMs

[37] Perhaps as another example, the sterling exchange rate against the US dollar steadily recovered back to the pre-referendum level by 2018 after crashing in the first two months following the Brexit vote.

[38] At the end of 2018, the UK government made its first Brexit proposal that signaled its wish for a "soft" Brexit. However, the proposal was rejected by the EU and, after a revision, by the UK Parliament. These developments further complicated the Brexit process and started to make a no-deal Brexit a real concern in 2019 (Bloom et al. 2019).

of MNEs in response to credit stress, which has been the focus of the existing literature.[39]

The third reason why the Brexit interregnum is a desirable natural experiment is that the uncertainty shock within the UK during the period of around 2.5 years is impactful enough to affect the consolidated debt structure of MNEs. To start with, the UK is one of the top 5 countries that host the largest production of majority-owned foreign subsidiaries (Cadestin et al. 2018). The country has also traditionally been the most important country for US MNEs in terms of output and value added of majority-owned foreign subsidiaries (BEA 2021). Thus, if an uncertainty shock can cause a substitution of external debt through the ICMs of MNEs, a substantial and persistent rise in uncertainty within the UK can bring sizable enough changes in the consolidated debt structure of MNEs, especially for US MNEs. Such sizeable changes are useful for me to detect the external debt substitution using the consolidated financial statements of US MNEs, which will be explained in the next section.

4.2 Measuring the Substitution: Data and Estimation at the Parent Level

Based on the identification of uncertainty shocks, I now address the measurement issue of the external debt substitution. To begin with, measuring a substitution of external debt within the ICMs of MNEs directly is challenging. One practical reason is that cross-border transaction-level data within the ICMs of MNEs is typically not available on a systematic scale. Even if the data is available, measuring a substitution of external debt by tracking transactions directly can be problematic since one actual transaction can be divided into numerous transactions among related parties. For instance, consider a US parent company (e.g., General Electric) that owns a manufacturing subsidiary in the UK (e.g., GE Aviation UK) and a US financial subsidiary (e.g., GE Capital Global Holdings). If General Electric would like to substitute a subsidiary-level bank loan of GE Aviation UK with a parent-level bond backed by the diversified cash flows of General Electric, the actual transaction can start with GE Capital Global Holdings and ends with GE Aviation UK with General Electric,

[39]For studies that explore this mechanism, see Biermann and Huber (2023), Buchuk et al. (2020), Santioni, Schiantarelli, and Strahan (2020), Kim, Wilcox, and Yasuda (2020), Almeida, Kim, and Kim (2015), etc. Desai, Foley, and Forbes (2008) additionally point out that foreign subsidiaries of MNEs are less likely to become financially constrained when facing credit stress or during crises. They report that foreign subsidiaries of US MNEs in emerging markets expand sales, assets, and investment significantly more than local firms during currency crises.

the parent company, in the middle as a related party. Specifically, General Electric can issue a bond through GE Capital Global Holdings with a parent guarantee. After receiving the proceeds from the bond sale, GE Capital Global Holdings can transfer the proceeds to General Electric as an equity transfer. General Electric can then transfer the "equity capital" to GE Aviation UK as an intra-group loan. By directly examining the firm-to-firm transactions, one may conclude that the intra-group loan between GE Aviation UK and General Electric is financed by equity, which masks the substitution of external debt by missing the other half of the transaction between General Electric and GE Capital Global Holdings.

To address the challenge of tracing related internal transactions directly, I instead examine whether an uncertainty shock can cause a substitution of external debt at both ends of the corporate ownership structure. Using the same example as an illustration, I first ask if the UK uncertainty shock made General Electric increase the usage of parent-level debt (e.g., the parent-level bond) in exchange for a decrease in subsidiary-level debt (e.g., the subsidiary-level bank loan) in its consolidated financial statements, without significantly reducing the ratio of total debt to total assets, as described by my Predictions 1 and 2. I then complete the analysis by examining the unconsolidated balance sheet of GE Aviation UK to see if the UK uncertainty shock made GE Aviation UK increase the usage of internal debt in exchange for a decrease in its external debt, without significantly reducing the ratio of total debt to total assets, as described by my Predictions 3 and 4. The combination of the parent-level analysis based on the consolidated financial statements with the subsidiary-level analysis based on the unconsolidated balance sheet forms my empirical evidence on whether, and to what extend, MNEs respond to a rise in country-level uncertainty by substituting their subsidiary-level debt in the country with parent-level debt to improve their debt structure. The rest of Section 4 describes my parent-level analysis. Section 5 presents my subsidiary-level analysis.

In order to examine changes in the components of the parent-level consolidated debt structure, I take advantage of the detailed disclosure requirements on US public firms by studying the consolidated financial statements of US MNEs exposed to the UK uncertainty shock. Specifically, the Regulations S-X and S-K of the Securities Act of 1933 require all US public firms to disclose detailed information on their capital and debt structure. Such information has been systematically compiled by Capital IQ after reviewing various regulatory filings, including financial footnotes, with scrutiny. From 2002 onward, the coverage by Capital IQ is comprehensive (Rauh and Sufi 2010, Colla, Ippolito, and Li 2013, Gurkaynak, Karasoy-Can, and Lee 2021).

Given the data of the consolidated debt structure, I start my parent-level analysis with a quarterly sample of US parent companies after merging Capital IQ with Compustat. While Capital IQ enables me to decompose the parent-level consolidated debt structure by detailed types of debt instruments, Compustat provides rich parent-level characteristics from the consolidated balance sheet and income statements. To ensure data quality, I drop the observations where the discrepancy in total debt between Capital IQ and Compustat is greater than 10% of the total debt from Compustat, following the practice of Colla, Ippolito, and Li (2013).

With the data from Capital IQ and Compustat, I merge my sample with Orbis to map out the complete ownership structure of the US parent companies with up to 10 levels of subsidiaries. The ownership mapping allows me to identify the US parent companies that are exposed to the UK uncertainty shock through non-financial subsidiaries in the UK. To ensure a parent company's control over the equity capital of its subsidiaries, I define subsidiaries by the majority ownership throughout my empirical analysis, where a majority ownership can be established through a direct ownership, indirect ownership, or a combination both. In addition, I require that all US parent companies in my sample owned at least one non-financial subsidiary in the US within the first three levels of the ownership structure below the parent company during the Brexit interregnum.[40] Based on such setup, I define a US parent company as having a UK exposure through its ICM if it owned at least one non-financial subsidiary in the UK within the first three levels of the ownership structure below the parent company during the Brexit interregnum. Furthermore, I define a US parent company without such exposure if it did not own any subsidiary in the UK during the same period. In the end, I make two sample restrictions. First, I focus on non-financial business groups via excluding

[40]Around 90% of the subsidiaries are within the first three levels of the ownership structure below the parent company in my sample. I include the level restriction to make sure that the classification of a subsidiary exposure is not driven by a minor subsidiary that is irrelevant to the business group.

the US parent companies in the financial and utility sectors by convention. Secondly, I focus on leveraged US parent companies that issued senior bonds in my sample for reasons that will be shortly explained. My final sample for the parent-level analysis includes a balanced panel of 1008 US non-financial business groups.

Though I am able to decompose the parent-level consolidated debt structure by detailed types of debt instruments, I face a problem common in the literature that it is difficult to comprehensively observe all debt instruments with a parent guarantee. However, we do know that bond debt, especially senior bond debt, is specialized as parent-level debt. In fact, around 90% of the US non-financial bond debt has been issued at the parent level over the past two decades according to SDC, FISD, and TRACE (Kolasinski 2009, Altieri, Manconi, and Massa 2019). The remaining 10% includes bonds issued by intermediate holding companies, which, in my model, still count as parent companies since their debt can be backed the diversified cash flows of their subsidiaries. In addition, recent empirical evidence reveals that non-financial subsidiaries primarily use bank loans, instead of bonds (e.g., Santioni, Schiantarelli, and Strahan 2020, Kim, Wilcox, and Yasuda 2020, etc.).[41] Therefore, to capture an increase in parent-level debt in exchange for subsidiary-level debt in the consolidated debt structure, I check if there is a rise in the ratio of senior bonds to total assets, conditioning on the ratio of total debt to total assets (i.e., book leverage). The underlying assumption is that a substitution of parent-level debt for subsidiary-level debt will be at least partially reflected by a higher senior-bond-to-asset ratio. In the case that some of the substitution cannot be covered by the senior-bond-to-asset ratio, my empirical analysis would underestimate the intensity of the external debt substitution. An example of such case is that a parent company uses parent-level syndicated loans to substitute for subsidiary-level term loans. To further confirm if a higher senior-bond-to-asset ratio leads to a substitution of parent-level debt for subsidiary-level debt, I also check if there is a corresponding substitution of internal debt for external debt on the subsidiary-level unconsolidated balance sheet. With the parent-level sample and the senior-bond-to-asset ratio, the following section explains my identification

[41] As additional evidence, Colla, Ippolito, and Li (2013) report that only the largest US public firms issue senior bonds, which further reduces the likelihood that smaller non-financial subsidiaries use senior bonds as standalone debt to finance their own operations.

strategy to estimate the effect of the UK uncertainty shock on the parent-level consolidated debt structure.

4.3 Identification Strategy: Difference-in-Differences Estimator

My parent-level sample allows me to compare changes in the consolidated debt structure between two groups of US non-financial parent companies: Those with the UK exposure through their ICMs and those that have active ICMs but without the UK exposure. In addition, both groups of the parent companies issued senior bonds in my sample, making both groups among the largest non-financial firms in the US stock market (Colla, Ippolito, and Li 2013). Given such data structure, I take advantage of the DID estimator to estimate the effect of the UK uncertainty shock on the parent-level consolidated debt structure, using the US parent companies with the UK exposure as the treatment group and the US parent companies without such exposure as the control group. The after period for my DID analysis is the Brexit interregnum (2016Q3-2018Q4), while I define the before period as a period of equal length before the interregnum (2014Q1-2016Q2).[42] The identification assumption is that the book leverage and senior-bond-to-asset ratio of the two groups would evolve along parallel paths in the absence of the UK uncertainty shock during the Brexit interregnum.

Figures 3 and 4 provide suggestive evidence for my identification assumption. To begin with, Figure 3, Panels A and B show that the book leverage and senior-bond-to-asset ratio of the two groups indeed track each other closely before the Brexit interregnum, which starts at the end of 2016Q2. While the book leverage of the two groups still follow each other relatively closely during the interregnum, as shown by Figure 4, Panel A, the senior-bond-to-asset ratio of the treatment group becomes noticeably higher relative to that of the control group, as suggested by Figure 4, Panel B. Interestingly, Figure 4, Panel A also reveals that the US parent companies with the UK exposure do not experience a significant deleverage, compared with the US parent companies in the control group. These patterns are in line with my Predictions 1 and 2 that the UK uncertainty shock made the US parent companies in the treatment group increase their parent-level debt in exchange for a decrease in the

[42] My results are robust to the definition of the before period, including using alternative start dates of the before period and including 2016Q2 into the after period.

subsidiary-level debt in the consolidated financial statements, without significantly reducing the ratio of total debt to total assets (i.e., book leverage).

To formally test the impact of the UK uncertainty shock, I specify my econometric model with the DID estimator as follows:

$$Y_{i,t} = \alpha_i + \beta After_t + \gamma After_t \times UK_i + \sum_{k=1}^{K} \varphi_k X_{k,i,t} + \epsilon_{i,t}, \tag{42}$$

where $After_t$ is a dummy variable indicating the Brexit interregnum, UK_i is a dummy variable indicating if a US parent company has the UK exposure through its ICM, and $\epsilon_{i,t}$ represents the error term. The subscripts i and t denote the US parent companies and time periods, respectively. In addition, the model does not include a stand-alone UK_i dummy variable because it is subsumed by the parent company fixed effects, α_i.

My parent-level analysis includes two dependent variables. First, I use the book leverage as a dependent variable to test if the UK uncertainty shock has caused a significant deleverage for the US parent companies in the treatment group relative to those in the control group. I define the book leverage in my sample as the ratio of the total debt (i.e., short-term debt + long-term debt) to total assets from Compustat. Secondly, I use the senior-bond-to-asset ratio as a dependent variable to test if the UK uncertainty shock has caused the US parent companies in the treatment group to raise parent-level debt significantly in the consolidated debt structure relative to those in the control group. The senior-bond-to-asset ratio in my analysis is defined as the ratio of senior bonds and notes from Capital IQ over total assets from Compustat.

Of course, the relative increase in the senior-bond-to-asset ratio itself does not necessarily reflect a substitution of external debt within the debt structure, ceteris paribus. This because the uncertainty shock can have both a controlled direct effect and indirect effect on the senior-bond-to-asset ratio. Specifically, the uncertainty shock can directly affect the senior-bond-to-asset ratio via the external debt substitution, conditioning on the book leverage, which is in line with my Prediction 1. Meanwhile, the uncertainty shock may indirectly affect the senior-bond-to-asset ratio through the book leverage by changing the capital structure between debt and equity, instead of altering the debt structure with the external debt substitution.

Therefore, to confirm the controlled direct effect, I further check if the DID coefficient is still significant after controlling for the book leverage when using the senior-bond-to-asset ratio as a dependent variable.[43] The remaining variables of $\{X_{k,i,t,}\}_{k=1}^{K}$ in Equation 42 are additional controls for robustness checks. They include measures of size, growth opportunities, and liquidity as well as time-varying trends at the industry level, which are known to be relevant to changes in the capital and debt structure of business groups through their ICMs (e.g., Buchuk et al. 2020).[44] In the end, to address any bias in standard errors when performing DID estimations over potentially serially correlated data, I follow Bertrand et al. (2004) and average the observations for each parent company in my sample over the before (2014Q1-2016Q2) and after periods (2016Q2-2018Q4).[45]

Table 1, Panel A provides summary statistics for my parent-level analysis. The US parent companies in the full sample has an average logarithm of total assets of 7.28 ($1.45 billion) with a standard deviation of 2.42. The averages (standard deviations) of the book leverage and senior-bond-to-asset ratio are 0.34 (0.2) and 0.18 (0.17), respectively. Additionally, the averages (standard deviations) of the Tobin's Q and quick ratio are 1.73 (1.15) and 0.77 (1.29), respectively. Table 1, Panel B compares the summary statistics between the treatment and control groups during the before period. The panel shows that the two groups in fact share very similar characteristics in terms of the book leverage, senior-bond-to-asset ratio, Tobin's Q, and quick ratio, although the parent companies in the treatment group tend to be larger. To ensure that my DID estimates are not affected by the size difference, I address the issue in various ways, including directly controlling for size and performing matching analyses to form balanced samples where the treatment and control groups are comparable

[43]Adding the book leverage as a control variable is appropriate if one is interested in establishing the controlled direct effect (see, for instance, Cinelli, Forney, and Pearl 2022 and references therein). Also, controlling for the book leverage will not introduce additional bias under the DID identification assumption since the UK uncertainty shock is the only time-varying factor that can cause a relative difference in the senior-bond-to-asset ratio between the treatment and control groups. One should not use the book leverage as a control when estimating the total effect of the uncertainty shock on the senior-bond-to-asset ratio since this will block parts of the very treatment effect we would like to estimate and create an "overcontrol bias."

[44]I use the logarithm of total assets from Compustat as a measure for size, Tobin's Q as a measure for growth opportunities, and the quick ratio as a measure for liquidity. The Tobin's Q is computed as the sum of market value of equity and book value of debt over total assets based on Compustat. The quick ratio is defined as cash and short-term investments over total assets from Compustat.

[45]Bertrand et al. (2004) present this approach as the most robust of the alternatives, including bootstrapping and asymptotic approximation of the variance-covariance matrix.

in size.

4.4 Evidence on the External Debt Substitution

Table 2 presents the main results of my parent-level DID analysis. I begin my analysis by using the book leverage as a dependent variable to test if the UK uncertainty shock has caused a significant deleverage for the US parent companies in the treatment group relative to those in the control group. As Table 2, Column 1 suggests, the treatment group does not experience any relative deleverage. In fact, the DID estimate on the book leverage is statistically insignificantly positive.

Based on the result on the book leverage, I then use the senior-bond-to-asset ratio as a dependent variable to test if the UK uncertainty shock has caused the US parent companies in the treatment group to raise parent-level debt significantly in the consolidated debt structure relative to those in the control group. As Table 2, Column 2 suggests, the treatment group experiences a 2.5 percentage points relative increase in the senior-bond-to-asset ratio. Compared with the DID estimate on the book leverage (Column 1), the rise in the senior-bond-to-asset ratio is large with a strong statistical significance.

Although the relative rise in the senior-bond-to-asset ratio is significantly larger, one still needs to confirm the magnitude of the controlled direct effect of the uncertainty shock behind such increase. Table 2, Column 3 shows that a substantial portion of the increase indeed comes from the direct effect after controlling for the book leverage. In specific, Column 3 indicates that parts of the relative rise in the senior-bond-to-asset ratio can be accounted for by the indirect effect. However, even conditioning on the book leverage, the UK uncertainty shock still significantly raises the senior-bond-to-asset ratio of the treatment group by 1.6 percentage point relative to that of the control group, reflecting a substitution of external debt within the consolidated debt structure. The substitution effect remains stable after controlling for size (Table 2, Column 4). The substitution effect is also consistent after additionally controlling for the Tobin's Q and quick ratio as measures for growth opportunities and liquidity, respectively, as well as time-varying trends at the industry level (Table 2, Column 5). Together, Table 2, Columns 1-5 provide evidence that the UK uncertainty shock did not cause the US parent companies in the treatment group to deleverage. While the uncertainty shock caused the US parent companies in the treatment group to increase their parent-level debt in the consolidated debt structure, conditioning on the book leverage. These results are consistent with my theoretical predictions (Predictions 1 and 2). The magnitude of the substitution effect is also economically meaningful as the around 1.6-1.8 percentage point relative rise in the senior-bond-to-asset ratio, conditioning on the book leverage, corresponds to an around 9 percent growth in the senior-bond-to-asset ratio of the treatment group.

Given the substitution effect from the main analysis, I perform a robustness check by using the parent companies of MNEs in the control group as a placebo treatment group.[46] As Table 2, Column 6 indicates, the DID estimate for the treatment group ($After{\times}UK$) remains stable, while the DID estimate for the placebo treatment group ($After{\times}MNE$) is close to zero and statistically insignificant.[47] Thus, Column 6 shows that my main results are not driven by time-varying factors that may have disproportionately affected the US MNEs relative to the US domestic business groups.

Although the control group of my main DID analysis can already account for time-varying changes shared by the treatment and control groups, I explicitly test if European factors that could be correlated with the UK uncertainty shock may affect my DID estimates. I do so by using the parent companies in the control group with an EU27 exposure through their ICMs as a placebo treatment group.[48] As Table 2, Column 7 indicates, the DID estimate for the treatment group ($After{\times}UK$) remains stable, while the DID estimate for the placebo treatment group ($After{\times}EU27$) is close to zero and statistically insignificant.[49] Therefore,

[46] Consistent with the definition of the treatment group, the placebo treatment group includes US parent companies in the control group that owned at least one non-financial subsidiary outside of the US within the first three levels of the ownership structure below the parent company during the Brexit interregnum. The remaining parent companies in the control group did not own any foreign subsidiary.

[47] The difference between the two coefficients are statistically significant with a P-value of 0.01.

[48] Consistent with the definition of the treatment group, the placebo treatment group includes US parent companies in the control group that owned non-financial subsidiaries in the EU27 countries within the first three levels of the ownership structure below the parent company during the Brexit interregnum. My results are robust if the placebo treatment group includes US parent companies in the control group that owned any subsidiary in the EU27 countries during the Brexit interregnum. My results are also robust when using alternative definitions of the EU27 countries, such as the EU27 countries plus Switzerland or the members of the European single market.

[49] The difference between the two coefficients are statistically significant with a P-value of 0.06. The lower statistical significance is likely caused by the relatively smaller number of parent companies in the treatment and placebo treatment groups.

Column 7 provides evidence that my main results are not driven by potential confounding factors from Europe.

Finally, my DID estimates on the book leverage and senior-bond-to-asset ratio without conditioning on the book leverage are also robust across the specifications in Table 2, as shown by Tables D1 and D2 in the appendix. In particular, Table D1, Column 4 reveals that the UK uncertainty shock almost causes no movement in the book leverage of the treatment group relative to the parent companies of US MNEs in the control group. With the existing findings from the parent-level analysis, the next section offers additional robustness checks to further confirm the impact of the uncertainty shock on the consolidated debt structure.

4.5 Additional Robustness Checks

My analysis so far has provided empirical evidence for a significant substitution of external debt within the parent-level consolidated debt structure, in line with my theoretical predictions (Predictions 1 and 2). I now perform additional robustness checks to confirm the substitution effect is not driven by pre-trends, is robust in balanced samples based on matching analyses, and is not affected by the policy intervention of the BoE or European Central Bank (ECB) during the Brexit interregnum.

4.5.1 Pre-Trend Analysis

The identification assumption of my parent-level DID analysis is that the book leverage and senior-bond-to-asset ratio of the treatment and control groups would evolve along parallel paths in the absence of the UK uncertainty shock during the Brexit interregnum. To test that my results are not driven by any existing trend before the shock, I conduct a placebo DID analysis by shifting the before and after periods to 2011Q1-2013Q2 and 2013Q3-2015Q4, respectively. In this way, both periods maintain the same length of their counterparts in the main analysis without having any major and persistent uncertainty shock in the UK.[50] Table 3 displays the results of my pre-trend analysis. As the table demonstrates, I pick up

[50] I can only shift the before period up to 2011Q1 since it is the starting point of my data on the corporate ownership structure, though the results of my pre-trend analysis are robust when using alternative cutoff points in defining the before and after periods. I also choose to not conduct any "placebo" test using the period after 2018Q4 due to the uncertainty associated with the no-deal Brexit and COVID-19 pandemic.

no treatment effect. All of the DID estimates for the treatment group are close to zero and statistically insignificant. If anything, the DID estimates for the treatment group on the senior-bond-to-asset ratio are negative.[51]

4.5.2 Mahalanobis Score Matching and Coarsened Exact Matching

Given the placebo DID analysis that relives the concern of pre-trends, I now investigate if the results of my main analysis could be affected by the imbalance between the treatment and control groups. Table 4, Panel A compares the summary statistics between the treatment and control groups during the before period (2014Q1-2016Q2) in the main DID analysis. As the panel suggests, the two groups display no significant difference across the control variables, except for size. It should be noted that any time invariant difference in size between the two groups and parallel trends associated with the size difference shared by the two groups can already be accounted for by the DID estimator. In addition, non-parallel trends associated with the size difference that generate pre-trends should have been detected by my pre-trend analysis. To further address the issue of imbalance, I perform additional matching analyses in this section.

My matching analyses begin with the Mahalanobis matching, which is a popular matching method belonging to the class of equal percent bias reducing (EPBR) matching. Despite its popularity, I acknowledge that an EPBR matching method has shortcomings in achieving balance between the treatment and control groups (e.g. Mielke and Berry 2007). In fact, an EPBR matching method does not guarantee a reduction in imbalance (Iacus, King, and Porro 2012). I therefore complement the Mahalanobis matching with the coarsened exact matching (CEM), the details of which will be shortly explained.

To implement the Mahalanobis matching to address the size difference, I calculate the Mahalanobis distance between each parent company in the treatment and control groups based on size and match each parent company in the treatment group with the top three parent companies in the control group based on the Mahalanobis distance. To improve the

[51] Tables D3 and D4 display the results of my pre-trend analysis for the book leverage and senior-bond-to-asset ratio without conditioning on the book leverage across all specifications of Table 3. Similar to Table 3, I pick up no treatment effect. If anything, the usage of parent-level debt in the consolidated debt structure seems to be decreasing for the treatment group.

matching quality, I perform the matching with replacements so that the selection of parent companies in the control group for each parent company in the treatment group is independent of each other. The results of my Mahalanobis matching are robust when I calculate the Mahalanobis distance using all of the control variables or when I match each parent company in the treatment group with different numbers of parent companies in the control group. The matching based on size and the top three parent companies in the control group produces the best matching outcome that reduces the size difference with a relatively large matched sample.

Table 4, Panel B describes the summary statistics for the matched sample. The panel shows that, although the difference in size between the treatment and control groups becomes smaller, it still remains statistically significant. Meanwhile, the Mahalanobis matching tends to raise the imbalance in the other control variables in exchange for the smaller size difference. Because of the shortcomings, I use the CEM as a second matching analysis to improve the Mahalanobis matching and as an additional robustness check.

Different with the Mahalanobis matching, the CEM is popular matching method belongs to the class of monotonic imbalance bounding matching, which bounds the maximum level of imbalance in the data ex ante and guarantees to eliminate all imbalances beyond the chosen bound. The basic idea of the CEM is to coarsen each variable of interest into bins, before exactly matching the coarsened data by the bins to prune unmatched observations. After pruning the unmatched observations, the bins are discarded and the original values of the data are retained to form the matched sample. Asides from a guaranteed reduction in the imbalance, the CEM can improve the Mahalanobis matching along two general dimensions. First, under the CEM, the coarsening choice for any given variable has no effect on the imbalance bound for other variables. In comparison, the Mahalanobis matching can reduce the imbalance for some variables ex post, while worsen the imbalance for some other variables. Secondly, the CEM can provide more robust inferences as it satisfies the congruence between the data space and analysis space, or the congruence principle (Mielke and Berry 2007). In comparison, the Mahalanobis matching can violate the congruence principle by projecting covariates from the natural n-dimensional data space to a different space defined by the Mahalanobis distance. As a consequence, the Mahalanobis matching can lead to less robust inferences with sub-optimal properties. Overall, the CEM can improve other commonly used matching methods in its ability to reduce imbalance, model dependence, estimation error, bias, and other criteria (Iacus, King, and Porro 2009, 2011).

To implement the CEM, I coarsen the variables that tend to display a significant difference between the treatment and control groups after the Mahalanobis matching with more bins to improve the balance for the matched sample. At the same time, I coarsen the remaining variables with less bins to maintain a relatively large sample size. In specific, I coarsen the logarithm of total assets and Tobin's Q by their 5th, 10th, 25th, 50th, 75th, 90th, and 95th percentiles in the main sample during the before period (Table 1, Panel A). Meanwhile, I coarsen the book leverage and quick ratio only by their 50th percentile in the same sample as the difference between the treatment and control groups in the two variables tend to be small.[52] To adjust for the different number of parent companies from the treatment and control groups inside each stratum formed by the bins, I weigh my matched sample following Iacus, King, and Porro (2012). Table 4, Panel C describes the summary statistics for the matched sample. As the panel indicates, my matched sample based on the CEM is decently balanced where there is no significant difference between the treatment and control groups in all of the controls, especially in size.

Table 5 presents the regression results of my matching analyses. To begin with, Table 5, Columns 1 and 2 review the results from my main DID analysis on the book leverage and senior-bond-to-asset ratio.[53] Table 5, Columns 3-6 document the regression outcomes based on the matched samples, where Columns 3 and 4 report the results based on the Mahalanobis matching and Columns 5 and 6 report the results based on the CEM. Despite the differences between the matching methods, Table 5 demonstrates that my DID estimates are robust across all of the specifications.

To complement the matching analyses between the treatment and control groups, I preform another set of matching exercises by implementing the Mahalanobis matching and CEM

[52]My results are robust to alternative ways of coarsening, including coarsening using different sets of the controls and different numbers of bins, though more bins are generally required on the logarithm of total assets and Tobin's Q to produce a balanced matched sample.

[53]Table 5, Column 2 is identical to Table 2, Column 5. Table 5, Column 1 displays the DID estimate on the book leverage based on the same specification and is identical to Table D1, Column 3 in the appendix.

between the treatment group and the multinational parent companies in the control group (i.e., the parent companies of US MNEs without the UK exposure through their ICMs). Table 6 describes the summary statistics for the additional matching exercises in the same manner of Table 4. Consistent with the matching analyses between the treatment and control groups, I can achieve a decently balanced matched sample based on the CEM with equivalent criteria when matching between the treatment group and multinational parent companies in the control group. Specifically, Table 6, Panel C shows that there is no significant difference between the two groups of parent companies in all of the controls, especially in size, within the matched sample based on the CEM.

Table 7 presents the regression results of the additional matching exercises in the same manner of Table 5. As Table 7 demonstrates, despite the differences in the regression sample and between the matching methods, my DID estimates are robust across all of the specifications. As a conclusion, my matching analyses can directly alleviate the concern that the main results of my parent-level analysis are affected by the imbalance between the treatment and control groups, particularly in size.

4.5.3 The Effect of Policy Interventions

So far I have documented two robust findings from the parent-level analysis: There has been a significant substitution of external debt within the consolidated debt structure, conditioning on the book leverage. Meanwhile, the parent companies in the treatment group experienced no significant change in the book leverage relative to the parent companies in the control group. Although policy interventions that typically affect the usage of debt relative to equity can be captured through changes in the book leverage, the BoE and ECB launched unconventional monetary policies during the Brexit interregnum, partially as a response to the UK uncertainty shock. Specifically, the BoE and ECB implemented corporate bond purchase programs to stabilize the credit market, which could impact the debt structure of the US parent companies in my sample, conditioning on the book leverage.

To investigate the effect of the corporate bond purchase programs, I review the historical records of the BoE and ECB by manually going through every corporate debt instrument that was eligible to be purchased by the BoE or ECB during the Brexit interregnum. For each issuer of a given debt instrument, I check whether the issuer can be linked to the US parent companies in my sample either directly or directly by examining the historical corporate ownership structure in Orbis.[54] In the end, I drop the US parent companies in my sample if any of their debt instruments behind the consolidated financial statements was eligible to be purchased by the BoE or ECB.

Table 8 presents the results of the robustness check, which leads to two conclusions. First, perhaps as expected, only 13 out of the 1008 US parent companies in the sample of my main analysis were potentially exposed to the corporate bond purchase programs. Secondly, my DID estimates remain robust after dropping the potentially exposed parent companies from the sample.[55] As a result, my robustness check provides evidence that the external debt substitution within the parent-level consolidated debt structure is unlikely to be driven by the unconventional policy interventions accompanied by the UK uncertainty shock.

5 Empirical Analysis: Subsidiary-Level Evidence

My parent-level analysis has provided evidence that the UK uncertainty shock caused a substitution of external debt within the consolidated debt structure of US MNEs exposed to the shock through their ICMs. While the evidence is consistent with my model predictions at the parent level (Predictions 1 and 2), the substitution of external debt between the parent company and foreign subsidiary in the model also implies changes on the unconsolidated balance sheet of the foreign subsidiary. Specifically, with the external debt substitution in response to a foreign uncertainty shock in the model, there should be a decrease in the ratio of external debt to total assets in exchange for an increase in the ratio of internal debt to total assets on the unconsolidated balance sheet of the foreign subsidiary (Prediction 3). Additionally, if the external debt substitution can substantially offset the contractionary impact of the foreign uncertainty shock, the ratio of total debt to total assets should remain

[54] Consistent with the argument that bond debt is specialized at the parent level, nearly all the corporate bonds that were eligible to be purchased by the BoE or ECB were issued by the ultimate parent companies, effective corporate headquarters, or their financial subsidiaries among all non-financial issuers that were parts of a business group.

[55] Table 8 displays the main results on the external debt substitution. Tables D5 and D6 in the appendix show that my DID estimates on the book leverage and senior-bond-to-asset ratio without conditioning on the book leverage are also robust.

relatively stable on the foreign subsidiary's unconsolidated balance sheet (Prediction 4). Given the parent-level evidence on Predictions 1 and 2, I now use subsidiary-level data to test if Predictions 3 and 4 hold at the same time.

5.1 Measuring the Substitution at the Subsidiary Level: UK Regulatory Data

Although the disclosure requirements of the US allow me to decompose the consolidated debt structure of US MNEs, the consolidation nets out the transactions within the ICMs by construction. Meanwhile, the disclosure of unconsolidated financial statements are not required by the US regulations, making the corresponding data publicly unavailable. Such lack of data availability is in fact a common problem across countries (Kim, Wilcox, and Yasuda 2020).

Luckily, the Companies Act of the UK requires all private limited and public firms in the UK to disclose their unconsolidated financial statements to the Companies House annually, including subsidiaries of domestic and foreign parent companies. The delivered accounting records must be prepared in compliance with the requirements of the Companies Act or UK-adopted International Accounting Standards. Failure to deliver the required accounts on time is a criminal offence. As a result, I take advantage of the regulatory data from the Companies House to examine changes in the unconsolidated balance sheet of the UK subsidiaries, where I am able to observe a firm's external and internal liabilities separately thanks to the requirements of the Companies Act. Specifically, the external liabilities include debt from external creditors (e.g., credit institutions, external trade creditors, etc.), whereas the internal liabilities include intragroup debt and/or payables.[56]

Given the decomposition of the unconsolidated balance sheet, I construct an annual sample for my subsidiary-level analysis by merging the regulatory data from the Companies House with Orbis. Orbis allows me to identify if a UK firm is a majority-owned subsidiary of

[56]The internal liabilities also include other liabilities that are not intragroup debt and/or payables, such as liabilities on pension contributions and social securities, corporate income tax or value-added tax liabilities, deferred revenues, etc., as well as provisions for these liabilities. Though only a subset of firms explicitly report their provisions, my results are robust within the subset after excluding the provisions from the internal liabilities. The next section details my identification strategy that addresses the inclusion of the other liabilities, which were unlikely to response to the uncertainty shock during the Brexit interregnum. Section 5.4.2 conducts an explicit robustness check.

a US MNE during the Brexit interregnum. Moreover, Orbis allows me to identify domestic subsidiaries of UK business groups during the same period.[57] Both groups of firms lived through the Brexit interregnum in the same country with active ICMs. As a result, both groups could have experienced the external debt substitution. However, the substitution for the UK subsidiaries of US MNEs should be stronger. The argument is that US MNEs tend to use more non-UK assets to support their parent-level debt, while the non-UK assets were less affected by the country-level uncertainty shock, if at all. Therefore, when facing the uncertainty shock that enabled an external debt substitution, parent companies of US MNEs could better utilize the opportunity by raising more external debt at the parent level. This argument allows me to test if the external debt substitution suggested by my parent-level evidence can in fact be seen from the unconsolidated balance sheet of the UK subsidiaries, while accounting for confounding factors in the UK. The details of the test will be explained in the coming section.

In the end, to avoid the concern that the uncertainty shock during the Brexit interregnum could have a significant expansionary element for domestically owned firms in the UK service sector, my subsidiary-level analysis focuses on the UK tradable sector for comparability. The final sample for my subsidiary-level analysis contains a balanced panel of 1349 UK subsidiaries of US MNEs and 7414 domestic subsidiaries of UK business groups.[58]

5.2 Identification Strategy: Difference-in-Differences Estimator

The subsidiary-level sample allows me to compare changes in the unconsolidated debt structure between two groups of UK firms: The UK subsidiaries of US MNEs and the domestic subsidiaries of UK business groups. Both groups experienced the unexpected uncertainty shock associated with the Brexit interregnum with active ICMs. Meanwhile, the former group

[57] Domestic subsidiaries of UK business groups are defined as UK firms that are ultimately owned by a UK parent company, without being owned by any foreign intermediate holding companies directly or indirectly and without owning any foreign subsidiaries directly or indirectly. This definition aims to capture the UK business groups that tend to use UK-based assets to support their parent-level debt, instead of the effectively foreign business groups that only have UK firms as holding companies. Following Section 4.2, ownership in my empirical analysis is defined by the majority ownership.

[58] To test if a stronger external debt substitution holds for foreign MNEs in general, I also perform a robustness check by comparing the UK subsidiaries of foreign MNEs with the domestic subsidiaries of UK business groups. The analysis sample for the robustness check includes a balanced panel of 4854 UK subsidiaries of foreign MNEs and the same 7414 domestic subsidiaries.

is expected to substitute external debt with internal funds on the unconsolidated balance sheet relative to the domestic subsidiaries due to their parent companies' better ability to raise external debt for the external debt substitution. Based on such data structure, I take advantage of the DID estimator to account for time-variant changes in the UK shared by the two groups, together with their time-invariant differences, using the UK subsidiaries of US MNEs as the treatment group and the domestic subsidiaries of UK business groups as the control group. The after period for my DID analysis covers the years of the Brexit interregnum (2017-2018). In line with my parent-level analysis, I define the before period as a period of equal length prior to the interregnum (2014-2015).[59] The identification assumption for the DID analysis is that the unconsolidated capital or debt structure of the treatment and control groups would evolve along parallel paths in the absence of the UK uncertainty shock during the Brexit interregnum.

Figure 5 provides suggestive evidence for my identification assumption by plotting the unconsolidated capital and debt structures of the treatment and control groups. As Figure 5, Panel A shows, the ratio of equity to total assets for both groups share a comparable trend before the Brexit interregnum. The ratios also tend to follow each other during the interregnum, though the one for the treatment group becomes higher. This development can reflect a substitution of external debt with internal funds via equity transfers. It can also be explained by changes in leverage unrelated with the external debt substitution. Whether the difference makes a significant impact will be formally tested by my econometric model.

In contrast with the relatively modest difference in the equity-to-asset ratio, Figure 5, Panel B reveals a significant change in the unconsolidated debt structure: The ratio of internal liabilities to total assets for the treatment group rises substantially following the uncertainty shock, compared with that of the control group. Meanwhile, there is a corresponding decline in the ratio of external liabilities to total assets. The substitution of external liabilities with internal liabilities among the UK subsidiaries of US MNEs is consistent with the external debt substitution suggested by my parent-level evidence.

[59] I choose to not include 2016 in either period since the Brexit interregnum begins on June 23, 2016. Nevertheless, my results are robust when defining the after period as 2016-2018. My results are also robust to alternative beginning points of the before period.

To formally test the impact of the uncertainty shock, I specific my econometric model with the DID estimator as follows:

$$Y_{i,t} = \alpha_i + \beta After_t + \gamma After_t \times Foreign_i + \sum_{k=1}^{K} \varphi_k X_{k,i,t} + \epsilon_{i,t}, \tag{43}$$

where $After_t$ is a dummy variable indicating the Brexit interregnum, $Foreign_i$ is a dummy variable indicating whether a UK subsidiary is in the treatment group, and $\epsilon_{i,t}$ represents the error term. The subscripts i and t denote the UK subsidiaries and time periods, respectively. In addition, the model does not include a stand-alone $Foreign_i$ dummy variable because it is subsumed by the subsidiary fixed effects, α_i.

My subsidiary-level analysis includes three dependent variables based on the unconsolidated balance sheet. To begin with, I use the ratio of internal liabilities to total assets as a dependent variable to test if the UK uncertainty shock has induced the treatment group to significantly increase the usage of internal debt relative to that of the control group. I then use the ratio of external liabilities to total assets as a dependent variable to test if any relative rise in internal debt comes with a comparable decline in external debt, which should be the case with an external debt substitution. Finally, I use the ratio of total liabilities to total assets (i.e., one minus the equity-to-asset ratio) as a dependent variable to test if the UK uncertainty shock has cause the treatment group to significantly change their leverage relative to that of the control group. The remaining variables of $\{X_{k,i,t,}\}_{k=1}^{K}$ in Equation 43 are additional controls for robustness checks. Similar to my parent-level analysis, I follow Bertrand et al. (2004) and average the observations for each UK subsidiary in my sample over the before (2014-2015) and after periods (2017-2018) to address any bias in standard errors when performing DID estimations over potentially serially correlated data.

Table 9, Panel A provides summary statistics for my subsidiary-level analysis. The UK subsidiaries in the full sample has an average logarithm of total assets of 7.9 (around 2.7 million GBP) with a standard deviation of 2.2. The averages (standard deviations) of the internal-liability-to-asset ratio and external-liability-to-asset ratio are 0.31 (0.41) and 0.29 (0.3), respectively. The average (standard deviation) of the leverage is 0.63 (0.52). Additionally, the average (standard deviation) of the ratio of provisions for other liabilities to total assets is 0.02 (0.07), where the provisions are for the other liabilities that are not intragroup debt and/or payables.[60] Table 9, Panel B compares the summary statistics between the treatment and control groups during the before period. The panel shows that, although the two groups have relatively similar leverage and the provision-to-asset ratio, the UK subsidiaries in the treatment group tend to be larger. I therefore include size as an additional control in robustness checks to ensure that my results are not explained by time-varying differences in size.

5.3 Subsidiary-Level Evidence on the External Debt Substitution

Table 10 presents the main results of my subsidiary-level DID analysis. I begin my analysis by using the internal-liability-to-asset ratio to test whether the UK subsidiaries of US MNEs has used more internal debt in their unconsolidated debt structure relative to the control group in response to the UK uncertainty shock. Such relative change is expected given the US parent companies' better ability to perform the external debt substitution and that they have substituted subsidiary-level debt with parent-level debt in their consolidated debt structure according to my parent-level evidence. Table 10, Column 1 shows that the rise in internal debt is indeed the case. Compared with the domestic subsidiaries of UK business groups, the UK subsidiaries of US MNEs has experienced a significant 6.6 percentage point increase in the internal-liability-to-asset ratio. Such increase cannot be explained by changes in size, as measured by the logarithm of total assets (Table 10, Column 2). It also cannot be explained by time-varying trends at the industry level (Table 10, Column 3) and changes in the leverage (Table 10, Column 4). Together, Table 10, Columns 1 to 4 indicate that the UK subsidiaries of US MNEs has seen an around 7 percentage point growth in the internal-liability-to-asset ratio relative to the control group.

If the rise in internal debt reflects a substitution of external debt as suggested by my parent-level evidence, there should be a comparable decline in the external-liability-to-asset ratio. Table 10, Column 5 shows that this is in fact the case. Compared with the domestic subsidiaries of UK business groups, the UK subsidiaries of US MNEs has experienced a

[60] All ratios are winsorized at 1% in each tail to avoid extreme values. My results are robust if I drop these observations instead.

significant 8.3 percentage point decline in the external-liability-to-asset ratio. Such decline also cannot be explained by changes in size (Table 10, Column 6), time-varying trends at the industry level (Table 10, Column 7), and changes in the leverage (Table 10, Column 8). Together, Table 10, Columns 5 to 8 demonstrate that, while there has been an around 7 percentage point growth in the internal-liability-to-asset ratio, the external-liability-to-asset ratio has lowered by around 7.5 to 8.3 percentage point.

To further investigate if the relative changes within the unconsolidated debt structure come with a significant change in leverage, I perform the DID analysis with the ratio of total liabilities to total assets (i.e., one minus the equity-to-asset ratio) as the dependent variable. As Table 10, Column 9 illustrates, though the sign of the DID estimate is negative, the coefficient is small and statistically insignificant, consistent with the stabilizing effect of the external debt substitution on leverage. This finding is robust after controlling for size (Table 10, Column 10) and time-varying trends at the industry level (Table 10, Column 11).

As a conclusion, my subsidiary-level analysis provides evidence that the UK subsidiaries of US MNEs has substituted external debt with internal debt on the unconsolidated balance sheet in response to the UK uncertainty shock, without significantly changing leverage relative to the control group. Meanwhile, my parent-level findings reveal that the uncertainty shock has induced US MNEs to substitute subsidiary-level debt with parent-level debt in their consolidated debt structure. The combination of the results at the parent and subsidiary levels supports the existence of a substantial external debt substitution through the ICMs of MNEs.

5.4 Additional Robustness Checks

My subsidiary-level analysis so far has provided empirical evidence for a significant substitution of external debt with internal debt in the subsidiary-level unconsolidated debt structure, consistent with my theoretical predictions (Predictions 3 and 4) and parent-level findings. I now perform further robustness checks to confirm the substitution effect is not driven by pre-trends, is robust after accounting for provisions for other liabilities, and can be seen from the UK subsidiaries of foreign MNEs in general.

5.4.1 Pre-Trend Analysis

The identification assumption of my subsidiary-level DID analysis is that the unconsolidated capital or debt structure of the treatment and control groups would evolve along parallel paths in the absence of the UK uncertainty shock during the Brexit interregnum. To test that my results are not driven by any existing trend before the shock, I conduct a placebo DID analysis by shifting the before and after periods to 2012-2013 and 2014-2015, respectively. In this way, both periods maintain the same length of their counterparts in the main analysis without having any major and persistent uncertainty shock in the UK.[61] Table 11 displays the results of my pre-trend analysis. As the table demonstrates, I pick up no treatment effect. All of the DID estimates for are close to zero and statistically insignificant. If anything, the coefficients bear the opposite sign related with the external debt substitution.

5.4.2 The Effect of Other Liabilities

In addition to the placebo DID analysis that alleviates the concern of pre-trends, I now investigate if the relative changes in the unconsolidated debt structure during the Brexit interregnum could be affected by movements in other liabilities that are not intragroup debt and/or payables. The internal liabilities include components that are not intragroup debt and/or payables, such as liabilities on pension contributions and social securities, corporate income tax or value-added tax liabilities, deferred revenues, etc. To the best of my knowledge, the Brexit interregnum is not correlated with changes that substantially alter the other liabilities of UK firms, especially considering that the UK remained inside the EU without real policy changes during the interregnum. Therefore, it is likely that movements in the other liabilities can already be accounted for by the DID estimator. Moreover, significant changes in the other liabilities should have caused corresponding changes in the equity-to-asset ratio, which is not what we have observed from the main subsidiary-level analysis.

[61] The results of my pre-trend analysis are robust when including 2011 into the before period or when using alternative cutoff points in defining the before and after periods. I also choose to not conduct any "placebo" test using the period after 2018 due to the uncertainty associated with the no-deal Brexit and COVID-19 pandemic.

Nevertheless, I perform a robustness check taking advantage of the fact that a subset of firms disclose their provisions for the other liabilities. This allows me to adjust the internal liabilities by excluding the provisions. Table 12 compares the regression results before and after such adjustment. As the table demonstrates, my DID estimates remain robust to those from the main subsidiary-level analysis (Table 10). Table 13 further reports the DID estimates from running the placebo test on the firms that disclose their provisions. As the table suggests, my DID estimates remain consistent with those from Table 11.

5.4.3 Subsidiary-Level Analysis with Foreign MNEs

The argument for the substitution effect from the main subsidiary-level analysis is that US MNEs can better support their UK subsidiaries since their parent-level debt is less affected by the UK uncertainty shock compared with those of UK business groups. To examine if a similar effect exists for foreign MNEs in general, I conduct a robustness check by switching the treatment group to the UK subsidiaries of foreign MNEs. Table 14 displays the regression results. As the table shows, there is indeed a significant substitution in the unconsolidated debt structure. The UK subsidiaries of foreign MNEs has experienced an around 6 percentage point increase in the internal-liability-to-asset ratio relative to that of the control group, in exchange for a comparable decline in the external-liability-to-asset ratio, without a significant change in leverage. The magnitude of the substitution is slightly smaller than that of the main analysis (Table 10). Such difference is expected as foreign MNEs contain European MNEs, the parent-level debt of which could also be negatively affected by the uncertainty shock associated with the Brexit in Europe.

Similar with the main analysis, my findings based on foreign MNEs are not driven by pre-trends, as can be seen from the DID estimates of the placebo test (Table 15). Furthermore, Tables 16 and 17 indicate that the results are robust after adjusting for the provisions for the other liabilities. To conclude, the evidence for the external debt substitution from my subsidiary-level analysis is not unique to US MNEs. It can be generalized to all foreign MNEs.

6 Conclusion

In this paper, I study the interaction between the ICMs of MNEs and external capital markets across borders through the lens of uncertainty shocks. I provide both theoretical explanation and empirical evidence that country-level uncertainty shocks induce a substitution of external debt across borders through the ICMs of MNEs. In response to a rise in country-level uncertainty, MNEs can support their foreign subsidiaries in the country with an inflow of international capital by substituting external debt at the subsidiary level with external debt at the parent level without deleveraging.

I begin by highlighting the role of subsidiary-level debt in the capital structure of MNEs based on a model of the ICM featuring agency problems not only between MNEs and their external lenders, but also between a parent company and its subsidiaries. When MNEs face uncertain returns at country level, parent companies have incentives to issue external debt at the parent level and fund their foreign subsidiaries internally as shareholders. In this way, the parent companies can minimize group-level funding cost as the parent-level debt can be backed by the diversified cash flows of the subsidiaries across countries. Meanwhile, when MNEs have a limited internal monitoring capacity due to the complexity of multinational operations, parent companies can utilize subsidiary-level debt as informed capital to incentive delegated monitoring from local lenders. As local lenders have a comparative advantage in accessing local private information and monitoring efficiency, the delegated monitoring can help the parent companies reduce agency problems from their subsidiaries and improves subsidiary-level returns. The combination of the incentives to use both parent- and subsidiary-level debt gives rise to an optimal capital structure: With subsidiary-level debt as informed capital in equilibrium, a parent company would blend the internal finances of their subsidiaries with a minimum portion of the subsidiary-level debt to maintain the monitoring incentive of the local lenders.

Given the optimal capital structure, I demonstrate that the model predicts two types of interactions between the ICMs of MNEs and external capital markets. To start with, without having the subsidiary-level debt as informed capital, a rise in country-level uncertainty would only lift the risk premium that pressures a MNE to deleverage, even if subsidiary-level debt is used for other purposes. In this case, the ICMs will help transmit the local shock globally. However, with the subsidiary-level debt as informed capital in equilibrium, it is possible for a MNE to counteract the contractionary impact of the uncertainty shock as the rise in country-level uncertainty can strengthen the monitoring incentive of the local lenders. This enables the MNE to partially substitute its subsidiary-level debt with cheaper parent-level debt without destroying the local lenders' incentive to monitor. Such substitution of external debt improves the debt structure of MNEs, which is an expansionary force accompanied by an inflow of international capital through the ICMs of MNEs to the affected country.

Guided by the theoretical framework, I test the different model predictions with detailed data both on parent-level consolidated debt structure and subsidiary-level unconsolidated balance sheet, taking advantaging of the Brexit interregnum as a natural experiment. I find strong evidence for the substitution of external debt through the ICMs of MNEs. In specific, I show that the UK uncertainty shock has induced US MNEs exposed to the shock via their UK subsidiaries to raise parent-level debt in their consolidated debt structure significantly (an around 1.6-1.8 percentage point or 9 percent increase in the ratio of parent-level debt to total assets). Meanwhile, the US MNEs do not experience a significant change in the book leverage (i.e., the ratio of total debt to total assets). Moreover, the rise in parent-level debt is reflected by a rise in the debt instrument that is typically not associated with delegated monitoring (i.e., bond debt). This is in line with an exchange of subsidiary-level debt as informed capital for parent-level debt as uninformed capital without the delegated monitoring in the consolidated debt structure.

Consistent with the parent-level results based on the consolidated debt structure, I also confirm a corresponding substitution at the subsidiary level. In specific, I show that the UK subsidiaries of US MNEs has substituted external debt with internal debt significantly on their unconsolidated balance sheet (an around 7 percentage point growth in the internal-liability-to-asset ratio with a comparable decline in the external-liability-to-asset ratio). Meanwhile, the substitution does not accompany with a significant change in leverage (i.e., the ratio of total liabilities to total assets). Furthermore, my subsidiary-level evidence reveals that the external debt substitution is stronger for foreign MNEs in general, compared with UK business groups. This is in line with the argument that parent companies of foreign

MNEs can better utilize the external debt substitution by raising more parent-level debt as their parent-level debt is less affected by domestic country-level uncertainty shocks.

Recent studies have indicated the importance of ICMs for business groups in reallocating equity capital when facing economic shocks, which creates significant international spillovers in the case MNEs (e.g., Santioni, Schiantarelli, and Strahan 2020, Biermann and Huber 2023). My research expands the importance by emphasizing that there are influential interactions directly between the ICMs of MNEs and external capital markets across borders, particularly in the form of external debt. My findings also suggest an unique role of local debt with monitoring even if MNEs can raise external debt from foreign capital markets to internally finance local investments. While my paper investigates uncertainty shocks, how do the ICMs of MNEs transmit shocks between regional and international financial markets is a generally understudied topic. Considering the global importance of MNEs, I hope my work can inspire future research endeavor on the interconnections between the ICMs of MNEs and financial markets across borders.

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Figure 1: The Parent-Level Debt Contract

This figure provides a visual representation of the parent-level debt contract. ω_{t+1} is the private productivity draw of the parent company. ω_{t+1}^{*} is the private productivity draw of the foreign subsidiary. Both draws come from independent log-normal distributions with a unit mean. The blue dashed lines mark the non-default thresholds of the parent-level debt contract, $\widehat{\omega}_{t+1}$ and $\widehat{\omega}_{t+1}^{*}$. The red solid line describes the state-contingent default threshold. The black dashed line shows the contractual threshold of the foreign lender, $\overline{\omega}_{t+1}^{*}$. When $\overline{\omega}_{t+1}^{*} > 0$ in equilibrium, the MNE faces a ``double debt curve," where the parent-level debt is stacked upon subsidiary-level debt. D and ND depict the non-default and default regions of the parent company for any combination of $(\omega_{t+1}, \omega_{t+1}^{*})$.

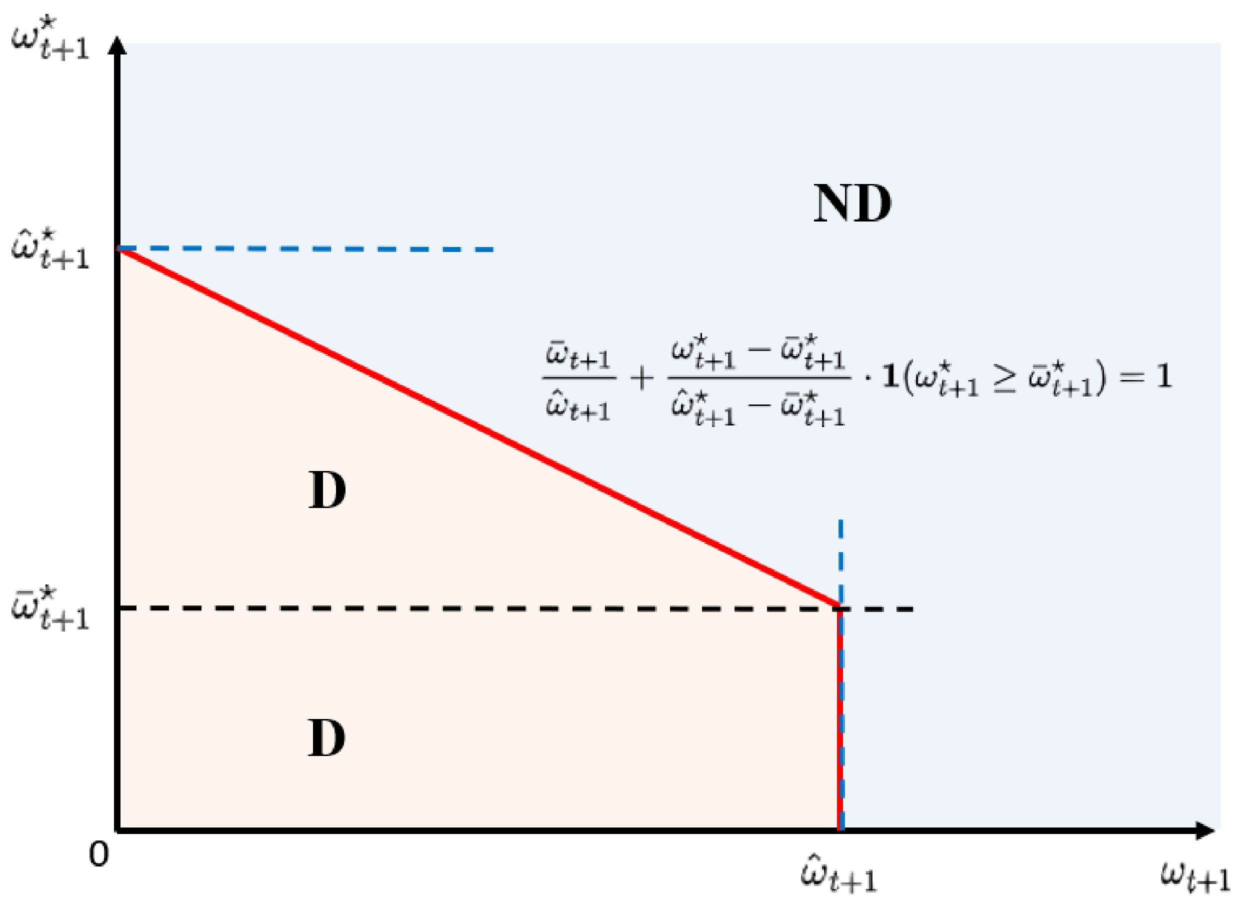


Figure 2: The Log-Normal CDF of the Productivity Draw

This figure demonstrates the change in the CDF of the productivity draw in response to an uncertainty shock. The productivity draw, labelled as Omega, is log-normally distributed with a unit mean. The uncertainty shock is a mean-preserving shock to the standard deviation of the productivity draw's natural logarithm. The standard deviation is labelled as sigma and can be set to around 0.28 as a point of reference. Sigma is estimated to be around 0.28 for the US with a standard deviation of around 0.2 (see, e.g., Carlstrom and Fuerst 1997, BGG 1999, Dorofeenko, Gabriel, and Salyer 2008, etc.).

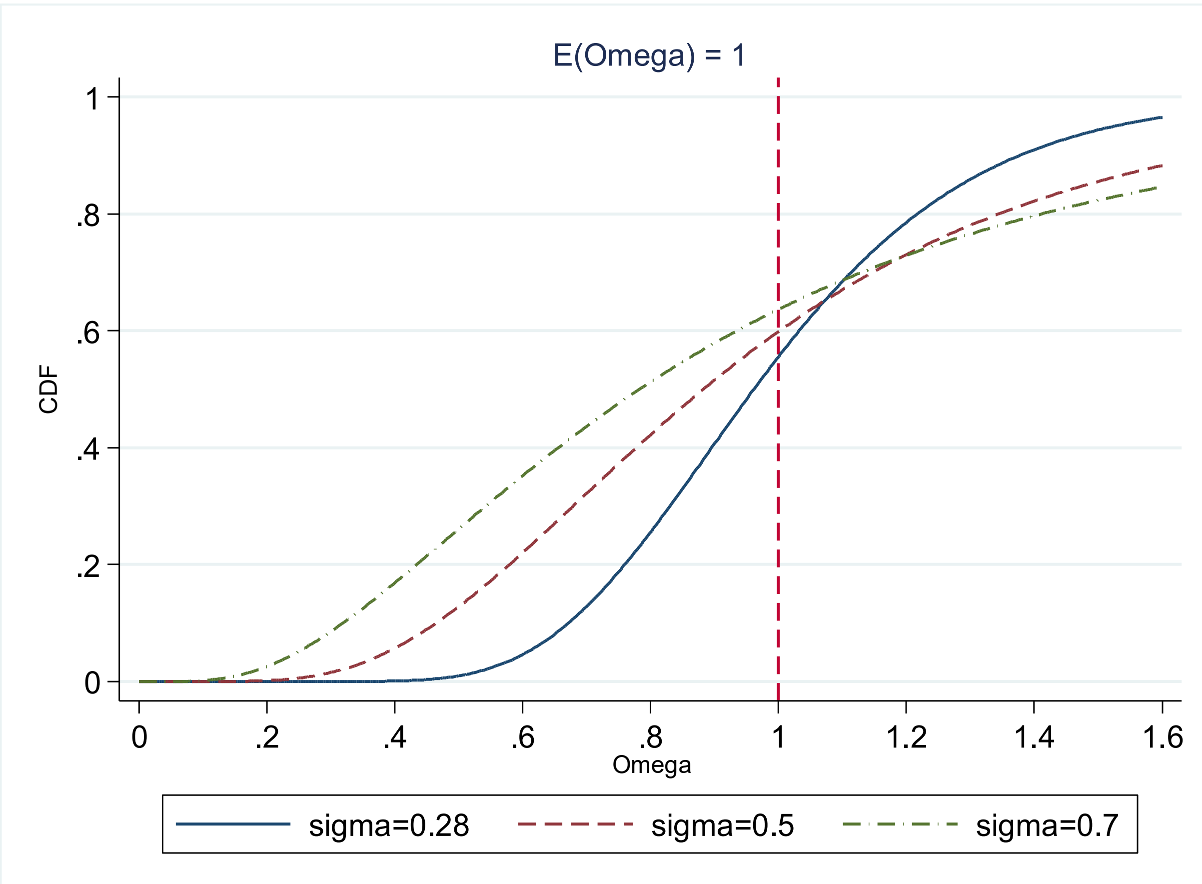
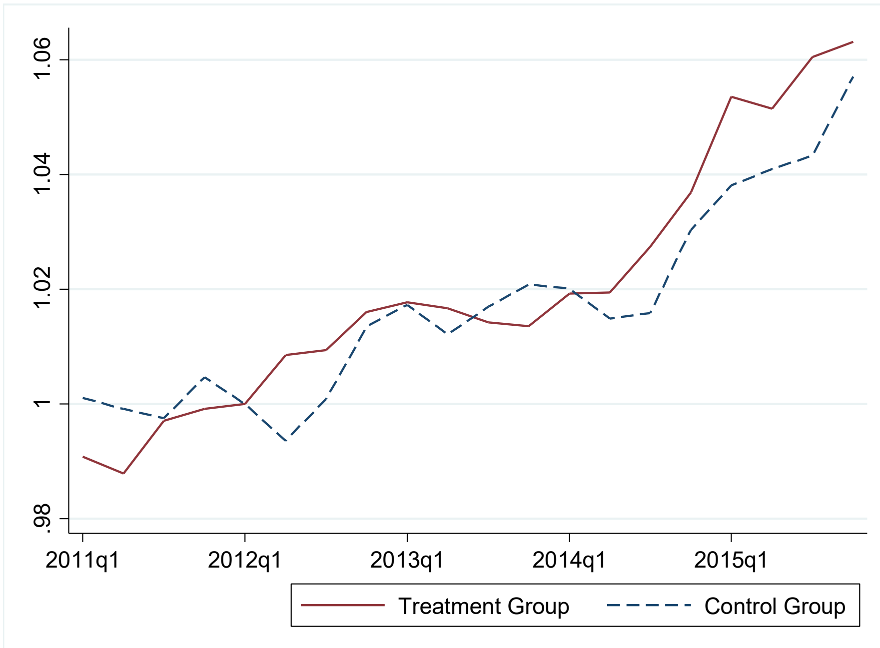


Figure 3: Consolidated Senior-Bond-to-Asset Ratio and Book Leverage, Pre-Trend

This figure plots the quarterly averages of the consolidated book leverage and senior-bond-to-asset ratio for the US parent companies in the treatment and control groups during 2011Q1-2015Q4. The book leverage is defined as the ratio of total debt (i.e., short-term debt + long-term debt) over total assets from Compustat. The senior-bond-to-asset ratio is defined as the ratio of senior bonds and notes from Capital IQ over total assets from Compustat. All variables are normalized with their values in 2012Q1 equals 1 to facilitate comparability.

Panel A: Book Leverage, Normalized



Panel B: Senior-Bond-to-Asset Ratio, Normalized

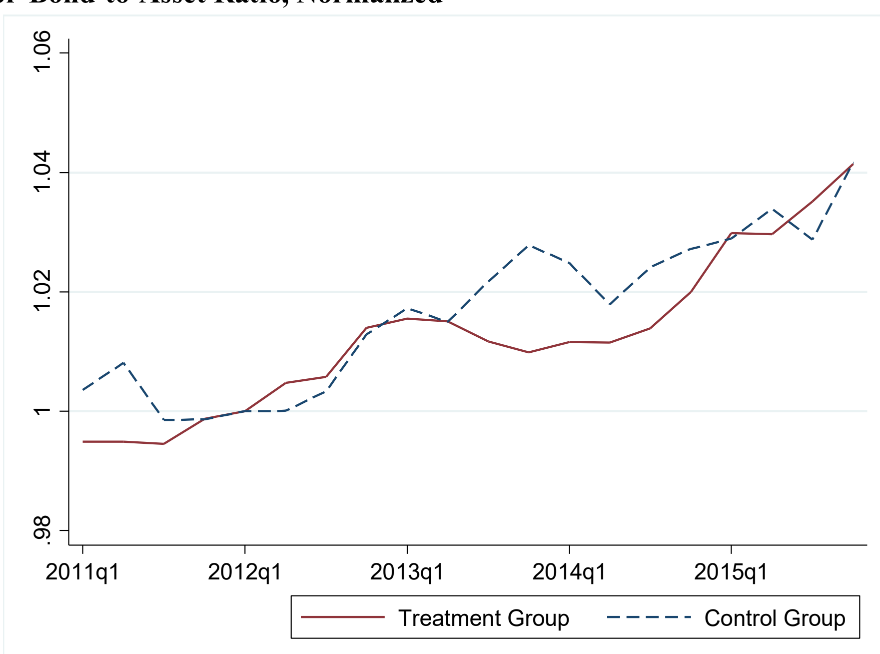
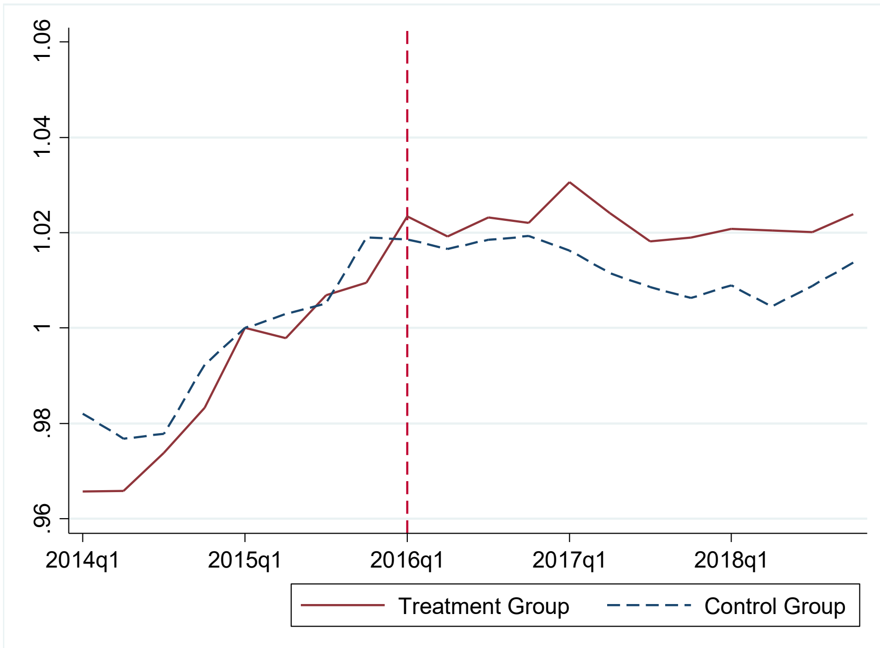


Figure 4: Consolidated Senior-Bond-to-Asset Ratio and Book Leverage

This figure plots the quarterly averages of the consolidated book leverage and senior-bond-to-asset ratio for the US parent companies in the treatment and control groups during 2014Q1-2018Q4. The book leverage is defined as the ratio of total debt (i.e., short-term debt + long-term debt) over total assets from Compustat. The senior-bond-to-asset ratio is defined as the ratio of senior bonds and notes from Capital IQ over total assets from Compustat. All variables are normalized with their values in 2015Q1 equals 1 to facilitate comparability.

Panel A: Book Leverage, Normalized



Panel B: Senior-Bond-to-Asset Ratio, Normalized

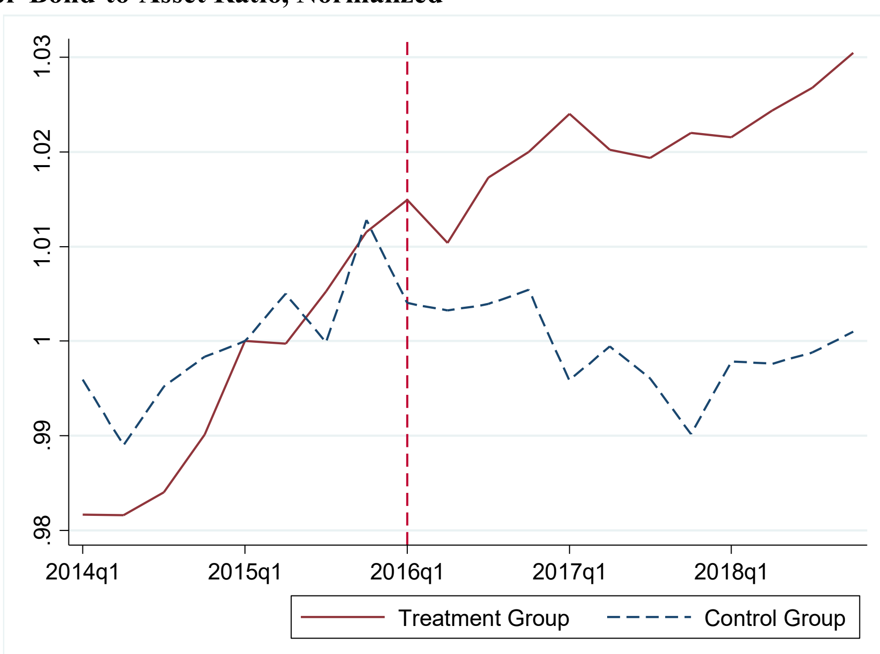
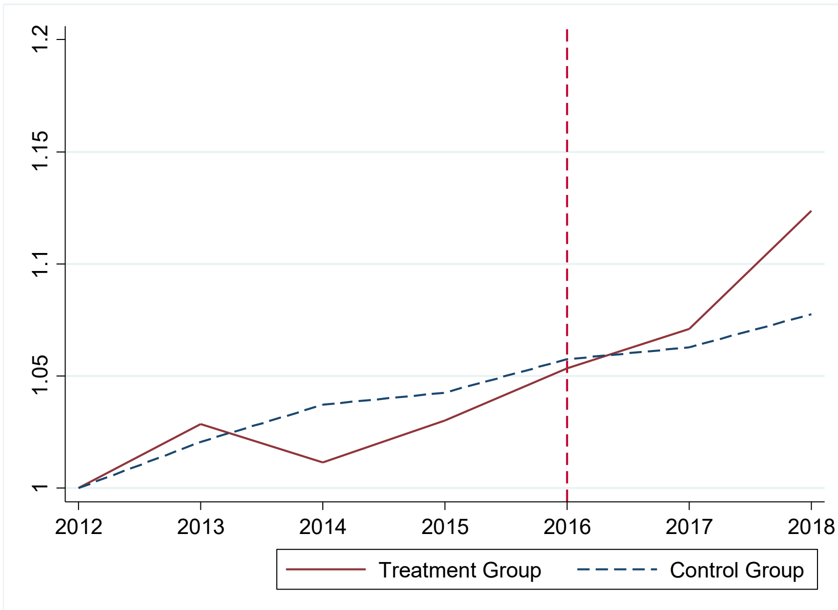


Figure 5: Unconsolidated Capital and Debt Structures

This figure plots the annual averages of the capita and debt structures of the UK firms in the treatment and control groups during 2012-2018 based on their unconsolidated balance sheets reported to the Companies House. Panel A plots the ratio of equity to total assets. The values of the ratio are normalized to 1 in 2012 for comparability. Panel B plots the ratio of internal liabilities to total assets of the treatment group minus that of the control group, together with the ratio of external liabilities to total assets of the treatment group minus that of the control group. Internal liabilities include intragroup debt and/or payables. External liabilities include debt from external creditors.

Panel A: Equity-to-Asset Ratio, Normalized



Panel B: Internal-Liability-to-Asset Ratio vs. External-Liability-to-Asset Ratio, Differences

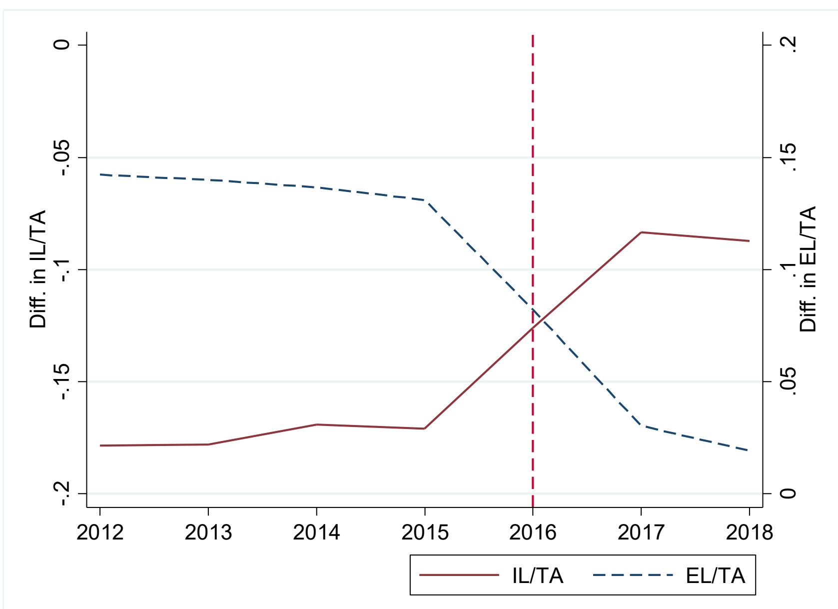


Table 1: Summary Statistics of Parent-Level Analysis

This table presents the summary statistics for the balanced sample of my parent-level DID analysis. Each observation in the sample is the average of the before (2014Q1-2016Q2) or after (2016Q2-2018Q4) period for a given US parent company. SeniorBondLeverage is the senior-bond-to-asset ratio defined as the ratio of senior bonds and notes from Capital IQ over total assets from Compustat. BookLeverage is defined as the ratio of total debt (i.e., short-term debt + long-term debt) over total assets from Compustat. LnTA is the logarithm of total assets in millions of US dollars from Compustat. Tobin'sQ is computed as the sum of market value of equity and book value of debt over total assets based on Compustat. Quick is the quick ratio defined as cash and short-term investments over total assets from Compustat.

Panel A: Full Sample

	The Before Period (2014Q1-2016Q2)						Full Period (2014Q1-2016Q2 vs. 2016Q3-2018Q4)					
	Mean	SD	Median	P1	P99	Num Obs	Mean	SD	Median	P1	P99	Num Obs
SeniorBondLeverage	.18	.17	.15	0	.79	1,008	.18	.17	.16	0	.74	2,016
BookLeverage	.33	.20	.30	.01	.91	1,008	.34	.20	.31	.009	.93	2,016
LnTA	7.21	2.42	7.63	.79	11.79	1,008	7.28	2.42	7.69	0.84	11.93	2,016
Tobin'sQ	1.76	1.19	1.40	.52	5.96	1,008	1.73	1.15	1.37	.51	5.96	2,016
Quick	.81	1.38	.41	.01	6.82	1,008	.77	1.29	.39	.01	5.94	2,016

Panel B: US Parent Companies with and without the UK Exposure during the Before Period (2014Q1-2016Q2)

	US Parent Companies with the UK Exposure						US Parent Companies without the UK Exposure					
	Mean	SD	Median	P1	P99	Num Obs	Mean	SD	Median	P1	P99	Num Obs
SeniorBondLeverage	.19	.16	.17	0	.71	539	.16	.18	.10	0	.81	469
BookLeverage	.32	.18	.29	.01	.88	539	.33	.22	.31	.004	0.91	469
LnTA	8.26	1.76	8.32	2.91	12.22	539	6.01	2.53	6.62	-.11	10.42	469
Tobin'sQ	1.81	1.10	1.49	.60	5.96	539	1.71	1.28	1.28	.51	5.96	469
Quick	.79	1.11	.47	.04	4.66	539	.83	1.64	.34	.005	7.28	469

Table 2: Parent-Level DID Analysis

This table presents the results of my parent-level DID analysis. The dependent variables are the book leverage (the ratio of total debt to total assets) in Column (1) and the ratio of senior bonds to total assets from Columns (2) to (7). Each observation in the sample is the average of the before (2014Q1-2016Q2) or after (2016Q3-2018Q4) period for a given US parent company. All models include parent-level fixed effects, which subsume the effect of the standalone treatment group dummy. The t-statistics reported in parentheses are based on robust standard errors clustered at the parent company level. Superscripts $***$, $**$, and $*$ indicate statistical significance at 1%, 5%, and 10% levels.

	(1) BookLev	(2) SnrBond/TA	(3) SnrBond/TA	(4) SnrBond/TA	(5) SnrBond/TA	(6) SnrBond/TA	(7) SnrBond/TA
After	0.017**	-0.003	-0.014***	-0.015***	-0.022*	-0.021	-0.022*
	(2.463)	(-0.411)	(-2.936)	(-2.998)	(-1.755)	(-1.554)	(-1.756)
After×UK	0.013	0.025***	0.016***	0.016***	0.018***	0.017**	0.018***
	(1.572)	(3.063)	(2.727)	(2.698)	(2.913)	(2.094)	(2.636)
After×MNE						-0.002	
						(-0.184)	
After×EU27							0.001
							(0.144)
BookLeverage			0.709***	0.710***	0.719***	0.719***	0.719***
			(14.902)	(14.920)	(15.040)	(15.019)	(15.046)
LnTA				0.003	0.003	0.003	0.003
				(0.307)	(0.240)	(0.236)	(0.243)
Tobin'sQ					0.003	0.003	0.003
					(0.473)	(0.473)	(0.471)
Quick					0.002	0.002	0.002
					(0.663)	(0.665)	(0.670)
Firm-Level FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
After×Industry	No	No	No	No	Yes	Yes	Yes
Observations	2016	2016	2016	2016	2016	2016	2016
R-squared	0.035	0.016	0.502	0.502	0.527	0.527	0.527

Table 3: Parent-Level DID Analysis for Pre-Trends

This table presents the results of my parent-level DID analysis. The dependent variables are the book leverage (the ratio of total debt to total assets) in Column (1) and the ratio of senior bonds to total assets from Columns (2) to (7). Each observation in the sample is the average of the before (2011Q1-2013Q2) or after (2013Q3-2015Q4) period for a given US parent company. All models include parent-level fixed effects, which subsume the effect of the standalone treatment group dummy. The t-statistics reported in parentheses are based on robust standard errors clustered at the parent company level. Superscripts ∗∗∗, ∗∗, and ∗ indicate statistical significance at 1%, 5%, and 10% levels.

	(1) BookLev	(2) SnrBond/TA	(3) SnrBond/TA	(4) SnrBond/TA	(5) SnrBond/TA	(6) SnrBond/TA	(7) SnrBond/TA
After	0.031***	0.034***	0.014**	0.009*	-0.018	-0.020	-0.020
	(4.194)	(5.050)	(2.567)	(1.731)	(-0.670)	(-0.755)	(-0.792)
After×UK	0.002	-0.007	-0.009	-0.008	-0.004	-0.002	-0.002
	(0.246)	(-0.915)	(-1.507)	(-1.384)	(-0.534)	(-0.176)	(-0.244)
After×MNE						0.004	
						(0.381)	
After×EU27							0.008
							(0.729)
BookLeverage			0.656***	0.655***	0.646***	0.646***	0.646***
			(14.049)	(14.827)	(14.221)	(14.210)	(14.207)
LnTA				0.021**	0.021*	0.021*	0.021*
				(2.022)	(1.873)	(1.871)	(1.870)
Tobin'sQ					-0.006	-0.006	-0.006
					(-0.963)	(-0.977)	(-0.978)
Quick					0.001	0.001	0.001
					(1.047)	(1.036)	(1.047)
Firm-Level FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
After×Industry	No	No	No	No	Yes	Yes	Yes
Observations	1964	1964	1964	1964	1964	1964	1964
R-squared	0.060	0.060	0.509	0.515	0.544	0.544	0.544

Table 4: Summary Statistics for US Parent Companies with and without the UK Exposure

This table presents the summary statistics for my matching analyses between the US parent companies with and without the UK exposure through their internal capital markets (i.e., the treatment and control groups). Each observation in the table is the average of the before (2014Q1-2016Q2) period for a given US parent company. BookLeverage is defined as the ratio of total debt (i.e., short-term debt + long-term debt) over total assets from Compustat. LnTA is the logarithm of total assets in millions of US dollars from Compustat. Tobin'sQ is computed as the sum of market value of equity and book value of debt over total assets based on Compustat. Quick is the quick ratio defined as cash and short-term investments over total assets from Compustat.

Panel A: Original Sample

	US Parent Companies with the UK Exposure (N = 539)					US Parent Companies without the UK Exposure (N = 469)					T-Test
	Mean	SD	Median	P1	P99	Mean	SD	Median	P1	P99	P-Value
BookLeverage	.32	.18	.29	.01	.88	.33	.22	.31	.004	.91	0.244
LnTA	8.26	1.76	8.32	2.91	12.22	6.01	2.53	6.62	-.11	10.42	0.000
Tobin'sQ	1.81	1.10	1.49	.60	5.96	1.71	1.28	1.28	.51	5.96	0.337
Quick	.79	1.11	.47	.04	4.66	.83	1.64	.34	.005	7.28	0.584

Panel B: Mahalanobis Matching on Size, Top 3 Matches with Replacements

	US Parent Companies with the UK Exposure (N = 539)					US Parent Companies without the UK Exposure (N = 336)					T-Test
	Mean	SD	Median	P1	P99	Mean	SD	Median	P1	P99	P-Value
BookLeverage	.32	.18	.29	.01	.88	.35	.20	.34	.03	.88	0.013
LnTA	8.26	1.76	8.32	2.91	12.22	7.00	2.00	7.36	1.26	10.46	0.000
Tobin'sQ	1.81	1.10	1.49	.60	5.96	1.46	.90	1.25	.52	4.78	0.000
Quick	.79	1.11	.47	.04	4.66	.69	1.35	.35	.005	5.67	0.239

Panel C: Coarsened Exact Matching

	US Parent Companies with the UK Exposure (N = 432)					US Parent Companies without the UK Exposure (N = 352)					T-Test
	Mean	SD	Median	P1	P99	Mean	SD	Median	P1	P99	P-Value
BookLeverage	.32	.18	.29	.01	.88	.34	.21	.30	.03	.82	0.380
LnTA	7.87	1.54	7.98	2.49	10.96	7.82	1.62	7.94	2.12	10.86	0.704
Tobin'sQ	1.65	.86	1.43	.60	5.16	1.65	.90	1.46	.58	5.96	0.995
Quick	.78	1.04	.48	.04	4.53	.76	1.16	.48	.005	4.59	0.846

Table 5: Matching Analyses – US Parent Companies with and without the UK Exposure

This table presents the results of my matching analyses between the US parent companies with and without the UK exposure through their internal capital markets (i.e., the treatment and control groups). The dependent variables are the book leverage (the ratio of total debt to total assets) in Columns (1), (3), and (5) and the ratio of senior bonds to total assets in Columns (2), (4), and (6). Each observation in the sample is the average of the before (2014Q1-2016Q2) or after (2016Q3-2018Q4) period for a given US parent company. All models include parent-level fixed effects, which subsume the effect of the standalone treatment group dummy. The t-statistics reported in parentheses are based on robust standard errors clustered at the parent company level. Superscripts ∗∗∗, ∗∗, and ∗ indicate statistical significance at 1%, 5%, and 10% levels.

	Original		Mahalanobis		CEM	
	(1)	(2)	(3)	(4)	(5)	(6)
	BookLev	SnrBond/TA	BookLev	SnrBond/TA	BookLev	SnrBond/TA
After	0.015	-0.022*	-0.008	-0.019	0.003	-0.007
	(0.789)	(-1.755)	(-0.384)	(-1.125)	(0.171)	(-0.777)
After×UK	0.011	0.018***	-0.005	0.020***	-0.001	0.022**
	(1.177)	(2.913)	(-0.525)	(2.750)	(-0.093)	(2.331)
BookLeverage		0.719***		0.710***		0.636***
		(15.040)		(12.091)		(11.761)
LnTA	-0.019	0.003	0.021	0.026*	-0.006	0.021*
	(-0.958)	(0.240)	(0.956)	(1.871)	(-0.290)	(1.715)
Tobin'sQ	0.001	0.003	-0.011	0.002	-0.022**	0.005
	(0.071)	(0.473)	(-0.844)	(0.188)	(-1.979)	(0.562)
Quick	-0.019***	0.002	-0.015**	0.001	-0.018**	0.007
	(-3.025)	(0.663)	(-2.014)	(0.302)	(-2.354)	(1.492)
Firm-Level FE	Yes	Yes	Yes	Yes	Yes	Yes
After×Industry	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2016	2016	1750	1750	1568	1568
R-squared	0.113	0.527	0.149	0.507	0.194	0.461

Table 6: Summary Statistics for US Multinational Parent Companies with and without the UK Exposure

This table presents the summary statistics for my matching analyses between the US multinational parent companies with and without the UK exposure through their internal capital markets (i.e., the treatment group and the parent companies of US MNEs in the control group). Each observation in the table is the average of the before (2014Q1-2016Q2) period for a given US parent company. BookLeverage is defined as the ratio of total debt (i.e., short-term debt + long-term debt) over total assets from Compustat. LnTA is the logarithm of total assets in millions of US dollars from Compustat. Tobin'sQ is computed as the sum of market value of equity and book value of debt over total assets based on Compustat. Quick is the quick ratio defined as cash and short-term investments over total assets from Compustat.

Panel A: Original Sample

	US Parent Companies with the UK Exposure (N = 539)					US Multinational Parents without the UK Exposure (N = 231)					T-Test
	Mean	SD	Median	P1	P99	Mean	SD	Median	P1	P99	P-Value
BookLeverage	.32	.18	.29	.01	.88	.32	.19	.31	.001	.82	0.904
LnTA	8.26	1.76	8.32	2.91	12.22	6.68	2.31	7.09	-.04	10.46	0.000
Tobin'sQ	1.81	1.10	1.49	.60	5.96	1.61	1.12	1.28	.52	5.96	0.023
Quick	.79	1.11	.47	.04	4.66	.79	1.32	.35	.008	6.66	0.938

Panel B: Mahalanobis Matching on Size, Top 3 Matches with Replacements

	US Parent Companies with the UK Exposure (N = 539)					US Multinational Parents without the UK Exposure (N = 207)					T-Test
	Mean	SD	Median	P1	P99	Mean	SD	Median	P1	P99	P-Value
BookLeverage	.32	.18	.29	.01	.88	.33	.18	.32	.01	.77	0.601
LnTA	8.26	1.76	8.32	2.91	12.22	7.06	2.04	7.33	1.92	10.46	0.000
Tobin'sQ	1.81	1.10	1.49	.60	5.96	1.49	.90	1.27	.52	4.66	0.000
Quick	.79	1.11	.47	.04	4.66	.69	1.17	.34	.008	6.20	0.292

Panel C: Coarsened Exact Matching

	US Parent Companies with the UK Exposure (N = 429)					US Multinational Parents without the UK Exposure (N = 211)					T-Test
	Mean	SD	Median	P1	P99	Mean	SD	Median	P1	P99	P-Value
BookLeverage	.33	.18	.30	.02	.91	.34	.19	.34	.03	.81	0.324
LnTA	7.99	1.51	8.08	2.91	10.66	7.93	1.56	8.11	2.77	10.59	0.650
Tobin'sQ	1.60	.77	1.41	.60	4.98	1.60	.79	1.40	.60	4.56	0.993
Quick	.73	.98	.46	.03	4.11	.72	.97	.46	.01	5.19	0.895

Table 7: Matching Analyses – US Multinational Parent Companies with and without the UK Exposure

This table presents the results of my matching analyses between the US multinational parent companies with and without the UK exposure through their internal capital markets (i.e., the treatment group and the parent companies of US MNEs in the control group). The dependent variables are the book leverage (the ratio of total debt to total assets) in Columns (1), (3), and (5) and the ratio of senior bonds to total assets in Columns (2), (4), and (6). Each observation in the sample is the average of the before (2014Q1-2016Q2) or after (2016Q3-2018Q4) period for a given US parent company. All models include parent-level fixed effects, which subsume the effect of the standalone treatment group dummy. The t-statistics reported in parentheses are based on robust standard errors clustered at the parent company level. Superscripts ∗∗∗, ∗∗, and ∗ indicate statistical significance at 1%, 5%, and 10% levels.

	Original		Mahalanobis		CEM	
	(1) BookLev	(2) SnrBond/TA	(3) BookLev	(4) SnrBond/TA	(5) BookLev	(6) SnrBond/TA
After	-0.023***	-0.007	-0.030***	-0.011	-0.028***	-0.007
	(-3.769)	(-0.352)	(-4.311)	(-0.556)	(-4.703)	(-0.676)
After×UK	0.004	0.020***	-0.008	0.021***	-0.005	0.017**
	(0.352)	(2.699)	(-0.793)	(2.699)	(-0.433)	(2.134)
BookLeverage		0.749***		0.729***		0.708***
		(12.118)		(10.713)		(9.690)
LnTA	-0.005	-0.006	0.019	0.005	0.028	0.017
	(-0.198)	(-0.487)	(0.724)	(0.364)	(1.088)	(1.290)
Tobin'sQ	-0.001	-0.004	0.000	-0.004	0.015	0.002
	(-0.057)	(-0.486)	(0.007)	(-0.567)	(0.785)	(0.234)
Quick	-0.018**	0.004	-0.020**	0.003	-0.012	0.011*
	(-2.170)	(0.948)	(-2.059)	(0.688)	(-1.469)	(1.958)
Firm-Level FE	Yes	Yes	Yes	Yes	Yes	Yes
After×Industry	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1540	1540	1492	1492	1280	1280
R-squared	0.140	0.543	0.168	0.522	0.132	0.545

Table 8: The Effect of the Corporate Bond Purchase Programs

This table presents the results of my robustness check on the corporate bond purchase programs implemented by the BoE and ECB during the Brexit interregnum. The dependent variable is the ratio of senior bonds to total assets in all columns. Each observation in the sample is the average of the before (2014Q1-2016Q2) or after (2016Q3-2018Q4) period for a given US parent company. All models include parent-level fixed effects, which subsume the effect of the standalone treatment group dummy. The t-statistics reported in parentheses are based on robust standard errors clustered at the parent company level. Superscripts $***$, $**$, and $*$ indicate statistical significance at 1%, 5%, and 10% levels.

	Original			No Exposure to the BoE and ECB		
	(1)	(2)	(3)	(4)	(5)	(6)
	SnrBond/TA	SnrBond/TA	SnrBond/TA	SnrBond/TA	SnrBond/TA	SnrBond/TA
After	-0.022*	-0.021	-0.022*	-0.022*	-0.021	-0.022*
	(-1.755)	(-1.554)	(-1.756)	(-1.741)	(-1.565)	(-1.742)
After×UK	0.018***	0.017**	0.018***	0.019***	0.018**	0.019***
	(2.913)	(2.094)	(2.636)	(3.043)	(2.229)	(2.751)
After×MNE		-0.002			-0.001	
		(-0.184)			(-0.137)	
After×EU27			0.001			0.002
			(0.144)			(0.155)
BookLeverage	0.719***	0.719***	0.719***	0.724***	0.724***	0.723***
	(15.040)	(15.019)	(15.046)	(15.253)	(15.231)	(15.260)
LnTA	0.003	0.003	0.003	0.003	0.003	0.003
	(0.240)	(0.236)	(0.243)	(0.282)	(0.278)	(0.285)
Tobin'sQ	0.003	0.003	0.003	0.004	0.004	0.004
	(0.473)	(0.473)	(0.471)	(0.630)	(0.629)	(0.628)
Quick	0.002	0.002	0.002	0.002	0.002	0.002
	(0.663)	(0.665)	(0.670)	(0.615)	(0.617)	(0.623)
Firm-Level FE	Yes	Yes	Yes	Yes	Yes	Yes
After×Industry	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2016	2016	2016	1990	1990	1990
R-squared	0.527	0.527	0.527	0.533	0.533	0.533

Table 9: Summary Statistics of Subsidiary-Level Analysis

This table presents the summary statistics for the balanced sample of my subsidiary-level DID analysis. Each observation in the sample is the average of the before (2014-2015) or after (2017-2018) period for a given UK subsidiary. All variables are based on the unconsolidated balance sheets of the UK subsidiaries reported to the Companies House. IntlLiabRatio is ratio of internal liabilities to total assets. ExtlLiabRatio is the ratio of external liabilities to total assets. LnTA is the logarithm of total assets in thousands of British pounds sterling. Leverage is the ratio of total liabilities to total assets (i.e., one minus the ratio of equity over total assets). ProvisionRatio is the ratio of provisions for other liabilities to total assets, where the provisions are for the other liabilities that are not intra-group debt and/or payables. All ratios are winsorized at 1% in each tail to avoid extreme values.

Panel A: Full Sample

	The Before Period (2014-2015)						Full Period (2014-2015 vs. 2017-2018)					
	Mean	SD	Median	P1	P99	Num Obs	Mean	SD	Median	P1	P99	Num Obs
IntlLiabRatio	.35	.42	.22	0	1.99	8763	.31	.41	.17	0	2.07	17526
ExtlLiabRatio	.26	.29	.16	0	1.12	8763	.29	.30	.21	0	1.12	17526
LnTA	7.85	2.18	7.99	1.81	13.27	8763	7.90	2.20	8.05	1.70	13.30	17526
Leverage	.64	.51	.56	.009	2.93	8763	.63	.52	.55	.007	3.03	17526
ProvisionRatio	.02	.06	.005	0	.18	7738	.02	.07	.005	0	.19	15476

Panel B: UK Subsidiaries of US MNEs vs. Domestic Subsidiaries of UK Business Groups during the Before Period (2014-2015)

	UK Subsidiaries of US MNEs						Domestic Subsidiaries of UK Business Groups					
	Mean	SD	Median	P1	P99	Num Obs	Mean	SD	Median	P1	P99	Num Obs
IntlLiabRatio	.19	.30	.11	0	1.55	1349	.38	.43	.25	0	2.02	7414
ExtlLiabRatio	.34	.30	.26	0	1.12	1349	.25	.29	.14	0	1.12	7414
LnTA	9.50	1.98	9.51	4.16	14.18	1349	7.55	2.08	7.73	1.61	12.69	7414
Leverage	.56	.51	.44	.002	2.96	1349	.65	.50	.58	.02	2.89	7414
ProvisionRatio	.02	.06	.002	0	.25	1226	.02	.06	.006	0	.17	6512

Table 10: Subsidiary-Level DID Analysis

This table presents the results of my subsidiary-level DID analysis. The dependent variables are the ratio of internal liabilities to total assets from Columns (1) to (4), the ratio of external liabilities to total assets from Columns (5) to (8), and the leverage (i.e., one minus the equity-to-asset ratio) from Columns (9) to (11). Each observation in the sample is the average of the before (2014-2015) or after (2017-2018) period for a given UK subsidiary. All models include subsidiary-level fixed effects, which subsume the effect of the standalone treatment group dummy. The t-statistics reported in parentheses are based on robust standard errors clustered at the subsidiary level. Superscripts ∗∗∗, ∗∗, and ∗ indicate statistical significance at 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	IL/TA	IL/TA	IL/TA	IL/TA	EL/TA	EL/TA	EL/TA	EL/TA	Leverage	Leverage	Leverage
After	-0.101***	-0.090***	-0.098***	-0.104***	0.080***	0.078***	0.100***	0.096***	-0.010**	0.004	0.015
	(-23.744)	(-19.679)	(-7.294)	(-8.490)	(27.208)	(25.645)	(8.702)	(8.626)	(-2.179)	(0.755)	(1.434)
After×Foreign	0.066***	0.066***	0.063***	0.070***	-0.083***	-0.083***	-0.078***	-0.075***	-0.019	-0.019	-0.016
	(7.887)	(8.299)	(7.848)	(8.816)	(-11.049)	(-11.059)	(-10.154)	(-11.401)	(-1.517)	(-1.546)	(-1.313)
LnTA		-0.108***	-0.107***	-0.050***		0.014**	0.014**	0.044***		-0.133***	-0.133***
		(-6.696)	(-6.696)	(-5.382)		(2.159)	(2.119)	(5.875)		(-7.218)	(-7.194)
Leverage				0.428***				0.228***			
				(14.383)				(17.177)			
Firm-Level FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
After×Industry	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes
Observations	17526	17526	17526	17526	17526	17526	17526	17526	17526	17526	17526
R-squared	0.066	0.110	0.116	0.332	0.078	0.079	0.084	0.202	0.001	0.054	0.059

Table 11: Subsidiary-Level DID Analysis for Pre-Trends

This table presents the results of my subsidiary-level DID analysis. The dependent variables are the ratio of internal liabilities to total assets from Columns (1) to (4), the ratio of external liabilities to total assets from Columns (5) to (8), and the leverage (i.e., one minus the equity-to-asset ratio) from Columns (9) to (11). Each observation in the sample is the average of the before (2012-2013) or after (2014-2015) period for a given UK subsidiary. All models include subsidiary-level fixed effects, which subsume the effect of the standalone treatment group dummy. The t-statistics reported in parentheses are based on robust standard errors clustered at the subsidiary level. Superscripts ∗∗∗, ∗∗, and ∗ indicate statistical significance at 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	IL/TA	IL/TA	IL/TA	IL/TA	EL/TA	EL/TA	EL/TA	EL/TA	Leverage	Leverage	Leverage
After	-0.000	0.009**	0.016	0.010	-0.021***	-0.023***	-0.018**	-0.020**	-0.020***	-0.006	0.013
	(-0.127)	(2.169)	(1.430)	(0.995)	(-10.075)	(-10.448)	(-2.043)	(-2.435)	(-4.494)	(-1.105)	(1.267)
After×Foreign	-0.003	-0.004	-0.002	-0.005	0.002	0.003	0.002	0.001	0.008	0.006	0.006
	(-0.449)	(-0.664)	(-0.359)	(-0.784)	(0.496)	(0.540)	(0.299)	(0.125)	(0.827)	(0.639)	(0.562)
LnTA		-0.094***	-0.093***	-0.027**		0.017***	0.017***	0.042***		-0.148***	-0.147***
		(-6.087)	(-6.015)	(-2.357)		(2.706)	(2.679)	(6.286)		(-6.365)	(-6.393)
Leverage				0.454***				0.175***			
				(12.669)				(13.957)			
Firm-Level FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
After×Industry	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes
Observations	14902	14902	14902	14902	14902	14902	14902	14902	14902	14902	14902
R-squared	0.000	0.032	0.038	0.351	0.016	0.018	0.024	0.145	0.003	0.051	0.062

Table 12: Subsidiary-Level DID Analysis – Internal Liabilities with/without Provisions

This table presents the results of my subsidiary-level DID analysis based on the sample where provisions for other liabilities are available. The dependent variable is the ratio of internal liabilities to total assets from Columns (1) to (4). The dependent variable for Columns (5) to (8) is the same ratio after excluding the provisions for other liabilities from the internal liabilities. Each observation in the sample is the average of the before (2014-2015) or after (2017-2018) period for a given UK subsidiary. All models include subsidiary-level fixed effects, which subsume the effect of the standalone treatment group dummy. The t-statistics reported in parentheses are based on robust standard errors clustered at the subsidiary level. Superscripts $***$, $**$, and $*$ indicate statistical significance at 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	IL/TA	IL/TA	IL/TA	IL/TA	No Provisions	No Provisions	No Provisions	No Provisions
After	-0.095***	-0.084***	-0.110***	-0.112***	-0.092***	-0.082***	-0.106***	-0.108***
	(-22.989)	(-18.759)	(-8.053)	(-8.972)	(-23.100)	(-19.404)	(-7.802)	(-8.539)
After×Foreign	0.062***	0.062***	0.059***	0.069***	0.062***	0.062***	0.057***	0.065***
	(7.909)	(8.357)	(7.628)	(8.979)	(8.185)	(8.587)	(7.653)	(8.932)
LnTA		-0.101***	-0.100***	-0.051***		-0.096***	-0.095***	-0.053***
		(-5.873)	(-5.880)	(-4.980)		(-6.208)	(-6.211)	(-5.431)
Leverage				0.377***				0.322***
				(11.807)				(10.863)
Firm-Level FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
After×Industry	No	No	Yes	Yes	No	No	Yes	Yes
Observations	15476	15476	15476	15476	15476	15476	15476	15476
R-squared	0.071	0.117	0.124	0.321	0.071	0.116	0.123	0.277

Table 13: Subsidiary-Level DID Analysis for Pre-Trends – Internal Liabilities with/without Provisions

This table presents the results of my subsidiary-level DID analysis based on the sample where provisions for other liabilities are available. The dependent variable is the ratio of internal liabilities to total assets from Columns (1) to (4). The dependent variable for Columns (5) to (8) is the same ratio after excluding the provisions for other liabilities from the internal liabilities. Each observation in the sample is the average of the before (2012-2013) or after (2014-2015) period for a given UK subsidiary. All models include subsidiary-level fixed effects, which subsume the effect of the standalone treatment group dummy. The t-statistics reported in parentheses are based on robust standard errors clustered at the subsidiary level. Superscripts ∗∗∗, ∗∗, and ∗ indicate statistical significance at 1%, 5%, and 10% levels.

	(1) IL/TA	(2) IL/TA	(3) IL/TA	(4) IL/TA	(5) No Provisions	(6) No Provisions	(7) No Provisions	(8) No Provisions
After	-0.001	0.007*	0.010	0.007	-0.003	0.003	0.008	0.005
	(-0.230)	(1.766)	(0.958)	(0.684)	(-1.026)	(0.954)	(0.765)	(0.519)
After×Foreign	-0.001	-0.003	-0.001	-0.002	-0.001	-0.003	-0.001	-0.002
	(-0.247)	(-0.520)	(-0.173)	(-0.332)	(-0.271)	(-0.528)	(-0.176)	(-0.318)
LnTA		-0.081***	-0.080***	-0.024**		-0.071***	-0.070***	-0.023**
		(-4.943)	(-4.848)	(-1.974)		(-4.939)	(-4.868)	(-1.989)
Leverage				0.406***				0.344***
				(10.294)				(9.430)
Firm-Level FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
After×Industry	No	No	Yes	Yes	No	No	Yes	Yes
Observations	13368	13368	13368	13368	13368	13368	13368	13368
R-squared	0.000	0.029	0.036	0.318	0.000	0.025	0.033	0.260

Table 14: Subsidiary-Level DID Analysis with Foreign MNEs

This table presents the results of my subsidiary-level DID analysis with the UK subsidiaries of foreign MNEs as the treatment group. The dependent variables are the ratio of internal liabilities to total assets from Columns (1) to (4), the ratio of external liabilities to total assets from Columns (5) to (8), and the leverage (i.e., one minus the equity-to-asset ratio) from Columns (9) to (11). Each observation in the sample is the average of the before (2014-2015) or after (2017-2018) period for a given UK subsidiary. All models include subsidiary-level fixed effects, which subsume the effect of the standalone treatment group dummy. The t-statistics reported in parentheses are based on robust standard errors clustered at the subsidiary level. Superscripts ∗∗∗, ∗∗, and ∗ indicate statistical significance at 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	IL/TA	IL/TA	IL/TA	IL/TA	EL/TA	EL/TA	EL/TA	EL/TA	Leverage	Leverage	Leverage
After	-0.101***	-0.090***	-0.097***	-0.107***	0.080***	0.078***	0.103***	0.098***	-0.010**	0.004	0.022**
	(-23.745)	(-20.227)	(-7.825)	(-9.383)	(27.209)	(25.916)	(9.723)	(9.499)	(-2.179)	(0.848)	(2.145)
After×Foreign	0.061***	0.062***	0.059***	0.056***	-0.061***	-0.061***	-0.057***	-0.058***	0.004	0.005	0.005
	(9.919)	(10.364)	(9.272)	(10.210)	(-13.037)	(-13.079)	(-11.692)	(-13.168)	(0.470)	(0.660)	(0.664)
LnTA		-0.107***	-0.106***	-0.050***		0.015***	0.014**	0.047***		-0.137***	-0.136***
		(-8.041)	(-7.959)	(-6.324)		(2.655)	(2.542)	(7.540)		(-8.799)	(-8.743)
Leverage				0.413***				0.242***			
				(17.098)				(20.959)			
Firm-Level FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
After×Industry	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes
Observations	24536	24536	24536	24536	24536	24536	24536	24536	24536	24536	24536
R-squared	0.054	0.099	0.103	0.320	0.059	0.061	0.066	0.205	0.000	0.054	0.058

Table 15: Subsidiary-Level DID Analysis for Pre-Trends with Foreign MNEs

This table presents the results of my subsidiary-level DID analysis with the UK subsidiaries of foreign MNEs as the treatment group. The dependent variables are the ratio of internal liabilities to total assets from Columns (1) to (4), the ratio of external liabilities to total assets from Columns (5) to (8), and the leverage (i.e., one minus the equity-to-asset ratio) from Columns (9) to (11). Each observation in the sample is the average of the before (2012-2013) or after (2014-2015) period for a given UK subsidiary. All models include subsidiary-level fixed effects, which subsume the effect of the standalone treatment group dummy. The t-statistics reported in parentheses are based on robust standard errors clustered at the subsidiary level. Superscripts ∗∗∗, ∗∗, and ∗ indicate statistical significance at 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	IL/TA	IL/TA	IL/TA	IL/TA	EL/TA	EL/TA	EL/TA	EL/TA	Leverage	Leverage	Leverage
After	-0.000	0.009**	0.008	0.007	-0.021***	-0.023***	-0.018**	-0.018**	-0.020***	-0.006	0.000
	(-0.127)	(2.364)	(0.710)	(0.782)	(-10.076)	(-10.825)	(-2.265)	(-2.427)	(-4.494)	(-1.352)	(0.025)
After×Foreign	-0.001	-0.003	-0.004	-0.005	0.004	0.005	0.005	0.005	0.006	0.003	0.003
	(-0.121)	(-0.532)	(-0.738)	(-1.156)	(1.258)	(1.398)	(1.417)	(1.383)	(0.891)	(0.470)	(0.392)
LnTA		-0.099***	-0.099***	-0.039***		0.023***	0.023***	0.051***		-0.138***	-0.138***
		(-7.496)	(-7.408)	(-4.090)		(4.195)	(4.189)	(8.583)		(-7.182)	(-7.271)
Leverage				0.436***				0.202***			
				(14.902)				(17.952)			
Firm-Level FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
After×Industry	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes
Observations	21238	21238	21238	21238	21238	21238	21238	21238	21238	21238	21238
R-squared	0.000	0.035	0.040	0.338	0.013	0.017	0.021	0.170	0.003	0.043	0.051

Table 16: Subsidiary-Level DID Analysis with Foreign MNEs – Internal Liabilities with/without Provisions

This table presents the results of my subsidiary-level DID analysis with the UK subsidiaries of foreign MNEs as the treatment group. The analysis is based on the sample where provisions for other liabilities are available. The dependent variable is the ratio of internal liabilities to total assets from Columns (1) to (4). The dependent variable for Columns (5) to (8) is the same ratio after excluding the provisions for other liabilities from the internal liabilities. Each observation in the sample is the average of the before (2014-2015) or after (2017-2018) period for a given UK subsidiary. All models include subsidiary-level fixed effects, which subsume the effect of the standalone treatment group dummy. The t-statistics reported in parentheses are based on robust standard errors clustered at the subsidiary level. Superscripts ∗∗∗, ∗∗, and ∗ indicate statistical significance at 1%, 5%, and 10% levels.

	(1) IL/TA	(2) IL/TA	(3) IL/TA	(4) IL/TA	(5) No Provisions	(6) No Provisions	(7) No Provisions	(8) No Provisions
After	-0.095***	-0.085***	-0.110***	-0.114***	-0.092***	-0.083***	-0.106***	-0.109***
	(-22.990)	(-19.441)	(-8.844)	(-9.940)	(-23.101)	(-20.072)	(-8.577)	(-9.504)
After×Foreign	0.055***	0.056***	0.051***	0.052***	0.055***	0.055***	0.051***	0.052***
	(9.454)	(9.824)	(8.471)	(9.812)	(9.803)	(10.149)	(8.852)	(9.967)
LnTA		-0.098***	-0.097***	-0.050***		-0.091***	-0.090***	-0.050***
		(-6.910)	(-6.855)	(-5.723)		(-7.387)	(-7.338)	(-6.390)
Leverage				0.360***				0.308***
				(13.709)				(12.133)
Firm-Level FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
After×Industry	No	No	Yes	Yes	No	No	Yes	Yes
Observations	21712	21712	21712	21712	21712	21712	21712	21712
R-squared	0.059	0.106	0.110	0.306	0.060	0.103	0.108	0.262

Table 17: Subsidiary-Level DID Analysis for Pre-Trends with Foreign MNEs – Internal Liabilities with/without Provisions

This table presents the results of my subsidiary-level DID analysis with the UK subsidiaries of foreign MNEs as the treatment group. The analysis is based on the sample where provisions for other liabilities are available. The dependent variable is the ratio of internal liabilities to total assets from Columns (1) to (4). The dependent variable for Columns (5) to (8) is the same ratio after excluding the provisions for other liabilities from the internal liabilities. Each observation in the sample is the average of the before (2012-2013) or after (2014-2015) period for a given UK subsidiary. All models include subsidiary-level fixed effects, which subsume the effect of the standalone treatment group dummy. The t-statistics reported in parentheses are based on robust standard errors clustered at the subsidiary level. Superscripts ∗∗∗, ∗∗, and ∗ indicate statistical significance at 1%, 5%, and 10% levels.

	(1) IL/TA	(2) IL/TA	(3) IL/TA	(4) IL/TA	(5) No Provisions	(6) No Provisions	(7) No Provisions	(8) No Provisions
After	-0.001	0.007^{*}	0.000	0.003	-0.003	0.004	0.004	0.006
	(-0.230)	(1.908)	(0.038)	(0.286)	(-1.026)	(1.030)	(0.446)	(0.695)
After×Foreign	-0.001	-0.003	-0.003	-0.003	-0.002	-0.004	-0.003	-0.003
	(-0.171)	(-0.566)	(-0.522)	(-0.668)	(-0.514)	(-0.866)	(-0.610)	(-0.735)
LnTA		-0.083^{***}	-0.083^{***}	-0.035^{***}		-0.073^{***}	-0.073^{***}	-0.031^{***}
		(-6.412)	(-6.312)	(-3.581)		(-6.175)	(-6.138)	(-3.328)
Leverage				0.379^{***}				0.330^{***}
				(12.100)				(10.651)
Firm-Level FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
After×Industry	No	No	Yes	Yes	No	No	Yes	Yes
Observations	18986	18986	18986	18986	18986	18986	18986	18986
R-squared	0.000	0.031	0.036	0.301	0.000	0.025	0.030	0.242

Appendices

A Optimal Contract for the Parent Company

A.1 The Proof of the Optimal Contract

This appendix derives the optimal contract for the parent company based on the setup from Section 3.1 and the CSV problem described in Section 3.2.1. Since the derivation of the optimal contract takes the return available to the parent company at the end of $t+1$ as given, I make the following assumptions to simplify notations without loss of generality. First, I assume that all returns are denominated in the same currency. Secondly, I assume that $\bar{\omega}^*_{t+1} = 0$ so that the total return available to the parent company at the end of $t+1$ before paying the home lender is $\omega_{t+1} I_t R_t + \omega^*_{t+1} I^*_t R^*_t$ (i.e., there is no enforceable contractual threshold by the foreign lender). The same argument applies when $\bar{\omega}^*_{t+1} > 0$ with the adjustment that the total return available to the parent company becomes $\omega_{t+1} I_t R_t + \left(\omega^*_{t+1} - \bar{\omega}^*_{t+1}\right) \mathbf{1}(\omega^*_{t+1} \geq \bar{\omega}^*_{t+1}) I^*_t R^*_t$.

Following the CSV problem, the parent company can freely observe the total return available on its balance sheet at the end of $t+1$, $\omega_{t+1} I_t R_t + \omega^*_{t+1} I^*_t R^*_t$, and report $\tilde{\omega}_{t+1} I_t R_t + \tilde{\omega}^*_{t+1} I^*_t R^*_t$ to the investor. Given the reported return, the investor can decide whether to audit the parent company or not. If the investor does not audit, the parent company obtains a payoff of $R^p_0(\tilde{\omega}_{t+1}, \tilde{\omega}^*_{t+1})$ and the investor collects a payoff of $R^I_0(\tilde{\omega}_{t+1}, \tilde{\omega}^*_{t+1})$. Alternatively, the investor can verify the parent company's balance sheet through an audit after paying $\nu(\omega_{t+1} I_t R_t + \omega^*_{t+1} I^*_t R^*_t)$ as the audit cost. Consistent with Section 3.2.1, the audit cost can be interpreted as the cost of default. In the case of an audit, the parent company obtains a payoff of $R^p_1(\omega_{t+1}, \omega^*_{t+1})$ and the investor collects a payoff of $R^I_1(\omega_{t+1}, \omega^*_{t+1})$ before paying the audit cost.

By the revelation principle (Myerson 1979), the optimal contract for the parent company induces truthful reporting, meaning there are $\tilde{\omega}_{t+1} = \omega_{t+1}$ and $\tilde{\omega}^*_{t+1} = \omega^*_{t+1}$ under the optimal contract. Let $y(\tilde{\omega}_{t+1}, \tilde{\omega}^*_{t+1}) = \{1, 0\}$ indicate whether there is an audit, where $y(\tilde{\omega}_{t+1}, \tilde{\omega}^*_{t+1}) = 1$ represents the action that the investor audits, the parent company's payoff under the optimal contract can be written as:

$$R^p(\omega_{t+1},\omega^*_{t+1}) = R^p_1(\omega_{t+1},\omega^*_{t+1})y(\omega_{t+1},\omega^*_{t+1}) + R^p_0(\omega_{t+1},\omega^*_{t+1})\left(1-y(\omega_{t+1},\omega^*_{t+1})\right). \quad (A.1)$$

Similarly, the payoff to the investor can be written as:

$$R^I(\omega_{t+1},\omega^*_{t+1}) = R^I_1(\omega_{t+1},\omega^*_{t+1})y(\omega_{t+1},\omega^*_{t+1}) + R^I_0(\omega_{t+1},\omega^*_{t+1})\left(1-y(\omega_{t+1},\omega^*_{t+1})\right) \quad (A.2)$$

with $R^p(\omega_{t+1},\omega^*_{t+1}) + R^I(\omega_{t+1},\omega^*_{t+1}) = \omega_{t+1}I_tR_t + \omega^*_{t+1}I^*_tR^*_t$ and $R^p(\omega_{t+1},\omega^*_{t+1}) \geq 0$.

Let D_t be the amount of external funds the parent company seeks to raise from the investor. The optimal contract solves for a schedule of $\{y(\omega_{t+1},\omega^*_{t+1}), R^p(\omega_{t+1},\omega^*_{t+1})\}$ that maximizes the expected payoff to the parent company, subject to the incentive constraint of truthful reporting (IC) and the individual rationality constraint of the investor (IR). The IR requires that the contract's expected payoff to the investor must at least equals their opportunity cost. The optimization problem can be written as:

$$\max_{y(\omega_{t+1},\omega^*_{t+1}),R^p(\omega_{t+1},\omega^*_{t+1})} \int_0^{+\infty}\int_0^{+\infty} R^p(\omega_{t+1},\omega^*_{t+1})dF(\omega_{t+1})dF(\omega^*_{t+1}) \quad (A.3)$$

such that:

$$\begin{aligned}&\int_0^{+\infty}\int_0^{+\infty}\left(1-y(\omega_{t+1},\omega^*_{t+1})\nu\right)\left(\omega_{t+1}I_tR_t+\omega^*_{t+1}I^*_tR^*_t\right)dF(\omega_{t+1})dF(\omega^*_{t+1})\\&-\int_0^{+\infty}\int_0^{+\infty} R^p(\omega_{t+1},\omega^*_{t+1})dF(\omega_{t+1})dF(\omega^*_{t+1}) \geq D_t(1+r^{rf}_t).\end{aligned} \quad (A.4)$$

The focus of this paper is leveraged MNEs. Thus, I focus on cases the where the IR holds in equilibrium with $R^p(\omega_{t+1},\omega^*_{t+1}) \geq 0$. Otherwise, the parent company is "rationed" from the external capital market under limited liability.

Since the IR binds by the optimal contract, there is:

$$\begin{aligned}&\int_0^{+\infty}\int_0^{+\infty} R^p(\omega_{t+1},\omega^*_{t+1})dF(\omega_{t+1})dF(\omega^*_{t+1}) =\\&\int_0^{+\infty}\int_0^{+\infty}\left(1-y(\omega_{t+1},\omega^*_{t+1})\nu\right)\left(\omega_{t+1}I_tR_t+\omega^*_{t+1}I^*_tR^*_t\right)dF(\omega_{t+1})dF(\omega^*_{t+1}) - D_t(1+r^{rf}_t).\end{aligned} \quad (A.5)$$

Substituting Equation A.5 to Condition A.3 shows that the optimal contract minimizes the expected audit cost:

$$\min_{y(\omega_{t+1},\omega^*_{t+1}),R^p(\omega_{t+1},\omega^*_{t+1})} \int_0^{+\infty}\int_0^{+\infty} \nu y(\omega_{t+1},\omega^*_{t+1})\left(\omega_{t+1}I_tR_t+\omega^*_{t+1}I^*_tR^*_t\right)dF(\omega_{t+1})dF(\omega^*_{t+1}). \tag{A.6}$$

The proposed optimal contract for the parent company is described as follows:

1. For any given $D_t > 0$ such that the IR can hold with $R^p(\omega_{t+1},\omega^*_{t+1}) \geq 0$, the optimal contract is a debt contract with a fixed income, $D_t(1+r_t)$, for the investor.

2. $y(\omega_{t+1},\omega^*_{t+1}) = 0$ if $\omega_{t+1}I_tR_t + \omega^*_tI^*R^*_t \geq D_t(1+r_t)$.

3. $y(\omega_{t+1},\omega^*_{t+1}) = 1$ if $\omega_{t+1}I_tR_t + \omega^*_tI^*R^*_t < D_t(1+r_t)$.

4. $R^p(\omega_{t+1},\omega^*_{t+1}) = \max\{\omega_{t+1}I_tR_t + \omega^*_tI^*R^*_t - D_t(1+r_t), 0\}$.

5. $R^I(\omega_{t+1},\omega^*_{t+1}) = \min\{D_t(1+r_t), \omega_{t+1}I_tR_t + \omega^*_tI^*R^*_t\}$.

To prove that the proposed debt contract is the optimal contract, I start by proving the following two lemmas.

Lemma A.1. *For any $\left(\omega_{t+1},\omega^*_{t+1}\right)$, where $y(\omega_{t+1},\omega^*_{t+1}) = 0$, $R^I(\omega_{t+1},\omega^*_{t+1}) = c$ must be a constant in the optimal contract.*

Proof. Let $\left(\omega_{t+1},\omega^*_{t+1}\right)$ and $\left(\omega'_{t+1},\omega^{*\prime}_{t+1}\right)$ be any two pairs of realized productivity draws, where $y(\omega_{t+1},\omega^*_{t+1}) = y(\omega'_{t+1},\omega^{*\prime}_{t+1}) = 0$ in an arbitrary contract. If there is $R^I(\omega_{t+1},\omega^*_{t+1}) > R^I(\omega'_{t+1},\omega^{*\prime}_{t+1})$, then with $\left(\omega_{t+1},\omega^*_{t+1}\right)$, the parent company can be strictly better off by reporting $\left(\tilde{\omega}_{t+1},\tilde{\omega}^*_{t+1}\right) = \left(\omega'_{t+1},\omega^{*\prime}_{t+1}\right)$, which breaks the IC. Thus, for a contract to be optimal, A.1 must hold. □

Lemma A.2. *For any $\left(\omega_{t+1},\omega^*_{t+1}\right)$, where $y(\omega_{t+1},\omega^*_{t+1}) = 1$, there must be $R^I(\omega_{t+1},\omega^*_{t+1}) \leq c$ in the optimal contract, where c is the constant payoff from A.1.*

Proof. Let $\left(\omega_{t+1},\omega^*_{t+1}\right)$ and $\left(\omega'_{t+1},\omega^{*\prime}_{t+1}\right)$ be any two pairs of realized productivity draws. If there are $y(\omega_{t+1},\omega^*_{t+1}) = 1$ and $y(\omega'_{t+1},\omega^{*\prime}_{t+1}) = 0$ in an arbitrary contract with $R^I(\omega_{t+1},\omega^*_{t+1})$

$> c$, but $R^I(\omega'_{t+1}, \omega^{*\prime}_{t+1}) = c$, then with $\left(\omega_{t+1}, \omega^*_{t+1}\right)$, the parent company can be strictly better off by reporting $\left(\tilde{\omega}_{t+1}, \tilde{\omega}^*_{t+1}\right) = \left(\omega'_{t+1}, \omega^{*\prime}_{t+1}\right)$, which breaks the IC. Thus, for a contract to be optimal, A.2 must hold. □

For any contract satisfying the payoff rules described by Lemmata A.1 and A.2 such that the IC holds and the IR binds, one can show that a debt contract with the following structure dominates the arbitrary contract in minimizing the expected audit cost:

1. For any realized $\left(\omega_{t+1}, \omega^*_{t+1}\right)$ such that $\omega_{t+1} I_t R_t + \omega^*_{t+1} I^*_t R^*_t \geq c$: $y(\omega_{t+1}, \omega^*_{t+1}) = 0$ and $R^I\left(\omega_{t+1}, \omega^*_{t+1}\right) = c$.

2. For any realized $\left(\omega_{t+1}, \omega^*_{t+1}\right)$ such that $\omega_{t+1} I_t R_t + \omega^*_{t+1} I^*_t R^*_t < c$: $y(\omega_{t+1}, \omega^*_{t+1}) = 1$ and $R^I\left(\omega_{t+1}, \omega^*_{t+1}\right) = \omega_{t+1} I_t R_t + \omega^*_{t+1} I^*_t R^*_t$.

To see this, define set $S_1 = \left\{\left(\omega_{t+1}, \omega^*_{t+1}\right)\right\}$ such that $\omega_{t+1} I_t R_t + \omega^*_{t+1} I^*_t R^*_t \geq c$ and $S_2 = \left\{\left(\omega_{t+1}, \omega^*_{t+1}\right)\right\}$ such that $\omega_{t+1}(h) I_t(h) R_{t+1} + \omega^*_{t+1}(j) I^*_t(j) R^*_{t+1} < c$. There are $S_1 \cap S_2 = \oslash$ and $S_1 \cup S_2 = \left\{\left(\omega_{t+1}, \omega^*_{t+1}\right)\right\}\ \forall\ \omega_{t+1}, \omega^*_{t+1} \in (0, +\infty)$. For any $\left(\omega_{t+1}, \omega^*_{t+1}\right) \in S_1$, switching from the arbitrary contract to the debt contract will minimize the expected audit cost since, under the debt contract, there will be no audit. The switch also maximizes the investor's payoff because $R^I\left(\omega_{t+1}, \omega^*_{t+1}\right) \leq c$ by A.1 and A.2, meaning the debt contract sustains the IR. Similarly, for any $\left(\omega_{t+1}, \omega^*_{t+1}\right) \in S_2$, switching from the arbitrary contract to the debt contract minimizes the expected audit cost and maximizes the investor's payoff as $R^p\left(\omega_{t+1}, \omega^*_{t+1}\right) \geq 0$. Therefore, the debt contract dominates the arbitrary contract in minimizing the expected audit cost, while sustaining the IC and IR. To find the optimal contract, one needs to find the debt contract that binds the IR.

Since the expected surplus payoff to the investor under the debt contract with the constant c is:

$$
\begin{aligned}
&\int_{\omega_{t+1} \in S_1} \int_{\omega^*_{t+1} \in S_1} c dF(\omega_{t+1}) dF(\omega^*_{t+1}) + \\
&\int_{\omega_{t+1} \in S_2} \int_{\omega^*_{t+1} \in S_2} (1-\nu)\left(\omega_{t+1} I_t R_t + \omega^*_{t+1} I^*_t R^*_t\right) dF(\omega_{t+1}) dF(\omega^*_{t+1}) - D_t(1 + r^{rf}_t) \geq 0, \qquad \text{(A.7)}
\end{aligned}
$$

the expected surplus payoff is continuous in c. Because when $c = 0$, the surplus payoff is:

$$-D_t(1 + r_t^{rf}) < 0, \tag{A.8}$$

there exists $c \geq c' > 0$ such that the IR binds.[1] As a result, setting the fixed income $D_t(1 + r_t) = c'$, the proposed debt contract is the optimal contract.

A.2 Parent-Level Debt in Equilibrium

This section proves the parent-level debt will always be used in equilibrium when the MNE can also have subsidiary-level debt under a standard contract supported by the return of the foreign project, ceteris paribus. To prove this, one can show that the parent-level debt is always preferred when only one type of debt is used.

Proof. Let D_t^* be a subsidiary-level debt that funds a portfolio of (I_t, I_t^*) and r_t^* be the risky return. The default threshold of the standard debt contract can be written in Home's currency as:

$$\bar{\omega}_{t+1}^* = \frac{F_{t+1} D_t^*(1 + r_t^*)}{F_{t+1} I_t^* R_t^*}. \tag{A.9}$$

Switching the lender to the parent-level debt contract with the same D_t^* and r_t^*, the original default threshold is identical to a non-default threshold of the parent-level debt contract:

$$\hat{\omega}_{t+1}^* = \bar{\omega}_{t+1}^* = \frac{F_{t+1} D_t^*(1 + r_t^*)}{F_{t+1} I_t^* R_t^*}. \tag{A.10}$$

When $I_t = 0$, the parent-level debt contract is the original standard debt contract. The lender's expected return from both contracts are equivalent in Home's currency by the CIP

[1] It is implicit that $c > 0$ in the optimal contract when the investor faces a positive opportunity cost. Since $R^I\left(\omega_{t+1}, \omega_{t+1}^*\right) \leq c$ in the optimal contract by A.1 and A.2, the IR can never be sustained with $c \leq 0$ and $D_t(1 + r_t^{rf}) > 0$.

Condition 3:

$$F_{t+1}D_t^*(1+r_t^{rf*}) = S_t D_t^*(1+r_t^{rf}). \tag{A.11}$$

When $I_t > 0$, the lender becomes strictly better off under the parent-level debt contract due to the existence of the additional non-default regions, as shown by Figure 1 with $\bar{\omega}_{t+1}^* = 0$. Therefore, when only the subsidiary-level debt is used, the subsidiary-level debt can always be switched to the parent-level debt with a potential improvement. When only the parent-level debt is used, the subsidiary-level standard debt contract will not be preferred since the parent-level debt contract is the optimal contract for the parent company. As a result, the parent-level debt will always be used in equilibrium because of the diversification benefit. □

A.3 The Expected Returns of the Home Lender and Parent Company

Based on the parent-level debt contract described in Section 3.2.1, the expected share of I_tR_t for the home lender, $\Omega_t^h = \Omega^h(\hat{\omega}_{t+1}, \hat{\omega}_{t+1}^*, \bar{\omega}_{t+1}^*)$, can be written as:

$$\begin{aligned}
\Omega_t^h = & \int_{\hat{\omega}_{t+1}}^{+\infty} \hat{\omega}_{t+1} dF(\omega_{t+1}) \\
& + \int_0^{\hat{\omega}_{t+1}^*} \int_{\bar{\omega}_{t+1}}^{\hat{\omega}_{t+1}} \bar{\omega}_{t+1} dF(\omega_{t+1}) dF(\omega_{t+1}^*) \\
& + \int_0^{\hat{\omega}_{t+1}^*} \int_0^{\bar{\omega}_{t+1}} (1-\nu)\omega_{t+1} dF(\omega_{t+1}) dF(\omega_{t+1}^*),
\end{aligned} \tag{A.12}$$

where:

$$\int_{\hat{\omega}_{t+1}}^{+\infty} \hat{\omega}_{t+1} dF(\omega_{t+1}) = \int_{\hat{\omega}_{t+1}^*}^{+\infty} \int_{\hat{\omega}_{t+1}}^{+\infty} \hat{\omega}_{t+1} dF(\omega_{t+1}) dF(\omega_{t+1}^*) + \int_0^{\hat{\omega}_{t+1}^*} \int_{\hat{\omega}_{t+1}}^{+\infty} \hat{\omega}_{t+1} dF(\omega_{t+1}) dF(\omega_{t+1}^*)$$

as $\hat{\omega}_{t+1}$ is independent with the realization of the foreign productivity draw.

The term $\int_0^{\hat{\omega}_{t+1}^*} \int_{\bar{\omega}_{t+1}}^{\hat{\omega}_{t+1}} \bar{\omega}_{t+1} dF(\omega_{t+1}) dF(\omega_{t+1}^*)$ in Equation A.12 can be expanded as:

$$\begin{aligned}
\int_0^{\hat{\omega}_{t+1}^*} \int_{\bar{\omega}_{t+1}}^{\hat{\omega}_{t+1}} \bar{\omega}_{t+1} dF(\omega_{t+1}) dF(\omega_{t+1}^*) = & \int_{\bar{\omega}_{t+1}^*}^{\hat{\omega}_{t+1}^*} \int_{\bar{\omega}_{t+1}}^{\hat{\omega}_{t+1}} \bar{\omega}_{t+1} dF(\omega_{t+1}) dF(\omega_{t+1}^*) \\
& + \int_0^{\bar{\omega}_{t+1}^*} 0 dF(\omega_{t+1}^*),
\end{aligned} \tag{A.13}$$

given $\bar{\omega}_{t+1} = \hat{\omega}_{t+1}\ \forall \omega^*_{t+1} \leq \bar{\omega}^*_{t+1}$.

The term $\int_0^{\hat{\omega}^*_{t+1}} \int_0^{\bar{\omega}_{t+1}} (1-\nu)\omega_{t+1} dF(\omega_{t+1}) dF(\omega^*_{t+1})$ in Equation A.12 can be expanded as:

$$\int_0^{\hat{\omega}^*_{t+1}} \int_0^{\bar{\omega}_{t+1}} (1-\nu)\omega_{t+1} dF(\omega_{t+1}) dF(\omega^*_{t+1}) = \int_{\bar{\omega}^*_{t+1}}^{\hat{\omega}^*_{t+1}} \int_0^{\bar{\omega}_{t+1}} (1-\nu)\omega_{t+1} dF(\omega_{t+1}) dF(\omega^*_{t+1}) + \int_0^{\bar{\omega}^*_{t+1}} \int_0^{\hat{\omega}_{t+1}} (1-\nu)\omega_{t+1} dF(\omega_{t+1}) dF(\omega^*_{t+1}) \quad \text{(A.14)}$$

for the same reason.

The expected share of $F_{t+1} I^*_t R^*_t$ for the home lender, $\Omega^f_t = \Omega^f(\hat{\omega}_{t+1}, \hat{\omega}^*_{t+1}, \bar{\omega}^*_{t+1})$, can be written as:

$$\begin{aligned}\Omega^f_t = & \int_{\hat{\omega}^*_{t+1}}^{+\infty} \int_0^{\hat{\omega}_{t+1}} \left(\hat{\omega}^*_{t+1} - \bar{\omega}^*_{t+1}\right) dF(\omega_{t+1}) dF(\omega^*_{t+1}) \\ & + \int_{\bar{\omega}^*_{t+1}}^{\hat{\omega}^*_{t+1}} \int_{\bar{\omega}_{t+1}}^{\hat{\omega}_{t+1}} \left(\omega^*_{t+1} - \bar{\omega}^*_{t+1}\right) dF(\omega_{t+1}) dF(\omega^*_{t+1}) \\ & + \int_{\bar{\omega}^*_{t+1}}^{\hat{\omega}^*_{t+1}} \int_0^{\bar{\omega}_{t+1}} (1-\nu) \left(\omega^*_{t+1} - \bar{\omega}^*_{t+1}\right) dF(\omega_{t+1}) dF(\omega^*_{t+1}).\end{aligned} \quad \text{(A.15)}$$

In both Equations A.12 and A.15, the first integral describes the expected share when either ω_{t+1} or ω^*_{t+1} is above the corresponding non-default threshold. The second integral describes the expected share when both ω_{t+1} and ω^*_{t+1} are below the non-default thresholds, but the combination of the productivity draws, $(\omega_{t+1}, \omega^*_{t+1})$, is in the non-default region. The third integral describes the expected share when $(\omega_{t+1}, \omega^*_{t+1})$ is in the default region.

Following the same logic for the home lender's shares, the expected share of $I_t R_t$ for the parent company, $\Upsilon^h_t = \Upsilon^h(\hat{\omega}_{t+1}, \hat{\omega}^*_{t+1}, \bar{\omega}^*_{t+1})$, can be written as:

$$\begin{aligned}\Upsilon^h_t = & \int_{\hat{\omega}_{t+1}}^{+\infty} \left(\omega_{t+1} - \hat{\omega}_{t+1}\right) dF(\omega_{t+1}) \\ & + \int_{\hat{\omega}^*_{t+1}}^{+\infty} \int_0^{\hat{\omega}_{t+1}} \omega_{t+1} dF(\omega_{t+1}) dF(\omega^*_{t+1}) \\ & + \int_0^{\hat{\omega}^*_{t+1}} \int_{\bar{\omega}_{t+1}}^{\hat{\omega}_{t+1}} \left(\omega_{t+1} - \bar{\omega}_{t+1}\right) dF(\omega_{t+1}) dF(\omega^*_{t+1}).\end{aligned} \quad \text{(A.16)}$$

The expected share of $F_{t+1}I_t^* R_t^*$ for the parent company, $\Upsilon_t^f = \Upsilon^f(\hat{\omega}_{t+1}, \hat{\omega}_{t+1}^*, \bar{\omega}_{t+1}^*)$, can be written as:

$$\Upsilon_t^f = \int_{\bar{\omega}_{t+1}^*}^{+\infty} \int_{\hat{\omega}_{t+1}}^{+\infty} \left(\omega_{t+1}^* - \bar{\omega}_{t+1}^*\right) dF(\omega_{t+1}) dF(\omega_{t+1}^*) + \int_{\hat{\omega}_{t+1}^*}^{+\infty} \int_{0}^{\hat{\omega}_{t+1}} \left(\omega_{t+1}^* - \hat{\omega}_{t+1}^*\right) dF(\omega_{t+1}) dF(\omega_{t+1}^*) \tag{A.17}$$

In both Equations A.16 and A.17, the first two integrals describe the expected share when either ω_{t+1} or ω_{t+1}^* is above the corresponding non-default threshold. The third integral of Equation A.16 describes the expected share when both ω_{t+1} and ω_{t+1}^* are below the non-default thresholds, but the combination of the productivity draws, $(\omega_{t+1}, \omega_{t+1}^*)$, is in the non-default region. In this case, the parent company will pay the equity received from the foreign subsidiary to the home lender according to the debt contract.

B Subsidiary-Level Debt Contract

B.1 The Binding Incentive Constraint

This appendix shows that, when the local informed capital with proper monitoring is used in equilibrium, the expected payoff to the foreign lender from monitoring increases in the foreign contractual threshold, $\bar{\omega}_{t+1}^*$. As a result, there is a minimum $\bar{\omega}_{t+1}^*$ to bind the incentive constraint for monitoring (Condition 13). The argument largely follows the framework of BGG (1999).

From Condition 13, let:

$$M(\bar{\omega}_{t+1}^*) = \Omega^*(\bar{\omega}_{t+1}^*) - \widetilde{\Omega}^*(\bar{\omega}_{t+1}^*) \tag{B.1}$$

be the expected payoff to the foreign lender from proper monitoring per unit of I_t^* with:

$$\Omega^*(\bar{\omega}_{t+1}^*) = \int_{\bar{\omega}_{t+1}^*}^{+\infty} \bar{\omega}_{t+1}^* dF(\omega_{t+1}^*) + \int_0^{\bar{\omega}_{t+1}^*} (1-\nu^*)\omega_{t+1}^* dF(\omega_{t+1}^*), \tag{B.2}$$

$$\widetilde{\Omega}^*(\bar{\omega}_{t+1}^*) = \int_{\frac{\bar{\omega}_{t+1}^*}{1-\psi^*}}^{+\infty} \bar{\omega}_{t+1}^* dF(\omega_{t+1}^*) + \int_0^{\frac{\bar{\omega}_{t+1}^*}{1-\psi^*}} (1-\nu^*)(1-\psi^*)\omega_{t+1}^* dF(\omega_{t+1}^*). \tag{B.3}$$

There is:

$$\begin{aligned}\frac{\partial M(\bar{\omega}_{t+1}^*)}{\partial \bar{\omega}_{t+1}^*} &= \frac{\partial \Omega^*(\bar{\omega}_{t+1}^*)}{\partial \bar{\omega}_{t+1}^*} - \frac{\partial \widetilde{\Omega}^*(\bar{\omega}_{t+1}^*)}{\partial \bar{\omega}_{t+1}^*} \\ &= \nu^* \frac{\bar{\omega}_{t+1}^*}{1-\psi^*} f(\frac{\bar{\omega}_{t+1}^*}{1-\psi^*}) - \nu^* \bar{\omega}_{t+1}^* f(\bar{\omega}_{t+1}^*) + F(\frac{\bar{\omega}_{t+1}^*}{1-\psi^*}) - F(\bar{\omega}_{t+1}^*) \end{aligned} \tag{B.4}$$

with:

$$\frac{\partial \Omega^*(\bar{\omega}_{t+1}^*)}{\partial \bar{\omega}_{t+1}^*} = 1 - F(\bar{\omega}_{t+1}^*) - \nu^* \bar{\omega}_{t+1}^* f(\bar{\omega}_{t+1}^*), \tag{B.5}$$

$$\frac{\partial \widetilde{\Omega}^*(\bar{\omega}_{t+1}^*)}{\partial \bar{\omega}_{t+1}^*} = \frac{\partial \Omega^*\left(\frac{\bar{\omega}_{t+1}^*}{1-\psi^*}\right)}{\partial \left(\frac{\bar{\omega}_{t+1}^*}{1-\psi^*}\right)} = 1 - F(\frac{\bar{\omega}_{t+1}^*}{1-\psi^*}) - \nu^* \frac{\bar{\omega}_{t+1}^*}{1-\psi^*} f(\frac{\bar{\omega}_{t+1}^*}{1-\psi^*}). \tag{B.6}$$

Equation B.5 implies that a rise in $\bar{\omega}_{t+1}^*$ has two opposite effects on the lender's expected return. A higher $\bar{\omega}_{t+1}^*$ increases the lender's payoff when the foreign subsidiary does not default, as reflected by the term $1 - F(\bar{\omega}_{t+1}^*) > 0$. Meanwhile, a higher $\bar{\omega}_{t+1}^*$ raises the probability of default, which reduces the lender's expected payoff due to the default loss, as reflected by the term $-\nu^* \bar{\omega}_{t+1}^* f(\bar{\omega}_{t+1}^*) < 0$. To discuss when $\partial \Omega^*(\bar{\omega}_{t+1}^*)/\partial \bar{\omega}_{t+1}^* > 0$, one can rewrite Equation B.5 as:

$$\frac{\partial \Omega^*(\bar{\omega}_{t+1}^*)}{\partial \bar{\omega}_{t+1}^*} = \left(1 - F(\bar{\omega}_{t+1}^*)\right)\left[1 - \nu^* \bar{\omega}_{t+1}^* h(\bar{\omega}_{t+1}^*)\right], \tag{B.7}$$

where the hazard rate $h(\bar{\omega}_{t+1}^*) \equiv f(\bar{\omega}_{t+1}^*)/\left(1 - F(\bar{\omega}_{t+1}^*)\right)$.

Because the log-normally distributed productivity draw satisfies the regularity condition:

$$\frac{\partial \left(\bar{\omega}_{t+1}^* h(\bar{\omega}_{t+1}^*)\right)}{\partial \bar{\omega}_{t+1}^*} > 0, \tag{B.8}$$

there exists a $\bar{\omega}^{*\max}_{t+1}$ such that:

$$\left(1 - F(\bar{\omega}^*_{t+1})\right)\left[1 - \nu^*\bar{\omega}^*_{t+1}h(\bar{\omega}^*_{t+1})\right] \gtreqless 0 \text{ for } \bar{\omega}^*_{t+1} \lesseqgtr \bar{\omega}^{*\max}_{t+1}. \tag{B.9}$$

Condition B.9 indicates that $\Omega^*(\bar{\omega}^*_{t+1})$ reaches a global maximum at an unique, interior value of $\bar{\omega}^*_{t+1}$.[2] If the foreign project has an insufficient R^*_t, with which no $\bar{\omega}^*_{t+1}$ exists to meet the foreign lender's required rate of return, the foreign subsidiary is rationed from the capital market and there will be $D^*_t = 0$ in the equilibrium. To allow a possible usage of the informed capital with proper monitoring, I focus on the case where the foreign project is productive enough so that there is $\bar{\omega}^*_{t+1} < \bar{\omega}^{*\max}_{t+1}$ in the equilibrium, consistent with BGG (1999).

Taking the derivative of Equation B.7 yields:

$$\frac{\partial^2\Omega^*(\bar{\omega}^*_{t+1})}{\left(\partial\bar{\omega}^*_{t+1}\right)^2} = -f(\bar{\omega}^*_{t+1})\left(1 - \nu^*\bar{\omega}^*_{t+1}h(\bar{\omega}^*_{t+1})\right) - \left(1 - F(\bar{\omega}^*_{t+1})\right)\nu^*\frac{\partial\left(\bar{\omega}^*_{t+1}h(\bar{\omega}^*_{t+1})\right)}{\partial\bar{\omega}^*_{t+1}}. \tag{B.10}$$

It follows that $\Omega^*(\bar{\omega}^*_{t+1})$ is increasing and strictly concave for $\bar{\omega}^*_{t+1} \leq \bar{\omega}^{*\max}_{t+1}$. Therefore, when $\bar{\omega}^*_{t+1} < \frac{\bar{\omega}^*_{t+1}}{1-\psi^*} \leq \bar{\omega}^{*\max}_{t+1}$, there is:

$$\frac{\partial\Omega^*(\bar{\omega}^*_{t+1})}{\partial\bar{\omega}^*_{t+1}} > \frac{\partial\Omega^*(\frac{\bar{\omega}^*_{t+1}}{1-\psi^*})}{\partial\frac{\bar{\omega}^*_{t+1}}{1-\psi^*}} = \frac{\partial\widetilde{\Omega}^*(\bar{\omega}^*_{t+1})}{\partial\bar{\omega}^*_{t+1}} \tag{B.11}$$

by the strict concavity. When $\bar{\omega}^*_{t+1} \leq \bar{\omega}^{*\max}_{t+1} < \frac{\bar{\omega}^*_{t+1}}{1-\psi^*}$, there is:

$$\frac{\partial\Omega^*(\bar{\omega}^*_{t+1})}{\partial\bar{\omega}^*_{t+1}} > 0 > \frac{\partial\Omega^*(\frac{\bar{\omega}^*_{t+1}}{1-\psi^*})}{\partial\frac{\bar{\omega}^*_{t+1}}{1-\psi^*}} = \frac{\partial\widetilde{\Omega}^*(\bar{\omega}^*_{t+1})}{\partial\bar{\omega}^*_{t+1}} \tag{B.12}$$

by the global maximum. In conclusion, when the local informed capital with proper monitoring is used in equilibrium:

$$\frac{\partial M(\bar{\omega}^*_{t+1})}{\partial\bar{\omega}^*_{t+1}} = \frac{\partial\Omega^*(\bar{\omega}^*_{t+1})}{\partial\bar{\omega}^*_{t+1}} - \frac{\partial\widetilde{\Omega}^*(\bar{\omega}^*_{t+1})}{\partial\bar{\omega}^*_{t+1}} > 0. \tag{B.13}$$

[2]The regularity condition is generally applicable to any monotonically increasing transformation of the normal distribution.

There is a minimum $\bar{\omega}^*_{t+1}$ required by the foreign lender to satisfy the incentive constraint so that it binds.

B.2 Informed Capital without Proper Monitoring

This appendix explains the potential optimal usage of the subsidiary-level informed capital without proper monitoring, and how it can enhance the incentives to use the parent-level debt with $T_t > 0$. To start with, consider any case where the home and foreign projects are productive enough so that the parent company would like to use the parent-level debt to fund $I_t > 0$ and $I^*_t > 0$.[3] The question is whether it could be optimal for the parent company to substitute some parent-level debt with the subsidiary-level debt to fund the same I_t and I^*_t. Since the substitution will not affect the private benefit of the foreign subsidiary, we can simplify the notations by assuming $\psi^* = 0$. This can save us from carrying the additional default threshold of the informed capital with proper monitoring when applying the same argument.

Let $\hat{\omega}_{t+1}$, $\hat{\omega}^*_{t+1}$, and $\bar{\omega}_{t+1}$ be the contractual thresholds of the original parent-level debt contract. A substitution is optimal when the joint expected payoff to the parent company and home lender experience a net increase after substituting the subsidiary-level debt for D^{u*}_t units of the parent-level debt in Foreign's currency without changing the original parent-level debt contract offered to the home lender to fund the same I_t and I^*_t. Define the net gain from this substitution as $G(\bar{\omega}^*_{t+1})$, we have:

$$G(\bar{\omega}^*_{t+1}) = D^{u*}_{t+1}(1 + r^{rf*}_{t+1}) - L(\bar{\omega}^*_{t+1}). \tag{B.14}$$

$\bar{\omega}^*_{t+1}$ is the default threshold of the newly added subsidiary-level debt. $L(\bar{\omega}^*_{t+1})$ denotes the loss of the expected payoff from the original parent-level debt contract after adding the subsidiary-level debt. $D^{u*}_{t+1}(1 + r^{rf*}_{t+1})$ is the gain for the home lender from lending D^{u*}_t units less but being offered the same contract. Note that $\hat{\omega}_{t+1}$, $\hat{\omega}^*_{t+1}$, and $\bar{\omega}_{t+1}$ are the contractual thresholds of the original parent-level debt contract contract. They are independent with the default threshold of the newly added subsidiary-level debt, $\bar{\omega}^*_{t+1}$.

[3] Appendix A.2 explains that if the parent company uses only the parent-level debt or the subsidiary-level informed capital without proper monitoring to fund I_t and I^*_t, the parent-level debt is always preferred.

The newly added subsidiary-level debt will be priced according to the participation constraint for the foreign lender in equilibrium as:

$$\left(\int_0^{\bar{\omega}^*_{t+1}} (1-\nu^*)\omega^*_{t+1} dF(\omega^*_{t+1}) + \int_{\bar{\omega}^*_{t+1}}^{+\infty} \bar{\omega}^*_{t+1} dF(\omega^*_{t+1})\right) I^*_t R^*_t = D^{u*}_t(1+r^{rf*}_{t+1}) + s^* I^*_t. \quad \text{(B.15)}$$

When substituting the subsidiary-level debt for D^{u*}_t units of the parent-level debt so that $\bar{\omega}^*_{t+1} \leq \hat{\omega}^*_{t+1}$, the loss of the expected payoff from the original parent-level debt contract is:

$$\begin{aligned} L(\bar{\omega}^*_{t+1}) = &\left[\int_0^{\bar{\omega}^*_{t+1}} \int_{\bar{\omega}_{t+1}}^{+\infty} \omega^*_{t+1} dF(\omega_{t+1}) dF(\omega^*_{t+1}) + \int_0^{\bar{\omega}^*_{t+1}} \int_0^{\bar{\omega}_{t+1}} (1-\nu)\omega^*_{t+1} dF(\omega_{t+1}) dF(\omega^*_{t+1})\right] I^*_t R^*_t + \\ &\left[\int_{\bar{\omega}^*_{t+1}}^{\hat{\omega}^*_{t+1}} \int_{\bar{\omega}_{t+1}}^{+\infty} \bar{\omega}^*_{t+1} dF(\omega_{t+1}) dF(\omega^*_{t+1}) + \int_{\bar{\omega}^*_{t+1}}^{\hat{\omega}^*_{t+1}} \int_0^{\bar{\omega}_{t+1}} (1-\nu)\bar{\omega}^*_{t+1} dF(\omega_{t+1}) dF(\omega^*_{t+1})\right] I^*_t R^*_t + \\ &\int_{\hat{\omega}^*_{t+1}}^{+\infty} \bar{\omega}^*_{t+1} dF(\omega^*_{t+1}) I^*_t R^*_t. \end{aligned} \quad \text{(B.16)}$$

By Equation B.15, there is:

$$\begin{aligned} L(\bar{\omega}^*_{t+1}) = &\left[\int_0^{\bar{\omega}^*_{t+1}} \nu^*\omega^*_{t+1} dF(\omega^*_{t+1}) - \int_0^{\bar{\omega}^*_{t+1}} \int_0^{\bar{\omega}_{t+1}} \nu\omega^*_{t+1} dF(\omega_{t+1}) dF(\omega^*_{t+1})\right] I^*_t R^*_t \\ &+ D^{u*}_t(1+r^{rf*}_{t+1}) + s^* I^*_{t+1} - \int_{\bar{\omega}^*_{t+1}}^{\hat{\omega}^*_{t+1}} \int_0^{\bar{\omega}_{t+1}} \nu\bar{\omega}^*_{t+1} dF(\omega_{t+1}) dF(\omega^*_{t+1}) I^*_t R^*_t. \end{aligned} \quad \text{(B.17)}$$

The net gain from the substitution is therefore:

$$\begin{aligned} G(\bar{\omega}^*_{t+1}) = &\int_{\bar{\omega}^*_{t+1}}^{\hat{\omega}^*_{t+1}} \int_0^{\bar{\omega}_{t+1}} \nu\bar{\omega}^*_{t+1} dF(\omega_{t+1}) dF(\omega^*_{t+1}) I^*_t R^*_t - s^* I^*_t \\ &- \left[\int_0^{\bar{\omega}^*_{t+1}} \nu^*\omega^*_{t+1} dF(\omega^*_{t+1}) - \int_0^{\bar{\omega}^*_{t+1}} \int_0^{\bar{\omega}_{t+1}} \nu\omega^*_{t+1} dF(\omega_{t+1}) dF(\omega^*_{t+1})\right] I^*_t R^*_t. \end{aligned} \quad \text{(B.18)}$$

The first term of Equation B.18 reflects a subtle benefit from the substitution. In the case of a parent-level default based on the original contract after the foreign lender getting paid in full, the default loss of the home lender can be reduced because they can know from the informed foreign lender that the realized productivity draw ω^*_{t+1} is at least above $\bar{\omega}^*_{t+1}$. Without this informational benefit, it would never be optimal to substitute the parent-level debt due to its diversification benefit. The remaining terms in Equation B.18 describe the frictions associated with the subsidiary-level debt. Specifically, the second line captures the negative tradeoff in credit risk from substituting the subsidiary-level debt with a standalone default risk for the parent-level debt with a diversification benefit. With $\nu \leq \nu^*$, there is:

$$\left[\int_0^{\bar{\omega}^*_{t+1}} \nu^* \omega^*_{t+1} dF(\omega^*_{t+1}) - \int_0^{\bar{\omega}^*_{t+1}} \int_0^{\bar{\omega}_{t+1}} \nu \omega^*_{t+1} dF(\omega_{t+1}) dF(\omega^*_{t+1})\right] I^*_t R^*_t > 0. \tag{B.19}$$

As Section 3.2.2 explains, the empirical focus of this paper is US MNEs with subsidiaries in developed economies, especially the UK, where the financial industries share a similar degree of development. I therefore assume that $\nu = \nu^*$ to reflect the similar institutional background. For US MNEs in general with subsidiaries that face a less developed financial industry, one can assume there is $\nu \leq \nu^*$ (e.g., Desai, Foley, and Forbes, 2008).

Equation B.18 suggests that it is not always optimal to substitute the subsidiary-level debt for the parent-level debt, even when the foreign lender can freely prevent a balance sheet shrinkage due to the moral hazard between the MNE and its lenders (i.e., $s^* = 0$). In fact, a substitution will not be optimal if the additional cost from taking on the standalone default risk is larger than the informational benefit drawn from the state of a parent-level default after the foreign lender getting paid in full. When the MNE has a strong diversification benefit so that a parent-level default is much less likely, which is already reasonable in reality, the usage of the additional subsidiary-level debt is not optimal. With additional frictions due to the moral hazard between the MNE and its lenders, it is clear that the MNE will not use the additional subsidiary-level debt when s^* is sufficiently high.

When the frictions associated with the subsidiary-level debt are low, the optimal level of substitution can be decided as the net gain function is strictly concave in $\bar{\omega}^*_{t+1}$. To see this, the first derivative of net gain function is:

$$\frac{\partial G(\bar{\omega}^*_{t+1})}{\partial \bar{\omega}^*_{t+1}} = \left[\int_{\bar{\omega}^*_{t+1}}^{\hat{\omega}^*_{t+1}} \int_0^{\bar{\omega}_{t+1}} \nu dF(\omega_{t+1}) dF(\omega^*_{t+1}) - \nu^* \bar{\omega}^*_{t+1} f(\bar{\omega}^*_{t+1})\right] I^*_t R^*_t. \tag{B.20}$$

When $\bar{\omega}^*_{t+1} \to 0$, $\partial G(\bar{\omega}^*_{t+1})/\partial \bar{\omega}^*_{t+1} > 0$. When $\bar{\omega}^*_{t+1} \to \hat{\omega}^*_{t+1}$, $\partial G(\bar{\omega}^*_{t+1})/\partial \bar{\omega}^*_{t+1} < 0$.

The second derivative of the net gain function is:

$$\frac{\partial^2 G(\bar{\omega}^*_{t+1})}{\partial \bar{\omega}^{*2}_{t+1}} = \left[-\int_0^{\bar{\omega}_{t+1}} \nu f(\bar{\omega}^*_{t+1}) dF(\omega) - \nu^* \frac{\partial \left[\bar{\omega}^*_{t+1} f(\bar{\omega}^*_{t+1}) \right]}{\partial \bar{\omega}^*_{t+1}} \right] I^*_t R^*_t < 0. \tag{B.21}$$

Therefore, $G(\bar{\omega}^*_{t+1})$ is strictly concave in $\bar{\omega}^*_{t+1}$ when $\bar{\omega}^*_{t+1} \leq \hat{\omega}^*_{t+1}$. For any given I_t and I^*_t funded by the parent-level debt, it is optimal to substitute the subsidiary-level debt for D^{u*}_t units of the parent-level debt so that:

$$\int_{\bar{\omega}^*_{t+1}}^{\hat{\omega}^*_{t+1}} \int_0^{\bar{\omega}_{t+1}} \nu dF(\omega_{t+1}) dF(\omega^*_{t+1}) = \nu^* \bar{\omega}^*_{t+1} f(\bar{\omega}^*_{t+1}) \tag{B.22}$$

with:

$$\bar{\omega}^*_{t+1} I^*_t R^*_t = D^{u*}_t (1 + r^{u*}_t) \tag{B.23}$$

and $G(\bar{\omega}^*_{t+1}) > 0$. $1 + r^{u*}_t$ denotes the risky return for the subsidiary-level informed capital without proper monitoring.

It can also be shown that it is not optimal to substitute the subsidiary-level debt for the parent-level debt till $\bar{\omega}^*_{t+1} > \hat{\omega}^*_{t+1}$. In this case, the net gain from the substitution is:

$$\begin{aligned} G(\bar{\omega}^*_{t+1}) = &- \left[\int_0^{\bar{\omega}^*_{t+1}} \nu^* \omega^*_{t+1} dF(\omega^*_{t+1}) - \int_0^{\hat{\omega}^*_{t+1}} \int_0^{\bar{\omega}_{t+1}} \nu \omega^*_{t+1} dF(\omega_{t+1}) dF(\omega^*_{t+1}) \right] I^*_t R^*_t \\ &- s^* I^*_t < 0. \end{aligned} \tag{B.24}$$

So far I have discussed the optimal usage of the subsidiary-level debt. I now explain its impact on the parent company's incentives to utilize the ICM. When it is optimal to substitute the subsidiary-level debt for the parent-level debt, the risk premium of the parent-level debt can be further reduced due to the informational benefit from the greater state contingency. Such benefit gives the parent company another incentive to active the ICM and internally finance the foreign subsidiary.

To best demonstrate this point, consider the case where the parent company only has the foreign project (i.e., $I^*_t > 0$ and $I_t = 0$) and is funding it with the parent-level debt.

Since there is no diversification benefit, the parent- and subsidiary-level debt are equivalent except for the additional friction $s^* \geq 0$ and default costs. In this case, the net gain from the substitution becomes:

$$G(\bar{\omega}^*_{t+1}) = \left[\int_{\bar{\omega}^*_{t+1}}^{\hat{\omega}^*_{t+1}} \nu \bar{\omega}^*_{t+1} dF(\omega^*_{t+1}) - \int_0^{\bar{\omega}^*_{t+1}} (\nu^* - \nu)\, \omega^*_{t+1} dF(\omega^*_{t+1}) \right] I^*_t R^*_t - s^* I^*_t \tag{B.25}$$

with $\bar{\omega}^*_{t+1} \leq \hat{\omega}^*_{t+1}$.[4]

Assuming for the moment that the parent- and subsidiary-level debt are identical with $s^* = 0$ and $\nu = \nu^*$, funding $I^*_t > 0$ using the parent-level debt is the same with using only the subsidiary-level debt without activating the ICM.[5] However, now there is:

$$G(\bar{\omega}^*_{t+1}) = \int_{\bar{\omega}^*_{t+1}}^{\hat{\omega}^*_{t+1}} \nu \bar{\omega}^*_{t+1} dF(\omega^*_{t+1}) I^*_t R^*_t > 0. \tag{B.26}$$

It is therefore better to active the ICM with $T_t > 0$ and use the additional subsidiary-level debt to obtain the informational benefit for the parent-level debt by making it more state contingent.

In general, the first derivative of net gain function with only the foreign project takes a similar form:

$$\frac{\partial G(\bar{\omega}^*_{t+1})}{\partial \bar{\omega}^*_{t+1}} = \left[\int_{\bar{\omega}^*_{t+1}}^{\hat{\omega}^*_{t+1}} \nu dF(\omega^*_{t+1}) - \nu^* \bar{\omega}^*_{t+1} f(\bar{\omega}^*_{t+1}) \right] I^*_t R^*_t. \tag{B.27}$$

When $\bar{\omega}^*_{t+1} \to 0$, $\partial G(\bar{\omega}^*_{t+1})/\partial \bar{\omega}^*_{t+1} > 0$. When $\bar{\omega}^*_{t+1} \to \hat{\omega}^*_{t+1}$, $\partial G(\bar{\omega}^*_{t+1})/\partial \bar{\omega}^*_{t+1} < 0$.

[4]Given that there is only the foreign project, the default threshold $\hat{\omega}^*_{t+1}$ of the parent-level debt contract is the default threshold of a standard debt contract. By offering the home lender the original parent-level debt contract after substituting the subsidiary-level debt for D^{u*}_t units of the parent-level debt, the joint expected payoff to the parent company and home lender cannot experience an increase if the default threshold of the newly added subsidiary-level debt, $\bar{\omega}^*_{t+1}$, is already above $\hat{\omega}^*_{t+1}$, provided $\nu \leq \nu^*$. The net gain from the substitution in this case is:

$$G(\bar{\omega}^*_{t+1}) = -\left[\int_0^{\bar{\omega}^*_{t+1}} \nu^* \omega^*_{t+1} dF(\omega^*_{t+1}) - \int_0^{\hat{\omega}^*_{t+1}} \nu \omega^*_{t+1} dF(\omega^*_{t+1}) \right] I^*_t R^*_t - s^* I^*_t < 0$$

with $\bar{\omega}^*_{t+1} > \hat{\omega}^*_{t+1}$.

[5]Recall that the opportunity costs of the parent- and subsidiary-level debt are equivalent in the same currency under the CIP condition (Condition 3).

The second derivative of net gain function is:

$$\frac{\partial^2 G(\bar{\omega}^*_{t+1})}{\partial \bar{\omega}^{*2}_{t+1}} = \left[-\nu f(\bar{\omega}^*_{t+1}) - \nu^* \frac{\partial \left[\bar{\omega}^*_{t+1} f(\bar{\omega}^*_{t+1}) \right]}{\partial \bar{\omega}^*_{t+1}} \right] I^*_t R^*_t < 0. \tag{B.28}$$

For any given $I^*_t > 0$ with $I_t = 0$ funded by the parent-level debt, it is optimal to substitute the subsidiary-level debt for D^{u*}_t units of the parent-level debt so that:

$$\int_{\bar{\omega}^*_{t+1}}^{\hat{\omega}^*_{t+1}} \nu dF(\omega^*_{t+1}) = \nu^* \bar{\omega}^*_{t+1} f(\bar{\omega}^*_{t+1}) \tag{B.29}$$

and $G(\bar{\omega}^*_{t+1}) > 0$.

Fixing the same $I^*_t > 0$, for any given $I^*_t > 0$ and $I_t > 0$ funded by the parent-level debt, D^{u*}_t still satisfies the participation constraint by Equation B.15. But now there is $\partial G(\bar{\omega}^*_{t+1})/\partial \bar{\omega}^*_{t+1} < 0$, instead of $\partial G(\bar{\omega}^*_{t+1})/\partial \bar{\omega}^*_{t+1} = 0$, since $\partial G(\bar{\omega}^*_{t+1})/\partial \bar{\omega}^*_{t+1}$ is reduced because of the diversification benefit from the home project by Equation B.20. Therefore, D^{u*}_t will become lower relative to the case with only $I^*_t > 0$. In other words, the existence of a diversification benefit will reduce the incentive to substitute the subsidiary-level debt for the parent-level debt due to the negative tradeoff associated with the standalone default risk, maintaining the point that there is $T_t > 0$ in equilibrium. In conclusion, the parent company has incentives to active the ICM with $T_t > 0$ when there is a diversification benefit or an informational benefit by making the parent-level debt more state contingent.

C Equilibrium Conditions

This section derives the equilibrium conditions for the lending rate of the parent-level debt, r_t, and the parent company's choices on I_t and T_t. The section also examines the impact of a marginal increase in I_t or T_t on the expected default loss and the conditions for the parent company to have a two-project equilibrium.

C.1 First Order Conditions

Given the equilibrium conditions for the foreign variables, the Lagrangian of the optimization problem from Section 3.3 is:

$$\boldsymbol{L} = \Upsilon_t^h I_t R_t + \Upsilon_t^f F_{t+1} I_t^* R_t^* + \lambda \left[\Omega_t^h I_t R_t + \Omega_t^f F_{t+1} I_t^* R_t^* - D_t(1 + r_t^{rf}) \right].$$

Appendix A.3 provides details on $\Upsilon_t^h = \Upsilon^h(\hat{\omega}_{t+1}, \hat{\omega}_{t+1}^*, \bar{\omega}_{t+1}^*)$, $\Upsilon_t^f = \Upsilon^f(\hat{\omega}_{t+1}, \hat{\omega}_{t+1}^*, \bar{\omega}_{t+1}^*)$, $\Omega_t^h = \Omega^h(\hat{\omega}_{t+1}, \hat{\omega}_{t+1}^*, \bar{\omega}_{t+1}^*)$, and $\Omega_t^f = \Omega^f(\hat{\omega}_{t+1}, \hat{\omega}_{t+1}^*, \bar{\omega}_{t+1}^*)$.

The first order condition (FOC) for r_t is:

$$\begin{aligned} \frac{\partial \boldsymbol{L}}{\partial r_t} =& \Upsilon_{\hat{\omega}_{t+1}}^h + \Upsilon_{\hat{\omega}_{t+1}^*}^h \frac{I_t R_t}{F_{t+1} I_t^* R_t^*} + \Upsilon_{\hat{\omega}_{t+1}}^f \frac{F_{t+1} I_t^* R_t^*}{I_t R_t} + \Upsilon_{\hat{\omega}_{t+1}^*}^f \\ &+ \lambda \left(\Omega_{\hat{\omega}_{t+1}}^h + \Omega_{\hat{\omega}_{t+1}^*}^h \frac{I_t R_t}{F_{t+1} I_t^* R_t^*} + \Omega_{\hat{\omega}_{t+1}}^f \frac{F_{t+1} I_t^* R_t^*}{I_t R_t} + \Omega_{\hat{\omega}_{t+1}^*}^f \right) = 0. \end{aligned} \tag{C.1}$$

Consistent with BGG (1999), λ reflects the increase of the cost of funds due to the expected default loss. It prescribes the additional shares of the returns the parent company needs to compensate the home lender due to the existence of the default cost ν:

$$\lambda = -\frac{\Upsilon_{\hat{\omega}_{t+1}}^h + \Upsilon_{\hat{\omega}_{t+1}^*}^h \frac{I_t R_t}{F_{t+1} I_t^* R_t^*} + \Upsilon_{\hat{\omega}_{t+1}}^f \frac{F_{t+1} I_t^* R_t^*}{I_t R_t} + \Upsilon_{\hat{\omega}_{t+1}^*}^f}{\Omega_{\hat{\omega}_{t+1}}^h + \Omega_{\hat{\omega}_{t+1}^*}^h \frac{I_t R_t}{F_{t+1} I_t^* R_t^*} + \Omega_{\hat{\omega}_{t+1}}^f \frac{F_{t+1} I_t^* R_t^*}{I_t R_t} + \Omega_{\hat{\omega}_{t+1}^*}^f} > 1. \tag{C.2}$$

with:

$$\Upsilon^h_{\hat\omega_{t+1}} + \Omega^h_{\hat\omega_{t+1}} = -\nu \int_0^{\hat\omega^*_{t+1}} \bar\omega_{t+1} f(\bar\omega_{t+1}) \frac{\partial \bar\omega_{t+1}}{\partial \hat\omega_{t+1}} dF(\omega^*_{t+1}) < 0, \tag{C.3}$$

$$\begin{aligned}\Upsilon^h_{\hat\omega^*_{t+1}} + \Omega^h_{\hat\omega^*_{t+1}} =& -\nu f(\hat\omega^*_{t+1}) \int_0^{\bar\omega_{t+1}} \omega_{t+1} dF(\omega_{t+1}) \\ &- \nu \int_0^{\hat\omega^*_{t+1}} \bar\omega_{t+1} f(\bar\omega_{t+1}) \frac{\partial \bar\omega_{t+1}}{\partial \hat\omega^*_{t+1}} dF(\omega^*_{t+1}) < 0,\end{aligned} \tag{C.4}$$

$$\Upsilon^f_{\hat\omega_{t+1}} + \Omega^f_{\hat\omega_{t+1}} = -\nu \int_{\bar\omega^*_{t+1}}^{\hat\omega^*_{t+1}} (\omega^*_{t+1} - \bar\omega^*_{t+1}) f(\bar\omega_{t+1}) \frac{\partial \bar\omega_{t+1}}{\partial \hat\omega_{t+1}} dF(\omega^*_{t+1}) < 0, \tag{C.5}$$

$$\begin{aligned}\Upsilon^f_{\hat\omega^*_{t+1}} + \Omega^f_{\hat\omega^*_{t+1}} =& -\nu \int_0^{\bar\omega_{t+1}} (\hat\omega^*_{t+1} - \bar\omega^*_{t+1}) f(\hat\omega^*_{t+1}) dF(\omega_{t+1}) < 0 \\ &- \nu \int_{\bar\omega^*_{t+1}}^{\hat\omega^*_{t+1}} (\omega^*_{t+1} - \bar\omega^*_{t+1}) f(\bar\omega_{t+1}) \frac{\partial \bar\omega_{t+1}}{\partial \hat\omega^*_{t+1}} dF(\omega^*_{t+1}) < 0,\end{aligned} \tag{C.6}$$

where:

$$\frac{\partial \bar\omega_{t+1}}{\partial \hat\omega_{t+1}} = 1 - \frac{(\omega^*_{t+1} - \bar\omega^*_{t+1})}{(\hat\omega^*_{t+1} - \bar\omega^*_{t+1})} \mathbf{1}(\omega^*_{t+1} \geq \bar\omega^*_{t+1}) > 0, \forall \omega^*_{t+1} < \hat\omega^*_{t+1}, \tag{C.7}$$

$$\frac{\partial \bar\omega_{t+1}}{\partial \hat\omega^*_{t+1}} = \frac{\hat\omega_{t+1}(\omega^*_{t+1} - \bar\omega^*_{t+1})}{(\hat\omega^*_{t+1} - \bar\omega^*_{t+1})^2} \mathbf{1}(\omega^*_{t+1} \geq \bar\omega^*_{t+1}) \geq 0, \forall \omega^*_{t+1} < \hat\omega^*_{t+1}. \tag{C.8}$$

When $\nu = 0$:

$$\begin{aligned}&-\left(\Upsilon^h_{\hat\omega_{t+1}} + \Upsilon^h_{\hat\omega^*_{t+1}} \frac{I_t R_t}{F_{t+1} I^*_t R^*_t} + \Upsilon^f_{\hat\omega_{t+1}} \frac{F_{t+1} I^*_t R^*_t}{I_t R_t} + \Upsilon^f_{\hat\omega^*_{t+1}}\right) \\ &= \left(\Omega^h_{\hat\omega_{t+1}} + \Omega^h_{\hat\omega^*_{t+1}} \frac{I_t R_t}{F_{t+1} I^*_t R^*_t} + \Omega^f_{\hat\omega_{t+1}} \frac{F_{t+1} I^*_t R^*_t}{I_t R_t} + \Omega^f_{\hat\omega^*_{t+1}}\right) > 0.\end{aligned} \tag{C.9}$$

The FOC for I_t is:

$$\frac{\partial \boldsymbol{L}}{\partial I_t} = \Upsilon^h_t R_t + \delta^I_t - \lambda \left[(1 + r^{rf}_t) - \Omega^h_t R_t\right] = 0. \tag{C.10}$$

δ_t^I captures the diversification effect from a marginal increase in I_t with:

$$\begin{aligned}\delta_t^I = & \left[(\Upsilon^h_{\hat{\omega}_{t+1}} + \lambda\Omega^h_{\hat{\omega}_{t+1}})\frac{\partial\hat{\omega}_{t+1}}{\partial I_t} + (\Upsilon^h_{\hat{\omega}^*_{t+1}} + \lambda\Omega^h_{\hat{\omega}^*_{t+1}})\frac{\partial\hat{\omega}^*_{t+1}}{\partial I_t}\right] I_t R_t \\ & + \left[(\Upsilon^f_{\hat{\omega}_{t+1}} + \lambda\Omega^f_{\hat{\omega}_{t+1}})\frac{\partial\hat{\omega}_{t+1}}{\partial I_t} + (\Upsilon^f_{\hat{\omega}^*_{t+1}} + \lambda\Omega^f_{\hat{\omega}^*_{t+1}})\frac{\partial\hat{\omega}^*_{t+1}}{\partial I_t}\right] F_{t+1} I_t^* R_t^*,\end{aligned} \tag{C.11}$$

where:

$$\frac{\partial\hat{\omega}_{t+1}}{\partial I_t} = -\frac{(T_t - A_t)(1+r_t)}{I_t^2 R_t}, \tag{C.12}$$

$$\frac{\partial\hat{\omega}^*_{t+1}}{\partial I_t} = \frac{(1+r_t)}{F_{t+1} I_t^* R_t^*}. \tag{C.13}$$

Similarly, the FOC for T_t is:

$$\frac{\partial \boldsymbol{L}}{\partial T_t} = \Upsilon_t^f \frac{F_{t+1}}{S_t \Lambda\left(\bar{\omega}^*_{t+1}\right)} R_t^* + \delta_t^T - \lambda\left[(1+r_t^{rf}) - \Omega_t^f \frac{F_{t+1}}{S_t\Lambda\left(\bar{\omega}^*_{t+1}\right)} R_t^*\right] = 0. \tag{C.14}$$

δ_t^T captures the diversification effect from a marginal increase in T_t with:

$$\begin{aligned}\delta_t^T = & \left[(\Upsilon^h_{\hat{\omega}_{t+1}} + \lambda\Omega^h_{\hat{\omega}_{t+1}})\frac{\partial\hat{\omega}_{t+1}}{\partial T_t} + (\Upsilon^h_{\hat{\omega}^*_{t+1}} + \lambda\Omega^h_{\hat{\omega}^*_{t+1}})\frac{\partial\hat{\omega}^*_{t+1}}{\partial T_t}\right] I_t R_t \\ & + \left[(\Upsilon^f_{\hat{\omega}_{t+1}} + \lambda\Omega^f_{\hat{\omega}_{t+1}})\frac{\partial\hat{\omega}_{t+1}}{\partial T_t} + (\Upsilon^f_{\hat{\omega}^*_{t+1}} + \lambda\Omega^f_{\hat{\omega}^*_{t+1}})\frac{\partial\hat{\omega}^*_{t+1}}{\partial T_t}\right] F_{t+1} I_t^* R_t^*.\end{aligned} \tag{C.15}$$

where:

$$\frac{\partial\hat{\omega}_{t+1}}{\partial T_t} = \frac{(1+r_t)}{I_t R_t}, \tag{C.16}$$

$$\frac{\partial\hat{\omega}^*_{t+1}}{\partial T_t} = -\frac{(I_t - A_t)(1+r_t) S_t \Lambda\left(\bar{\omega}^*_{t+1}\right)}{F_{t+1} T_t^2 R_t^*}. \tag{C.17}$$

C.2 Investments and the Expected Default Loss

Conditions C.10 and C.14 suggest that a marginal increase in I_t or T_t affects the expected default loss through both changing the relative size of the projects (the diversification effect) and lifting the leverage. Let η_t denote the expected default loss of the home lender:

$$\eta_t = \int_{\bar{\omega}^*_{t+1}}^{\hat{\omega}^*_{t+1}} \int_0^{\bar{\omega}_{t+1}} \nu \left(\omega^*_{t+1} - \bar{\omega}^*_{t+1}\right) dF(\omega_{t+1}) dF(\omega^*_{t+1}) F_{t+1} I^*_t R^*_t + \int_0^{\hat{\omega}^*_{t+1}} \int_0^{\bar{\omega}_{t+1}} \nu \omega_{t+1} dF(\omega_{t+1}) dF(\omega^*_{t+1}) I_t R_t. \tag{C.18}$$

The impact of a marginal increase in I_t on η_t is:

$$\frac{d\eta_t}{dI_t} = \frac{\partial \eta_t}{\partial \hat{\omega}_{t+1}} \frac{\partial \hat{\omega}_{t+1}}{\partial I_t} + \frac{\partial \eta_t}{\partial \hat{\omega}^*_{t+1}} \frac{\partial \hat{\omega}^*_{t+1}}{\partial I_t} + \frac{\partial \eta_t}{\partial I_t R_t} \frac{\partial I_t R_t}{\partial I_t} \tag{C.19}$$

with:

$$\frac{\partial \eta_t}{\partial \hat{\omega}_{t+1}} = -\left(\Upsilon^f_{\hat{\omega}_{t+1}} + \Omega^f_{\hat{\omega}_{t+1}}\right) F_{t+1} I^*_t R^*_t - \left(\Upsilon^h_{\hat{\omega}_{t+1}} + \Omega^h_{\hat{\omega}_{t+1}}\right) I_t R_t > 0, \tag{C.20}$$

$$\frac{\partial \eta_t}{\partial \hat{\omega}^*_{t+1}} = -\left(\Upsilon^f_{\hat{\omega}^*_{t+1}} + \Omega^f_{\hat{\omega}^*_{t+1}}\right) F_{t+1} I^*_t R^*_t - \left(\Upsilon^h_{\hat{\omega}^*_{t+1}} + \Omega^h_{\hat{\omega}^*_{t+1}}\right) I_t R_t > 0, \tag{C.21}$$

$$\frac{\partial \eta_t}{\partial I_t R_t} \frac{\partial I_t R_t}{\partial I_t} = \int_0^{\hat{\omega}^*_{t+1}} \int_0^{\bar{\omega}_{t+1}} \nu \omega_{t+1} dF(\omega_{t+1}) dF(\omega^*_{t+1}) R_t > 0. \tag{C.22}$$

The first term in Equation C.19, $(\partial \eta_t / \partial \hat{\omega}_{t+1}) (\partial \hat{\omega}_{t+1} / \partial I_t)$, can reflect a diversification benefit. The diversification benefit exists when $\partial \hat{\omega}_{t+1} / \partial I_t < 0$ following Equation C.12, assuming the foreign project is productive enough so that $T_t - A_t > 0$ in equilibrium for the capital constrained MNE. Equation C.12 also shows that the diversification benefit from expanding I_t is large when the home project is relatively small compared with the foreign project (i.e., $(T_t - A_t)/I_t$ is large). More importantly, Equation C.12 demonstrates that the diversification benefit diminishes in I_t, conditioning on $(T_t - A_t)/I_t$.

The rest of the terms in Equation C.19 contribute to a rise in η_t. The second term $\left(\partial \eta_t / \partial \hat{\omega}^*_{t+1}\right) \left(\partial \hat{\omega}^*_{t+1} / \partial I_t\right) > 0$ as $\partial \hat{\omega}^*_{t+1} / \partial I_t > 0$ from Equation C.13. It captures the effect that a larger I_t makes it more difficult to use the foreign return to serve D_t. The last term $(\partial \eta_t / \partial I_t R_t) \ (\partial I_t R_t / \partial I_t) > 0$ reflects the impact of enlarging I_t from lifting the leverage. Since the diversification benefit diminishes in I_t, conditioning on $(T_t - A_t)/I_t$, a marginal increase in I_t eventually raises the cost of funds via $d\eta_t / dI_t > 0$.

The impact of a marginal increase in T_t on η_t can also be examined as:

$$\frac{d\eta_t}{dT_t} = \frac{\partial \eta_t}{\partial \hat{\omega}_{t+1}} \frac{\partial \hat{\omega}_{t+1}}{\partial T_t} + \frac{\partial \eta_t}{\partial \hat{\omega}^*_{t+1}} \frac{\partial \hat{\omega}^*_{t+1}}{\partial T_t} + \frac{\partial \eta_t}{\partial F_{t+1} I^*_t R^*_t} \frac{\partial F_{t+1} I^*_t R^*_t}{\partial T_t} \tag{C.23}$$

with $\partial \eta_t / \partial \hat{\omega}_{t+1} > 0$ and $\partial \eta_t / \partial \hat{\omega}^*_{t+1} > 0$ by Equations C.20 and C.21, and:

$$\begin{aligned} \frac{\partial \eta_t}{\partial F_{t+1} I^*_t R^*_t} \frac{\partial F_{t+1} I^*_t R^*_t}{\partial T_t} = & \int_{\bar{\omega}^*_{t+1}}^{\hat{\omega}^*_{t+1}} \int_0^{\bar{\omega}_{t+1}} \nu \left(\omega^*_{t+1} - \bar{\omega}^*_{t+1} \right) dF(\omega_{t+1}) dF(\omega^*_{t+1}) \\ & \frac{F_{t+1} R^*_t}{S_t \Lambda \left(\bar{\omega}^*_{t+1} \right)} > 0. \end{aligned} \tag{C.24}$$

Similar to the case of I_t, the second term in Equation C.23, $\left(\partial \eta_t / \partial \hat{\omega}^*_{t+1} \right) \left(\partial \hat{\omega}^*_{t+1} / \partial T_t \right)$, can reflect a diversification benefit. The diversification benefit exists when $\partial \hat{\omega}^*_{t+1} / \partial T_t < 0$ following Equation C.17, assuming the home project is productive enough so that $I_t - A_t > 0$ in equilibrium for the capital constrained MNE. Like the previous case, the diversification benefit from expanding T_t is large when the foreign project is relatively small compared with the home project. The diversification benefit also diminishes in T_t, conditioning on the relative size of the projects.

The first term in Equation C.23 captures the effect that a larger T_t makes it more difficult to use the home return to serve D_t with $\partial \hat{\omega}_{t+1} / \partial T_t > 0$ from Equation C.16. The last term in Equation C.23 reflects the impact of enlarging T_t with a higher leverage. Since the diversification benefit diminishes in T_t, conditioning on the relative size of the projects, a marginal increase in T_t eventually raises the cost of funds via $d\eta_t / dT_t > 0$.

C.3 Conditions for a Two-Project Equilibrium

Based on the equilibrium conditions, I now study when it is optimal for the parent company to have $I_t > 0$ and $T_t > 0$ in equilibrium. To begin with, when $T_t \to 0$ for a given $I_t > 0$, there are $\hat{\omega}^*_{t+1} \to +\infty$ and $\hat{\omega}_{t+1} = \bar{\omega}_{t+1}$ by the parent-level debt contract. Appendix

A.3 provides the definitions of Υ_t^h, Υ_t^f, Ω_t^h, and Ω_t^f, from which one can derive:

$$\Upsilon^h_{\hat{\omega}_{t+1}} \to F(\hat{\omega}_{t+1}) - 1, \quad \Omega^h_{\hat{\omega}_{t+1}} \to 1 - F(\hat{\omega}_{t+1}) - \nu\hat{\omega}_{t+1} f(\hat{\omega}_{t+1}), \tag{C.25}$$

$$\Upsilon^h_{\hat{\omega}^*_{t+1}} \to 0, \quad \Omega^h_{\hat{\omega}^*_{t+1}} \to 0, \tag{C.26}$$

$$\Upsilon^f_{\hat{\omega}^*_{t+1}} \to 0, \quad \Omega^f_{\hat{\omega}^*_{t+1}} \to 0. \tag{C.27}$$

Conditions C.26 and C.27, combined with $T_t \to 0$, imply that the Lagrangian multiplier, λ, becomes:

$$\lambda = -\frac{\Upsilon^h_{\hat{\omega}_{t+1}}}{\Omega^h_{\hat{\omega}_{t+1}}} = -\frac{\Upsilon^h_{\bar{\omega}_{t+1}}}{\Omega^h_{\bar{\omega}_{t+1}}} = \frac{1 - F(\hat{\omega}_{t+1})}{1 - F(\hat{\omega}_{t+1}) - \nu\hat{\omega}_{t+1} f(\hat{\omega}_{t+1})} > 1, \tag{C.28}$$

which is equivalent to that of BGG (1999) with only one project in the equilibrium.[6]

Applying the changes to Equations C.11 and C.15, it follows that $\delta_t^I \to 0$ and $\delta_t^T \to 0$ when the equilibrium converges to a one-project equilibrium.[7] The FOC for I_t becomes:

$$\Upsilon_t^h R_t = \lambda \left[(1 + r_t^{rf}) - \Omega_t^h R_t \right]. \tag{C.29}$$

The FOC for T_t becomes:

$$\Upsilon_t^f \frac{F_{t+1}}{S_t \Lambda\left(\bar{\omega}^*_{t+1}\right)} R_t^* = \lambda \left[(1 + r_t^{rf}) - \Omega_t^f \frac{F_{t+1}}{S_t \Lambda\left(\bar{\omega}^*_{t+1}\right)} R_t^* \right], \tag{C.30}$$

where the expected shares of the return for any $T_t > 0$ converges to:

$$\Upsilon_t^f = \Upsilon^f(\hat{\omega}_{t+1}, \bar{\omega}^*_{t+1}) = \int_{\bar{\omega}^*_{t+1}}^{+\infty} \left(\omega^*_{t+1} - \bar{\omega}^*_{t+1}\right) dF(\omega^*_{t+1})(1 - F(\hat{\omega}_{t+1})), \tag{C.31}$$

$$\Omega_t^f = \Omega^f(\hat{\omega}_{t+1}, \bar{\omega}^*_{t+1}) = \int_{\bar{\omega}^*_{t+1}}^{+\infty} (1-\nu) \left(\omega^*_{t+1} - \bar{\omega}^*_{t+1}\right) dF(\omega^*_{t+1}) F(\hat{\omega}_{t+1}). \tag{C.32}$$

Substituting Equations C.31 and C.32 to Equation C.30, it is thus optimal for the parent

[6] I focus on the case where the home project won't be individually rationed from the capital market, which entails that $\Omega^h_{\hat{\omega}_{t+1}} = 1 - F(\hat{\omega}_{t+1}) - \nu\hat{\omega}_{t+1} f(\hat{\omega}_{t+1}) > 0$, as explained by BGG (1999).

[7] Specifically, as $T_t \to 0$, $I_t^* \to 0$ by Condition 24, $\Upsilon^h_{\hat{\omega}_{t+1}} + \lambda\Omega^h_{\hat{\omega}_{t+1}} \to 0$, $\Upsilon^h_{\hat{\omega}^*_{t+1}} \to 0$, and $\Omega^h_{\hat{\omega}^*_{t+1}} \to 0$.

company to have $T_t > 0$ in this case when the foreign project has a large enough R_t^*:

$$\int_{\bar{\omega}_{t+1}^*}^{+\infty} \left(\omega_{t+1}^* - \bar{\omega}_{t+1}^*\right) dF(\omega_{t+1}^*) \frac{F_{t+1}R_t^*}{S_t\Lambda\left(\bar{\omega}_{t+1}^*\right)} > \frac{(1+r_t^{rf})}{1-\nu F(\hat{\omega}_{t+1}) - \nu\hat{\omega}_{t+1}f(\hat{\omega}_{t+1})}. \tag{C.33}$$

The analysis when $I_t \to 0$ for a given $T_t > 0$ is similar. As $I_t \to 0$, $\hat{\omega}_{t+1} \to +\infty$ by the parent-level debt contract. It can be derived from the definitions of Υ_t^h, Υ_t^f, Ω_t^h, and Ω_t^f that:

$$\Upsilon_{\hat{\omega}_{t+1}^*}^f \to -1 + F(\hat{\omega}_{t+1}^*), \quad \Omega_{\hat{\omega}_{t+1}^*}^f \to 1 - F(\hat{\omega}_{t+1}^*) - \nu\left(\hat{\omega}_{t+1}^* - \bar{\omega}_{t+1}^*\right) f(\hat{\omega}_{t+1}^*), \tag{C.34}$$

$$\Upsilon_{\hat{\omega}_{t+1}}^h \to 0, \quad \Omega_{\hat{\omega}_{t+1}}^h \to 0, \tag{C.35}$$

$$\Upsilon_{\hat{\omega}_{t+1}}^f \to 0, \quad \Omega_{\hat{\omega}_{t+1}}^f \to 0. \tag{C.36}$$

Conditions C.35 and C.36, combined with $I_t \to 0$, imply that the Lagrangian multiplier, λ, becomes:

$$\lambda = -\frac{\Upsilon_{\hat{\omega}_{t+1}^*}^f}{\Omega_{\hat{\omega}_{t+1}^*}^f} = \frac{1-F(\hat{\omega}_{t+1}^*)}{1-F(\hat{\omega}_{t+1}^*) - \nu\left(\hat{\omega}_{t+1}^* - \bar{\omega}_{t+1}^*\right) f(\hat{\omega}_{t+1}^*)} > 1, \tag{C.37}$$

which is consistent to that of BGG (1999) with only one project in the equilibrium, conditioning on the potential usage of the local informed capital.[8]

Applying the changes to Equations C.11 and C.15, it also follows that $\delta_t^I \to 0$ and $\delta_t^T \to 0$ when the equilibrium converges to a one-project equilibrium.[9] As a result, The FOC for T_t becomes Condition C.30. The FOC for I_t becomes Condition C.29, where the expected shares of the return for any $I_t > 0$ converges to:

$$\Upsilon_t^h = \Upsilon^h\left(\hat{\omega}_{t+1}^*(\bar{\omega}_{t+1}^*)\right) = 1 - F(\hat{\omega}_{t+1}^*), \tag{C.38}$$

$$\Omega_t^h = \Omega^h\left(\hat{\omega}_{t+1}^*(\bar{\omega}_{t+1}^*)\right) = (1-\nu)\, F(\hat{\omega}_{t+1}^*). \tag{C.39}$$

Substituting Equations C.38 and C.39 to Equation C.29, it is thus optimal for the parent

[8]Consistent with the previous analysis, I focus on the case where the foreign project won't be individually rationed from the capital market, which entails that $1 - F(\hat{\omega}_{t+1}^*) - \nu\hat{\omega}_{t+1}^* f(\hat{\omega}_{t+1}^*) > 0$ following BGG (1999). This, of course, implies that $1 - F(\hat{\omega}_{t+1}^*) - \nu\left(\hat{\omega}_{t+1}^* - \bar{\omega}_{t+1}^*\right) f(\hat{\omega}_{t+1}^*) > 0$.

[9]Specifically, as $I_t \to 0$, $\Upsilon_{\hat{\omega}_{t+1}^*}^f + \lambda\Omega_{\hat{\omega}_{t+1}^*}^f \to 0$, $\Upsilon_{\hat{\omega}_{t+1}}^f \to 0$, and $\Omega_{\hat{\omega}_{t+1}}^f \to 0$.

company to have $I_t > 0$ in this case when the home project has a large enough R_t:

$$R_t > \frac{1 + r_t^{rf}}{1 - \nu F(\hat{\omega}^*_{t+1}) - \nu \left(\hat{\omega}^*_{t+1} - \bar{\omega}^*_{t+1}\right) f(\hat{\omega}^*_{t+1})}. \tag{C.40}$$

In conclusion, this appendix has shown that it would be optimal for the parent company to have $I_t > 0$ and $T_t > 0$ in equilibrium when both the home and foreign projects are productive enough (i.e., R_t and R^*_t are large enough).

Table D1: Parent-Level DID Analysis, Book Leverage

This table presents the results of my parent-level DID analysis with the book leverage (the ratio of total debt to total assets) as the dependent variable in all columns. Each observation in the sample is the average of the before (2014Q1-2016Q2) or after (2016Q3-2018Q4) period for a given US parent company. All models include parent-level fixed effects, which subsume the effect of the standalone treatment group dummy. The t-statistics reported in parentheses are based on robust standard errors clustered at the parent company level. Superscripts $***$, $**$, and $*$ indicate statistical significance at 1%, 5%, and 10% levels.

	(1) BookLev	(2) BookLev	(3) BookLev	(4) BookLev	(5) BookLev
After	0.017**	0.019***	0.015	0.009	0.015
	(2.463)	(2.793)	(0.789)	(0.393)	(0.785)
After×UK	0.013	0.013	0.011	0.017	0.013
	(1.572)	(1.635)	(1.177)	(1.397)	(1.304)
After×MNE				0.012	
				(0.868)	
After×EU27					0.009
					(0.544)
LnTA		-0.020	-0.019	-0.018	-0.019
		(-1.112)	(-0.958)	(-0.942)	(-0.950)
Tobin'sQ			0.001	0.001	0.001
			(0.071)	(0.072)	(0.062)
Quick			-0.019***	-0.019***	-0.019***
			(-3.025)	(-3.052)	(-3.030)
Firm-Level FE	Yes	Yes	Yes	Yes	Yes
After×Industry	No	No	Yes	Yes	Yes
Observations	2016	2016	2016	2016	2016
R-squared	0.035	0.040	0.113	0.114	0.114

Table D2: Parent-Level DID Analysis, Senior-Bond-to-Asset Ratio

This table presents the results of my parent-level DID analysis with the ratio of senior bonds to total assets as the dependent variable in all columns. Each observation in the sample is the average of the before (2014Q1-2016Q2) or after (2016Q3-2018Q4) period for a given US parent company. All models include parent-level fixed effects, which subsume the effect of the standalone treatment group dummy. The t-statistics reported in parentheses are based on robust standard errors clustered at the parent company level. Superscripts ∗∗∗, ∗∗, and ∗ indicate statistical significance at 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)
	SnrBond/TA	SnrBond/TA	SnrBond/TA	SnrBond/TA	SnrBond/TA
After	-0.003	-0.001	-0.012	-0.015	-0.012
	(-0.411)	(-0.189)	(-0.915)	(-1.012)	(-0.922)
After×UK	0.025***	0.025***	0.026***	0.029**	0.028***
	(3.063)	(3.077)	(2.870)	(2.524)	(2.830)
After×MNE				0.007	
				(0.507)	
After×EU27					0.008
					(0.569)
LnTA		-0.011	-0.011	-0.011	-0.011
		(-0.576)	(-0.522)	(-0.515)	(-0.517)
Tobin'sQ			0.004	0.004	0.003
			(0.357)	(0.358)	(0.349)
Quick			-0.012**	-0.012**	-0.012**
			(-2.324)	(-2.334)	(-2.333)
Firm-Level FE	Yes	Yes	Yes	Yes	Yes
After×Industry	No	No	Yes	Yes	Yes
Observations	2016	2016	2016	2016	2016
R-squared	0.016	0.018	0.070	0.070	0.070

Table D3: Parent-Level DID Analysis for Pre-Trends, Book Leverage

This table presents the results of my parent-level DID analysis with the book leverage (the ratio of total debt to total assets) as the dependent variable in all columns. Each observation in the sample is the average of the before (2011Q1-2013Q2) or after (2013Q3-2015Q4) period for a given US parent company. All models include parent-level fixed effects, which subsume the effect of the standalone treatment group dummy. The t-statistics reported in parentheses are based on robust standard errors clustered at the parent company level. Superscripts ∗∗∗, ∗∗, and ∗ indicate statistical significance at 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)
	BookLev	BookLev	BookLev	BookLev	BookLev
After	0.031***	0.030***	0.119***	0.117***	0.120***
	(4.194)	(3.774)	(4.556)	(4.462)	(4.436)
After×UK	0.002	0.002	0.014	0.016	0.013
	(0.246)	(0.266)	(1.320)	(1.183)	(1.134)
After×MNE				0.005	
				(0.323)	
After×EU27					-0.004
					(-0.197)
LnTA		0.004	0.006	0.006	0.006
		(0.175)	(0.238)	(0.237)	(0.238)
Tobin'sQ			-0.007	-0.007	-0.007
			(-0.552)	(-0.563)	(-0.551)
Quick			-0.002	-0.002	-0.002
			(-0.643)	(-0.647)	(-0.643)
Firm-Level FE	Yes	Yes	Yes	Yes	Yes
After×Industry	No	No	Yes	Yes	Yes
Observations	1964	1964	1964	1964	1964
R-squared	0.060	0.061	0.130	0.130	0.130

Table D4: Parent-Level DID Analysis for Pre-Trends, Senior-Bond-to-Asset Ratio

This table presents the results of my parent-level DID analysis with the ratio of senior bonds to total assets as the dependent variable in all columns. Each observation in the sample is the average of the before (2011Q1-2013Q2) or after (2013Q3-2015Q4) period for a given US parent company. All models include parent-level fixed effects, which subsume the effect of the standalone treatment group dummy. The t-statistics reported in parentheses are based on robust standard errors clustered at the parent company level. Superscripts $***$, $**$, and $*$ indicate statistical significance at 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)
	SnrBond/TA	SnrBond/TA	SnrBond/TA	SnrBond/TA	SnrBond/TA
After	0.034***	0.029***	0.059	0.055	0.057
	(5.050)	(3.853)	(1.423)	(1.376)	(1.428)
After×UK	-0.007	-0.006	0.005	0.009	0.006
	(-0.915)	(-0.811)	(0.546)	(0.652)	(0.597)
After×MNE				0.007	
				(0.510)	
After×EU27					0.006
					(0.390)
LnTA		0.024	0.025	0.025	0.025
		(1.058)	(1.079)	(1.077)	(1.077)
Tobin'sQ			-0.011	-0.011	-0.011
			(-0.952)	(-0.971)	(-0.959)
Quick			-0.000	-0.000	-0.000
			(-0.114)	(-0.122)	(-0.113)
Firm-Level FE	Yes	Yes	Yes	Yes	Yes
After×Industry	No	No	Yes	Yes	Yes
Observations	1964	1964	1964	1964	1964
R-squared	0.060	0.067	0.140	0.140	0.140

Table D5: The Effect of the Corporate Bond Purchase Programs, Book Leverage

This table presents the results of my robustness check on the corporate bond purchase programs implemented by the BoE and ECB during the Brexit interregnum. The dependent variable is the book leverage (the ratio of total debt to total assets) in all columns. Each observation in the sample is the average of the before (2014Q1-2016Q2) or after (2016Q3-2018Q4) period for a given US parent company. All models include parent-level fixed effects, which subsume the effect of the standalone treatment group dummy. The t-statistics reported in parentheses are based on robust standard errors clustered at the parent company level. Superscripts $***$, $**$, and $*$ indicate statistical significance at 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)
	BookLev	BookLev	BookLev	BookLev	BookLev
After	0.017**	0.019***	0.015	0.009	0.014
	(2.463)	(2.787)	(0.785)	(0.399)	(0.780)
After×UK	0.012	0.013	0.010	0.016	0.012
	(1.466)	(1.532)	(1.068)	(1.294)	(1.198)
After×MNE				0.011	
				(0.838)	
After×EU27					0.009
					(0.540)
LnTA		-0.020	-0.019	-0.019	-0.019
		(-1.097)	(-0.973)	(-0.957)	(-0.965)
Tobin'sQ			0.000	0.000	-0.000
			(0.001)	(0.003)	(-0.009)
Quick			-0.019***	-0.019***	-0.019***
			(-3.007)	(-3.033)	(-3.013)
Firm-Level FE	Yes	Yes	Yes	Yes	Yes
After×Industry	No	No	Yes	Yes	Yes
Observations	1990	1990	1990	1990	1990
R-squared	0.033	0.038	0.110	0.111	0.110

Table D6: The Effect of the Corporate Bond Purchase Programs, Senior-Bond-to-Asset Ratio

This table presents the results of my robustness check on the corporate bond purchase programs implemented by the BoE and ECB during the Brexit interregnum. The dependent variable is the ratio of senior bonds to total assets in all columns. Each observation in the sample is the average of the before (2014Q1-2016Q2) or after (2016Q3-2018Q4) period for a given US parent company. All models include parent-level fixed effects, which subsume the effect of the standalone treatment group dummy. The t-statistics reported in parentheses are based on robust standard errors clustered at the parent company level. Superscripts $***$, $**$, and $*$ indicate statistical significance at 1%, 5%, and 10% levels.

	(1)	(2)	(3)	(4)	(5)
	SnrBond/TA	SnrBond/TA	SnrBond/TA	SnrBond/TA	SnrBond/TA
After	-0.003	-0.001	-0.011	-0.015	-0.011
	(-0.411)	(-0.186)	(-0.905)	(-1.009)	(-0.912)
After×UK	0.025^{***}	0.025^{***}	0.026^{***}	0.030^{**}	0.028^{***}
	(3.031)	(3.046)	(2.856)	(2.529)	(2.819)
After×MNE				0.007	
				(0.523)	
After×EU27					0.008
					(0.577)
LnTA		-0.011	-0.011	-0.010	-0.010
		(-0.583)	(-0.515)	(-0.507)	(-0.510)
Tobin'sQ			0.004	0.004	0.004
			(0.403)	(0.404)	(0.395)
Quick			-0.012^{**}	-0.012^{**}	-0.012^{**}
			(-2.342)	(-2.352)	(-2.350)
Firm-Level FE	Yes	Yes	Yes	Yes	Yes
After×Industry	No	No	Yes	Yes	Yes
Observations	1990	1990	1990	1990	1990
R-squared	0.016	0.017	0.070	0.071	0.070