Roles of Global Banks in Local Asset Markets under Regulations

Sining Liu*

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Abstract

Stronger regulations in fact enhance roles of global banks as marginal investors in the local asset markets. After the Global Financial Crisis, leverages of global banks become significant in predicting asset returns in local markets where their subsidiaries are located, while are muted in pre-crisis period. This transmission of roles of global banks is motivated by the positive funding advantage in local currency for dollar lenders through the FX swap market as a consequence of tighter balance sheet constraints imposed on global banks under the Basel III framework. For global banks with higher capital requirement, the effect of funding advantage is stronger. A two-bank two-currency model is proposed to justify the empirical findings.

JEL-Classification: F31, F42, G15, G21, G28

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*Faculty of Business and Economics, The University of Hong Kong, `siningll@connect.hku.hk`.

1 Introduction

In response to the 2008 Global Financial Crisis (GFC), series of regulation standards set by the Basel Committee on Banking Supervision (BCBS) are imposed on international active banks through the Basel III framework[1]. Under the compulsory disclosure requirement and strict breaching consequences, global banks have tighter balance sheet constraints following requirements on their risk-based capital ratio, non-risk-based leverage ratio and liquidity coverage ratio. Above these, to better explore the cross-border negative externalities posed by systemically important banks, the Financial Stability Board (FSB) publishes lists of 'Global systemically important banks' (GSIBs), who not only needs to meet the common requirements under Basel III but are subject to additional loss absorbency restrictions. In this paper, I ask what are the consequences of such strong regulations on global banks especially GSIBs. I document that as a consequence of stricter regulations on global banks, there is a positive funding advantage through the FX swap market for dollar lender GSIBs to obtain local currency funding. With cheaper local currency funding, GSIBs in each country start to play significant roles in local asset markets after the GFC justified by the enhanced predictive power of their leverage ratio in local asset returns.

GSIBs are imposed with supervisions and regulations mainly through three aspects. First, international active banks have a minimum capital ratio requirement. Basel III refines the calculation of risk-weighted assets (RWA) and all banks should raise minimum Common Equity Tier 1 to at least 4.5% of RWA. In addition, a capital conservation buffer comprising common equity of 2.5% of RWA is also requested by the BCBS, together bringing the total common equity standard to 7%. If the credit growth of a bank is building up unacceptable systematic risk, another countercyclical buffer ranging from 0-2.5% of common equity will be applicable for the bank[2]. Beyond these capital requirements common to all international active banks, GSIBs are also subject to higher loss absorbency requirements ranging from 1% to 3.5%, which are the key reflections of their importance in the global economy. Second,banks must meet a 3% non-risk based leverage ratio minimum requirement at all times such that banks are required to have sufficient Tier 1 capital as percentage to their both on-

[1]Basel III mainly reports data on large international active banks that have Tier 1 capital of more than €3 billion, which are recognized as "Group 1" banks. All other banks are considered "Group 2" banks with limited coverage from member countries in the Committee. As in the Basel III Monitoring Report published in September 2022, among the whole sample of 182 banks, 117 banks are "Group 1" banks, and 65 "Group 2" banks. See https://www.bis.org/bcbs/publ/d541.htm

[2]See Basel Framework about risk-based capital requirements at https://www.bis.org/basel_framework/index.htm.

balance sheet and off-balance sheet items.[3]. GSIBs are required to meet additional leverage ratio buffer, which is set at 50% of a GSIB's higher loss absorbency risk-based requirements. For example, a GSIB subject to a 2% higher loss absorbency requirement would be subject to a 1% leverage ratio buffer requirement. Third, there is a universal liquidity requirement to international active banks including GSIBs. After the GFC, the most critical reform of the Basel III is the Liquidity Coverage Ratio (LCR) such that all international active banks are required to have adequate stock of High quality liquid assets (HQLA) which consist of cash or assets that can be converted into cash at little loss of value to meet their short-term liquidity needs. The minimum LCR requirement has reached 100% in 2019 ensuring that for the expected net cash outflows, banks should at least keep the same amount of stock of HQLA[4].

Given the aim of Basel's framework is to strengthen the risk management of banks in the global financial system, a natural question is what are the consequences of such strong regulations on global banks especially GSIBs? BCBS publishes a report to assess the long-term economic impact of stronger capital and liquidity requirements from the perspective of economic benefit and macroeconomic growth[5]. However, the effect of regulations on the functioning of these global banks in the financial system, especially local asset markets where the GSIBs and their subsidiaries are operating, remains unknown. In this paper, I investigate the roles of GSIBs of 17 advanced economies in four local asset markets: stock, the 10-year Treasury, currency and 30-year swap spread arbitrage markets in each country from the perspective of their asset pricing power. I find that in the post-crisis period, leverages of GSIBs become more significant in predicting local asset returns of countries where their subsidiaries are located while they are muted in the pre-crisis period. Taking the leverage ratio of financial intermediary as a proxy for risk aversion following the literature, I find that one standard deviation increase in the leverage ratio of GSIBs predicts higher local stock returns by 6.50%, Treasury returns by 3.30%, currency returns by 0.24% and larger arbitrage profit of the swap spread trade by 5.38 bps after the GFC.

The reason of this transition of GSIBs' roles in local asset pricing is that after the GFC GSIBs are able to fund the local currency (LC) at a lower interest rate through the FX swap market than the LC borrowing rate in the cash market. GSIBs engage in the FX swap market

[3]Leverage ratio $= \frac{\text{capital measure}}{\text{exposure measure}}$. See Basel Framework about leverage ratio at https://www.bis.org/basel_framework/index.htm.

[4]For more details, see Basel Committee, Basel III: The Liquidity Coverage Ratio and liquidity risk monitoring tools (January 2013) at www.bis.org/publ/bcbs238.htm.

[5]Known as LEI report. See https://www.bis.org/publ/bcbs173.htm.

by first shorting dollar, exchanging into LC at current exchange rate and converting back into dollar in the future at a pre-determined forward rate, the transaction of which expands the balance sheet of banks. Under the tighter balance sheet restrictions and pressure of public disclosure, GSIBs will require a higher positive premium to get involved in the forward contract as dollar lenders, resulting in a more expensive synthetic dollar rate in the FX swap market than the direct dollar rate from the retail deposit market or the wholesale funding market. In other words, the synthetic LC rate is cheaper than the LC interest rate in the cash market, because when GSIBs serve as dollar lenders in the FX swap market, they are simultaneously LC borrowers.

I first use the negative value of the deposit rate implied Covered interest rate parity(CIP) deviation to measure this funding advantage in LC. I find that after the GFC, GSIBs tend to have positive funding advantage in LC in 15 out of 17 advanced economies/currencies and even for the two exceptions, Australian Dollar (AUD) and Canadian Dollar (CAD), the synthetic rate in LC tends to be close and lower than LC deposit rate comparing with pre-crisis period. To examine the effect of the positive LC funding advantage on GSIBs' asset pricing power in local asset markets, leverage ratios of GSIBs are interacted with the funding advantage in asset pricing regressions. With a positive funding advantage in place, I find that one standard deviation increase in the leverage ratio of GSIBs will drive up the prediction by 2.55% in local stock returns, 2.03% in Treasury returns, 0.43% in currency returns, and widen the arbitrage benefit by 7.46 bps in the swap spread market. I also show that this phenomenon is not driven solely by 'big' banks, in other words, GSIBs' sizes don't affect the result.

Second, I show that the funding advantage in LC implied by the deposit CIP can be decomposed into two components: one common FX swap market component which is the negative value of interbank rate CIP deviation, and one bank specific component which captures the difference between the funding advantage in the interbank market and cash market for dollar and LC respectively. Interestingly I find that the common market rate CIP deviation plays the dominant role suggesting that it is the positive benefit equivalently the cheap synthetic LC rate in the FX swap market that affects the predictive power of GSIBs in local asset markets.

Next, by sorting GSIBs of each country into High and Low group based on their capital requirements on loss absorbency, I find the effect of LC funding advantage is more prominent in GSIBs falling in capital buckets with higher loss absorbency ratios. After replacing GSIBs in each country with global banks that are not recognized as GSIBs, I find insignificant predictive power of leverages of this type of banks although the sign of the slopes remain positive. This evidence justifies the channel that global banks with tighter capital regulations indeed obtain stronger asset pricing power in local asset markets.

Finally, I propose a two-bank two-currency model with the involvement of the FX swap market for dollar and LC funding, which generates consistent predictions as my empirical findings. In the model, there is a global bank who has privilege in dollar funding at the deposit rate in the cash market and another financial intermediary who has advantage in LC funding from the retail deposit market. I prove that the optimal funding strategy for both banks is to obtain the currency that they have direct funding advantage from the cash markets and to fund the other currency through the FX swap market. When the relative funding advantage of the global bank becomes positive indicating an additional benefit for dollar lenders meanwhile LC borrowers in the FX swap market, the predictive power of the global bank will surge.

My paper first contributes to the strand of literature investigating the unintended influence of intermediary regulations after the GFC. For example, capital requirements may result in a migration of traditional banks' activities to unregulated shadow banks, potentially making the financial system more fragile (Irani et al., 2021); requirements of the liquidity coverage ratio of Basel III lead to problematic connections between banks, money market funds (MMFs) and substitutes of risky private debts (Sundaresan and Xiao, 2018); post-crisis regulations create price dislocations in wholesale dollar funding markets through frictions in the bargaining power(Aldasoro et al., 2022). Basel Committee's LEI report finds that in the long-term, stronger capital and liquidity requirements have positive economic profit due to the reduced probability and losses of financial crisis with only moderate impact on GDP. However, the link between bank regulations and intermediary asset pricing is missing in the literature. A new perspective connecting the regulations and functioning of global intermediaries in the local asset markets is provided in this paper.

My paper is also related to the literature on intermediary asset pricing. Financial intermediary is treated as one representative agent in the traditional literature and has been justified as the pricing kernel in asset markets theoretically (He and Krishnamurthy, 2013; Adrian et al., 2014). Empirically, Adrian et al. (2013) find that innovation to dealer's leverage performs well in explaining both time-series and cross-section of equity and bond portfolios while He et al. (2017) apply one intermediary capital risk factor to a wide range of asset classes in US, including equity, government bonds, derivatives, commodities, and currencies and find common significant explanatory power. Also focusing in US market, Haddad and

Muir (2021) investigate the asset pricing power of household investors and financial intermediaries simultaneously and find that return predictability of intermediary factors is more pronounced in sophisticated assets such as options, mortgage-backed securities and credit default swaps. Similar predictive power of intermediary balance sheet variables can be found in corporate credit (Greenwood and Hanson, 2013), bank stock (Baron and Xiong, 2017), Treasury bond (Haddad and Sraer, 2020) and currency and residential real estate (Baron and Muir, 2022). In addition to the above assets, a growing literature is linking the balance sheet constraints of banks to the persistent CIP deviation (Borio et al., 2016; Du and Schreger, 2016; Du et al., 2018b; Avdjiev et al., 2019; Cerutti et al., 2021) and negative swap spread (Boyarchenko et al., 2018; Klingler and Sundaresan, 2019; J Jermann, 2020). This strand of literature mainly focuses on US studies, with one exception extending the scope of work to British and Japanese commercial banks and securities firms by Baron and Muir (2022) who confirm that significant intermediary asset pricing power is not a phenomenon unique to US. However, there is no formal investigation of intermediary asset pricing in the international scope. My paper fills this gap by applying the analysis to a wide range of advanced economies and their local asset markets in panel regressions.

My paper also adds to a growing literature emphasizing that the heterogeneity of intermediaries matters in asset pricing. Ma (2018) shows that a stochastic discount factor considering the differences in constraints of intermediaries generates higher cross-sectional R^2 than factors constructed by taking intermediary as one representative agent. Heterogeneity of financial intermediaries in their VaR constraints results in the risk-shifting behaviour which originates time-varying macroeconomic risks as shown in Coimbra and Rey (2017)'s model. Kargar (2021) reconciles the puzzling opposite evidence of two intermediary factors in Adrian et al. (2014) and He et al. (2017) by studying the composition of the financial sector. My paper explores the heterogeneous asset pricing power of intermediaries depending on a new perspective, that is their divergent importance to the global financial system since the importance of global banks in international financial markets has been documented in Ivashina et al. (2015), Bruno and Shin (2015), Correa et al. (2016) and Bräuning and Ivashina (2020). One work evaluates asset pricing of global banks is Baron and Muir (2022) who investigate the predictability of the loan growth of local and global banks in stock returns of 32 countries and find that both local and global factors can be important. In their paper, to proxy for global banks, commercial banks in US and UK are applied universally to all countries in the sample. However in my work, instead of using only global banks operating in predominant financial centers, I consider important global banks in each specific country, which could be quite different across countries.

The paper most related to my study is the work by Haddad and Muir (2021). The authors relate intermediary asset pricing to diverse types of assets, showing that intermediaries as one agent tend to have more significant asset pricing power in bank-intermediated asset markets in US, which suggests that intermediary asset pricing power depends on the attributes of assets. Unlike their work, my paper investigates heterogeneity of intermediaries in determining their asset pricing capability as marginal investors in a panel of international countries, indicating that for the same assets, intermediary asset pricing power depends on types of intermediaries.

The paper is structured as follows. Section 2 describes how I collect GSIBs list for each country as well as other data sources. The validation and prediction of financial intermediary as one representative agent in local asset returns is estimated internationally in Section 3. Section 4 reviews the predictive power of GSIBs in local asset markets in pre-crisis and post-crisis period respectively. Section 5 connects roles of GSIBs in local asset markets to the funding advantage in LC through the FX swap market resulting from the tighter balance sheet regulations under the Basel III framework. A two-bank two-asset model generating consistent predictions as empirical findings is shown in Section 6 while Section 7 concludes.

2 Data

I obtain stock total return indices and 10-year government bond total return indices in local currencies of countries in the sample from Datastream and the Global Financial Data (GFD) respectively. Most 3-month deposit rates are also downloaded from the GFD but for countries with missing data, I replace them with either deposit rates or interbank rates from Bloomberg depending on the quality of data. Both GFD and Bloomberg lack the deposit rates for most countries in the European Union (EU) [6] after October 2010, in which cases the interbank rate of Euro is added. For Canada, Denmark and the United Kingdom, Bloomberg deposit rates substitute the GFD missing data after March 2015, November 2013 and Octomber 2015 respectively. Daily spot and 3-month forward exchange rates are obtained via Bloomberg following tickers used in Du and Schreger (2016) and Du et al. (2018a). I obtian the 3-month interbank rates mainly from Bloomberg but replace the missing data with those from the Federal Reserve Economic Data(FRED) for EU countries. Daily swap rates and government

[6] In my sample these include Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands and Spain.

bond yields with maturities of 2, 5, 10 and 30 years are obtained from Bloomberg and their tickers are listed in the Appendix. The dataset featuring the financial system characteristics is obtained from the Global Financial Development Database of the World Bank.

Balance sheet variables of financial intermediaries including total assets, common shareholders' equity, common shares outstanding and stock prices are collected via Datastream. Stock prices are in monthly frequency while most accounting data is available in each quarter. For intermediaries lacking public disclosure in their quarterly balance sheets, the semiannual or annual reported data are applied depending on their availability.

I obtain the list of primary dealers in each country from their official websites as the scope of financial intermediaries in that country following He et al. (2017). For countries without an official disclosure of primary dealers, I choose their top 10% banks in balance sheet size as a proxy. Among primary dealers, the category of GSIBs are collected from the Financial Stability Board (FSB). The control group capturing the prediction of other institutional investors in addition to GSIBs is estimated by the Domestic systemically important banks(DSIBs) who are comparable financial intermediaries with GSIBs but are recognized focusing on their spill-over effects in domestic economies. DSIBs lists are hand collected from country-specific official government websites. For EU countries who don't have individual announcement on DSIBs, an analogous banking group called 'Other Systemically Important Institutions' (O-SIIs) is published by the European Banking Authority, which will be used as controls. My sample includes 17 advanced economies: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Netherlands, Norway, Spain, Sweden, Switzerland and the United Kingdom [7]. One example of the classification of intermediaries in the United Kingdom is shown in Table 1. The first two columns list all primary dealers and the headquarters of their holding companies. Among 25 primary dealers, only 7 banks are local British intermediaries. 12 intermediaries are recognized as DSIBs while 17 are GSIBs, with a few banks that are systemically important to both domestic and global economy simultaneously such as JPMorgan and HSBC. Likewise, there are also intermediaries that are trading counterparties with the government but have no great impact on the local and global financial systems such as Danske Bank and Jefferies Financial Group.

[7] When calculating CIP deviation and currency returns, EU countries will be replaced with Euro.

3 Intermediary: One Representative Agent

In this section, I first test intermediary asset pricing treating the financial intermediary as one representative agent meanwhile at the international level. Test assets include stock, 10-year Treasury bond, currency and one bank-intermediated arbitrage: 30-year swap spread in each country. The baseline regression for stock, Treasury bond and currency returns is in one-period predictive panel format

$$Y_{i,j,t+1} = \alpha_j + \beta_j Lev_{i,t} + \omega_i + \delta_t + \epsilon_{i,j,t}, \tag{1}$$

and for the swap spread arbitrage, since their payoff is determined at time t already, the baseline regression will therefore be contemporaneous:

$$Y_{i,j,t} = \alpha_j + \beta_j Lev_{i,t} + \omega_i + \delta_t + \epsilon_{i,j,t}, \tag{2}$$

where $Y_{i,j,t}$ and $Y_{i,j,t+1}$ refer to excess returns or arbitrage value for asset j in country i at time t and $t+1$. The stock and Treasury excess returns are calculated as raw returns subtracting the risk-free rates which are measured by the interbank rates in domestic currencies. For currency returns, I take the view of local investors who short local currencies and invest in dollars[8], whose excess returns are measured as the difference between exchange rate in next period and forward rate

$$rx_{t+1} = i_t^{\$} - i_t^* + \Delta s_{t+1} = s_{t+1} - f_t,$$

where $i^{\$}$, i^*, s_t and f_t refer to US risk-free rate, risk-free rate of local currency, exchange rate and forward rate. Exchange rate and forward rate are described as local currency(*) per unit of dollar($) and an increase in spot rate indicates an appreciation of dollar. Notations in lower cases are expressed in logs. Swap spread captures the difference between the swap rate and the Treasury rate. As swap spread becomes negative, there is an arbitrage opportunity. Think about a trade that you pay the fixed leg in swap and long the Treasury with the same maturity, meanwhile fund the Treasury through the repurchase agreement (repo) market and receive the floating leg, which will generate a cash flow equal to (Libor-repo rate)-(swap rate-Treasury rate). Thus a lower and more negative swap spread indicates a widening of

[8] Non-US entities borrow US dollars for diverse purposes including but not limited to seeking deep and broad investment markets, meeting liquidity demand and invoicing international trade.

this arbitrage, especially for swaps with longer maturities[9]. While the literature focuses on US dollars, I explore this arbitrage opportunity in an international scope with currencies including Australian Dollar (AUD), Canadian Dollar (CAD), Swiss Franc (CHF), Danish Krone (DKK), Euro (EUR), British Pound (GBP) and Japanese Yen (JPY) relying on data availability. 2-year, 5-year, 10-year and 30-year swap spreads are depicted in Figure 1. Consistent with findings in the literature for US, longer maturity 30-year swap spread arbitrage is more profitable across countries thus the regressions in this paper will focus on 30-year swap spread as test assets.

Lev denotes the leverages of different subsets of financial intermediaries, which can be all intermediaries as one agent, global or even more granular level of intermediaries. Leverage of country i at time t is the squared of value weighted average of leverage (inverse of capital ratio) of each intermediary f in country i:

$$Lev_{i,t} = (\frac{\sum_{f \in i} BD_{f,t} + ME_{f,t}}{\sum ME_{f,t}})^2. \tag{3}$$

The reason of using this expression is that I want to find an proxy for the market risk premium when the intermediary is the marginal investor in the market. He et al. (2017) justify that the market risk premium is proportional to this squared leverage and this form is also applied in Cerutti et al. (2021)'s work when they try to explore the macro-determinants of CIP deviation. But my result is also robust when the leverage ratio in log is used. In regressions, *Lev* is demeaned and scaled by its standard deviation. Figure 2 depicts the time-series changes of raw leverage ratios (1 minus the capital ratio, without square) when financial intermediaries in each country is traded as one representative agent. In pre-crisis period, there is an increasing trend of leverages due to a rapid development of financial system but when financial markets crash and regulations intervene, the leverage of representative intermediary sector drops. Summary statistics of one representative leverage in each country can be found in Table 3 with the notation Lev_{All}. Country fixed effect ω_i and time fixed effect δ_t are added to the panel regression. In bad times when the expected return or risk premium is high, the leverage (market value) of intermediaries increases as a consequence of the shrinking equity, thus the leverage of financial intermediaries is counter-cyclical and a higher leverage predicts higher expected returns[10]. For swap spread, the arbitrage is widened

[9]See Boyarchenko et al. (2018), Klingler and Sundaresan (2019) and J Jermann (2020) for more discussions.

[10]For discussions of the cyclicality of intermediary leverage, please refer to Adrian and Shin (2010), Adrian and Boyarchenko (2012) Adrian and Shin (2014), Adrian et al. (2014), Haddad and Muir (2021), Adrian et al. (2016), Nuno and Thomas (2017) and Baron and Muir (2022) for evidence of pro-cyclicality and

if they become more negative, thus a higher leverage ratio should be related to a larger (more negative) arbitrage value. Therefore the regression coefficient β_j is expected to be positive when test assets are local stock, Treasury and currency and negative when the test asset is swap spread arbitrage.

Financial intermediary being one sector has no pricing power in all 4 local assets or arbitrage markets as reported in Table 4 during the full sample period 2000-2020. The leverage ratio (squared) is not able to significantly predict asset returns of local stock, 10-year Treasury bond, currency and the 30-year swap spread arbitrage. Overall I don't find a universal asset pricing power of the leverage of financial intermediaries in international countries if we take them as one representative agent. While it is not entirely implausible that intermediary is not marginal investors after all, it is more important to consider the heterogeneity of intermediaries when conducting return predictability tests. In the following section, I examine the heterogeneity of intermediaries by classifying intermediaries into sub-categories based on their importance to the global economy and investigate the time-series change of their predictions in local asset markets.

4 GSIBs

In this section, financial intermediaries are no longer taken as one representative sector and the asset pricing power of their subsets-GSIBs-will be investigated. Whether certain intermediaries are marginal investors in asset markets depends on how important they are in intermediating and trading such assets. Therefore, one natural angle to explore the heterogeneity of intermediaries is to detect their importance in asset markets and the financial system in domestic economy or even worldwide. Thanks to the fact that governments and authorities in the world are paying more attentions to the critical roles of banks in maintaining the stability of the financial system after the GFC, reliable lists of banks that are recognized 'systemically important', both on the domestic and global level, are available to the public.

Xiong (2001) He and Krishnamurthy (2013), He et al. (2017), He and Krishnamurthy (2018) for evidence of counter-cyclicality.

4.1 Background

I first provide background information on the determination of GSIBs and relative summary statistics. The Financial Stability Board (FSB) publishes a list of Global Systemically Important Banks (GSIBs) based on the assessment methodology designed by the Basel Committee on Banking Supervision (BCBS), which requires banks to report a set of indicators to their national supervision authorities. These indicators will then be aggregated to calculate the scores of the reported banks. Banks above a cut-off score are identified as GSIBs and will be allocated to five capital buffer buckets with different loss absorbency requirements[11]. Banks are required to report denominators reflecting their ***Cross-jurisdictional activity***, ***Size***, ***Interconnectedness***, ***Substitutability/financial institution infrastructure*** and ***Complexity***, each with 20% equal weight. Definitions and weights of detailed individual indicators are listed in the following table. The basic methodology is that if a bank has a bigger market share in the financial system or certain services, a stronger connection with other institutions, a more complex operation too sophisticated to resolve and a larger international effect of its distress or failure, then this bank is more likely to be recognized as GSIBs[12].

GSIBs Indicators

Category	Individual indicator	Weight
Cross-jurisdictional activity(20%)	Cross-jurisdictional claims	10%
	Cross-jurisdictional liabilities	10%
Size(20%)	Total exposures as defined for use in the Basel III leverage ratio	20%
Interconnectedness(20%)	Intra-financial system assets	6.67%
	Intra-financial system liabilities	6.67%
	Securities outstanding	6.67%
Substitutability/ financial institution infrastructure (20%)	Assets under custody	6.67%
	Payments	6.67%
	Value of underwritten transactions in debt and equity markets	6.67%
Complexity(20%)	Notional amount of over-the-counter (OTC) derivatives	6.67%
	Level 3 assets	6.67%
	Trading and available-for-sale securities	6.67%

[11]GSIBs in each capital buffer bucket is designated with an additional capital requirement calculated as an additional common equity loss absorbency as a percentage of risk-weighted assets that each GSIB will be required to hold. This additional requirement is above and over the standard Basel requirements applying to all internationally active banks. Please refer to https://www.bis.org/basel_framework/chapter/SCO/40.htm and Chapter 50.3 at https://www.bis.org/basel_framework/chapter/SCO/50.htm for more descriptions.

[12]For more detailed definitions and discussions, see the 'Global systemically important banks: updated assessment methodology and the higher loss absorbency requirement' at https://www.bis.org/publ/bcbs255.pdf.

Allowing for national discretion in recognizing financial institutions that may not be significant from a global perspective but are important in their domestic financial system, the BCBS has developed a set of principles to constitute the framework of Domestic Systemically Important Banks (DSIBs), which are used in this paper to control the effect of other institutional investors in the regressions. Like GSIBs, DSIBs' importance is measured at the concept of 'loss-given-default' that captures what effect the bank will cause to the domestic economy if it falls. Focusing on the domestic level review, the Committee suggests national authorities to assess the importance of banks based on their ***Size***, ***Interconnectedness***, ***Substitutability/financial institution infrastructure*** and ***Complexity*** with the absence of the denominator of 'cross-jurisdictional activity'. Unlike GSIBs which talk about externalities of banks to the global economy, DSIBs focus on effects to the domestic financial system with regulations not as strict as GSIBs[13].

I report descriptive statistics of numbers and relative percentages of other financial institutional investors (estimated as DSIBs) and GSIBs to total number of primary dealers in each country in Table 2. The United Kingdom, with the largest number of primary dealers, also contains 17 GSIBs, the greatest amount of GSIBs in the country sample. On the other hand, there are only 1 GSIB in Sweden and even no GSIB in Norway. On average, above half of financial intermediaries are GSIBs. Both panels indicate some evidence of banking sector integration such that foreign intermediaries also play roles in local economies in the aspect of trading securities with local governments. If the primary dealers are classified as local and non-local intermediaries based on the location of their holding companies, 15 out of 17 countries in my sample have more non-local primary dealers than local ones. On average the number of non-local banks are above twice of that of local banks.

The time-series mean and standard deviation of the raw leverage ratio (calculated as one minus the capital ratio, without squared) of GSIBs in each country are reported in Table 3 while the time-series transitions are drawn in Figure 3. Leverages for GSIBs are raised up in all countries with the peak during the GFC but there is a decreasing trend of leverage afterwards. The average leverage ratio of GSIBs across countries is 93.53%, equivalent to a 6.5% capital ratio, with 2.36% standard deviation. In addition, GSIBs are categorized into two sub groups: low group G_L with GSIBs falling in buffer bucket 1 and high group G_H with GSIBs falling in buffer bucket 2-5. On average, GSIBs imposed with tighter capital requirements have a leverage of 93.10% equivalent with a 6.9% capital ratio, lower than GSIBs in the low constraint group which has a mean leverage of 94.34% equivalent with

[13]See https://www.bis.org/basel_framework/chapter/SCO/50.htm for detailed descriptions.

a 5.7% capital ratio. This heterogeneity of GSIBs matter in their prediction in local asset markets when there is a positive funding advantage in LC and will be further discussed in Section 5.3.

4.2 Before and After the GFC

In this section, I show that instead of taking financial intermediaries in each country as one representative agent, the global subsample GSIBs are becoming marginal investors in local asset markets and their significant pricing power emerges after the GFC.

Table 5 reports the results of panel regressions of local asset returns and arbitrage payoffs on the leverage of GSIBs in the pre and post crisis period. The leverage of other institutional investors and the heterogeneity of financial structure in each country are controlled in this table and the following regressions. Other institutional investors are estimated as DSIBs and variables capturing finance structure include Deposit Money Bank Assets to GDP, Bank Concentration, Bank ROA, Stock Market Capitalization and International Debt Issues to GDP etc[14]. Regressions in this table include two sub-periods: period before the GFC between 2000 Q1 to 2007 Q3 and period after the GFC covering 2007 Q4 to 2020 Q4. Comparing with the pre-crisis sample when GSIBs are muted in predicting local asset returns, leverage ratio of GSIBs starts to significantly predict asset returns in local stock, Treasury and currency markets and arbitrage payoffs in swap spread markets of countries where their subsidiaries are operated after the GFC. One standard deviation increase in the leverage of GSIBs will predict higher annual returns by 6.50%, 3.30% and 0.24% in local stock, Treasury and currency markets respectively, as well as 5.38 bps larger benefit through swap spread arbitrage, which also provides consistent evidence of counter-cyclical leverages.

5 Funding Advantage in Local Currency

In this section, I relate the significant pricing power of GSIBs in local asset markets in the post-crisis period to their funding advantage in LC through the FX swap market as a consequence of tighter balance sheet regulations. Intermediaries recognized as GSIBs are facing tighter balance sheet constraints due to the additional capital buffer requirements.

[14]Other control variables regarding the finance structure of each country include Liquid Liabilities to GDP, Private Credit by Deposit Money Banks to GDP, Bank Credit to Bank Deposits, Number of listed companies per 10K Population, Private Bond Market Capitalization to GDP. Please refer to the Global Financial Development Database of the World Bank.

Under the restricted balance sheet capacity and the pressure to disclose the information, GSIBs, as main dollar lenders in the FX swap market will ask for additional compensations from their counterparties to engage in the FX forward contract (Du et al. (2018b)). This causes a synthetic dollar rate higher than the dollar interest rate in the cash market for the dollar borrowers who short a different currency, exchanges into dollar at current exchange rate and convert them back at a pre-determined forward rate, the difference of which is also documented as the Covered interest rate parity (CIP) deviation. More negative the CIP deviation, higher the synthetic rates for the dollar borrowers in the FX swap market in different local currencies(LC, denoted with*), more expensive for institutional investors to obtain dollar funding. However, from the perspective of GSIBs who are usually dollar lenders in the FX swap market, they earn a positive benefit equivalent to the absolute value of the CIP deviation by shorting dollar, exchanging into LC at the spot rate and longing dollar forward in the future. In other words, GSIBs raise the LC at a lower synthetic rate than the interest rate in the cash market. This positive arbitrage benefit measured as the difference between the LC cash rate and the LC synthetic rate or the opposite value to the negative CIP deviation captures the funding advantage for dollar lenders to fund LC in the FX swap market, which suggests a favorable result from the bank regulations on GSIBs.

The literature usually uses the interbank rate, the Treasury yield or the Overnight Index Swap (OIS) rate to measure the interest rate in the wholesale funding market in order to calculate the CIP deviation. However, this implementation doesn't take into consideration the heterogeneity of financial intermediaries in their funding power for different currencies in the cash markets. It's reasonable to believe that GSIBs are able to borrow dollar at a lower interest rate than the market average interbank rate due to their high level of cross-jurisdictional claims and liabilities in dollars and the strong internal capital funding (Houston et al., 1997; Cetorelli and Goldberg, 2012; Bräuning and Ivashina, 2020). Thus to measure the maximum of the funding advantage in LC for GSIBs, I use the deposit rate as the most favorable interest rate GSIBs could obtain dollar. Then the funding advantage in LC through the FX swap market can be formally written as:

$$G_{funding} = r^{*}_{depo} - (r^{\$}_{depo} + fd), \tag{4}$$

where r^{*}_{depo}, $r^{\$}_{depo}$ and fd are notations for the deposit rate of LC, deposit rate of dollar and forward discount, respectively. The expression of GSIBs' funding advantage is the difference between the LC deposit rate r^{*}_{depo} and the synthetic rate to borrow LC through the FX swap market: $r^{\$}_{depo} + fd$. A positive value indicates stronger funding advantage in LC. Figure

4 depicts the time series changes of the LC deposit rate r^*_{depo} and the synthetic LC rate $r^\$_{depo} + fd$ through the FX swap market. Before the GFC, synthetically funding LC for dollar lenders in the forward contract characterizes a higher or no smaller interest rate than the direct deposit rate from individual investors. This cost difference ranges from close to zero such as the British Pound (GBP), Japanese Yen (JPY) and the Euro (EUR) to around 2% e.g. the Australian Dollar (AUD), Canadian Dollar (CAD) and Swedish Krona (SEK). This situation is switched after the GFC, where this is a sharp decrease in the synthetic rate in LC, most of which drops to levels below the deposit rate. The first and fourth column of Table 6 report the average funding advantage in LC for each country and their cross-sectional means before and after the GFC. In the pre-crisis period, there is actually a funding disadvantage in LC through the FX swap market with a -0.71% on average. However, the funding advantage turns positive after the GFC with an average value of 0.25%, which indicates around 1% increase in this funding privilege. It's a huge advantage considering the size of the FX swap market. According to the BIS report by Davies and Kent (2020) [15], FX swap market is the largest market for banks outside US to get dollars funding, with a total amount outstanding around 50 trillion dollars. 1% increase in the LC funding advantage generates profit of 0.5 trillion dollars on average, which is approximately one-third of GDP in Australia, one-fourth of GDP in Canada, one-sixth of GDP in the United Kingdom and is 150 times larger than the total assets of JP Morgan and HSBC. For currencies in the sample, capability of intermediaries in engaging in the FX swap market as dollar lenders/LC borrowers brings them more favorable LC interest rate comparing to pre-crisis period and to intermediaries who borrow LC directly from the domestic cash market.

5.1 Interaction with GSIBs

In this section, to link this LC funding advantage through the FX swap market and the asset pricing power of the leverage ratio of GSIBs in local assets, I introduce a dummy variable indicating whether GSIBs have funding advantage or disadvantage in LC as an interaction term to the following regression

$$Y_{i,j,t+1}/Y_{i,j,t} = \alpha_j + \beta_{j,G} Lev_{i,t,G} + \beta_{j,G_{funding}} Lev_{i,t,G} G_{funding} + G_{funding} + X_{i,t} + \omega_i + \delta_t + \epsilon_{i,j,t}, \quad (5)$$

[15]See https://www.bis.org/publ/cgfs65.htm for more information

where $Y_{i,j,t}$ and $Y_{i,j,t+1}$ are the return of asset j in country i at time t and $t+1$, $Lev_{i,t,G}$ is the valued weighted leverage ratio of GSIBs in country i at time t, $X_{i,t}$ refers to control variables including the leverage ratio of other institutional investors and heterogeneous financial structures in each country i at time t and the country fixed effect ω_i and quarter fixed effect δ_t. $G_{funding} = 1$ if the funding advantage in LC as in equation 4 is greater than 0, otherwise $G_{funding} = 0$. If the benefit of LC funding in the FX swap market as a consequence of tighter balance sheet regulations drives up GSIBs' predictive power in local asset markets, we should expect that when $G_{funding} = 1$, the leverage ratio of GSIBs would significantly predict larger asset returns and arbitrage benefits than the case without the funding advantage in LC which is $G_{funding} = 0$. In other words, we care $\beta_{j,G_{funding}}$ for each asset j.

Estimations in Table 7 justifies this channel. GSIBs barely have any predictive power in local asset markets when there is no funding advantage in LC through the FX swap market, as suggested by the insignificant coefficients on the leverage ratio of GSIBs denoted by G. However, when the LC funding advantage becomes positive as result of tighter balance sheet regulations on global banks especially GSIBs, I find a universal increase in GSIBs' predictions in local asset markets. With a positive funding advantage in LC, one standard deviation increase in the leverage ratio of GSIBs will make their predictions grow by 2.25% in local stock market although insignificantly, 2.03% in local Treasury returns, 0.43% in the currency returns as well as 7.46 bps in the swap spread arbitrage annually with significance (notice that more negative arbitrage value in swap spread indicates higher arbitrage benefit). When the funding advantage is treated as a dummy variable, in three out of four local asset markets, GSIBs are becoming marginal investors comparing with time periods when there is no favorable funding advantage in LC.

We've compared effects of GSIBs' leverage ratio in asset pricing with and without positive funding advantage in LC in Table 7, but the magnitude of this funding advantage which is indeed the negative value of the deposit rate CIP deviation, measuring how strong their favorable synthetic rate in LC could be by lending dollars in the FX forward contracts, is also expected to make a difference in affecting leverage predicting power of GSIBs. Table 8 reports estimations of equation 5 but replaces the dummy variable $G_{funding}$ with its original magnitude and we can tell that with larger funding advantage in LC, GSIBs are more likely to become marginal investors in local asset markets as their leverage ratio has stronger asset pricing abilities in all four local assets. With 1% increase in the funding advantage in LC, one standard deviation increase in GSIBs' leverage ratio will predict higher returns of 2.84%, 1.34% and 0.25% in local stock, Treasury and currency markets meanwhile larger swap spread arbitrage by 3.20 bps.

Figure 5 explores the leverage ratio prediction coefficients of GSIBs versus LC funding advantage in the cross-section of 17 advanced economies in local stock and Treasury market and G10 currencies in local currency and swap spread markets in post-crisis period. The GSIBs beta in the Y-axis is obtained from country specific regressions of asset returns or arbitrage payoffs on the leverage ratios of GSIBs. For each country/currency i and asset category j, we run one quarter ahead predictive regressions for local stock, Treasury and currency returns while we run contemporaneous regressions for the arbitrage market as follows

$$Y_{t+1}/Y_t = \alpha + \beta_G Lev_{G,t} + X_t + \epsilon_t, \tag{6}$$

where β_G is taken as the GSIBs beta in the Y-axis. X-axis indicates the average funding advantage in LC through the FX swap market in each country as derived in equation 4. In the cross-section, I find that for countries of currencies with larger synthetic funding advantage, the asset pricing power of GSIBs' leverage in those countries is stronger as well. GSIBs' prediction becomes more positive (upward sloping) in predicting local stock, Treasury and currency returns and more negative (downward sloping) in explaining the swap spread arbitrage payoffs as the LC funding advantage rises, both suggesting larger prediction magnitudes. The cross-sectional trends for GSIBs are robust if European Union countries are all introduced to the sample[16], which can be found in Figure 6 in the Online Appendix[17].

5.2 Decomposition

In this section, I show that it is the profit in the common FX swap market but not how beneficial currencies are funded in their cash markets that dominates the effect of LC funding advantage $G_{funding}$ on GSIBs' pricing power in local asset markets.

The funding advantage in LC i.e. the negative value to the deposit rate CIP deviation can further be decomposed into two components: the difference between separate funding power in dollar and LC in the cash market and interbank market, which is bank specific, and a common FX swap market component equal to the negative value of the interbank

[16]This is feasible because deposit rates in EU countries are different, although with Euro as their official currency they have the same synthetic rate in Euro through the FX swap market. Their differences, the funding advantage as in equation 4, are diverse.

[17]In the Online Appendix, I also show that the predictive power of other institutional investors (DSIBs as proxy) in countries with stronger synthetic funding advantage is weaker, which is more obvious in the Treasury and swap spread markets as described in Figure 7 and 8 .

CIP, which depends only on counterparties of currencies without considering heterogeneity in financial intermediaries:

$$G_{funding} = r^*_{depo} - (r^{\$}_{depo} + fd_t) = -CIP_{interbank} + [(r^{\$} - r^{\$}_{depo}) + (r^* - r^*_{depo})], \tag{7}$$

where r^* and $r^{\$}$ refer to interbank rate of LC and dollar respectively. A natural question is to ask which component dominates the influence of funding advantage in LC on GSIBs' asset pricing power in local assets. Since the balance sheet constraint directly affects the synthetic borrowing cost in the FX swap market, theoretically the interbank CIP deviation, as a widely recognized method to proxy for the market CIP deviation, should be the dominant constitute no matter how GSIBs and other financial institutional investors obtain dollar and LC funding in the cash markets.

Table 6 reports the time-series average of these two components in periods before and after the GFC. Before the GFC, the component of the interbank CIP deviation is close to zero while the funding disadvantage mostly comes from the funding differences for dollar and LC in the cash market and interbank market, which on average is -0.71% indicating a funding cost through the FX swap market for dollar lenders to borrow LC. This situation is switched in the post-crisis period. After the GFC, as shown in the right panel, funding differences for dollar and LC in the cash market and interbank market have rised to aroud zero but the funding benefit in LC through the FX swap market with interbank rates has climbed to 0.28% on average across advanced economies. For clear comparison of the effect of these two components, both of them are introduced as interaction terms in panel regressions and the results are reported in Table 9. I find that the negative value to the interbank CIP (denoted as $-CIP_{interbank}$) plays a more prominent role than the difference between the original funding advantages in dollar and LC (denoted by $Intdiff$) in affecting the asset pricing ability of leverage of GSIBs. 1% increase in the interbank CIP implied funding advantage in LC will adds 2.80%, 4.68% and 0.56% increase to the effect of GSIBs' leverage in predicting local stock, Treasury and currency returns, and 11.93 bps increase in explaining swap spread arbitrage, when another component $Intdiff$ is muted in the stock, currency and swap spread arbitrage markets. The only exception is in the local Treasury market that 1% increase in the difference between the original funding advantages in dollar and LC will drive up 0.75% in GSIBs' prediction, which however is much weaker than the effect of $-CIP_{interbank}$. Overall, the interbank rate CIP dominates in the funding advantage of LC for GSIBs in affecting the prediction of their leverage ratio in local asset returns. $Intdiff$ capturing the the size of bank-specific funding advantage between the interbank rate and cash rate for dollar and LC has changed from negative to zero. If the interbank FX swap still generates zero benefit like the case before the GFC, $G_{funding}$ should also be added up to zero and there will be no funding advantage for GSIBs to borrow LC and lend dollars through the FX swap market. For LC borrowers, this indicates a transition from costly funding to an indifferent funding of LC in the FX swap market. However, when the common FX swap market (negative value to the interbank CIP deviation) component turns positive, it suggests an absolute funding advantage for GSIBs to obtain LC funding by engaging in a FX forward contract, which motivates their holding of LC and investment in local assets such that GSIBs are becoming marginal investors in local asset markets.

5.3 Capital Buffer Buckets

In this section, GSIBs are sorted into Low and High groups according to their higher loss absorbency requirements to examine the effect of funding advantage in LC. I find that the strengthening of positive funding advantage on prediction of global banks in local assets is more significant for GSIBs with stronger capital restrictions than GSIBs that are less regulated.

Corresponding to the required levels of additional capital buffers, GSIBs are allocated into 5 buckets: bucket 1 to bucket 5 with incremental buffers. Bucket 1 to 5 are assigned with loss absorbency requirements which request banks to keep additional common equity as a percentage of risk-weighted assets ranging from 1.0%, 1.5%, 2.0%, 2.5% to 3.5%, respectively. Bucket 5 is initially set to be empty to maintain incentives for banks to avoid becoming more globally systemically important. Most GSIBs fall into the first four buckets. In the 2020 GSIBs list, with no banks falling in bucket 4 and 5, among 30 banks, 19 banks are allocated to bucket 1, 8 banks are allocated to bucket 2 and only 3 banks fall in bucket 3, which are Citigroup, HSBC and JP Morgan Chase. GSIBs in the higher bucket are exposed with tighter balance sheet constraints such that engaging in the FX swap market as dollar lenders requires higher premium from dollar borrowers. In other words, to motivate GSIBs in higher buckets to lend dollar through the currency forward contract, the synthetic rate of funding LC should be lower than the LC deposit rate, the gap of which exceeds that of banks in lower buckets. GSIBs in higher buckets play more significant roles in local assets when the deposit rate CIP becomes more negative because they obtain larger positive benefit. To test this validity, I classify GSIBs of each country into two groups: Low buffer group with banks in capital bucket 1 and High buffer group with banks in bucket 2 to bucket 5 in order to balance the number of banks in each group. In panel regressions, leverage ratios of both the low and high buffer groups will be put in the regressions interacting with the funding advantage in LC. Summary statistics of leverage ratios for GSIBs in each group are listed in Table 10. GSIBs in the low buffer group is denoted as G_L while as G_H for GSIBs in the high buffer group. Under tighter balance sheet constraints, G_H maintains a cross-sectional average leverage of 94.47% equivalent to a 5.53% capital ratio, which is lower than the leverage ratio of G_L.

Table 11 reports the regression estimations when the LC funding advantage is a dummy variable. When there is a positive funding benefit in LC through the FX swap market, GSIBs with higher capital buffer requirement will significantly predict asset returns and arbitrage payoffs. With positive funding advantage of LC in place, one standard deviation increase in leverage ratio of GSIBs in high buffer group will predict 10.38%, 2.00% and 0.62% increase in local stock, Treasury and currency returns, meanwhile 7.97 bps wider in swap spread arbitrage. In Table 12, the effect of the funding advantage value on respective GSIBs groups is tested. When these exists a 1% increase in the LC funding advantage $G_{funding}$, the predictive power of GSIBs in the high buffer group will significantly surge by 5.54% in stock returns, 0.96% in Treasury returns, 0.40% in currency returns and 3.05 bps in swap spread arbitrage, while the increases in the prediction of GSIBs in the low buffer group are positive in 3 out of 4 local asset markets but with insignificance.

5.4 Non-GSIB Global Banks

In this section, I explore how the funding advantage in LC affects the leverage prediction of non-GSIB global banks. One big difference between GSIBs and non-GSIB global banks is that the latter is not exposed to additional loss absorbency requirement in their common equity. Without stricter balance sheet constraints, it's expected that global banks not recognized as GSIBs will have weaker prediction power in asset markets. Table 13 justifies this expectation. In this table, non G indicates global banks in each country that are not listed as GSIBs. Its interaction with the positive funding advantage dummy variable generates higher but insignificant increase in the prediction of leverage ratio in local stock, Treasury and FX markets. For the swap spread, when there is a positive LC funding advantage, prediction of non-GSIB global banks will grow by 4.42 bps, which is also weaker comparing with GSIBs' prediction in Table 7.

5.5 Size

In this section, I first examine the relationship between the GSIBs' prediction power in local assets and their bank sizes. One concern challenging the channel that the significant predictive power of the leverage ratio of GSIBs is achieved through their advantages in funding LC in the FX swap market is the size of GSIBs. Regardless of where and at what interst rate the banks obtain funding in dollar and LC, large banks which comprise higher market shares in asset markets shall have stronger asset pricing power as marginal investors. Therefore, an alternative explanation for the significant prediction of local asset returns by GSIBs' leverage is that after the GFC, GSIBs are becoming marginal investors since they have larger market value. If this proposition is correct, we are expecting that leverage ratio of GSIBs with higher market value predicts higher asset returns and arbitrage payoffs.

Table 14 declines this effect of bank sizes on predictive power of GSIBs' leverage. In this table, the indicator G_{size} measuring the market equity of GSIBs are interacted with GSIBs' leverage ratios and we find a significant influence of banks sizes only in the local stock market. In the other three local asset markets, the insignificant coefficients before $G \times G_{size}$ reject the size channel such that a bigger size of GSIBs doesn't improve the prediction of their leverage ratios in local Treasury and currency returns as well as the swap spread arbitrage market. Size is one important indicator of whether a bank should be characterized as GSIBs by the BCBS, however, from the perspective of intermediary asset pricing, size itself doesn't affect how strong GSIBs' leverage predicts local asset returns. This fact alleviates concerns of the size channel because after all, size is only 20% weighted in determining GSIBs classifications, leaving rich ground for the cross-jurisdictional activity, interconnectedness, substitutability and complexity of banks.

Second, I examine the relationship between bank sizes and the effect of a positive LC funding advantage on the prediction of GSIBs' leverage ratio in local asset returns. In order to test whether larger GSIBs are more likely to be affected by the funding advantage, the bank sizes are interacted with the product of GSIBs' leverage ratio and the LC funding advantage as in Table 15. Judged by the insignificant coefficients before the term $G \times G_{funding} \times G_{size}$, the improving influence of a positive LC funding advantage in GSIBs' predictive power in the local stock, FX and swap spread arbitrage markets is not related with bank sizes of GSIBs. Contrary to normal expectations, for larger GSIBs the effect of LC funding advantage on leverage is in fact weaker in predicting Treasury returns.

6 Model

In this section, I propose a two-bank, two-asset model based on Haddad and Muir (2021)'s work. While in their model, intermediary is introduced as one representative agent and the assets are all traded in the same currency, I extend their model to include two banks: a global Bank G and a Bank D to proxy for other institutional investors and two assets: local asset 1 traded in local currency (LC, marked with superscription *) and dollar asset 2 traded in US dollar (USD, marked with superscription \$). Both Bank D and G are able to optimize their portfolios of holding both assets, however, their funding rates in the two currencies could be quite different.

6.1 Optimal Funding Rates

I first illustrate what are the optimal interest rates for banks when they raise fundings. In order to fund each asset, equivalent to fund each currency, banks can borrow either directly at the deposit rates in the cash markets, from the other bank at the interbank rate, or through the FX swap market at relative synthetic rates. The following table summarizes all available interest rates for each bank and each asset.

Available Interest Rates

Bank D	deposit	interbank	synthetic
LC	r^*_D	r^*	$r^\$ + fd$
dollar	$r^\$_{D_{depo}}$	$r^\$$	$r^*_D - fd$
Bank G	**deposit**	**interbank**	**synthetic**
LC	$r^*_{G_{depo}}$	r^*	$r^\$_G + fd$
dollar	$r^\$_G$	$r^\$$	$r^* - fd$

To differentiate funding advantage of Bank D and Bank G, I assume that: **I**. If Bank D borrows LC, the deposit rate he could obtain is lower than the LC interbank rate $r^*_D < r^*$, while when funding dollar from the cash market, his interest rate is higher than dollar interbank rate, $r^\$_{D_{depo}} > r^\$$.

When Bank D funds LC, it could borrow either at a deposit rate r^*_D in the cash market, at the interbank rate r^*, or it could first short dollar, exchange into LC at current exchange rate meanwhile lend dollar in the FX swap market while entering a forward contract to switch dollar back in the future, the synthetic LC rate of which is $r^\$_{D_{depo}} + fd$, where fd

captures the forward discount of LC per unit of dollar. Under assumption **I**, the actual FX swap synthetic rate for Bank D is $r^{\$} + fd$ since $r^{\$}_{D_{depo}} + fd > r^{\$} + fd$. When Bank D raises dollar funding, available funding includes direct deposit borrowing at an interest rate $r^{\$}_{D_{depo}}$, interbank rate funding at $r^{\$}$ and a synthetic dollar borrowing for which Bank D in the first place shorts LC, exchanges into dollar at current spot rate and swap back LC at a pre-determined forward rate, which generates an interest rate of $r^*_D - fd$. This interest rate is achievable because Bank D is able to borrow at a lower LC deposit rate r^*_D. When there is no mispricing in the FX swap market, the CIP deviation[18] is zero no matter whether the bank is LC lender or dollar lender in the FX swap market:

$$r^{\$} - (r^* - fd) = r^* - (r^{\$} + fd) = 0. \tag{8}$$

In this case, the synthetic rate for Bank D in LC funding is higher than the deposit rate Bank D could obtain $r^{\$} + fd = r^* > r^*_D$ while the synthetic rate in dollar funding is the lowest among three interest rates $r^*_D - fd < r^* - fd = r^{\$} < r^{\$}_{D_{depo}}$. Consequently, it's optimal for Bank D to borrow LC at the deposit rate r^*_D and borrow dollar through the FX swap market at $r^*_D - fd$, respectively[19].

Applying similar analysis to the global Bank G, we can easily draw a conclusion that the optimal way for Bank G to raise dollar is direct deposit rate funding in the cash market while engage in the FX swap market as a dollar lender to raise LC at a favorable synthetic interest rate under my second assumption: **II**. If global Bank G borrows dollar, the deposit rate he could obtain is lower than the dollar interbank rate $r^{\$}_G < r^{\$}$, while when funding LC from the cash market, his interest rate is higher than LC interbank rate, $r^*_{G_{depo}} > r^*$.

When the global Bank G funds LC, it's able to borrow either at the interbank rate r^* or from the deposit market at a higher rate $r^*_{G_{depo}}$ or becoming a dollar lender in the FX swap market by shorting dollar in the first place, exchanging into LC and swapping dollar back at a forward rate, which yields a synthetic LC rate of $r^{\$}_G + fd$. When the global Bank G borrows dollar, again there are three choices. The bank could borrow at the interbank dollar

[18] CIP deviation without subscript refers to interbank rate calculated CIP deviation.

[19] This is also optimal when the market interbank CIP deviation becomes negative (from dollar borrower's perspective). Theoretically, in this case, the synthetic LC rate is lower than the LC interbank rate $r^{\$}+fd < r^*$ but is not for sure to be lower than deposit rate r^*_D. Similarly, the synthetic dollar rate $r^*_D - fd$ is smaller than the interbank rate implied synthetic dollar rate $r^* - fd$, which is larger than the $r^{\$}$, making the comparison between $r^*_D - fd$ and $r^{\$}$ ambiguous. However, negative CIP deviation indicates a world with high demand but a short supply for dollars, which makes Bank D unable or at a higher cost to borrow dollar directly from deposit and interbank markets. Thus for Bank D, the FX swap funding for LC, and deposit and interbank fundings for dollar are not feasible.

rate $r^{\$}$, a lower deposit rate $r^{\$}_G$, or it may first raise LC instead, exchange into dollar at the current exchange rate and sign a forward contract with counterpaties in the FX swap market to receive LC in the future at a pre-determined forward rate. This transaction gives Bank G a synthetic dollar rate of $r^*_{G_{depo}} - fd$, which under assumption **II** is larger than $r^* - fd$, thus the latter one is the actual synthetic rate. According to equation 8 when CIP holds, the synthetic rate for the global Bank G to borrow LC is the lowest reachable interest rate $r^{\$}_G + fd < r^{\$} + fd = r^* < r^*_{G_{depo}}$. Meanwhile, when Bank G raises dollar, both the FX swap synthetic dollar rate and the interbank dollar rate are higher than the deposit rate Bank G is able to borrow at: $r^* - fd = r^{\$} > r^{\$}_G$. These comparisons suggest that it is optimal for the global Bank G to directly borrow dollar at the favorable deposit rate in the cash market and to fund LC by lending dollar through the FX swap market[20]. The following table describes the optimal method of funding for LC and dollar for two banks respectively.

Optimal Funding Rates

Bank	Borrow	Optimal interest rate
D	LC	deposit r^*_D
	Dollar	FX swap synthetic rate $r^{\$}_D = r^*_D - fd$
G	LC	FX swap synthetic rate $r^*_G = r^{\$}_G + fd$
	Dollar	deposit $r^{\$}_G$

6.2 Setup

Previously I show that when CIP deviation is zero or negative, banks' optimal funding choice in currencies they don't have funding advantage in the cash markets is to borrow them from the FX swap market by shorting the currency they have funding power, exchanging into the other currency and engaging in a forward contract to swap back. Meanwhile, banks' funding preference for currencies they have funding advantage, that is they could borrow this currency at the lower deposit rate, is always to directly raise the fund through the cash market. In the setting of my two-bank two-asset[21] model, the optimal funding choice for Bank D is to borrow LC from deposit market and borrow dollar in the FX swap market,

[20]Negative CIP deviation (dollar borrower's perspective) doesn't alter Bank G's optimal choices but instead makes his motivation stronger. In this case, the synthetic LC rate $r^{\$}_G + fd$ drops while the synthetic dollar rate $r^* - fd$ increases, which suggests that it's even more beneficial to fund dollar at the deposit rate while fund LC through the FX swap market.

[21]It can also be expressed as a two-bank two-currency model.

while for the global Bank G, it's optimal to obtain dollar funding at the deposit rate and raise LC at the synthetic LC rate through a forward contract. Given their funding choices, no matter the banks invest in LC asset or dollar asset, they have to first borrow in currencies they have advantageous funding power in the cash markets. Bank D raises LC at a gross interest rate of R_D^* while Bank G raises dollar at a gross cost of $R_G^\$$ and I assume these two banks have mean-variance utility for which the endowment doesn't affect agents' demands for assets.

There are two risky assets: asset 1 traded in LC with an expected gross return of R_1 and asset 2 traded in dollar with an expected gross return of R_2, both of which have a supply of 1 share. Two risky assets have a positive definite variance covariance matrix of Σ. There are two periods, t and $t+1$. Decisions are made at time t and the returns are realized at time $t+1$.

Let's start with Bank D. At time t, the objective function of Bank D is

$$\max_{D_{1D},D_{2D}} D_{1D}R_1 + \frac{D_{2D}}{S_t}R_2S_{t+1} + (\frac{D_{2D}}{S_t}F_t - \frac{D_{2D}}{S_t}S_{t+1}) - (D_{1D} + D_{2D})R_D^* - \frac{\gamma_D}{2}\mathbf{D_D}'\Sigma\mathbf{D_D}, \quad (9)$$

where D_{1D}, D_{2D} denote Bank D's demand for local asset 1 and dollar asset 2 respectively while $\mathbf{D_D}$ is a vector of these two demands. S_t and F_t refer to exchange rate and forward rate measured as LC(*) per unit of dollar($). Increase in S_t indicates an appreciation of dollar. The first term captures the expected return in local asset 1 while the second term illustrates the expected returns by investing in dollar asset 2. Here, Bank D not only obtains the risky asset payoffs in the dollar asset market, but also benefits from the appreciation of dollar as captured in the currency return $\frac{S_{t+1}}{S_t}$. Bank D funds dollar asset through the FX swap market, as justified previously, by exchanging LC into dollar at current exchange rate and swap LC back at the forward rate. His engagement in the FX swap market as an LC lender exactly hedges the currency risk of investing in dollar asset market, which is reflected in the third term in the parenthesis. In addition to the required LC funding rate of R_D^*, the portfolio variance will also have a negative effect to the utility, which depends on γ_D, the risk aversion of Bank D.

For the simplicity of calculation, expressing the objective utility in excess returns of log forms will be:

$$\max_{D_{1D},D_{2D}} D_{1D}\mu_1 + D_{2D}\mu_2 + D_{2D}fd_t - (D_{1D} + D_{2D})r_D^* - \frac{\gamma_D}{2}\mathbf{D_D}'\Sigma\mathbf{D_D}, \quad (10)$$

where μ_1 and μ_2 are expected returns of local asset 1 and dollar asset 2, r_D^* is the deposit rate,

fd_t is the forward discount, all in logs. Rearranging the utility function with an introduction of the interbank rates r^* and $r^\$$, equation 10 can be written as

$$\max_{D_{1D},D_{2D}} D_{1D}(\mu_1 - r^*) + D_{2D}(\mu_2 - r^\$) - D_{2D}(r^* - r^\$ - fd_t) + (D_{1D} + D_{2D})(r^* - r^*_D) - \frac{\gamma_D}{2}\mathbf{D_D}'\Sigma\mathbf{D_D}$$

$$\Leftrightarrow \mathbf{D_D}'\mu - \frac{\gamma_D}{2}\mathbf{D_D}'\Sigma\mathbf{D_D} - \mathbf{D_D}'\mathbf{C_D} + \mathbf{D_D}'\mathbf{1}(r^* - r^*_D), \tag{11}$$

where $\mathbf{D_D} = \begin{pmatrix} D_{1D} \\ D_{2D} \end{pmatrix}$, $\mu = \begin{pmatrix} \mu_1 - r^* \\ \mu_2 - r^\$ \end{pmatrix}$, and $\mathbf{C_D} = \begin{pmatrix} 0 \\ r^* - r^\$ - fd_t \end{pmatrix} = \begin{pmatrix} 0 \\ -CIP \end{pmatrix}$ denotes the 'cost' for Bank D to invest in two assets through the FX swap market. This 'cost' only has the second entry because only when Bank D demands dollar asset 2 will he engage in the FX swap market. The utility will be higher if the expected excess returns of assets μ and the LC funding advantage in the cash market $r^* - r^*_D$ grow up while the utility drops when there is an increase in bank's risk aversion γ_D, portfolio volatility Σ and the cost through the FX forward contract $\mathbf{C_D}$.

For the global Bank G, his objective function is to maximize

$$\max_{D_{1G},D_{2G}} D_{1G}\frac{R_1 S_t}{S_{t+1}} + D_{2G}R_2 + (D_{1G}\frac{S_t}{F_t} - D_{1G}\frac{S_t}{S_{t+1}}) - (D_{1G} + D_{2G})R^\$_G - \frac{\gamma_G}{2}\mathbf{D_G}'\Sigma\mathbf{D_G}, \tag{12}$$

where D_{1G} and D_{2G} are demands for local asset 1 and dollar asset 2 of Bank G. Unlike receiving a direct dollar asset return R_2, when Bank G invests in local asset, in addition to an expected return R_1 on the asset, he also benefits from the appreciation of the LC i.e. suffers from the depreciation of dollar as captured by $\frac{S_t}{S_{t+1}}$ in the first term. This currency risk is totally hedged when Bank G serves as the dollar lender in the FX swap market by exchanging into the LC at current spot rate and selling LC forward. Similar to Bank D, Bank G is required to cover the funding rate at the dollar deposit rate $R^\$_G$, meanwhile suffers a utility drop from the volatility of portfolio, which depends on his risk appetite γ_G. Therefore if we rewrite the utility of Bank G in net returns instead of gross returns, we'll have

$$\max_{D_{1G},D_{2G}} D_{1G}\mu_1 + D_{2G}\mu_2 - D_{1G}fd_t - (D_{1G} + D_{2G})r^\$_G - \frac{\gamma_G}{2}\mathbf{D_G}'\Sigma\mathbf{D_G}, \tag{13}$$

where $r^\$_G$ is the deposit of dollar in logs. Again, I introduce the interbank rate of LC and dollar to equation 13 and rewrite it as

$$\max_{D_{1G},D_{2G}} D_{1G}(\mu_1 - r^*) + D_{2G}(\mu_2 - r^\$) - D_{1G}(fd_t + r^\$ - r^*) + (D_{1G} + D_{2G})(r^\$ - r_G^\$) - \frac{\gamma_G}{2}\mathbf{D_G}'\Sigma\mathbf{D_G}$$

$$\Leftrightarrow \max_{D_{1G},D_{2G}} \mathbf{D_G}'\mu - \frac{\gamma_G}{2}\mathbf{D_G}'\Sigma\mathbf{D_G} - \mathbf{D_G}'\mathbf{C_G} + \mathbf{D_G}'\mathbf{1}(r^\$ - r_G^\$), \tag{14}$$

where $\mathbf{D_G} = \begin{pmatrix} D_{1G} \\ D_{2G} \end{pmatrix}$, $\mu = \begin{pmatrix} \mu_1 - r^* \\ \mu_2 - r^\$ \end{pmatrix}$, and $\mathbf{C_G} = \begin{pmatrix} fd_t + r^\$ - r^* \\ 0 \end{pmatrix} = \begin{pmatrix} CIP \\ 0 \end{pmatrix}$ denotes the 'cost' for Bank G to invest in two assets by the FX swap funding. This cost has the first entry to be non-zero because only when Bank G demands local asset 1 will he need to obtain LC funding through the FX swap market. Similar to Bank D, Bank G's utility will be higher if the expected excess returns of assets μ and the dollar funding advantage in the cash market $r^\$ - r_G^\$$ increase while the utility drops when there are larger risk aversion γ_G, portfolio volatility Σ and the cost through the FX forward contract $\mathbf{C_G}$.

The equilibrium of this economy characterizes two asset excess returns μ and optimal demand $\mathbf{D_D^{**}}$ and $\mathbf{D_G^{**}}$[22] that solve the banks' optimization problems in equation 10 and 13, meanwhile satisfy the market clearing condition of risky assets such that the demands for each asset should sum up to 1 share:

$$\mathbf{D_D^{**}} + \mathbf{D_G^{**}} = \mathbf{1}. \tag{15}$$

6.3 Equilibrium

We can solve the equilibrium demand of Bank D and Bank G respectively as:

$$\mathbf{D_D^{**}} = \frac{1}{\gamma_D}\Sigma^{-1}\mu - \frac{1}{\gamma_D}\Sigma^{-1}\mathbf{C_D} + \frac{1}{\gamma_D}\Sigma^{-1}\mathbf{1}(r^* - r_D^*)$$

and

$$\mathbf{D_G^{**}} = \frac{1}{\gamma_G}\Sigma^{-1}\mu - \frac{1}{\gamma_G}\Sigma^{-1}\mathbf{C_G} + \frac{1}{\gamma_G}\Sigma^{-1}\mathbf{1}(r^\$ - r_G^\$).$$

In addition to the classic Markowitz solution which is the mean-variance efficient portfolio, both demands of intermediaries depend on a 'cost' of engaging in the FX swap market for dollar or LC funding meanwhile hedging the currency risks they face. Another determinant of their optimal demands in assets is related to the deposit funding advantage in cash market

[22] Here I use double stars $**$ to differentiate the optimal demand notation with local currency notation $*$.

over the interbank rate: for Bank D it is the relative funding power in LC while for Bank G it's in dollar. The effects of the 'cost' and relative funding advantage in cash markets on asset demands more or less depend on the degree of risk aversion for the two banks γ_D and γ_G as well as the variance-covariance matrix of the two assets Σ.

The expected asset returns therefore can be obtained by plugging the optimal demands into the market clearing equation 15:

$$\mu = \frac{\gamma_G \gamma_D}{\gamma_G + \gamma_D}\Sigma\mathbf{1} + \frac{\gamma_D}{\gamma_G + \gamma_D}\mathbf{C_G} + \frac{\gamma_G}{\gamma_G + \gamma_D}\mathbf{C_D} - \frac{\gamma_D}{\gamma_G + \gamma_D}\mathbf{1}(r^\$ - r^\$_G) - \frac{\gamma_G}{\gamma_G + \gamma_D}\mathbf{1}(r^* - r^*_D),$$

and specifically, we get expressions for expected returns of local asset 1 and dollar asset 2 separately as follows:

$$\begin{aligned} \mu_1 - r^* &= \frac{\gamma_G \gamma_D}{\gamma_G + \gamma_D}(\sigma_1^2 + \sigma_{12}) + \frac{\gamma_D}{\gamma_G + \gamma_D}CIP - \frac{\gamma_D}{\gamma_G + \gamma_D}(r^\$ - r^\$_G) - \frac{\gamma_G}{\gamma_G + \gamma_D}(r^* - r^*_A) \\ \mu_2 - r^\$ &= \frac{\gamma_G \gamma_D}{\gamma_G + \gamma_D}(\sigma_2^2 + \sigma_{12}) - \frac{\gamma_G}{\gamma_G + \gamma_D}CIP - \frac{\gamma_D}{\gamma_G + \gamma_D}(r^\$ - r^\$_G) - \frac{\gamma_G}{\gamma_G + \gamma_D}(r^* - r^*_A) \end{aligned}. \quad (16)$$

I focus on risk premium of the local asset, which is $\mu_1 - r^*$ in this paper. When the interbank CIP holds and there are no differences between the interbank rates and deposit rates, asset returns will increase when the risk aversions of banks γ_D and γ_G become higher. Using the leverage of financial intermediary as a proxy for the risk aversion, it suggests that a higher leverage predicts a higher asset return, which is consistent with the empirical findings of counter-cyclical leverage ratios..

We then explore how the CIP deviation and relative funding advantages of banks in the cash markets affect the movement of local asset risk premium to global Bank G' risk aversions, which is β_{1G}. By taking the first derivatives of local asset returns in equation 16 on the risk aversion of Bank G, we'll have the expression for the prediction of Bank G in local asset returns as

$$\begin{aligned} \beta_{1G} &= \frac{\partial(\mu_1 - r^*)}{\partial \gamma_G} \\ &= \frac{\gamma_D^2}{(\gamma_G + \gamma_D)^2}(\sigma_1^2 + \sigma_{12}) - \frac{\gamma_D}{(\gamma_G + \gamma_D)^2}CIP + \frac{\gamma_D}{(\gamma_G + \gamma_D)^2}((r^\$ - r^\$_G) - (r^* - r^*_D)) \\ &= \frac{\gamma_D^2}{(\gamma_G + \gamma_D)^2}(\sigma_1^2 + \sigma_{12}) + \frac{\gamma_D}{(\gamma_G + \gamma_D)^2}(r^*_D - (r^\$_G + fd_t)) \\ &= \frac{\gamma_D^2}{(\gamma_G + \gamma_D)^2}(\sigma_1^2 + \sigma_{12}) - \frac{\gamma_D}{(\gamma_G + \gamma_D)^2}CIP_{depo}, \end{aligned} \quad (17)$$

where CIP_{depo} is the deposit rate implied CIP deviation. This equation captures the predictive power in local asset markets for Bank G which serves as the dollar lender as well as the LC borrower in the FX swap market. As CIP_{depo} is becoming more negative which is equivalent to that my empirical measure of the LC funding advantage $G_{funding}$ in equation 4 is turning more positive, the effect of its risk aversion γ_G on the local asset risk premium is actually turning stronger. With Bank G proxies for GSIBs, my model generates consistent prediction with the empirical finding that when the LC funding advantage through the FX swap market is positive and larger, the prediction of GSIBs' leverage in local asset returns will be stronger. Meanwhile, if Bank G is exposed with tighter balance sheet constraint e.g. a higher common equity buffer is required, the significant boosting effect of negative CIP_{depo} on β_{1G} is larger since γ_G is depressed when using the leverage ratio as a proxy. This prediction is also consistent with the fact that the effect of funding advantage in LC will be more prominent for GSIBs in higher buffer groups.

According to the second equation in equation 17, the effect of the negative value to deposit rate implied CIP deviation can further be decomposed into the the negative value of the interbank CIP deviation CIP and the relative funding advantage of Bank G and Bank D in currencies they have achievable larger funding power in the cash markets $(r^{\$} - r^{\$}_G) - (r^* - r^*_D)$.

Interbank CIP deviation, a widely documented method of CIP deviation calculation in the literature, is a common component that does not incorporate bank specific interest rates. It reflects the overall market funding cost of dollar by capturing the difference between the dollar rate and the synthetic dollar rate through FX swap funding contract. A negative interbank CIP deviation suggests a shortage of dollar supply with a high demand for dollar in the market such that it's more costly to borrow dollar by engaging in a FX swap transaction. However, in other words, a negative interbank CIP deviation is beneficial for the LC borrower or the dollar lender (global Bank G) in the FX swap market who can seize this positive arbitrage value in hand. My model has this prediction as suggested by the opposite sign before CIP: larger (more negative) the interbank CIP deviation, stronger the effect of the global Bank G's risk aversion on the asset risk premium.

The bank specific component of CIP_{depo} goes to the relative funding advantage between Bank G and Bank D in the cash market $(r^{\$} - r^{\$}_G) - (r^* - r^*_D)$. $r^* - r^*_D$ captures how Bank D is able to borrow LC at an interest rate in the cash market lower than the interbank rate, while $r^{\$} - r^{\$}_G$ indicates how the global Bank G is capable of funding dollar at a favorable rate than the dollar interbank rate. When the interbank CIP deviation is zero, if Bank D funds LC at a much lower rate, he definitely has the motivation to invest in local asset and dollar asset through the FX swap market since his original borrowing cost has decreased. Like Bank D, if Bank G is able to obtain dollar funding at a lower deposit rate, he's more likely to engage in investments of both risk assets. Therefore, the net effect determining how banks' risk aversions predict asset returns relies on the differences between banks' own funding powers in dollar and LC in the cash markets even when the interbank CIP is zero. If Bank D has a relatively higher funding advantage in cash market than Bank G, that is $(r^{\$} - r^{\$}_G) - (r^* - r^*_D) < 0$, this net influence will to some degree shrink the benefit for Bank G to lend dollar and borrow LC in the FX swap market, offsetting the increased effect of Bank G's risk aversion on local asset risk premium caused by a negative interbank CIP, which is consistent with the insignificant predicting power of this component in empirical findings. On the other hand, if Bank G has a relatively higher funding advantage than Bank D in the cash market, that is $(r^{\$} - r^{\$}_G) - (r^* - r^*_D) > 0$, the benefit for Bank G to invest in local asset through the FX swap market is enlarged, resulting in a higher β_{1G}.

7 Conclusion

I document that GSIBs, recognized as systemically important to the global economy, are becoming marginal investors in local asset markets of countries where their subsidiaries are located after the GFC. Although muted in pre-crisis period, increases in the leverage ratio of GSIBs have a significant asset pricing power in the local stock, 10-year Treasury bond, currency and swap spread arbitrage markets in the post-crisis period. One standard deviation increase in the leverage of GSIBs will predict higher annual returns by 6.50%, 3.30% and 0.24% in local stock, Treasury and currency markets respectively, as well as 5.38 bps larger swap spread arbitrage. This transmission of roles for GSIBs in local asset markets are motivated by the positive and incremental funding advantage in local currency through the FX swap market as a consequence of tighter balance sheet constraints GSIBs are facing under the Basel III framework. GSIBs as main dollar lenders in the FX swap market engage in the transaction by exchanging dollar for local currency at current spot rate and converting dollar bank at a pre-determined forward rate. Under stricter capital regulations, GSIBs request a higher synthetic dollar rate from dollar borrowers, which in other words indicates that GSIBs are provided with a lower synthetic rate in local currency through the FX swap market than the interest rate funded in the cash market. As the funding advantage in local currency surges, predictive power of GSIBs' leverage for local asset returns grows. This effect is more prominent for GSIBs falling in higher capital buffer buckets and can not be explained solely by the size effect.

The FX swap market is the critical determinant of this effect. The funding advantage in local currency can be decomposed into two components: the difference between separate funding power of dollar and LC in the cash markets, which is bank specific, and the common interbank CIP deviation. I find that the common market average funding advantage in LC through the FX swap market, measured as the negative value to the interbank rate CIP, plays a dominating role in fostering the predictive power of GSIBs' leverage for local asset returns.

My paper provides a new perspective to evaluate the influence of the capital regulations on the financial system after the GFC by connecting GSIBs' balance sheet restrictions to their asset pricing power in the local asset markets through their involvement in the FX swap market. Despite imposed with stronger constraints, global banks are indeed becoming more important in local asset markets. My findings call for assessment of regulation policies from comprehensive aspects in addition to their macroeconomic impacts.

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Appendix

A Tables and Figures

Table 1: **Primary Dealers in the United Kingdom**

Financial Intermediaries	Headquarter	DSIBs	GSIBs	Local
Mitsubishi UFJ Financial Group, Inc	Japan	0	1	0
JPMorgan Chase & Co.	US	1	1	0
BNP Paribas	France	0	1	0
HSBC Holdings PLC	UK	1	1	1
Bank of America Corporation	US	1	1	0
Crdit Agricole Group	France	0	1	0
Citigroup Inc	US	1	1	0
Santander Group	Spain	0	1	0
Barclays PLC	UK	1	1	1
Deutsche Bank AG	Germany	0	1	0
TD Bank Group	Canada	0	1	0
Royal Bank of Canada	Canada	0	1	0
The Goldman Sachs Group, Inc	US	1	1	0
Lloyds Banking Group PLC	UK	1	0	1
Morgan Stanley	US	1	1	0
UBS Group AG	Switzerland	0	1	0
NatWest Group	UK	1	0	1
Credit Suisse Group AG	Switzerland	1	1	0
The Bank of Nova Scotia	Canada	0	0	0
Standard Chartered PLC	UK	1	1	1
Danske Bank AS	Denmark	0	0	0
Nomura Holdings, Inc.	Japan	1	0	0
Investec PLC	UK	0	0	1
Jefferies Financial Group Inc	US	0	0	0
Close Brothers Group PLC	UK	0	0	1
Total	25	12	17	7

Notes: This table reports numbers of the holding companies of primary dealers in the United Kingdom, their headquarters and different classifications of financial intermediaries. GSIBs refer to the global systemically important banks recognized by the Basel Committee on Banking Supervision and published by the Financial Stability Board. DSIBs denote the domestic systemically important banks recognized by the officials of each country and is used as a proxy for other institutional investors in additional to GSIBs. Local refers to intermediaries whose headquarters are in the domestic country, in this case, the United Kingdom. Entry of 1 suggests the intermediaries fall in this group.

Table 2: **Heterogeneous types of banks**

	Numbers					Percentage			
	Total	D	G	Local	non-Local	D	G	Local	non-Local
Australia	19	4	12	4	15	0.21	0.63	0.21	0.79
Austria	18	4	11	4	14	0.22	0.61	0.22	0.78
Belgium	15	5	11	1	14	0.33	0.73	0.07	0.93
Canada	9	6	4	7	2	0.67	0.44	0.78	0.22
Denmark	10	5	4	4	6	0.50	0.40	0.40	0.60
Finland	14	1	10	1	13	0.07	0.71	0.07	0.93
France	14	4	10	3	11	0.29	0.71	0.21	0.79
Germany	24	5	16	2	22	0.21	0.67	0.08	0.92
Ireland	15	6	10	2	13	0.40	0.67	0.13	0.87
Italy	17	3	12	4	13	0.18	0.71	0.24	0.76
Japan	18	5	14	7	11	0.28	0.78	0.39	0.61
Netherlands	12	2	7	2	10	0.17	0.58	0.17	0.83
Norway	4	1	0	1	3	0.25	0.00	0.25	0.75
Spain	18	4	11	5	13	0.22	0.61	0.28	0.72
Sweden	7	4	1	3	4	0.57	0.14	0.43	0.57
Switzerland	12	3	3	10	2	0.25	0.25	0.83	0.17
UK	25	12	17	7	18	0.48	0.68	0.28	0.72
Mean	15	4	9	4	11	0.31	0.55	0.30	0.70

Notes: This table reports the numbers and percentages of heterogeneous types of intermediaries in each country. 'Total' reports number of primary dealers. D denotes DSIBs as a proxy for other institutional investors in additional to GSIBs. G denotes GSIBs. 'Local' and 'non-Local' refer to intermediaries, the holding companies of which are located in the same domestic country and in foreign countries respectively. Left panel reports the number counts while the right panel reports the fraction of each category in total number of primary dealers.

Table 3: **Summary Statistics: Leverage**

	Lev_{All}		G		G_L		G_H	
	avg	std	avg	std	avg	std	avg	std
Australia	92.42	1.22	92.83	2.19	93.46	1.82	92.43	2.64
Austria	93.49	1.24	93.20	2.47	94.18	2.28	92.90	2.61
Belgium	93.98	1.12	93.97	2.44	95.23	2.53	93.35	2.54
Canada	90.97	1.08	90.65	2.54	90.71	1.06	90.68	3.26
Denmark	92.94	1.22	92.69	1.98	92.29	3.17	92.74	1.89
Finland	93.66	1.18	93.53	2.44	95.83	1.82	92.90	2.61
France	93.71	1.21	93.04	2.61	95.07	2.40	92.21	2.83
Germany	94.07	1.12	93.92	2.29	95.13	2.12	92.90	2.61
Ireland	93.24	1.27	93.12	2.45	93.99	2.16	92.90	2.61
Italy	93.63	1.18	93.53	2.47	95.03	2.43	92.90	2.61
Japan	94.32	1.05	94.40	2.22	95.55	2.21	93.62	2.40
Netherlands	92.95	1.25	92.70	2.97	95.03	1.79	91.60	3.64
Norway	94.22	1.22						
Spain	93.94	1.03	93.82	2.39	94.70	2.34	93.35	2.54
Sweden	95.00	1.01	96.14	2.40			96.14	2.40
Switzerland	95.27	0.86	95.49	1.75	94.82	1.44	96.14	2.40
UK	93.49	1.07	93.47	2.13	94.14	1.79	92.90	2.61
Mean	93.60	1.14	93.53	2.36	94.34	2.09	93.10	2.64

Notes: This table reports the time-series average and standard deviation of leverage ratio for different category of intermediaries in each country. The leverage ratio of each bank is calculated as one minus the capital ratio which is the percentage of market value of common equity to total asset of each intermediary. The leverage ratio of each sub-sample of intermediaries is the value weighted leverage of banks belonging to this group. Categories include Lev_{all} when all financial intermediaries are taken as one representative agent, G for all GSIBs in each country, G_L for GSIBs in the capital buffer bucket 1 and G_H for GSIBs in the capital buffer bucket 2-5. The sample covers quarterly data from 2000 Q1 to 2020 Q4.

Table 4: **Intermediary as One Representative Agent**

	Stock	Treasury	FX	SS
		2000-2020		
lev	0.75	1.54	0.14	-2.80
	(2.29)	(1.98)	(0.18)	(4.50)
constant	2.17***	2.92***	-0.01***	51.21***
	(0.01)	(0.01)	(0.00)	(4.01)
N	1,577	1,577	747	667
R^2	0.73	0.60	0.66	0.34

Notes: Panel regressions of test asset returns or arbitrage market payoffs on leverage ratio (squared) of all primary dealers in each country by taking financial intermediaries as one representative agent denoted by *lev*. Country/currency and quarter fixed effect are added. For Stock, 10-year Treasury bond and currency returns (FX), results of one quarter ahead predictive regressions are shown with the standard errors clustered at quarters. For the 30-year swap spread arbitrage (SS), contemporaneous regressions results are shown with the Driscoll-Kraay standard errors. Number of observations and R-squared are reported in N and R^2. The sample covers quarterly data from 2000 Q1 to 2020 Q4. Statistical significance: ***$p \leq 1\%$, **$p \leq 5\%$, *$p \leq 10\%$.

Table 5: **Before and After the GFC: GSIBs**

	Stock	Treasury	FX	SS
		before GFC(2000-2007Q3)		
G	-3.51	-1.44	-0.05	1.37
	(3.56)	(0.96)	(0.15)	(3.64)
Constant	-18.83	3.68	-0.54	-117.50
	(29.45)	(4.55)	(1.70)	(113.48)
Control	Y	Y	Y	Y
N	503	503	263	125
R^2	0.71	0.75	0.69	0.89
		after GFC(2007Q4-2020)		
G	6.50*	3.30***	0.24*	-5.38**
	(3.52)	(0.97)	(0.13)	(2.07)
Constant	27.49	80.35*	-2.08	195.34**
	(83.95)	(46.26)	(10.88)	(76.45)
Control	Y	Y	Y	Y
N	332	332	204	132
R^2	0.82	0.63	0.62	0.83

Notes: Panel regressions of test asset returns or arbitrage market payoffs on leverage ratio (squared) of GSIBs in each country denoted by G before and after the Global Financial Crisis (GFC). *Control* variables include leverage ratio of other institutional investors proxied by DSIBs and financial structure indicators in each country which are Deposit Money Bank Assets to GDP, Bank Concentration, Bank ROA, Stock Market Capitalization, International Debt Issues to GDP, Liquid Liabilities to GDP, Private Credit by Deposit Money Banks to GDP, Bank Credit to Bank Deposits, Number of listed companies per 10K Population and Private Bond Market Capitalization to GDP. Country/currency and quarter fixed effect are added. For the Stock, 10-year Treasury bond and currency returns (FX), results of one quarter ahead predictive regressions are shown with the standard errors clustered at quarters. For the 30-year swap spread arbitrage (SS), contemporaneous regressions results are shown with the Driscoll-Kraay standard errors. Number of observations and R-squared are reported in N and R^2 The sample covers quarterly data from 2000 Q1 to 2020 Q4. Statistical significance: $^{***}p \leq 1\%$, $^{**}p \leq 5\%$, $^{*}p \leq 10\%$.

Table 6: **Funding Advantage: Before and After the GFC**

	Before the GFC			After the GFC		
	$G_{funding}$	$-CIP_{interbank}$	$Intdiff$	$G_{funding}$	$-CIP_{interbank}$	$Intdiff$
AUD	-1.77	0.04	-1.81	-0.20	-0.06	-0.14
AUT	-2.18	-0.02	-2.16	-0.03	0.31	-0.34
BEL	-0.16	-0.05	-0.11	0.28	0.31	-0.02
CAD	-1.95	0.00	-1.95	-0.42	0.20	-0.61
CHF	-0.35	0.01	-0.36	0.36	0.25	0.11
DKK	-1.15	0.02	-1.17	0.70	0.58	0.12
EUR	-0.17	-0.05	-0.12	0.31	0.31	0.00
FIN	-0.23	-0.05	-0.18	0.33	0.31	0.02
FRA	-0.28	-0.01	-0.27	0.79	0.29	0.50
GBP	0.05	0.07	-0.02	0.17	0.16	0.01
DEU	-0.17	-0.05	-0.12	0.31	0.31	0.00
IRL	-0.08	-0.02	-0.05	0.50	0.31	0.19
ITL	-1.54	-0.05	-1.49	0.30	0.31	0.00
JPY	0.05	0.04	0.01	0.19	0.28	-0.08
NLD	0.02	-0.05	0.07	0.22	0.31	-0.09
NOK	-1.02	0.05	-1.07	0.09	0.27	-0.18
SEK	-1.35	0.05	-1.40	0.06	0.25	-0.20
SPN	-0.58	-0.02	-0.56	0.56	0.31	0.25
Mean	-0.71	-0.01	-0.71	0.25	0.28	-0.03

Notes: This table reports the time-series mean of the funding advantage in local currency denoted by $G_{funding}$, the common component of the FX swap market calculated as the negative value of the interbank rate CIP deviation $-CIP_{interbank}$ and the bank-specific component capturing the difference of funding advantage in dollar and local currency in the cash markets denoted as $Intdiff$ in pre and post crisis periods. Numbers are in percentage. The sample covers quarterly data from 2000 Q1 to 2020 Q4.

Table 7: **Interaction with LC Funging Advantage: Dummy**

	Stock	Treasury	FX	SS
		2000-2020		
G	-1.43	1.45	-0.11	2.18
	(3.96)	(2.23)	(0.20)	(2.55)
$G \times G_{funding}$	2.55	2.03**	0.43**	-7.46**
	(2.96)	(0.87)	(0.20)	(3.25)
$G_{funding}$	2.25	1.33	0.20	-5.82**
	(2.91)	(0.95)	(0.19)	(2.65)
$Constant$	-41.82*	9.90	-4.46***	171.73***
	(23.34)	(6.90)	(1.48)	(27.99)
$Control$	Y	Y	Y	Y
N	852	852	476	257
R^2	0.74	0.66	0.61	0.80

Notes: Panel regressions of test asset returns or arbitrage market payoffs on leverage ratio (squared) of GSIBs in each country denoted by G, the funding advantage in the LC through the FX swap market $G_{funding}$ and their interactions. $G_{funding}$ is a dummy variable which equals 1 if there is a positive funding advantage in local currency and 0 elsewise. $Control$ variables include leverage ratio of other institutional investors proxied by DSIBs and financial structure indicators in each country which are Deposit Money Bank Assets to GDP, Bank Concentration, Bank ROA, Stock Market Capitalization, International Debt Issues to GDP, Liquid Liabilities to GDP, Private Credit by Deposit Money Banks to GDP, Bank Credit to Bank Deposits, Number of listed companies per 10K Population and Private Bond Market Capitalization to GDP. Country/currency and quarter fixed effect are added. For the Stock, 10-year Treasury bond and currency returns (FX), results of one quarter ahead predictive regressions are shown with the standard errors clustered at quarters. For the 30-year swap spread arbitrage (SS), contemporaneous regressions results are shown with the Driscoll-Kraay standard errors. Number of observations and R-squared are reported in N and R^2 The sample covers quarterly data from 2000 Q1 to 2020 Q4. Statistical significance: ***$p \leq 1\%$, **$p \leq 5\%$, *$p \leq 10\%$.

Table 8: **Interaction with LC Funging Advantage: Magnitude**

	Stock	Treasury	FX	SS
		2000-2020		
G	-0.05	2.59	0.08	-2.93
	(3.07)	(1.98)	(0.21)	(1.79)
$G \times G_{funding}$	2.84*	1.34***	0.25*	-3.20*
	(1.66)	(0.46)	(0.15)	(1.92)
$G_{funding}$	-1.79	-0.52	0.15	-12.21***
	(2.18)	(0.71)	(0.15)	(4.19)
$Constant$	-41.16*	11.54	-4.27**	136.58***
	(23.55)	(7.34)	(1.81)	(29.36)
$Control$	Y	Y	Y	Y
N	792	792	464	233
R^2	0.76	0.66	0.61	0.82

Notes: Panel regressions of test asset returns or arbitrage market payoffs on leverage ratio (squared) of GSIBs in each country denoted by G, the funding advantage in the LC through the FX swap market $G_{funding}$, and their interactions. $Control$ variables include leverage ratio of other institutional investors proxied by DSIBs and financial structure indicators in each country which are Deposit Money Bank Assets to GDP, Bank Concentration, Bank ROA, Stock Market Capitalization, International Debt Issues to GDP, Liquid Liabilities to GDP, Private Credit by Deposit Money Banks to GDP, Bank Credit to Bank Deposits, Number of listed companies per 10K Population and Private Bond Market Capitalization to GDP. Country/currency and quarter fixed effect are added. For the Stock, 10-year Treasury bond and currency returns (FX), results of one quarter ahead predictive regressions are shown with the standard errors clustered at quarters. For the 30-year swap spread arbitrage (SS), contemporaneous regressions results are shown with the Driscoll-Kraay standard errors. Number of observations and R-squared are reported in N and R^2 The sample covers quarterly data from 2000 Q1 to 2020 Q4. Statistical significance: $^{***}p \leq 1\%$, $^{**}p \leq 5\%$, $^{*}p \leq 10\%$.

Table 9: **LC Funging Advantage Decomposition**

	Stock	Treasury	FX	SS
	2000-2020			
G	0.60	0.64	-0.18	-0.07
	(4.21)	(1.62)	(0.26)	(3.23)
$G \times Intdiff$	0.68	0.75**	-0.03	-1.39
	(2.89)	(0.36)	(0.19)	(2.66)
$G \times (-CIP_{interbank})$	2.80*	4.68***	0.56*	-11.93**
	(1.51)	(1.48)	(0.34)	(5.29)
$Intdiff$	-2.18	-0.85	0.22	-16.43***
	(2.29)	(0.71)	(0.16)	(4.13)
$-CIP_{interbank}$	7.79	2.14	0.94	1.77
	(10.03)	(5.71)	(0.73)	(8.20)
$Constant$	-41.94*	8.60	-3.94**	130.73***
	(23.81)	(6.29)	(1.78)	(29.28)
$Control$	Y	Y	Y	Y
N	792	792	464	233
R^2	0.76	0.66	0.62	0.83

Notes: Panel regressions of test asset returns or arbitrage market payoffs on leverage ratio (squared) of GSIBs in each country denoted by G, the common component of the FX swap market calculated as the negative value of the interbank rate CIP deviation $-CIP_{interbank}$ and the bank-specific component capturing the difference of funding advantage in dollar and local currency in the cash markets denoted as $Intdiff$ and their interactions. $Control$ variables include leverage ratio of other institutional investors proxied by DSIBs and financial structure indicators in each country which are Deposit Money Bank Assets to GDP, Bank Concentration, Bank ROA, Stock Market Capitalization, International Debt Issues to GDP, Liquid Liabilities to GDP, Private Credit by Deposit Money Banks to GDP, Bank Credit to Bank Deposits, Number of listed companies per 10K Population and Private Bond Market Capitalization to GDP. Country/currency and quarter fixed effect are added. For the Stock, 10-year Treasury bond and currency returns (FX), results of one quarter ahead predictive regressions are shown with the standard errors clustered at quarters. For the 30-year swap spread arbitrage (SS), contemporaneous regressions results are shown with the Driscoll-Kraay standard errors. Number of observations and R-squared are reported in N and R^2 The sample covers quarterly data from 2000 Q1 to 2020 Q4. Statistical significance: ***$p \leq 1\%$, **$p \leq 5\%$, *$p \leq 10\%$.

Table 10: **Summary Statistics: Leverage for G_L and G_H**

	G_L		G_H	
	avg	std	avg	std
Australia	93.80	1.06	93.79	1.41
Austria	95.38	1.08	94.21	1.35
Belgium	96.41	1.09	94.63	1.15
Canada	90.59	0.92	92.72	1.45
Denmark	92.77	2.08	93.59	1.20
Finland	96.87	0.80	94.21	1.35
France	96.20	0.97	93.63	1.44
Germany	96.19	0.94	94.21	1.35
Ireland	94.93	1.14	94.21	1.35
Italy	96.31	0.95	94.21	1.35
Japan	96.65	0.74	94.83	1.30
Netherlands	95.84	1.12	93.65	1.40
Norway				
Spain	95.90	0.96	94.63	1.15
Sweden			97.44	0.71
Switzerland	95.24	1.06	97.44	0.71
UK	94.95	0.88	94.21	1.35
Mean	95.20	1.05	94.47	1.25

Notes: This table reports the time-series average and standard deviation of leverage ratios of GSIBs falling in the low capital buffer group G_L and the high capital buffer group G_H for each country. The leverage ratio of each bank is calculated as one minus the capital ratio which is the percentage of market value of common equity to total asset of each intermediary. The leverage ratio of each subsample of intermediaries is the value weighted leverage of banks belonging to this group. Numbers are in percentage. G_L consists of GSIBs allocated to the capital buffer bucket 1 while G_H consists of GSIBs allocated to capital buffer buckets 2 to 5 as published in the most updated list of GSIBs by the Financial Stability Board. The sample covers quarterly data from 2000 Q1 to 2020 Q4.

Table 11: **GSIBs Capital Bucket: Dummy**

	Stock	Treasury	FX	SS
	2000-2020			
G_L	-3.68	-1.11	-0.24	-8.32**
	(3.19)	(1.22)	(0.15)	(3.30)
$G_L \times G_{funding}$	-2.96	0.39	0.28	9.69**
	(2.80)	(2.13)	(0.18)	(3.91)
G_H	-0.90	3.67	0.04	2.17
	(3.59)	(3.84)	(0.28)	(1.61)
$G_H \times G_{funding}$	10.38**	2.00*	0.62**	-7.97***
	(5.12)	(1.02)	(0.27)	(2.96)
$G_{funding}$	3.41	1.85	0.30	-5.52**
	(3.43)	(1.15)	(0.22)	(2.60)
$Constant$	-45.64*	11.01*	-4.94***	147.09***
	(23.58)	(6.58)	(1.38)	(27.49)
$Control$	Y	Y	Y	Y
N	804	804	428	257
R^2	0.74	0.66	0.60	0.80

Notes: Panel regressions of test asset returns or arbitrage market payoffs on leverage ratio (squared) of GSIBs in the low buffer group denoted by G_L, GSIBs in the high buffer group denoted by G_H, the funding advantage in the LC through the FX swap market $G_{funding}$ and their interactions. $G_{funding}$ is a dummy variable which equals 1 if there is a positive funding advantage in local currency and 0 elsewise. $Control$ variables include leverage ratio of other institutional investors proxied by DSIBs and financial structure indicators in each country which are Deposit Money Bank Assets to GDP, Bank Concentration, Bank ROA, Stock Market Capitalization, International Debt Issues to GDP, Liquid Liabilities to GDP, Private Credit by Deposit Money Banks to GDP, Bank Credit to Bank Deposits, Number of listed companies per 10K Population and Private Bond Market Capitalization to GDP. Country/currency and quarter fixed effect are added. For the Stock, 10-year Treasury bond and currency returns (FX), results of one quarter ahead predictive regressions are shown with the standard errors clustered at quarters. For the 30-year swap spread arbitrage (SS), contemporaneous regressions results are shown with the Driscoll-Kraay standard errors. Number of observations and R-squared are reported in N and R^2 The sample covers quarterly data from 2000 Q1 to 2020 Q4. Statistical significance: $^{***}p \leq 1\%$, $^{**}p \leq 5\%$, $^{*}p \leq 10\%$.

Table 12: **GSIBs Capital Bucket: Magnitude**

	Stock	Treasury	FX	SS
	2000-2020			
G_L	1.15	-0.72	0.16	-0.20
	(2.50)	(1.83)	(0.20)	(1.82)
$G_L \times G_{funding}$	0.52	0.47	0.20	2.45
	(1.45)	(1.14)	(0.16)	(2.35)
G_H	-2.00	4.31	-0.04	-2.89*
	(2.97)	(3.06)	(0.26)	(1.72)
$G_H \times G_{funding}$	5.54***	0.96**	0.40**	-3.05*
	(2.05)	(0.48)	(0.16)	(1.76)
$G_{funding}$	-1.17	-0.52	0.27	-11.79***
	(2.16)	(0.86)	(0.17)	(4.11)
$Constant$	-37.65	13.26*	-4.60***	118.43***
	(23.20)	(7.40)	(1.71)	(28.55)
$Control$	Y	Y	Y	Y
N	744	744	416	233
R^2	0.76	0.65	0.60	0.82

Notes: Panel regressions of test asset returns or arbitrage market payoffs on leverage ratio (squared) of GSIBs in the low buffer group denoted by G_L, GSIBs in the high buffer group denoted by G_H, the funding advantage in the LC through the FX swap market $G_{funding}$ and their interactions. $Control$ variables include leverage ratio of other institutional investors proxied by DSIBs and financial structure indicators in each country which are Deposit Money Bank Assets to GDP, Bank Concentration, Bank ROA, Stock Market Capitalization, International Debt Issues to GDP, Liquid Liabilities to GDP, Private Credit by Deposit Money Banks to GDP, Bank Credit to Bank Deposits, Number of listed companies per 10K Population and Private Bond Market Capitalization to GDP. Country/currency and quarter fixed effect are added. For the Stock, 10-year Treasury bond and currency returns (FX), results of one quarter ahead predictive regressions are shown with the standard errors clustered at quarters. For the 30-year swap spread arbitrage (SS), contemporaneous regressions results are shown with the Driscoll-Kraay standard errors. Number of observations and R-squared are reported in N and R^2 The sample covers quarterly data from 2000 Q1 to 2020 Q4. Statistical significance: $^{***}p \leq 1\%$, $^{**}p \leq 5\%$, $^{*}p \leq 10\%$.

Table 13: **Global banks that are non-GSIBs**

	Stock	Treasury	FX	SS
		2000-2020		
non G	-1.23	2.50	-0.26*	0.19
	(3.68)	(2.45)	(0.15)	(1.67)
non $G \times G_{funding}$	1.99	1.40	0.11	-4.42*
	(2.35)	(1.34)	(0.21)	(2.43)
$G_{funding}$	0.07	1.00	0.24	-5.53**
	(2.92)	(0.77)	(0.25)	(2.62)
$Constant$	-38.49*	10.52	-5.21***	170.13***
	(22.94)	(6.56)	(1.74)	(28.88)
$Control$	Y	Y	Y	Y
N	780	780	404	257
R^2	0.76	0.67	0.70	0.80

Notes: Panel regressions of test asset returns or arbitrage market payoffs on leverage ratio (squared) of non-GSIB global banks in each country denoted by non G, the funding advantage in the LC through the FX swap market $G_{funding}$ and their interactions. $G_{funding}$ is a dummy variable which equals 1 if there is a positive funding advantage in local currency and 0 elsewise. *Control* variables include leverage ratio of other institutional investors proxied by DSIBs and financial structure indicators in each country which are Deposit Money Bank Assets to GDP, Bank Concentration, Bank ROA, Stock Market Capitalization, International Debt Issues to GDP, Liquid Liabilities to GDP, Private Credit by Deposit Money Banks to GDP, Bank Credit to Bank Deposits, Number of listed companies per 10K Population and Private Bond Market Capitalization to GDP. Country/currency and quarter fixed effect are added. For the Stock, 10-year Treasury bond and currency returns (FX), results of one quarter ahead predictive regressions are shown with the standard errors clustered at quarters. For the 30-year swap spread arbitrage (SS), contemporaneous regressions results are shown with the Driscoll-Kraay standard errors. Number of observations and R-squared are reported in N and R^2 The sample covers quarterly data from 2000 Q1 to 2020 Q4. Statistical significance: ***$p \leq 1\%$, **$p \leq 5\%$, *$p \leq 10\%$.

Table 14: **Intermediary Size and GSIBs Prediction**

	Stock	Treasury	FX	SS
	2000-2020			
G	-2.44	-1.35	0.16	-3.31
	(1.59)	(1.47)	(0.10)	(6.54)
$G \times Gsize$	9.40***	0.77	0.02	-0.69
	(3.50)	(0.75)	(0.16)	(4.06)
$Constant$	-54.08**	12.83	-3.65**	54.16
	(24.29)	(8.14)	(1.60)	(60.35)
$Control$	Y	Y	Y	Y
N	852	852	476	209
R^2	0.75	0.66	0.61	0.84

Notes: Panel regressions of test asset returns or arbitrage market payoffs on leverage ratio (squared) of GSIBs in each country denoted by G and their interactions with GSIBs bank sizes measured by the common equity with the notation G_{size}. $Control$ variables include leverage ratio of other institutional investors proxied by DSIBs and financial structure indicators in each country which are Deposit Money Bank Assets to GDP, Bank Concentration, Bank ROA, Stock Market Capitalization, International Debt Issues to GDP, Liquid Liabilities to GDP, Private Credit by Deposit Money Banks to GDP, Bank Credit to Bank Deposits, Number of listed companies per 10K Population and Private Bond Market Capitalization to GDP. Country/currency and quarter fixed effect are added. For the Stock, 10-year Treasury bond and currency returns (FX), results of one quarter ahead predictive regressions are shown with the standard errors clustered at quarters. For the 30-year swap spread arbitrage (SS), contemporaneous regressions results are shown with the Driscoll-Kraay standard errors. Number of observations and R-squared are reported in N and R^2 The sample covers quarterly data from 2000 Q1 to 2020 Q4. Statistical significance: $***p \leq 1\%$, $**p \leq 5\%$, $*p \leq 10\%$.

Table 15: **Intermediary Size and LC Funding Advantage**

	Stock	Treasury	FX	SS
		2000-2020		
G	-2.60	2.38	-0.09	-3.80
	(4.22)	(3.15)	(0.24)	(5.29)
$G \times G_{funding}$	5.27**	3.88***	0.52*	-5.24*
	(2.51)	(1.12)	(0.33)	(2.68)
$G \times G_{funding} \times G_{size}$	0.81	-2.81***	-0.08	-0.23
	(3.35)	(1.05)	(0.24)	(5.48)
$G_{funding}$	-3.32	1.60	0.12	4.00
	(3.04)	(1.23)	(0.22)	(4.12)
$Constant$	-42.11*	12.21	-4.22***	60.18
	(23.71)	(7.36)	(1.50)	(44.52)
$Control$	Y	Y	Y	Y
N	852	852	476	257
R^2	0.75	0.66	0.62	0.89

Notes: Panel regressions of test asset returns or arbitrage market payoffs on leverage ratio (squared) of GSIBs in each country denoted by G, the funding advantage in the LC through the FX swap market $G_{funding}$, and their interactions with GSIBs bank sizes measured by the common equity with the notation G_{size}. $G_{funding}$ is a dummy variable which equals 1 if there is a positive funding advantage in local currency and 0 elsewise. $Control$ variables include leverage ratio of other institutional investors proxied by DSIBs and financial structure indicators in each country which are Deposit Money Bank Assets to GDP, Bank Concentration, Bank ROA, Stock Market Capitalization, International Debt Issues to GDP, Liquid Liabilities to GDP, Private Credit by Deposit Money Banks to GDP, Bank Credit to Bank Deposits, Number of listed companies per 10K Population and Private Bond Market Capitalization to GDP. Country/currency and quarter fixed effect are added. For the Stock, 10-year Treasury bond and currency returns (FX), results of one quarter ahead predictive regressions are shown with the standard errors clustered at quarters. For the 30-year swap spread arbitrage (SS), contemporaneous regressions results are shown with the Driscoll-Kraay standard errors. Number of observations and R-squared are reported in N and R^2 The sample covers quarterly data from 2000 Q1 to 2020 Q4. Statistical significance: ***$p \leq 1\%$, **$p \leq 5\%$, *$p \leq 10\%$.

International Swap Spread

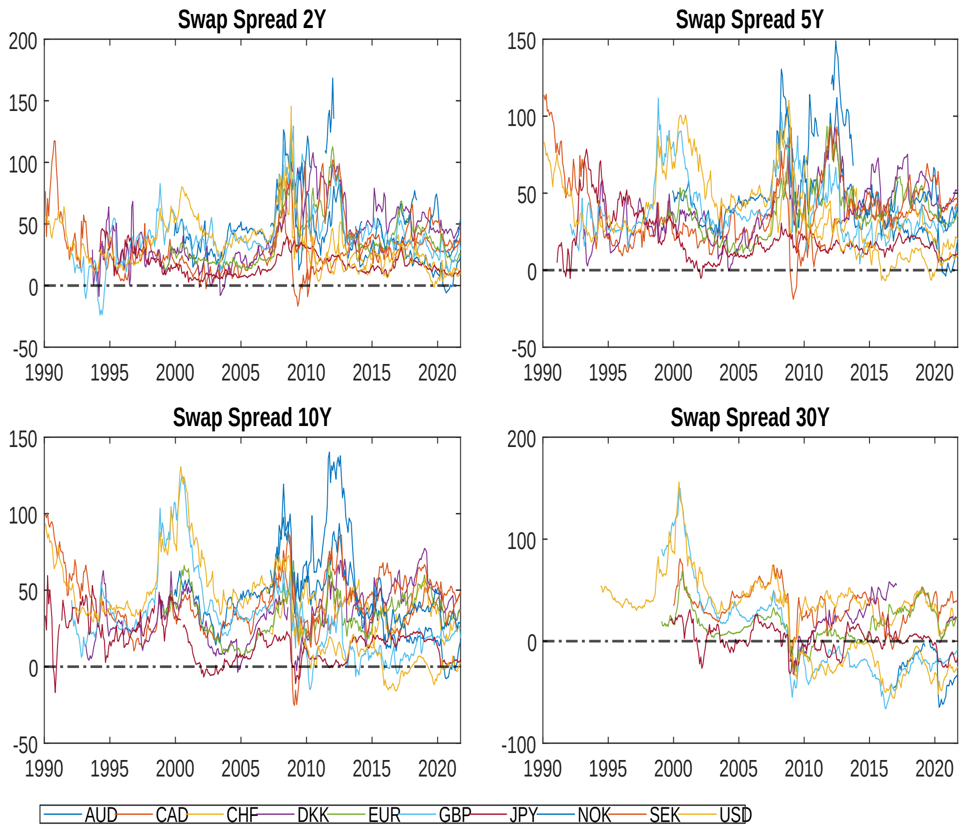

Figure 1: 2-year, 5-year, 10-year and 30-year Swap spread for AUD, CAD, CHF, DKK, EUR, GBP, JPY, NOK, SEK and USD. X-axis indicates the timeline while Y-axis indicates the value of swap spread in basis point. Swap spread is the difference between the swap rate and the Treasury rate of each currency. Data tickers are reported in the Online Appendix.

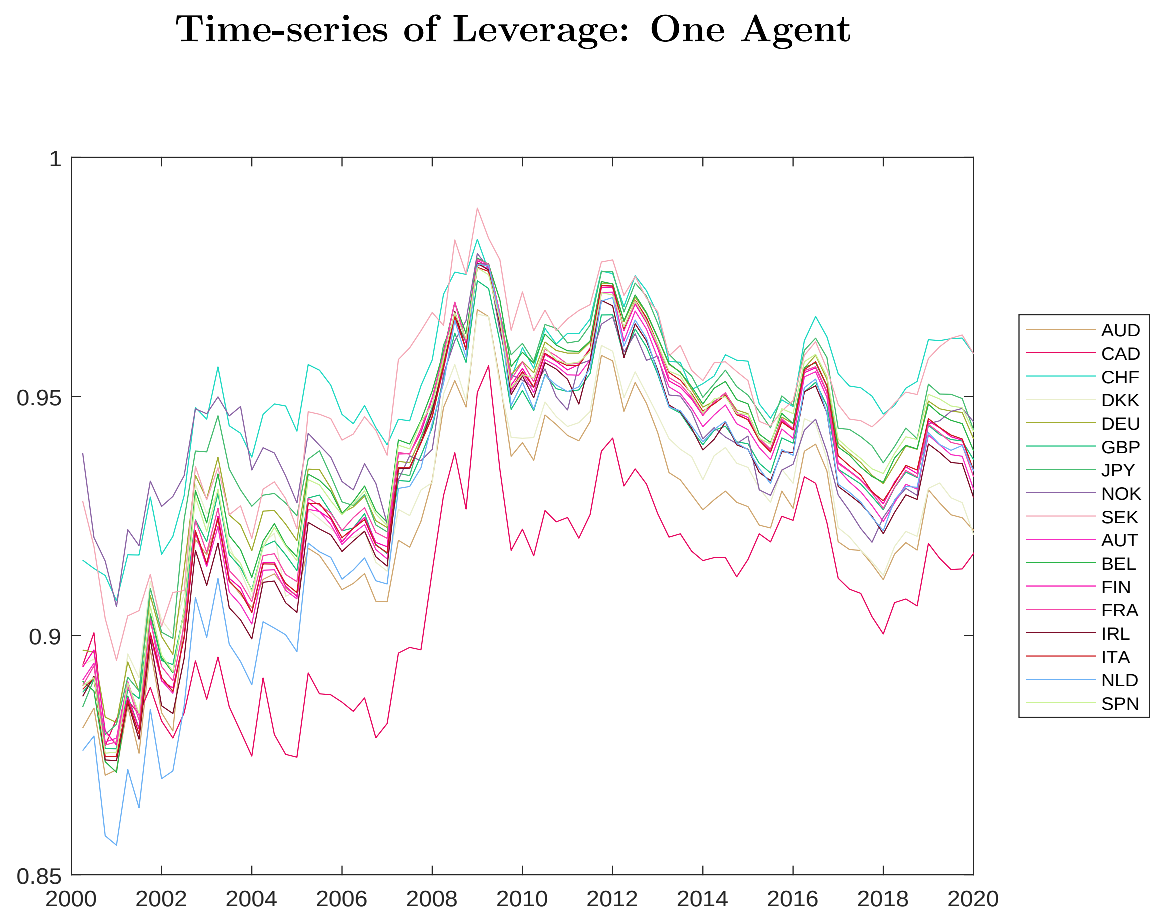

Figure 2: Leverage ratio of financial intermediaries in each country. Primary dealers are chosen as the full set of intermediaries. All intermediaries are recognized as one representative agent and the leverage ratio is calculated as one minus the capital ratio, which is the value weighted common equity as a fraction of total asset of all intermediaries in each country. Sample includes 17 advanced economies and covers quarterly data from 2000 Q1 to 2020 Q4.

Time-series of Leverage: GSIBs

Figure 3: Leverage ratio of Global Systemically Important Banks (GSIBs) in each country. The leverage ratio is calculated as one minus the capital ratio, which is the value weighted common equity as a fraction of total asset of all GSIBs in each country. Sample includes 17 advanced economies and covers quarterly data from 2000 Q1 to 2020 Q4.

LC Deposit rate and LC Synthetic rate

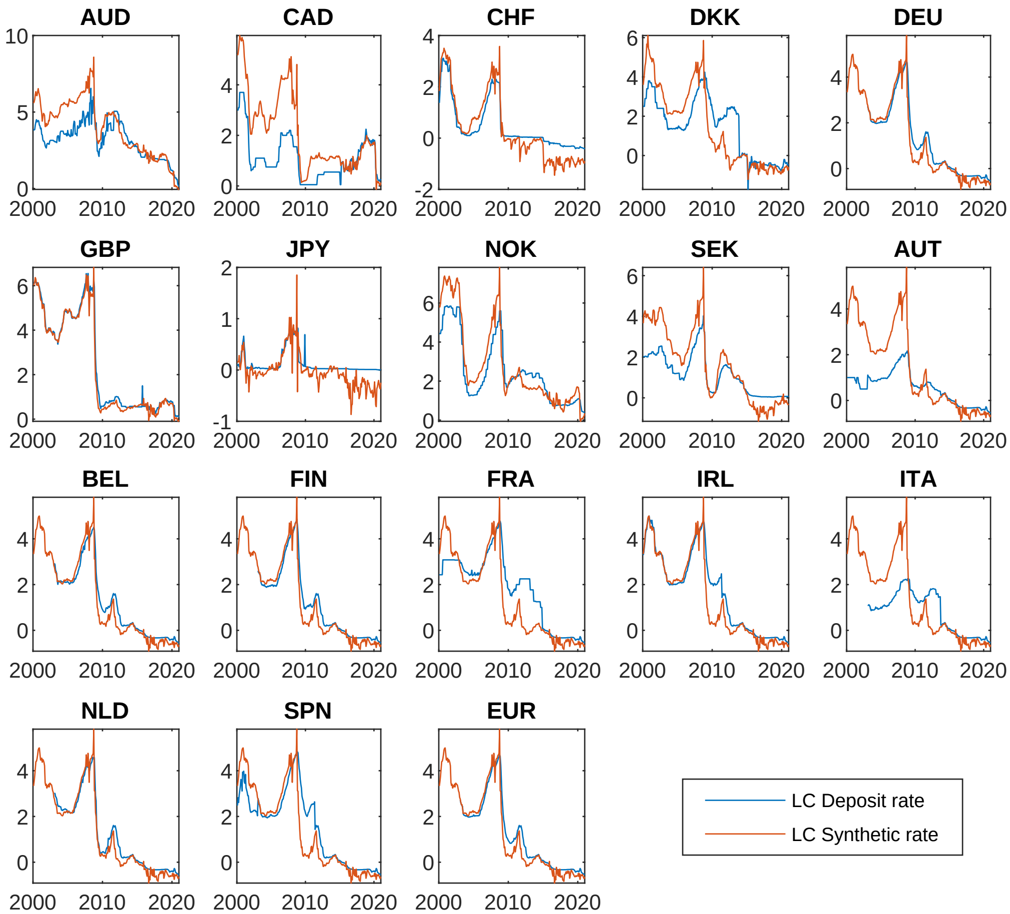

Figure 4: Time plot of monthly deposit rate (blue) of local currency(LC) versus the synthetic rate(red) of LC through the FX swap market in each country in the sample. For European Union countries, the synthetic rate of their LC is the synthetic rate of Euro (EUR). Both interest rates are in annual percentage, as depicted in the Y-axis. X-axis indicates time lines. Sample includes 17 advanced economies plus the Euro (EUR) and covers 2000 to 2020.

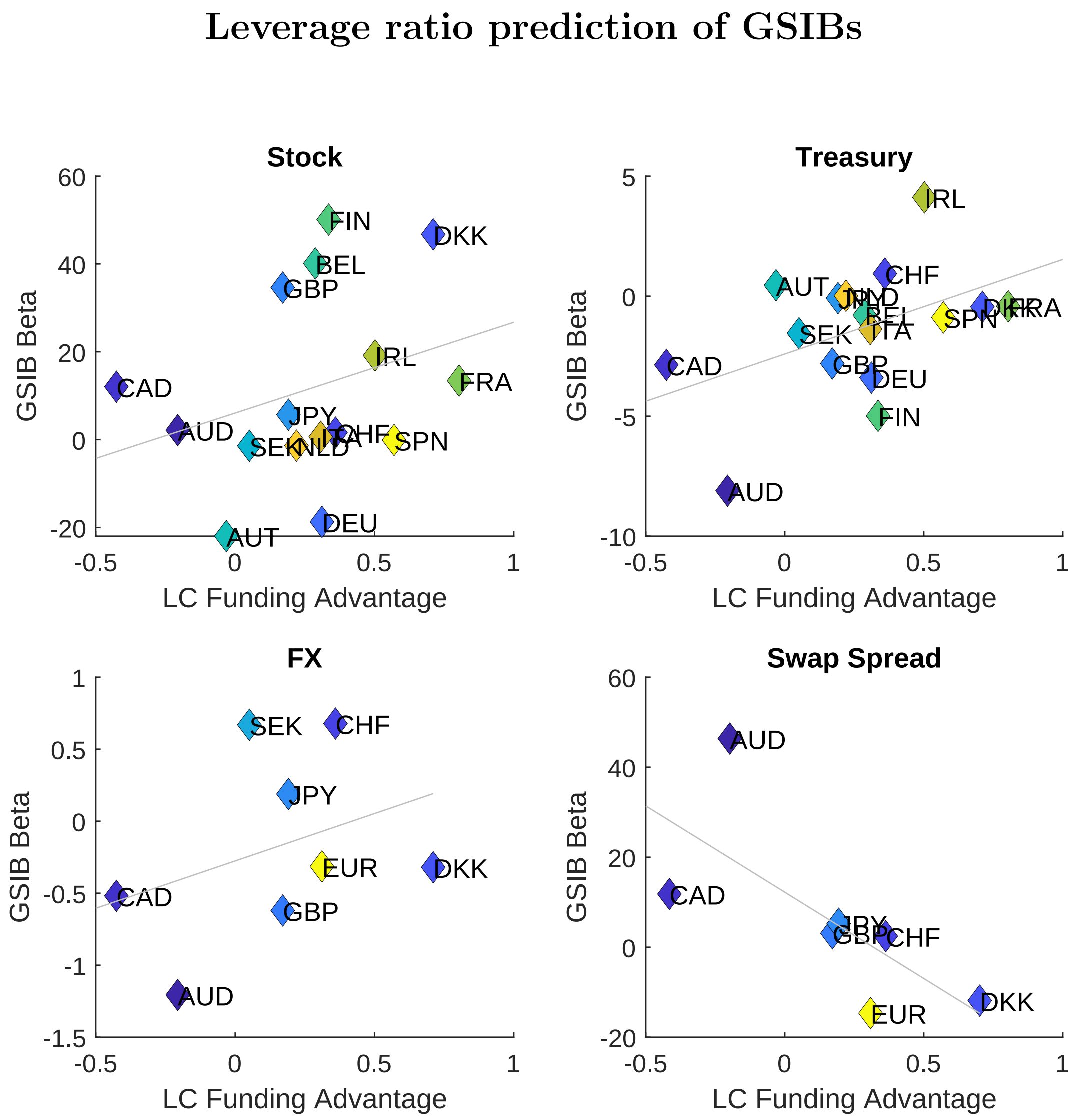

Figure 5: Scatter plot of GSIBs' prediction coefficients versus the funding advantage in local currency (LC) of each country. Y-axis indicates the predictive coefficients of leverage ratio of GSIBs: GSIB Beta. For Stock, Treasury and currency (FX) markets, Y-axis is in annual percentage while for the swap spread arbitrage market (Swap Spread), Y-axis is in basis points per annum. X-axis is marked with the funding advantage in LC for dollar lenders through the FX swap market in percentage, which is the difference between the deposit rate and the synthetic rate as defined in equation 4. Stock and Treasury returns include all countries in the sample, while for currency and swap spread markets, returns and arbitrage payoffs are aggregated at the currency level such that all European Union countries obtain returns in the Euro (EUR). The sample period covers the post-crisis period from 2007 Q4 to 2020 Q4.

Online Appendix

In section A, I provide robust test justifying the effect of funding advantage in LC on the prediction of GSIBs' leverage in local asset markets when the leverage is in log forms. Next I provide figures showing the relationship between the cross-sectional funding advantage in LC and GSIBs predictions when EU countries are included in currency returns and figures depicting the relationship between the cross-sectional funding advantage in LC and predictions of other institutional investors (DSIBs as a proxy) in each country. Data tickers for the swaps and government bonds are provided in section B.

A Robustness

Table 16: **Interaction with LC Funding Advantage Dummy: Log Leverage**

	Stock	Treasury	FX	SS
		2000-2020		
G	-2.17	-1.15	0.13	4.36
	(2.72)	(1.98)	(0.27)	(2.68)
$G \times G_{funding}$	2.18	1.94*	0.24*	-9.03**
	(1.67)	(1.00)	(0.14)	(3.86)
$G_{funding}$	1.82*	1.82***	0.27**	-5.56**
	(0.97)	(0.66)	(0.12)	(2.65)
$Constant$	9.83	1.72***	-1.20**	176.53***
	(7.81)	(0.39)	(0.57)	(26.79)
$Control$	Y	Y	Y	Y
N	852	852	476	257
R^2	0.66	0.62	0.65	0.79

Notes: Panel regressions of test asset returns or arbitrage market payoffs on leverage ratio (log) of GSIBs in each country denoted by G, the funding advantage in local currency through the FX swap market $G_{funding}$ and their interactions. $G_{funding}$ is a dummy variable which equals 1 if there is a positive funding advantage in local currency and 0 elsewise. *Control* variables include leverage ratio of other institutional investors proxied by DSIBs and financial structure indicators in each country which are Deposit Money Bank Assets to GDP, Bank Concentration, Bank ROA, Stock Market Capitalization, International Debt Issues to GDP, Liquid Liabilities to GDP, Private Credit by Deposit Money Banks to GDP, Bank Credit to Bank Deposits, Number of listed companies per 10K Population and Private Bond Market Capitalization to GDP. Country/currency and quarter fixed effect are added. For the Stock, 10-year Treasury bond and currency returns (FX), results of one quarter ahead predictive regressions are shown with the standard errors clustered at quarters. For the 30-year swap spread arbitrage (SS), contemporaneous regressions results are shown with the Driscoll-Kraay standard errors. Number of observations and R-squared are reported in N and R^2 The sample covers quarterly data from 2000 Q1 to 2020 Q4. Statistical significance: ***$p \leq 1\%$, **$p \leq 5\%$, *$p \leq 10\%$.

Leverage Ratio Prediction of GSIBs: All

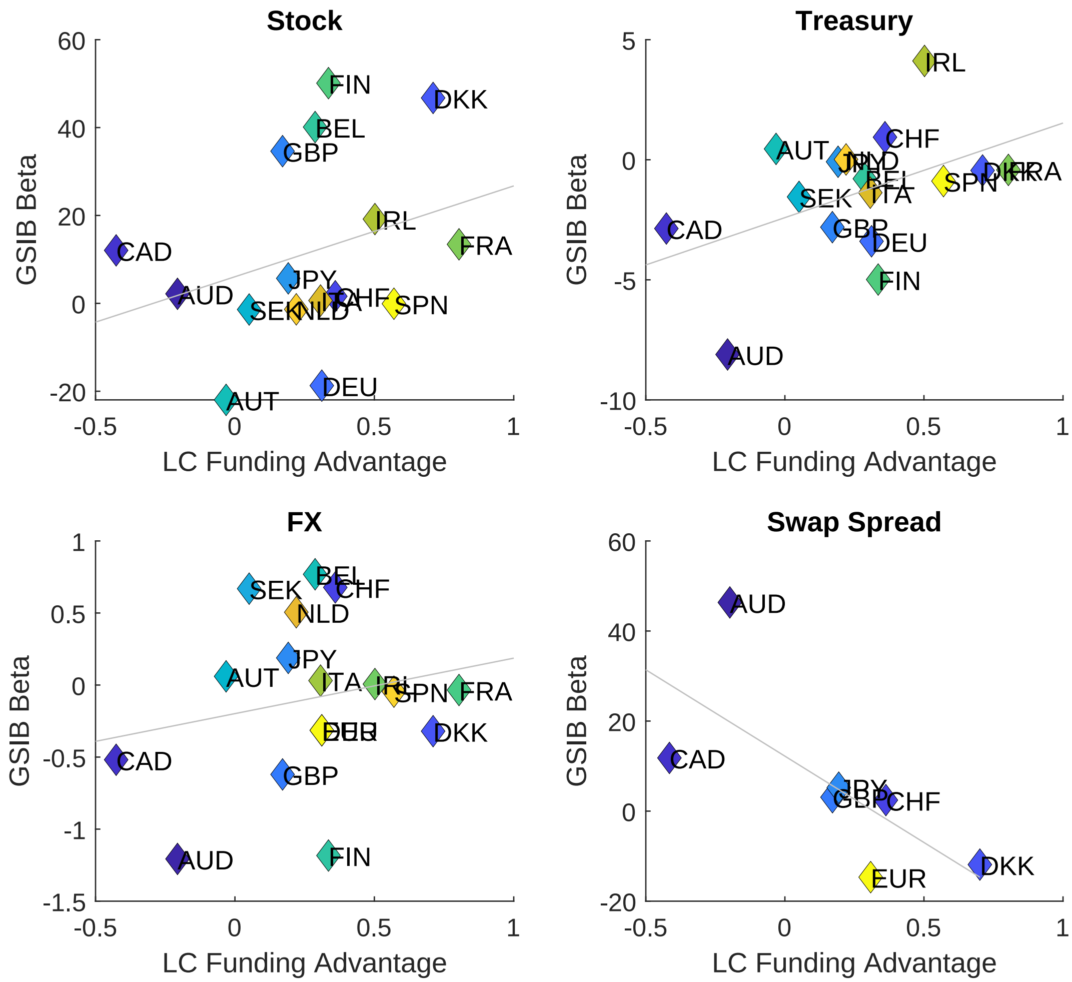

Figure 6: Scatter plot of GSIBs' prediction coefficients versus the funding advantage in local currency (LC) of each country. Y-axis indicates the predictive coefficients of leverage ratio of GSIBs: GSIB Beta. For Stock, Treasury and currency (FX) markets, Y-axis is in annual percentage while for the swap spread arbitrage market (Swap Spread), Y-axis is in basis points per annum. X-axis is marked with the funding advantage in LC for dollar lenders through the FX swap market in percentage, which is the difference between the deposit rate and the synthetic rate as defined in equation 4. Stock, Treasury and currency (FX) returns include all countries in the sample, while for the swap spread market, arbitrage payoffs are aggregated at the currency level such that all European Union countries obtain returns in the Euro (EUR). The sample period covers the post-crisis period from 2007 Q4 to 2020 Q4.

Leverage Ratio Prediction of Other Institutional Investors

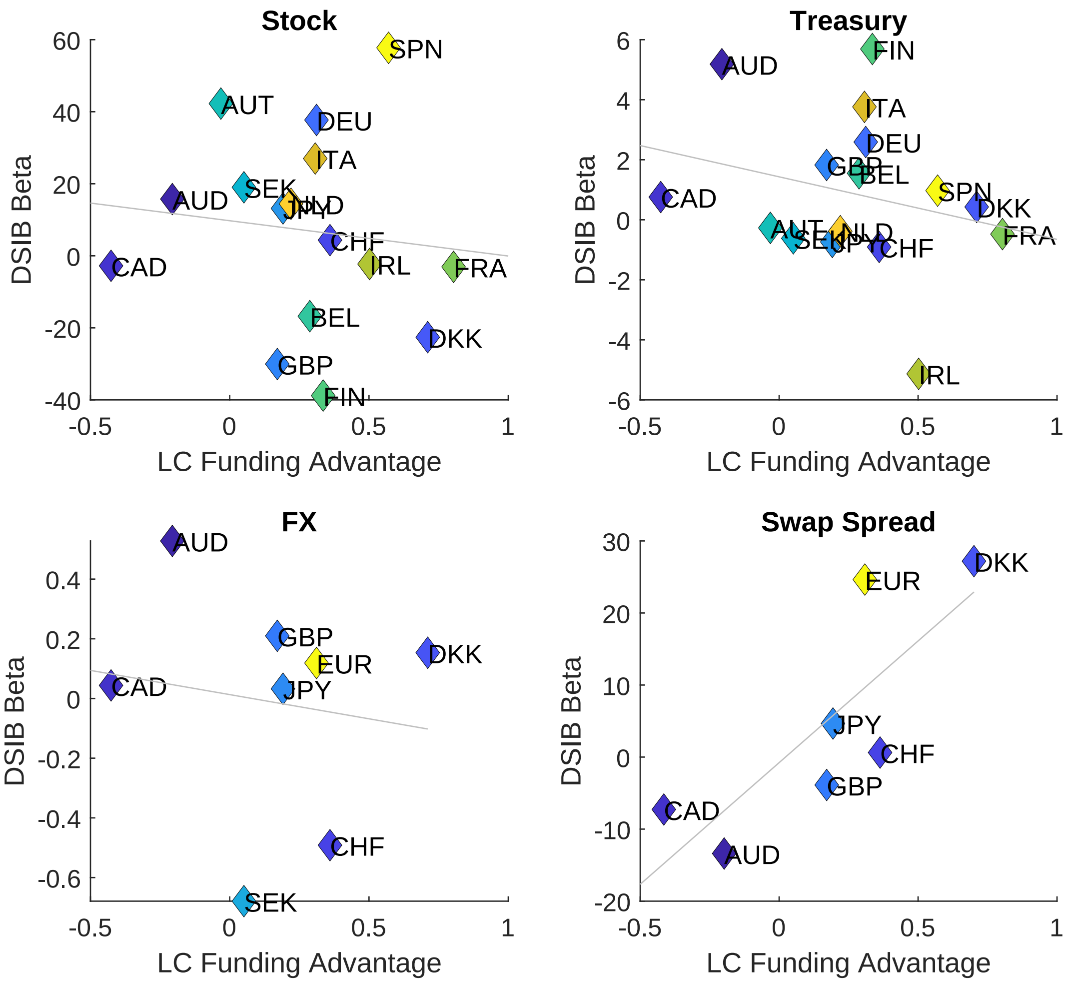

Figure 7: Scatter plot of prediction coefficients of other institutional investors versus the funding advantage in local currency (LC) of each country. Domestic Systemically Important Banks (DSIBs) are taken as the proxy for other insitutional investors. Y-axis indicates the predictive coefficients of leverage ratio of DSIBs: DSIB Beta. For Stock, Treasury and currency (FX) markets, Y-axis is in annual percentage while for the swap spread arbitrage market (Swap Spread), Y-axis is in basis points per annum. X-axis is marked with the funding advantage in LC for dollar lenders through the FX swap market in percentage, which is the difference between the deposit rate and the synthetic rate as defined in equation 4. Stock and Treasury returns include all countries in the sample, while for currency and swap spread markets, returns and arbitrage payoffs are aggregated at the currency level such that all European Union countries obtain returns in the Euro (EUR). The sample period covers the post-crisis period from 2007 Q4 to 2020 Q4.

Leverage Ratio Prediction of Other Institutional Investors: All

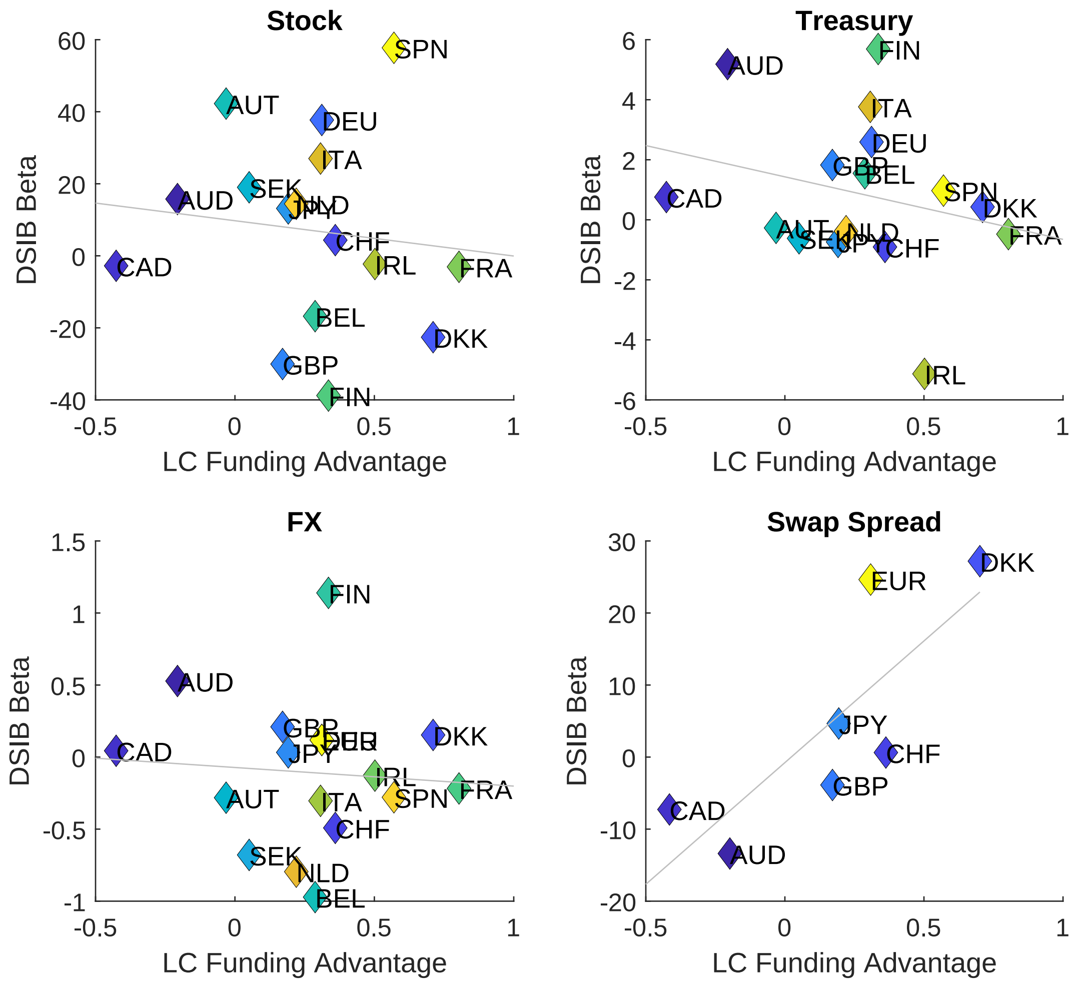

Figure 8: Scatter plot of prediction coefficients of other institutional investors versus the funding advantage in local currency (LC) of each country. Domestic Systemically Important Banks (DSIBs) are taken as the proxy for other insitutional investors. Y-axis indicates the predictive coefficients of leverage ratio of DSIBs: DSIB Beta. For Stock, Treasury and currency (FX) markets, Y-axis is in annual percentage while for the swap spread arbitrage market (Swap Spread), Y-axis is in basis points per annum. X-axis is marked with the funding advantage in LC for dollar lenders through the FX swap market in percentage, which is the difference between the deposit rate and the synthetic rate as defined in equation 4. Stock, Treasury and currency (FX) returns include all countries in the sample, while for the swap spread market, arbitrage payoffs are aggregated at the currency level such that all European Union countries obtain returns in the Euro (EUR). The sample period covers the post-crisis period from 2007 Q4 to 2020 Q4.

B Data Tickers

Table 17: **Data Tickers**

	Ticker	Description
Swap	ADSW30 BGN Curncy	AUD SA (vs. 6M Bank Bills) 30Y
	CDSW30 BGN Curncy	CAD Semi Annual (vs 3M CDOR)
	EUSA30 BGN Curncy	EUR Annual (vs. 6M EURIBOR)
	JYSW30 BGN Curncy	JPY Semi Annual (vs. 6M LIBOR)
	NKSW30 BGN Curncy	NOK Annual (vs. 6M NIBOR)
	BPSW30 BGN Curncy	GBP Semi Annual (vs. 6M LIBOR)
	SKSW30 BGN Curncy	SEK Annual (vs. 3M STIBOR)
	SFSW30 BGN Curncy	CHF Annual (vs. 6M LIBOR)
	DKSW30 BGN Curncy	DKK Annual (vs. 6M CIBOR)
	USSW30 BGN Curncy	USD Semi Anl 30/360(vs.3M LIBOR)
Government Bond	GTAUD30Y Govt	Australian Dollar Government Bond
	GTCAD30Y Govt	Canadian Dollar Government Bond
	GTEUR30Y Govt	Euro Government Bond
	GTJPY30Y Govt	Japanese Yen Government Bond
	GTNOK30Y Govt	Norwegian Krone Government Bond
	GTGBP30Y Govt	Great Britain Pound Government Bond
	GTSEK30Y Govt	Swedish Krona Government Bond
	GTCHF30Y Govt	Swiss franc Government Bond
	GTDKK30Y Govt	Danish krone Government Bond
	GT30 Govt	USD Government Bond

Notes: This table reports data tickers and their descriptions for the 30-year swaps and 30-year government bonds in each country/currency obtained from Bloomberg. Tickers of 2-year, 5-year and 10-year swaps and government bonds replace 30-year with relative maturities.