Carry Trades and FX Risk Buffers: Foreign Currency Debt of Emerging Market Firms*

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Abstract

The surge in foreign currency (FC) corporate debt in emerging economies has sparked concerns about macroeconomic stability, heightened by speculation about non-financial firms engaging in carry trades. Using firm-level data on the currency denomination of both assets and liabilities, we find evidence of firms' carry trades: firms save in local currency liquid assets and earn higher interest income after issuing short-term FC debt. They also set aside FC liquid assets as FX risk buffers. A large degree of heterogeneity in incentives is observed. Notably, listed firms participate more in carry trades and allocate less FX risk buffers than non-listed firms.

JEL Classification Codes: F3, F4, G1

Keywords: Carry trade, Currency mismatch, Foreign currency debt

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1 Introduction

After the Global Financial Crisis, the U.S. entered a period of exceptionally accommodative monetary policy, hitting the zero lower bound, followed by quantitative easing. Emerging economies have benefited from low U.S. dollar interest rates in the international financial markets, leading to a massive surge in external corporate debt, mostly denominated in dollars.

The rapid rise of foreign currency (FC) corporate debt has prompted concerns among policymakers about heightened macroeconomic vulnerability and financial fragility.[1] Furthering the concerns, recent studies by Bruno and Shin (2017) and Acharya and Vij (2020) have found that firms that borrow more in FC tend to accumulate liquid assets (deposits and short-term financial instruments), supporting non-financial firms' "carry trade." Firms borrow cheaply abroad and park those funds as domestic liquid assets, such as short-term savings accounts. This practice may result in a currency mismatch on firms' balance sheets, exposing firms themselves and the domestic banking sector to financial disruptions.

Despite these insights, a comprehensive assessment of the scale and characteristics of non-financial firms' carry trades remains challenging due to limited data, mainly because of incomplete information on the currency composition of both sides of firms' balance sheets – assets and liabilities. For instance, saving in liquid assets after issuing debt could also be consistent with a "precautionary" motive as documented in both the sovereign debt literature (Bianchi et al. (2018)) and the U.S. corporate finance literature (Xiao (2020)). In these strands of papers, economic agents borrow and retain liquid assets to insure against uncertainties and adverse shocks.

In this paper, we offer an extensive empirical analysis of non-financial firms' liquid asset accumulation when issuing foreign currency debt, employing a unique firm-level dataset of Korean firms. Our dataset, KISVALUE, enables us to see the currency denomination of detailed asset and liability instruments for more than 23,000 firms, ten times the number of listed firms in Korea. Our

[1] For example, "India's corporate sector, which has borrowed heavily in foreign currency, is not immune to this vulnerability. Corporate sector debt has risen very rapidly, nearly doubling in the last 5 years to about $120 billion," said Christine Lagarde in her address at the Reserve Bank of India seated alongside RBI Governor Raghuram Rajan in 2015. See also IMF Global Financial Stability Report (IMF (2015)).

findings provide evidence that firms engage in carry trades and set aside precautionary savings as buffers against foreign exchange (FX) risk, which we term as "FX risk buffers."

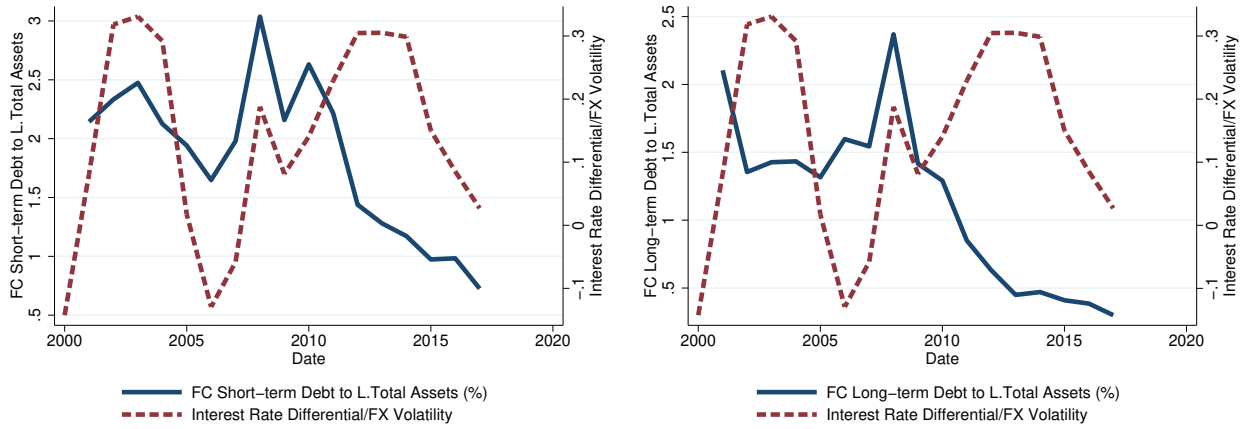
Figure 1 illustrates the key data patterns of interest using the KISVALUE data. As shown in the upper panel of Figure 1, firms respond to cheaper dollar funding costs by increasing their FC borrowing especially at the shorter end of maturity. The upper panel of Figure 1 shows that the aggregate short-term FC debt positively co-moves with the ratio of the money market rate differential between Korea and the United States to the 3-month FX volatility, while there is a negative correlation for the aggregate long-term FC debt. Firms actively adjust their FC short-term borrowing in response to the relative cost of borrowing in FC over local currency (LC) and FX risk.

On top of that, firms that borrow more in short-term FC debt actually hold more LC liquid assets and FC liquid assets, as illustrated in the lower panel of Figure 1. The former aligns with what one would expect when firms engage in carry trades, while the latter supports saving against the foreign exchange rate risk. For each year, we confine the sample to those firms that borrow in short-term FC debt and compute the cross-sectional averages of (i) firms' short-term FC debt to lagged total assets ratios, and (ii) firms' LC and FC liquid assets to lagged total assets ratios. We observe a strong positive correlation between the average short-term FC debt and the average LC liquid assets, and the average short-term FC debt and the average FC liquid assets, with the estimated correlation of 0.72 and 0.54, respectively.[2] These correlations contrast with the traditional pecking order theory that firms should exhaust internal sources of funding before seeking external financing. Such predictions imply a negative correlation between liquid assets and debt. Motivated by these empirical relationships shown in Figure 1, we empirically explore further if firms engage in carry trade by borrowing in FC and saving in LC, while setting aside some FC liquid assets as a FX risk buffer.

[2]The spike in FC liquid assets in 2014-17, despite a fall in short-term FC debt, stems from heightened FX volatility during this period, as shown in the Appendix F.

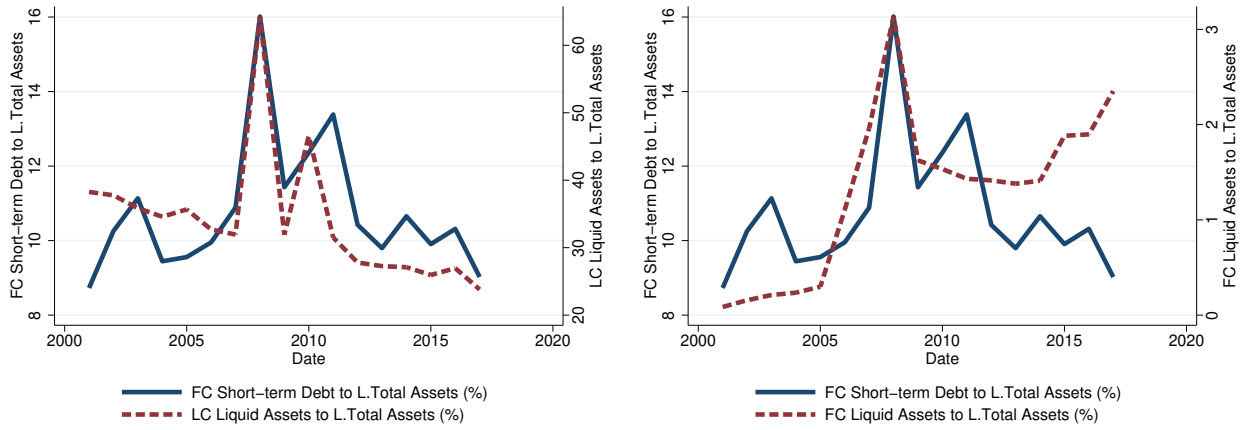
Figure 1: Key Empirical Patterns: Firms' FC Borrowing

Interest Rate Differential, FX Volatility and Foreign Currency Corporate Debt



Notes: All the balance sheet data are aggregated from the Korean firm-level data in KISVALUE. All the aggregate variables are computed by summing up firm-level variables. Figures show the aggregate short-term FC debt (LHS) and the aggregate long-term FC debt (RHS) in the corporate sector, both normalized by the aggregate total assets in the previous year, and depicted as a blue solid line in both figures. The two ratios are then multiplied by 100. The interest rate differential is the money market rate of Korea minus the United States from the IMF IFS. The FX volatility is the option implied exchange rate volatility from 3-month at-the-money exchange rate options (annual average of end-of-month values) from the Bloomberg Terminal. The ratio of the interest rate differential to the 3-month FX volatility is plotted as a dashed red line in both figures.

Foreign Currency Short-term Debt and Liquid Assets, Conditional on Positive Short-term FC Debt



Notes: All the balance sheet data are aggregated from the Korean firm-level data in KISVALUE. Figures show the cross-sectional average of firm-level variables with a subsample of firms with positive short-term FC debt in each year. Figures show the cross-sectional averages of (i) firms' short-term FC debt to lagged total assets ratios, depicted as a blue solid line in both figures, (ii) firms' LC liquid assets to lagged total assets ratios (LHS), depicted as a red dashed line, and (iii) FC liquid assets to lagged total assets ratios (RHS), depicted as a red dashed line. All ratios are multiplied by 100.

In the baseline empirical model, we find that only the issuance of short-term FC debt is linked to the accumulation of LC liquid assets, emphasizing the role of maturity in conducting carry trades; however, the issuance of FC debt across all maturities is generally associated with the accumulation of FC liquid assets. We corroborate our key findings from the baseline analysis with three extensions. First, we compare our regression estimates on short-term FC debt with those on the current portion of long-term FC debt, which both result in an increase in short-term FC liability, but the latter is not associated with cash inflows in the current year. This analysis confirms that, in the absence of actual cash inflows, firms do not save in LC liquid assets but still set aside FC liquid assets as FX risk buffers. This finding further validates that higher LC liquid assets come from actual cash inflows in FC, while higher FC liquid assets are the result of FC liability. Second, we demonstrate that listed firms participate significantly more in carry trades and set aside less FX risk buffers than non-listed firms. This underscores the importance of a broad coverage of firms for a comprehensive understanding of the use of FC debt proceeds. Finally, we find strong evidence of firms that borrow more in short-term FC debt earning higher interest income. Moreover, the predicted carry trade interest income from the baseline regression is tightly associated with the actual interest income on the cash flow statements.

We delve further into the incentives driving engagement in carry trades and accumulation of FX risk buffers. Our analysis reveals that firms engage in more carry trades when the interest rate differential between South Korea and the United States widens. Firms opt for additional FX risk buffers when exchange rate volatility increases and if they operate in sectors where sales are highly sensitive to the exchange rate fluctuations. In terms of heterogeneity, we find that the incentives to participate in carry trades and and set aside FX risk buffers are stronger in the post-2008 era, but both channels are also present in the pre-2008 period. Moreover, firms in financially dependent sectors engage more in carry trades, while firms in export-oriented sectors tend to accumulate more FX risk buffers.

Our analysis highlights three key insights for policymakers. First, firms involved in carry trade exhibit a great deal of heterogeneity. Listed firms and more financially dependent firms engage

more in carry trades, and they should be monitored more closely. Second, there is no evidence of carry trades using long-term FC debt. As explained in the Appendix D, this observation is related to the lower expected return and higher return volatility when the maturity of debt is longer. This finding suggests that long-term and short-term FC debt should be treated differently when shaping regulations. Third, average firms are aware of the exchange rate risk and manage exchange rate risk buffers actively in response to market situations, such as higher exchange rate volatility. This FX risk buffer provides firms a cushion against exchange rate fluctuations. Overall, enhancing data quality and availability both in terms of firm coverage and balance sheet items on the currency composition of assets and liabilities can aid policymakers in making more informed decisions and risk management.

Related Literature.

This paper is related to a broader literature that investigates the interplay of international capital market and emerging market corporate leverage. Motivated by the currency crisis in the 1990s, early work such as Aguiar (2005), Dominguez and Tesar (2006), Bleakley and Cowan (2008) and Kim et al. (2015) investigate the consequences of debt denominated in foreign currency, especially after large depreciations.[3] The recent global corporate debt surge raises the concern about the interplay of international market fluctuation, corporate fragility, and leverage (McCauley et al. (2015), Chui et al. (2016), Alfaro et al. (2017), Alfaro et al. (2019), Abraham et al. (2020), Salomao and Varela (2021) and Kalemli-Ozcan et al. (2021)). Burger et al. (2012) and Hale et al. (2020) unveil the determinants of the international local currency corporate bond market. Du and Schreger (2017), Bevilaqua et al. (2020) and Wu (2021) provide evidence of linkage between corporate leverage and sovereign risk. Didier et al. (2021), Calomiris et al. (2019) and Wang et al. (2023) look at the firm responses after accessing the international capital market. We contribute to the literature by showing the corporate asset and liability currency dimension responses to international market conditions.

This paper is closely related to a growing empirical international capital market literature that

[3] See also Kim and Lee (2024) and Hardy (2018) for recent studies with more granular level of data.

studies the currency denomination of firms' debt issuance. Papers such as Bruno and Shin (2017), Huang et al. (2018), Acharya and Vij (2020) and Hardy and Saffie (2023) find that emerging market FC debt issuance increases when the carry trade environment is more favorable.[4] They document firms behave increasingly more like financial intermediaries and conduct carry trades. In particular, Bruno and Shin (2017) and Acharya and Vij (2020) point to carry trade activities via short-term deposit and Hardy and Saffie (2023), Huang et al. (2018) and Hardy et al. (2023) find important role for trade credit. De Gregorio and Jara (2024) find evidence that firms response to carry trade but investment also starts to increase in two year time. Due to data limitation, these papers do not distinguish between LC and FC deposits or trade credit. We advance the understanding of liquid asset accumulation by showing explicitly how various liquid asset items in *different currencies* change in response to debt issuance *in different currencies* and at different maturities for a large set of firms. Some papers argue that the currency choice in debt issuance is driven by natural hedging motives of firms. Kedia and Mozumdar (2003), Jiao et al. (2021), and Colacito et al. (2022) show empirically that the currency choice in debt issuance is driven by motives to lower their operational exchange rate risk exposure. On the other hand, other papers argue that the role of operational hedging in foreign currency debt issuance might be rather limited. For instance, Alfaro et al. (2021) use the Chilean administrative data and show that natural hedging is limited; large firms actively use foreign exchange derivatives to lower their operational exposure to exchange rate risk. A related finding by Jung (2021) shows that reduction in FX derivative due to regulation reduces firm exports in Korea. Bocola and Lorenzoni (2020), Christiano et al. (2021) and Gutierrez et al. (2023) show empirically and theoretically how local depositors' preference for dollar savings is an important factor for the supply of foreign currency credit.

Our paper sheds light on the debate about exchange rates and macroeconomic policies following the Asian financial crisis, which advocates for and against flexible exchange rate policies and the buildup of foreign-currency debt. This debate includes prominent studies by Aghion et al. (2001), Caballero and Krishnamurthy (2001), and Céspedes et al. (2004). Recent empirical ad-

[4]Carry trade is highly related to the concept of uncovered interest parity deviation. See Engel (2014) and Lustig et al. (2011).

vancements show that heterogeneous firm responses are important in understanding the policy implications. Di Giovanni et al. (2022) explore the spillovers of international risk premiums to domestic credit and emphasize the role of the domestic banking sector. Hegarty et al. (2022) highlight that firm responses to international risk premium spillovers depend on the default risk of a firm and advocate for a flexible exchange rate policy to facilitate the general equilibrium response. Bacchetta et al. (2023) and Wang et al. (2023) show that firms have heterogeneous responses to international borrowing costs, and capital controls are effective in muting this response. Our paper contributes by showing the characteristics of firms that engage in more carry trade and FX risk buffering.

This paper draws linkage between the literatures on international capital market and corporate cash hoarding (Opler et al. (1999), Graham and Harvey (2001), Bates et al. (2009) and Chen et al. (2017)). Recently, many papers focus on cash hoarding due to firms' precautionary saving motive upon a rise in uncertainty (Arellano et al. (2019), Xiao (2020)). We contribute to the literature by showing a strong precautionary saving behavior of firms even in normal times, specifically against FX risk, which depends on the currency denomination and the maturity of debt.

Layout. Section 2 introduces our dataset. Section 3 presents our baseline analysis and the three extensions. Section 4 investigates the incentive of carry trades and FX risk buffers. Section 5 shows the heterogeneity across time and across sectors. Section 6 provides regression results of variables other than liquid assets. Section 7 presents longer horizon effects and Section 8 concludes.

2 Data Descriptions

We employ an extensive Korean firm-level dataset, KISVALUE, to ultimately answer what firms do with their debt issuance in different currencies and at different maturities. The dataset is from the NICE (National Information & Credit Evaluation, formerly the Korea Information Service Inc., KIS). Our dataset includes firms with assets over 10 billion Korean Won as of 2017, who are subject to the external audits and need to report their balance sheet information to the

Financial Supervisory Commission.[5] We focus on the sample period from 2001 to 2017. The KISVALUE dataset includes around 23,000 firms, and the number of listed firms is 2,040 firms as of 2017. The majority of firms in the dataset are non-listed small and medium-sized firms. We exclude financial firms in our analysis.[6] Firms are allowed to enter, to exit, and to pause reporting for a number of years during the sample period if their assets go below the threshold. The total number of employees covered by the dataset is 3,525,241 as of 2017, which represents 22% of the aggregate employment in all sectors excluding the financial sector and self employment.[7]

The KISVALUE dataset has a number of advantages over other datasets typically used in the literature. First, the dataset includes the detailed information on the currency composition of items in the assets and liabilities on the balance sheet. Second, it contains information about the maturity of debt and the currency composition, allowing us to explore how firms may use debt issuance proceeds differently across maturities. Third, the dataset contains non-listed small and medium-sized firms. The very fact that our dataset includes smaller non-listed firms allows us to investigate the heterogeneous incentives of issuing foreign currency debt across sectors, where some of those sectors are populated by smaller firms. Lastly, the dataset contains a wide range of balance sheet items besides the currency composition of short-term debt, long-term debt and liquid assets. The availability of a wide range of variables allows us to explore the firm-level heterogeneity and mostly importantly to present a strong and direct evidence in favor of firms' carry trade using the interest rate income measures.

To further elaborate how well our firm-level data from the KISVALUE are capturing the aggregate dynamics of the key variables that we are interested in, we compare the aggregated firm-level data and the aggregate data counterpart from the Bank of Korea Financial Statement Analysis Data. The aggregate data from the Bank of Korea include all firms who submitted their financial

[5]The threshold was lower in the past. For example, as reported by Kim et al. (2015), the threshold was 7 billion Korean won in 1999.

[6]Specifically, we exclude firms that are in these three sectors: "Financial Institutions, Except Insurance and Pension Funding", "Insurance and Pension Funding" and "Activities Auxiliary to Financial Service and Insurance Activities."

[7]The data of number of workers employed in all sectors excluding the financial sector and self employment are from the Korean Statistical Information Service. The survey is for all the firms with employees greater than equal to one.

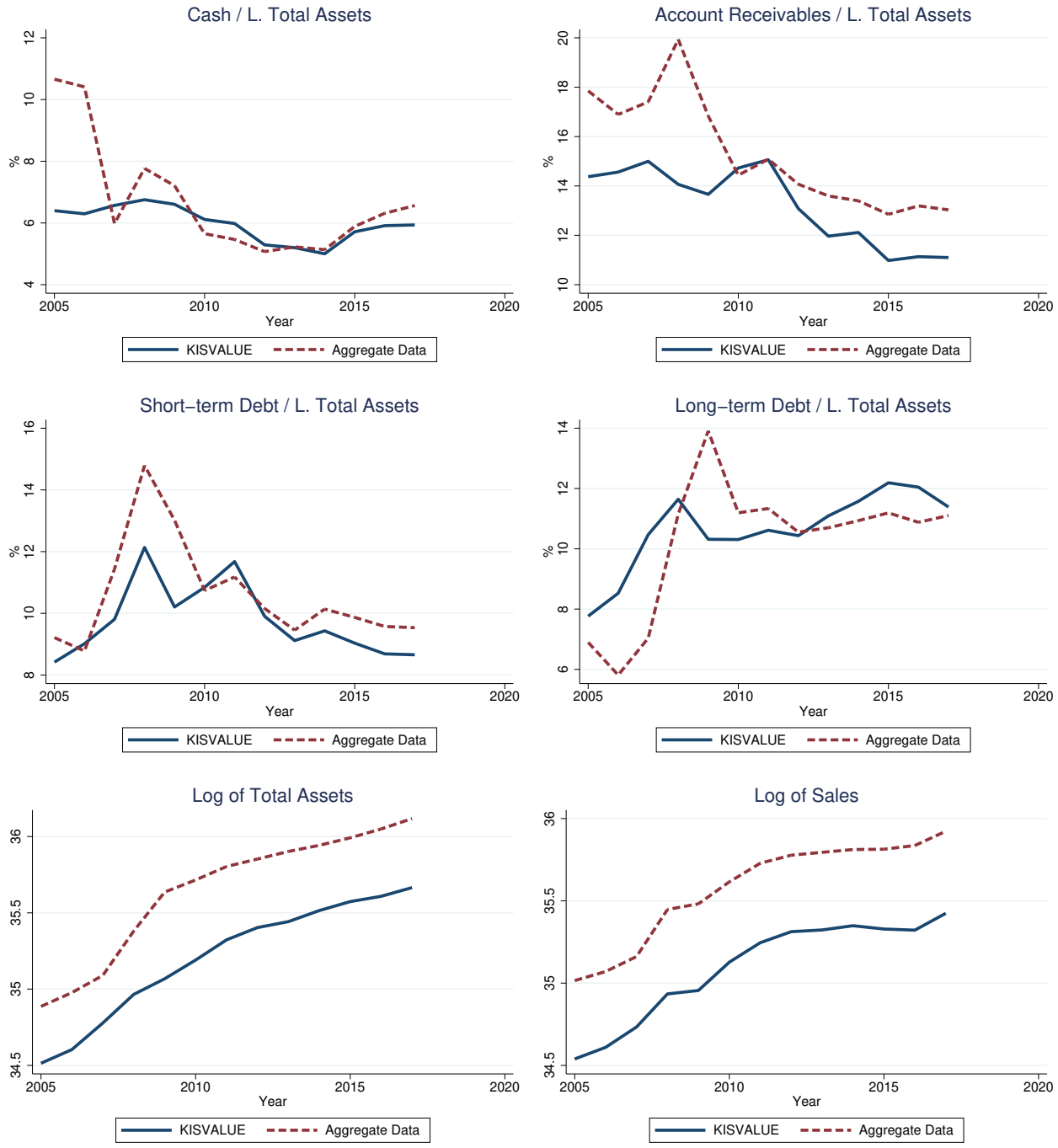
statements to the National Tax Service for corporate tax returns, excluding finance and insurance companies, self-employed businesses, holding companies and special purpose enterprises. The key variables that we looked at are: cash and cash equivalents, accounts receivables, short-term debt, long-term debt, and total assets.[8] We summed over the firm-level variables in a given year and normalized the computed aggregate variables by the aggregated total assets in the previous year. We then compare the aggregate values computed from our micro-level data with those from the Bank of Korea from 2005 to 2017.[9] Figure 2 shows the dynamics of the key variables that we are interested in. The time-series patterns of our aggregated micro-level data are very much aligned with the actual aggregate data patterns for most of the years even though the aggregate Bank of Korea data include every single non-financial firms, paying corporate taxes. Additionally, when we compare the total assets, our dataset covers around 57 – 73 % of the aggregate total assets as reported in the Appendix A. Furthermore, as shown in Table 13 in Appendix B, we observe that 11% of firm-year observations has a positive FC debt. Conditional on borrowing in FC debt, there are on average 30% of total debt denominated in FC.[10]

[8]The Bank of Korea does not provide the currency split of the aggregate short-term and long-term borrowing; therefore, the aggregate short-term and long-term debt include both local-currency and foreign-currency borrowing. The aggregate short-term financial instruments are not available from the Bank of Korea.

[9]The variables of our interest from the Bank of Korea Financial Statement Analysis Data are available from 2004. We normalize the variables by lagged assets so the series start from 2005.

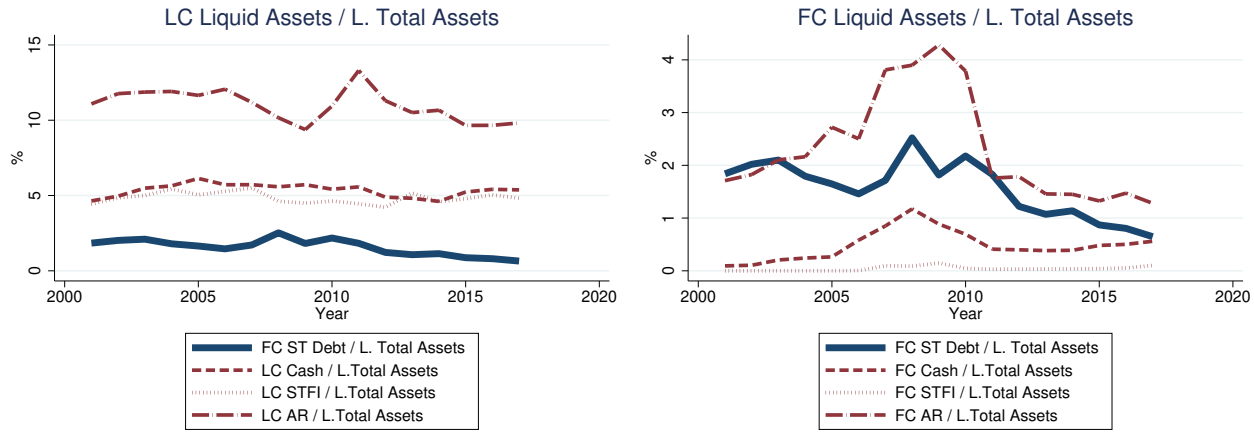
[10]Cross-country comparisons of FC corporate debt sizes are presented in the Appendix E.

Figure 2: Firm-level Data and Aggregate Data



Notes: Aggregate data are from the Bank of Korea Financial Statement Analysis Data. KISVALUE data are the total sum of all firms in the KISVALUE dataset. We normalize the key aggregate variables of our interest by lagged aggregate total assets. Account receivables in this figure do not include other receivables as other receivables are only available in 2004-2007 in the Bank of Korea Financial Statement Analysis Data.

Figure 3: Foreign Currency Corporate Debt and Liquid Assets



Notes: All the data come from the KISVALUE dataset. All the variables are normalized by the aggregate total assets in the previous year. The blue solid line is the aggregate short-term FC debt. The LHS figure shows the each components of LC liquid assets: LC cash, LC short-term financial instruments (STFI), and LC accounts receivables and other receivables (AR). The RHS figure shows each components of FC liquid assets: FC cash, FC short-term financial instruments (STFI), and FC accounts receivables and other receivables (AR).

Since our key interest is how the issuance of FC debt, especially at a shorter end of maturities, may relate to carry trade and the accumulation of FX risk buffers, we depict the relative size of short-term FC debt to each items of LC and FC liquid assets. In Figure 3, we report two figures, where the solid line is the aggregate short-term FC debt normalized by aggregate total assets in the previous year. In the left figure, the size of the aggregate short-term FC debt and those of aggregate LC cash and aggregate LC short-term financial instruments are in the same order of magnitude. Aggregate LC account receivables and other receivables (AR) are larger than aggregate short-term FC debt. The right panel shows that all the balance sheet items of FC liquid assets are similar in magnitude to that of the aggregate short-term FC debt. Figure 3 confirms the quantitative relevance of carry trades and FX risk buffer accumulation that we document in Section 3.[11]

3 Empirical Results

Section 3 presents empirical results analyzing how debt issuance in different currencies at different maturities is associated with liquid assets in different currencies.

3.1 Baseline Regressions

We present the baseline regression analysis to understand how the shift in the currency composition of debt issuance is associated with changes in liquid asset holdings. Our main interest in the analysis is how liquid assets change when there is an increase debt in foreign currency at different maturities, controlling for the total cashflow from debt issuance and other sources and firm size. That is, we explore the equilibrium empirical relationships between liquid assets in different currencies and the currency composition of debt issuance at different maturities. All the regressions in the main text are restricted to sample with net positive issuance ($debt_t > debt_{t-1}$) firm-year

[11] We include three other figures in the Appendix F: (i) Figure 9 shows FC short-term debt and liquid assets with a subsample of firms with positive FC short-term debt; (ii) Figure 10 shows FC debt and liquid assets; and (iii) Figure 11 shows FC debt and liquid assets with a subsample of firms with positive FC debt.

observations so we can confirm there is a debt issuance.[12] We estimate the following regression:

$$\begin{aligned}\frac{y_{i,t}}{TA_{i,t-1}} = \quad & \beta^{STFC}\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} + \beta^{LTFC}\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}} \\ & + \beta^{ST}\frac{ST debt_{i,t}}{TA_{i,t-1}} + \beta^{LT}\frac{LT debt_{i,t}}{TA_{i,t-1}} + \gamma_1\frac{OS_{i,t}}{TA_{i,t-1}} \\ & + \gamma_2 lnTA_{i,t-1} + \alpha + \alpha_c + \alpha_t + \varepsilon_{i,t}\end{aligned} \tag{1}$$

, where $y_{i,t}$ is a measure of liquid assets, TA stands for total assets and OS stands for cashflows from other sources.[13] In the dataset, all variables are reported in Korean Won.[14] We consider 8 different measures of $y_{i,t}$: cash and cash equivalents (cash), short-term financial instruments (STFI), and accounts receivables and other receivables (AR), and the sum of three items in both foreign currency (FC) and in local currency (LC), respectively. Cash and cash equivalents and short-term financial instruments comprise of short-term financial assets with maturity less than 3 months and one year, respectively. Accounts receivables are the funds that customers owe a company for products or services that have been invoiced. Other receivables include money owed from non-trade activities. Account receivables and other receivables effectively capture firms' extension of short-term credit to other firms as documented by Huang et al. (2018) and Hardy and Saffie (2023). They are key variables of interest in the literature exploring carry trade motives of corporate FC debt issuance.

LT and ST on the right hand side stand for long-term and short-term debt (e.g. the variable $LT\ debt_{i,t}$ is the total long-term debt for firm i at time t. The variable $LT\ FCdebt_{i,t}$ is the foreign currency long-term debt for firm i at time t). All the variables are normalized by the total assets of the firm at time $t-1$. α_c, α_t are sector and time fixed effects respectively (185 sectors and 17 years). The regression standard errors are clustered at the sector level.

[12] None of the results are driven by this restriction. In Appendix C, we show that all the results are intact if we relax this restriction and include all observations.

[13] The right hand side of the regression capture directly all sources of funds for a firm. We follow Kim and Weisbach (2008) and Bruno and Shin (2017) to define the total sources of funds for a firm to be the sum of funds from operations, sale of property, plant, and equipment, debt issuance, and sale of common and preferred stock. The total sources of funds include everything from both internal cash flows from operations and external financing. We separate out the variables of our interest, the debt in different currencies and different maturities from the total sources of funds and label the rest as $OS_{i,t}$: the total cashflows from other sources (i.e., excluding those from debt financing).

[14] The year-end exchange rate is employed whenever it is necessary for firms to convert their FC assets or liabilities to Korean Won values, following the accounting reporting standards in Korea.

Table 1: FC Debt and Liquid Assets (Equation (1))

	Local Currency Liquid Assets				Foreign Currency Liquid Assets			
	Sum	Cash	Short-term FI	AR	Sum	Cash	Short-term FI	AR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}}$	14.5***	7.5***	9.3***	-0.9	12.6***	3.1***	0.4***	9.9***
	(2.7)	(1.1)	(0.8)	(2.1)	(1.8)	(0.5)	(0.1)	(1.6)
$\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}}$	-8.8***	-0.7	0.4	-9.0***	4.5***	1.6***	0.3*	2.8***
	(1.9)	(0.7)	(0.7)	(1.4)	(1.2)	(0.6)	(0.2)	(0.6)
$\frac{ST\ debt_{i,t}}{TA_{i,t-1}}$	-13.7***	-6.4***	-4.3***	-3.5***	-0.4	-0.7***	-0.1**	0.4
	(1.3)	(0.6)	(0.3)	(1.0)	(0.3)	(0.1)	(0.0)	(0.2)
$\frac{LT\ debt_{i,t}}{TA_{i,t-1}}$	-17.1***	-3.3***	-3.7***	-11.1***	-2.9***	-0.8***	-0.1***	-2.0***
	(2.6)	(0.8)	(0.3)	(1.9)	(0.5)	(0.1)	(0.0)	(0.3)
$lnTA_{i,t-1}$	-3.9***	-1.5***	-0.5***	-2.9***	0.6***	0.0	0.0	0.6***
	(0.4)	(0.1)	(0.1)	(0.3)	(0.1)	(0.0)	(0.0)	(0.1)
$\frac{OS_{i,t}}{TA_{i,t-1}}$	1.6	6.2***	5.4***	-5.8***	0.2	0.6***	0.1***	-0.4
	(1.4)	(0.8)	(0.6)	(1.3)	(0.3)	(0.1)	(0.0)	(0.2)
Adjusted R^2	0.30	0.10	0.06	0.28	0.11	0.05	0.01	0.10
Within R^2	0.08	0.05	0.02	0.05	0.03	0.01	0.00	0.03
N	135317	145472	145911	134729	145915	146021	146026	145955

Notes: The table show results from annual panel regressions. The sample period is 2001-2017. The dependent variables are described as the column headers (normalized by total assets at $t-1$), which are cash and cash equivalents, short-term financial instruments, accounts receivables and other receivables, and the sum of the three in local currency (LC) and foreign currency (FC). *TA* is total assets and *OS* is the cashflow from other sources. Regressions are restricted to firm-year observations with positive increase in debt level. Regressions without the restriction are reported in the Appendix C. All regressions include sector and year fixed effects. The coefficients are scaled up by 100 for presentation. The estimated beta can be interpreted as the amount of won increase per 100 won of debt proceeds. Standard errors in parentheses are clustered at the sector level. * p<0.1, ** p<0.05, *** p<0.01.

β^{STFC} and β^{LTFC} are the coefficients of interest. β^{STFC} represents the change in LC or FC liquid assets for a 100 Korean won increase in *short-term* foreign currency debt, holding total short-term debt constant, and β^{LTFC} represents the change in LC or FC liquid assets for a 100 Korean won increase in *long-term* foreign currency debt, holding total long-term debt constant.

Table 1 summarizes the coefficient estimates of Equation (1). Consistent with the carry trade motive behind issuing foreign currency debt, an increase in short-term foreign currency debt whilst holding total short-term debt constant is associated with higher LC liquid assets. We observe, for each 100 Korean won of short-term FC debt, it increases significantly LC cash and STFI by 7.5 won and 9.3 won on average, respectively. The coefficient of AR on short-term FC debt is not statistically significant, implying that an average Korean firm does not engage in carry trades with AR.[15] Firms borrow in short-term FC debt at a low interest rate and save in local currency liquid assets at a higher rate over a short time window, expecting a profitable carry trade profit.[16]

While firms engage in carry trades when borrowing in short-term FC debt, we do not see such patterns when the currency composition of long-term debt shifts to FC. The coefficients of cash and STFI on long-term FC debt, β^{LTFC}, are not significantly different from zero. Firms do not engage in carry trades with long-term FC debt because interest rates on longer maturity debt are usually higher so this strategy results in lower rate of carry trade returns with higher volatility. We provide a detailed analysis of carry trade with longer term debt in Appendix D.

On top of the carry trade motives behind FC debt issuance especially in the short-term, firms save more in FC liquid assets when the currency composition of debt shifts towards FC. We observe, for each 100 Korean won of *short-term* FC debt, it increases FC cash, STFI, and AR by 3.1 won, 0.4 won and 9.9 won on average, respectively. It is also found that higher long-term FC debt whilst holding total long-term debt constant is associated with higher FC liquid assets. A firm raises external funds in FC and saves some of the proceeds in FC liquid assets. The observation is consistent with firms' motive to save against FX risk. We provide more evidence on this linkage

[15] We find different results when we split the firms into listed and non-listed firms. See Section 3.3 for the analysis.

[16] We investigate the connection with interest rate differential in Section 4. See also Salomao and Varela (2018) and Liao (2020) for empirical evidence of firms capital structure responses to uncovered interest parity deviation and covered interest parity deviation.

with exchange rate risk in Section 4.

One thing to note is that higher total debt issuance is associated with lower liquid assets in both LC and FC. The observed relationship is aligned with the predictions of the pecking order theory of corporate finance that issuing debt – is more costly than internal financing. Upon fluctuations in profits and investment opportunities, firm first draws down its cash balance or sells its marketable securities, rather than resorting to external financing. What is interesting is that firms on average hold more cash in LC and in FC when their short-term debt is more tilted towards FC, consistent with firms' carry trade engagement and FX risk management.

3.2 Comparisons of Short-term Debt and Current Portion of Long-term Debt

We further corroborate firms' saving against FX risk and engagement in carry trade by exploiting the remaining maturity of long-term debt. On the balance sheet, long-term debt comprises all debt with a maturity more than one year upon issuance. As time passes, part of it gets to mature in less than a year and is recorded as the current portion of long-term debt. The current portion of long-term debt shares the same remaining maturity as short-term debt, but the decision of the amount of this debt issuance is *not* made at year t and no debt proceeds are received at year t. This analysis enables us to compare how liquid assets respond differently to an increase of FC liability that is maturing soon and to an increase of short-term FC debt with actual cash inflows.

In Table 2, we separate long-term FC debt in Table 1 into long-term debt with a remaining maturity larger than a year and the current portion of long-term debt with a remaining maturity of less than a year. In Columns (1)-(4), the estimated coefficients of LC liquid assets on the current portion of long-term FC debt are all negative. The coefficient of LC cash on the current portion of long-term FC debt is negative and those of LC short-term financial instruments and LC accounts receivables and other receivables on the current portion of long-term FC debt is negative and statistically significant.

Table 2: FC Debt and Liquid Assets: Current Portion of Long-term Debt

	Local Currency Liquid Assets				Foreign Currency Liquid Assets			
	Sum	Cash	Short-term FI	AR	Sum	Cash	Short-term FI	AR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}}$	14.5***	7.5***	9.4***	-0.9	12.6***	3.1***	0.4***	9.9***
	(2.7)	(1.1)	(0.8)	(2.1)	(1.8)	(0.5)	(0.1)	(1.6)
Current $\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}}$	-26.9***	-2.3	-4.4***	-21.9***	3.4**	1.6*	0.0	3.1**
	(3.9)	(1.5)	(1.3)	(3.1)	(1.5)	(0.8)	(0.1)	(1.4)
Rest of $\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}}$	-4.3*	-0.3	1.6**	-5.7***	4.8***	1.6**	0.4*	2.8***
	(2.3)	(0.8)	(0.7)	(1.7)	(1.2)	(0.6)	(0.2)	(0.6)
$\frac{ST\ debt_{i,t}}{TA_{i,t-1}}$	-13.8***	-6.4***	-4.3***	-3.6***	-0.4	-0.7***	-0.1**	0.4
	(1.3)	(0.6)	(0.3)	(1.0)	(0.3)	(0.1)	(0.0)	(0.2)
$\frac{LT\ debt_{i,t}}{TA_{i,t-1}}$	-17.3***	-3.3***	-3.7***	-11.3***	-3.0***	-0.8***	-0.1***	-2.0***
	(2.6)	(0.8)	(0.3)	(1.9)	(0.5)	(0.1)	(0.0)	(0.3)
$lnTA_{i,t-1}$	-3.9***	-1.5***	-0.5***	-2.9***	0.6***	0.0	0.0	0.6***
	(0.4)	(0.1)	(0.1)	(0.3)	(0.1)	(0.0)	(0.0)	(0.1)
$\frac{OS_{i,t}}{TA_{i,t-1}}$	1.7	6.2***	5.4***	-5.7***	0.2	0.6***	0.1***	-0.4
	(1.4)	(0.8)	(0.6)	(1.3)	(0.3)	(0.1)	(0.0)	(0.2)
Adjusted R^2	0.296	0.102	0.065	0.281	0.115	0.049	0.006	0.102
Within R^2	0.076	0.050	0.024	0.051	0.033	0.012	0.001	0.031
N	135317	145472	145911	134729	145915	146021	146026	145955

Notes: The table show results from annual panel regressions. The sample period is 2001-2017. The dependent variables are described as the column headers (normalized by total assets at $t-1$), which are cash and cash equivalents, short-term financial instruments, accounts receivables and other receivables, and the sum of the three in local currency (LC) and foreign currency (FC). *TA* is total assets and *OS* is the cashflow from other sources. Regressions are restricted to firm-year observations with positive increase in debt level. Regressions without the restriction are reported in the Appendix C. All regressions include sector and year fixed effects. The coefficients are scaled up by 100 for presentation. The estimated beta can be interpreted as the amount of won increase per 100 won of debt proceeds. Standard errors in parentheses are clustered at the sector level. * p<0.1, ** p<0.05, *** p<0.01.

On the other hand, the coefficients on short-term FC debt are identical to those in Table 1 and are positive and significant for LC cash, LC short-term financial instruments and the total liquid assets. The result shows that an increase in FC liabilities maturing in the near future, without additional FC debt proceeds, does not come with an increase in LC liquid assets. Higher LC liquid assets only result from actualcash inflows in FC due to short-term FC debt issuance. The empirical relationship supports firms' carry trade engagement, rather than merely capturing a mechanical increase in liquid assets due to an increase in FC debt approaching maturity.

In Columns (5)-(8), the estimated coefficients of FC liquid assets on the current portion of long-term FC debt are positive. We see a higher FC liquid asset is associated with more long-term FC debt issued in past years but maturing this year. Therefore, an increase in FC liquid assets does not purely arise from a mechanical increase due to new debt proceeds from FC debt issuance. The empirical result is rather consistent with firms' management of FX risk faced when repaying their debt in FC.

To sum up, from the empirical correlations that we document between liquid assets and the current portion of long-term FC debt, we confirm that the accumulation of LC liquid assets is related to the use of actual FC debt proceeds and supports firms' participation in carry trades. We also corroborate that a higher FC liquidity buffer when firms are more indebted in FC is not a mere consequence of cash inflows in FC. It arises even when firms do not have FC cash inflows from debt proceeds this year but have more debt in FC maturing soon.

3.3 Heterogeneity Across Firms: Listed vs. Non-Listed

One of the advantages of our dataset lies in its comprehensive coverage of numerous non-listed firms, typically smaller and with less financial market access. In Table 3, we inspect the differential use of FC debt proceeds for the listed and non-listed firms.

Table 3: FC Debt and Liquid Assets: Listed vs. Non-Listed Firms

	Local Currency Liquid Assets				Foreign Currency Liquid Assets			
	Sum	Cash	Short-term FI	AR	Sum	Cash	Short-term FI	AR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}}$	12.2***	6.6***	8.9***	-2.3	12.2***	3.2***	0.5***	9.4***
	(2.6)	(1.1)	(0.8)	(2.1)	(1.8)	(0.5)	(0.2)	(1.5)
$\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}}$	17.7***	5.9***	2.7	11.1**	3.1	-1.0	-0.3*	3.8
$\times Listed$	(4.5)	(1.9)	(1.9)	(5.1)	(3.7)	(0.7)	(0.2)	(3.4)
$\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}}$	-8.2***	-0.2	0.4	-8.8***	4.3***	1.6**	0.4*	2.6***
	(2.1)	(0.8)	(0.7)	(1.6)	(1.3)	(0.7)	(0.2)	(0.6)
$\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}}$	-4.3	-3.4*	1.7	-0.6	3.3	-0.3	-0.4*	3.6
$\times Listed$	(5.5)	(2.0)	(2.7)	(4.8)	(2.8)	(0.8)	(0.2)	(2.6)
$\frac{ST\ debt_{i,t}}{TA_{i,t-1}}$	-13.4***	-6.1***	-4.2***	-3.4***	-0.4	-0.7***	-0.1**	0.4
	(1.3)	(0.6)	(0.3)	(1.0)	(0.3)	(0.1)	(0.0)	(0.2)
$\frac{LT\ debt_{i,t}}{TA_{i,t-1}}$	-16.9***	-3.1***	-3.6***	-11.1***	-2.9***	-0.8***	-0.1***	-2.0***
	(2.5)	(0.8)	(0.3)	(1.9)	(0.5)	(0.1)	(0.0)	(0.3)
$lnTA_{i,t-1}$	-4.2***	-1.7***	-0.6***	-3.0***	0.6***	0.0	0.0	0.5***
	(0.4)	(0.1)	(0.1)	(0.3)	(0.1)	(0.0)	(0.0)	(0.1)
$\frac{OS_{i,t}}{TA_{i,t-1}}$	1.7	6.1***	5.4***	-5.8***	0.2	0.6***	0.1***	-0.4
	(1.4)	(0.8)	(0.6)	(1.3)	(0.3)	(0.1)	(0.0)	(0.2)
Listed	2.6***	2.5***	0.7***	1.2	0.1	0.1	0.0	0.0
	(0.8)	(0.3)	(0.2)	(0.7)	(0.2)	(0.0)	(0.0)	(0.2)
Adjusted R^2	0.297	0.107	0.066	0.282	0.115	0.050	0.006	0.102
Within R^2	0.078	0.056	0.024	0.052	0.034	0.012	0.001	0.032
N	135317	145472	145911	134729	145915	146021	146026	145955

Notes: The table show results from annual panel regressions. The sample period is 2001-2017. The dependent variables are described as the column headers (normalized by total assets at $t-1$), which are cash and cash equivalents, short-term financial instruments, accounts receivables and other receivables, and the sum of the three in local currency (LC) and foreign currency (FC). *TA* is total assets and *OS* is the cashflow from other sources. Regressions are restricted to firm-year observations with positive increase in debt level. Regressions without the restriction are reported in the Appendix C. All regressions include sector and year fixed effects. The coefficients are scaled up by 100 for presentation. The estimated beta can be interpreted as the amount of won increase per 100 won of debt proceeds. Standard errors in parentheses are clustered at the sector level. * p<0.1, ** p<0.05, *** p<0.01.

We include the interaction terms between short-term and long-term FC debt, and a listed firm dummy variable that assigns a value of one if the firm is listed or zero otherwise. In the second row, we observe a significantly positive and quantitatively sizable coefficient of cash, accounts receivables, and the sum of the three liquid items on $\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} \times Listed$. In Column (1), the coefficient on $\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} \times Listed$ is 17.7 for listed firms, making it on average a total amount of 29.9 won of carry trades for each 100 won of short-term FC debt raised.

Interestingly, the coefficient of LC account receivables and other receivables on $\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} \times Listed$ is significantly positive but insignificant for $\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}}$. This finding suggests the existence of additional carry trade activities employing trade receivables, a phenomenon exclusive to listed firms. This result echoes findings from Huang et al. (2018) and Hardy et al. (2023), who find that very large firms are acting like shadow banks to extend inter-firm loans and trade credits when issuing FC debt. For the FC liquid assets, we find that listed firms accumulate less FC short-term financial instruments when they issue more short-term or long-term debt in foreign currency.

In sum, this analysis underscores the added insight gained from our dataset's broader coverage of firms across different sizes. When we focus solely on listed firms, the overall size of carry trade activities is substantially larger, mostly stemming from the active use of accounts receivables. Non-listed firms engage in carry trade activities on a smaller scale, and they place much more weight on accumulating FX risk buffers than on carry trades.

3.4 FC Debt and Interest Income

Having presented evidence of firms borrowing in short-term FC debt and saving in LC liquid assets, we now provide direct evidence of carry trades employing balance sheet items on interest incomes. Our analysis confirms that firms earn higher interest incomes when borrowing more in short-term FC debt. Additionally, we demonstrate that the size of the average carry trade income we predict closely matches the size of the interest income on the cash flow statement.

Table 4: FC Debt and Interest Income (Equation (2))

LHS:	Gross Interest Rate Income
	(1)
$\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}}$	0.382***
	(0.063)
$\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}}$	0.065
	(0.060)
$\frac{ST\ debt_{i,t}}{TA_{i,t-1}}$	-0.274***
	(0.031)
$\frac{LT\ debt_{i,t}}{TA_{i,t-1}}$	-0.416***
	(0.029)
$lnTA_{i,t-1}$	-0.037***
	(0.007)
$\frac{OS_{i,t}}{TA_{i,t-1}}$	0.178***
	(0.048)
Adjusted R^2	0.11
Within R^2	0.11
N	108209

Notes: The table show results from annual panel regressions. The sample period is 2001-2017. The dependent variable is gross interest income from the cash flow statement. *TA* is total assets and *OS* is the cashflow from other sources. Regressions are restricted to firm-year observations with positive increase in debt level. Regressions without the restriction are reported in the Appendix C. All regressions include sector and year fixed effects. Standard errors in parentheses are clustered at the sector level. * p<0.1, ** p<0.05, *** p<0.01.

Formally, we estimate the following regression:

$$\begin{aligned}\frac{GII_{i,t}}{TA_{i,t-1}} = \quad & \beta_{GII}^{STFC}\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} + \beta_{GII}^{LTFC}\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}} \\ & + \beta_{GII}^{ST}\frac{STdebt_{i,t}}{TA_{i,t-1}} + \beta_{GII}^{LT}\frac{LTdebt_{i,t}}{TA_{i,t-1}} + \gamma_1\frac{OS_{i,t}}{TA_{i,t-1}} \\ & + \gamma_2 lnTA_{i,t-1} + \alpha + \alpha_c + \alpha_t + \varepsilon_{i,t},\end{aligned} \tag{2}$$

where $GII_{i,t}$ is the gross interest income for firm i in year t from the cash flow statement. When a firm issues debt, there is no specific relationship between debt and interest incomes. For example, if a firm issues debt and uses the proceeds entirely for capital expenditure or wage payments, β_{GII} is expected to be zero because both capital expenditure or wage payments do not generate interest income. Therefore, a positive association of short-term FC debt and gross interest income ($\beta_{GII}^{STFC} > 0$) provides strong evidence that short-term FC debt issuance is associated with an interest rate-bearing activity.

The regression result is reported in Table 4. β_{GII}^{STFC} is estimated to be positive and significant at 1% level, indicating a significant increase in gross interest income when short-term FC debt increases. There is no significant association for β_{GII}^{LTFC}, which confirms again that firms do not employ long-term debt for carry trade activities. We can interpret the coefficient β_{GII}^{STFC} quantitatively in two ways. First, if we divide β_{GII}^{STFC} by the interest rate of the carry trade activities, we can obtain the implicit size of carry trade that rationalizes the reported interest income. The average Korean short-term interest rate is 2.86% from 2001 to 2017. Therefore, $\hat{\beta_{GII}}^{STFC}/0.0286 = 0.38/0.0286 = 13.4$, indicating that for each 100 unit of short-term FC debt, 13.4 won of the proceeds are used for carry trade activities (with a standard error of 2.20). This estimate closely matches the carry trade size of 14.5 won for each 100 won of FC short-term borrowing that we have obtained when estimating Equation (1), reported in Table 1, further confirming firms' carry trades.

Second, equivalently, we show how much of the predicted carry trade activity from Equation (1) is directly observed in the gross interest rate data on the cashflow statement. Specifically, we compute the predicted carry trade income as $Predicted\ \ GII_{\text{carrytrade}} = \hat{\beta}^{STFC}\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} \times i^{KR}$

, where $\hat{\beta}^{STFC}$ is an estimate from Equation (1) reported in Column 1 in Table 1 and i^{KR} is the average short-term interest rate in Korea. We then ask if the predicted income is quantitatively aligned with gross interest income, $GII_{i,t}$, on the cashflow statements after controlling for other sources of financing and income. We find that 91% of predicted carry trade income appears as interest income on the cashflow statement. The regression is reported in Appendix G.1.

4 Exploring Heterogeneity in Incentives: Carry Trades and FX Risk Buffers

Having established the evidence of carry trades and FC saving against FX risk of Korean firms, we extend our analysis to understand the underlying incentives of these behaviors.

4.1 Interest Rate Differential and Carry Trades

In this section, we explore if firms participate more in carry trade when the carry trade condition is more favorable. We add an interaction term of short-term FC debt and the ratio of money market interest rate differential between Korea and the US to the exchange rate volatility to the baseline specification of Equation (1). Dependent variables are LC liquid assets.

$$\begin{aligned}\frac{y_{i,t}}{TA_{i,t-1}} = \quad & \beta^{STFC}\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} + \beta^{LTFC}\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}} \\ & + \beta^{ST}\frac{STdebt_{i,t}}{TA_{i,t-1}} + \beta^{LT}\frac{LTdebt_{i,t}}{TA_{i,t-1}} + \gamma_1\frac{OS_{i,t}}{TA_{i,t-1}} \\ & + \gamma_2 lnTA_{i,t-1} + \alpha + \alpha_c + \alpha_t + \varepsilon_{i,t} \\ & + \delta_1\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} \times \left(\frac{i_t^{diff}}{3mFXvol_t}\right)\end{aligned} \tag{3}$$

, where i_t^{diff} is the Korea minus US money market rates of annual average of monthly values from the IMF International Financial Statistics, and $3mFXvol_t$ is the option implied exchange rate volatility from 3-month at-the-money exchange rate options (annual average of end-of-month values) from the Bloomberg Terminal. The underlying idea is that a higher interest rate differential and lower exchange rate volatility should increase in firms' incentives to conduct carry trades.

Table 5: FC Debt and LC Liquid Assets: Carry Trades and Interest Rate Differential (Equation (3))

	Local Currency Liquid Assets			
	Sum	Cash	Short-term FI	AR
	(1)	(2)	(3)	(4)
$\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}}$	11.4***	6.6***	8.2***	-1.9
	(2.8)	(1.1)	(0.9)	(2.3)
$\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}}$	-8.8***	-0.7	0.4	-9.0***
	(1.9)	(0.7)	(0.7)	(1.4)
$\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} \times \frac{i_t^{diff}}{3mFXvol_t}$	19.2**	5.7*	6.9*	6.3
	(7.5)	(3.1)	(3.7)	(6.6)
$\frac{ST\ debt_{i,t}}{TA_{i,t-1}}$	-13.7***	-6.4***	-4.3***	-3.5***
	(1.3)	(0.6)	(0.3)	(1.0)
$\frac{LT\ debt_{i,t}}{TA_{i,t-1}}$	-17.1***	-3.3***	-3.7***	-11.1***
	(2.6)	(0.8)	(0.3)	(1.9)
$lnTA_{i,t-1}$	-3.9***	-1.5***	-0.5***	-2.9***
	(0.4)	(0.1)	(0.1)	(0.3)
$\frac{OS_{i,t}}{TA_{i,t-1}}$	1.6	6.2***	5.4***	-5.8***
	(1.4)	(0.8)	(0.6)	(1.3)
Adjusted R^2	0.296	0.102	0.065	0.281
Within R^2	0.076	0.050	0.024	0.051
N	135317	145472	145911	134729

Notes: The table show results from annual panel regressions. The sample period is 2001-2017. The dependent variables are described as the column headers (normalized by total assets at $t-1$), which are cash and cash equivalents, short-term financial instruments, accounts receivables and other receivables in local currency (LC), and the sum of three. $i_t^{diff} = i_t^{KRW} - i_t^{USD}$ is the money market interest rate differential. $3mFXvol$ is the implied volatility imputed from 3-month at-the-money exchange rate options. TA is total assets and OS is the cashflow from other sources. Regressions are restricted to firm-year observations with positive increase in debt level. Regressions without the restriction are reported in the Appendix C. All regressions include sector and year fixed effects. The coefficients are scaled up by 100 for presentation. The estimated beta can be interpreted as the amount of won increase per 100 won of debt proceeds. Standard errors in parentheses are clustered at the sector level. * p<0.1, ** p<0.05, *** p<0.01.

Table 5 summarizes the regression results of Equation (3). Consistent with our conjecture, we see positive estimates of the interaction term. When the interest rate differential is high relative to the exchange rate volatility, a more favorable condition for carry trades, a rise in short-term FC debt is associated with a significantly higher overall LC liquid assets, including LC cash and LC short-term financial instruments. The coefficient of LC account receivables on the interaction term is also positive but insignificant.

4.2 FX volatility and FX Risk Buffers

In this section, we further corroborate how the accumulation of FC liquid assets when borrowing in FC is related to firms' FX risk management.

First, we investigate whether a positive correlation between FC debt and FC liquid assets is indeed a result of saving against FX risk. Our hypothesis is if the positive correlation is indeed a result of firms' management of FX risk, we should see more of it when the exchange rate volatility increases as it increases firms' needs of having FX risk buffers. We add an interaction term of FC debt and exchange rate volatility measures to the baseline regressions with FC liquid assets as dependent variables.

$$\begin{aligned}\frac{y_{i,t}}{TA_{i,t-1}} = & \beta^{STFC}\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} + \beta^{LTFC}\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}} \\ & + \beta^{ST}\frac{STdebt_{i,t}}{TA_{i,t-1}} + \beta^{LT}\frac{LTdebt_{i,t}}{TA_{i,t-1}} + \gamma_1\frac{OS_{i,t}}{TA_{i,t-1}} \\ & + \gamma_2 lnTA_{i,t-1} + \alpha + \alpha_c + \alpha_t + \varepsilon_{i,t} \\ & + \delta_1\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} \times (3mFXvol_t) + \delta_2\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}} \times (1yFXvol_t)\end{aligned} \tag{4}$$

, where $3mFXvol_t$ and $1yFXvol_t$ are implied volatility imputed from annual average of end-of-month 3 month and 1 year at-the-money exchange rate options obtained from the Bloomberg Terminal. Each volatility measure is standardized by subtracting its sample mean and dividing by its sample standard deviation; each has a zero mean and a unit variance. We expect the estimates of δ_1 and δ_2 to be positive in Equation (4)).

Table 6: FC Debt and FC Liquid Assets: FX Risk Buffers and FX Volatility (Equation (4))

	Foreign Currency Liquid Assets			
	Sum	Cash	Short-term FI	AR
	(1)	(2)	(3)	(4)
$\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}}$	12.5***	3.0***	0.4***	9.9***
	(1.8)	(0.5)	(0.1)	(1.6)
$\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}}$	4.5***	1.6**	0.3*	2.8***
	(1.2)	(0.6)	(0.2)	(0.6)
$\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} \times (3mFXvol_t)$	0.3	0.5***	0.2*	-0.3
	(0.5)	(0.1)	(0.1)	(0.5)
$\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}} \times (1yFXvol_t)$	-0.6	-0.0	0.1	-0.7**
	(0.4)	(0.3)	(0.1)	(0.3)
$\frac{ST\ debt_{i,t}}{TA_{i,t-1}}$	-0.4	-0.7***	-0.1**	0.4
	(0.3)	(0.1)	(0.0)	(0.2)
$\frac{LT\ debt_{i,t}}{TA_{i,t-1}}$	-2.9***	-0.8***	-0.1***	-2.0***
	(0.5)	(0.1)	(0.0)	(0.3)
$lnTA_{i,t-1}$	0.6***	0.0	0.0	0.6***
	(0.1)	(0.0)	(0.0)	(0.1)
$\frac{OS_{i,t}}{TA_{i,t-1}}$	0.2	0.6***	0.1***	-0.4
	(0.3)	(0.1)	(0.0)	(0.2)
Adjusted R^2	0.115	0.050	0.006	0.102
Within R^2	0.034	0.012	0.001	0.031
N	145915	146021	146026	145955

Notes: The table show results from annual panel regressions. The sample period is 2001-2017. The dependent variables are described as the column headers (normalized by total assets at $t-1$), which are cash and cash equivalents, short-term financial instruments, accounts receivables and other receivables in foreign currency (FC), and the sum of three. $1yFXvol$ and $3mFXvol$ are the implied volatility imputed from at-the-money exchange rate options. TA is total assets and OS is the cashflow from other sources. Regressions are restricted to firm-year observations with positive increase in debt level. Regressions without the restriction are reported in the Appendix C. All regressions include sector and year fixed effects. The coefficients are scaled up by 100 for presentation. The estimated beta can be interpreted as the amount of won increase per 100 won of debt proceeds. Standard errors in parentheses are clustered at the sector level. * p<0.1, ** p<0.05, *** p<0.01.

Table 6 reports the regression results of Equation (4). When exchange rate volatility is high, a rise in short-term FC debt comes with a significantly higher FC cash and FC short-term financial instruments. This result is aligned with our predictions that FC liquid saving as a FX risk buffer would be higher when exchange rate volatility increases. The coefficient of FC accounts receivables is negative but insignificant. On the other hand, the coefficients of FC Cash, FC short-term FI, and FC AR on long-term FC debt are positive and significant, while the interaction term of long-term FC debt and 1-year option implied exchange rate volatility is insignificant. This finding indicates that issuing long-term debt has a significant and positive average effect on FC liquid saving but an increase in the exchange rate volatility has a limited incremental effect on the accumulation of FX risk buffers. It is reasonable as long-term debt does not raise concerns as much as short-term debt upon a heightened FX risk.

Second, we examine whether a positive correlation between FC debt and FC liquid assets is higher for "riskier" sectors, whose sales are negatively correlated with the exchange rate depreciation (defined as the KRW price of USD). We first compute each sector's sales by summing up sales of all firms in each sector for each year t. We then regress the log of sectoral sales on the log of the exchange rate to measure how each sector's sales fluctuate with the exchange rate, $SectorFXBeta_c$. We interact $SectorFXBeta_c$ with short-term and long-term FC debt to investigate if firms accumulate more FC liquid savings when they are in a riskier sector, where sales decrease as Korean won depreciates against the U.S. dollar (that is, $SectorFXBeta_c < 0$). In other words, we expect the estimates of δ_1 and δ_2 to be negative in Equation (5):

$$\begin{aligned}\frac{y_{i,t}}{TA_{i,t-1}} = & \beta^{STFC}\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} + \beta^{LTFC}\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}} \\ & + \beta^{ST}\frac{STdebt_{i,t}}{TA_{i,t-1}} + \beta^{LT}\frac{LTdebt_{i,t}}{TA_{i,t-1}} + \gamma_1\frac{OS_{i,t}}{TA_{i,t-1}} \\ & + \gamma_2 lnTA_{i,t-1} + \alpha + \alpha_c + \alpha_t + \varepsilon_{i,t} \\ & + \delta_1\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} \times (SectorFXBeta_c) + \delta_2\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}} \times (SectorFXBeta_c)\end{aligned} \tag{5}$$

Table 7: FC Debt and FC Liquid Assets: FX Risk Buffers and Sectoral Exposure to FX Risk (Equation (5))

	Foreign Currency Liquid Assets			
	Sum	Cash	Short-term FI	AR
	(1)	(2)	(3)	(4)
$\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}}$	9.7***	2.2***	0.6**	7.5***
	(2.4)	(0.5)	(0.3)	(2.0)
$\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} \times SectorFXBeta_c$	-3.4*	-1.0***	0.2	-2.9*
	(1.9)	(0.3)	(0.2)	(1.7)
$\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}}$	4.5***	1.7***	0.3	2.8***
	(1.3)	(0.6)	(0.2)	(0.8)
$\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}} \times SectorFXBeta_c$	-0.1	0.1	-0.1	-0.0
	(0.9)	(0.3)	(0.1)	(0.6)
$\frac{ST\ debt_{i,t}}{TA_{i,t-1}}$	-0.4	-0.7***	-0.1**	0.4
	(0.3)	(0.1)	(0.0)	(0.2)
$\frac{LT\ debt_{i,t}}{TA_{i,t-1}}$	-2.9***	-0.8***	-0.1***	-2.0***
	(0.5)	(0.1)	(0.0)	(0.3)
$lnTA_{i,t-1}$	0.6***	0.0	0.0	0.6***
	(0.1)	(0.0)	(0.0)	(0.1)
$\frac{OS_{i,t}}{TA_{i,t-1}}$	0.2	0.6***	0.1***	-0.4
	(0.3)	(0.1)	(0.0)	(0.2)
Adjusted R^2	0.115	0.050	0.006	0.102
Within R^2	0.034	0.012	0.001	0.032
N	145915	146021	146026	145955

Notes: The table show results from annual panel regressions. The sample period is 2001-2017. The dependent variables are described as the column headers (normalized by total assets at $t-1$), which are cash and cash equivalents, short-term financial instruments, accounts receivables and other receivables in foreign currency (FC), and the sum of three. $SectorFXBeta_c$ is the sensitivity of each sector's sales to the exchange rate, the KRW price of USD. TA is total assets and OS is the cashflow from other sources. Regressions are restricted to firm-year observations with positive increase in debt level. Regressions without the restriction are reported in the Appendix C. All regressions include sector and year fixed effects. The coefficients are scaled up by 100 for presentation. The estimated beta can be interpreted as the amount of won increase per 100 won of debt proceeds. Standard errors in parentheses are clustered at the sector level. * p<0.1, ** p<0.05, *** p<0.01.

Table 7 summarizes the regression results of Equation (5). Negative $SectorFXBeta_c$ means that sectors' sales are low when KRW depreciates against the U.S. dollar, which is precisely when firms face higher debt burden from FC borrowing. Firms in sectors with negative $SectorFXBeta_c$ save more in FC liquid assets when borrowing in short-term FC debt. The coefficients of total liquid FC assets, including FC cash and FC AR on the interaction term of $SectorFXBeta_c$ and short-term FC debt are negative and significantly different from zero. The coefficient of FC liquid assets on the interaction term of $SectorFXBeta_c$ and long-term FC debt are small and insignificant.

Overall, we see more FX risk buffers set aside by firms in the riskier sectors, which experience lower sales with Korean won depreciation. This empirical observation further supports our idea that the accumulation of FC liquid assets is an outcome of firms' FX risk management.

5 Sectoral and Temporal Heterogeneity

In this section, we investigate sectoral heterogeneity and analyze whether there is a structural break after the Global Financial Crisis. Specifically, we show that firms in sectors with high financial dependence conduct more carry trades, while firms in more export-oriented sectors exhibit a higher degree of saving against FX risk when borrowing in FC. We also find that both carry trades and accumulation of FX risk buffers are present before 2008 and became stronger after 2008.

5.1 Trade Exposures and Financial Dependence

A sectoral analysis is important to identify sectoral characteristics that engage more in carry trades and accumulate more FX risk buffers, and this understanding would be critical to assess the consequence of FC borrowing to the macroeconomic stability. For instance, if a service sector, whose business operations are mainly domestic, engages more in carry trades, then it could be a destabilizing factor for the macroeconomy upon a large depreciation shock. In this subsection, we focus on two types of sectoral heterogeneity: financial dependence and trade exposures.

We first focus on financial dependence. We measure external financial dependence as in the

seminal work by Rajan and Zingales (1998). For each firm i, it is calculated as:

$$FinDep_i = \frac{\sum_{t=0}^{T} (\text{increase is investment assets}_{i,t} \text{ - cashflow from operation}_{i,t})}{\sum_{t=0}^{T} \text{increase is investment assets}_{i,t}}.$$

$FinDep_i$ captures the long-term shortfall in financing a firm i's investment needs with internal funds. Following Rajan and Zingales (1998), we take the median firm's value in each sector as the sector financial dependence measure, $FinDep_c$, to capture a long-run sectoral characteristic.[17]

We then modify Equation (1) with the interaction term of short-term FC debt and $FinDep_c$:[18]

$$\begin{aligned} \frac{y_{i,t}}{TA_{i,t-1}} = \quad & \beta^{STFC} \frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} + \beta^{LTFC} \frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}} \\ & + \beta^{ST} \frac{ST debt_{i,t}}{TA_{i,t-1}} + \beta^{LT} \frac{LT debt_{i,t}}{TA_{i,t-1}} + \gamma_1 \frac{OS_{i,t}}{TA_{i,t-1}} \\ & + \gamma_2 lnTA_{i,t-1} + \alpha + \alpha_c + \alpha_t + \varepsilon_{i,t} \\ & + \delta_1 \frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} \times FinDep_c \end{aligned} \tag{6}$$

The regression results are reported in Table 8. The interaction term (δ_1 in Equation (6)) is the one we are interested in. From Columns (1)-(4), we see that firms in a higher financial dependence sector are on average holding higher LC liquid assets when borrowing in short-term FC debt. The coefficient of cash on the interaction term is estimated to be positive and significant. This provides evidence that firms in a higher financial dependence sector are more active in carry trade activities.

On the other hand, we also see, in Columns (5)-(8), firms in a financial dependent sector hold more FC liquid assets, when borrowing in short-term FC debt. For the short-term FC debt, two of the three coefficients on $\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} \times FinDep_c$ are estimated to be positive and significant. However, the size of the coefficient of FC cash is three times smaller than that of LC cash, hinting us that firms in a financial dependent sector on average expose its balance sheets to higher exchange rate risk and actively participate in carry trades.

[17] The top 5 sectors with the highest financial dependence are: (i) extraction of crude petroleum and natural gas; (ii) heavy construction; (iii) amusement and theme park operation; (iv) research and experimental development on natural sciences and engineering; and (v) fishing and gathering of marine materials.

[18] The standalone effect of $FinDep_c$ is absorbed by fixed effects.

Table 8: FC Debt and Liquid Assets: Sectoral Financial Dependence (Equation (6))

	Local Currency Liquid Assets				Foreign Currency Liquid Assets			
	Sum	Cash	Short-term FI	AR	Sum	Cash	Short-term FI	AR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}}$	-8.5	-2.6	6.3	-8.2	7.5	-0.1	-0.2	7.6
	(5.4)	(3.4)	(5.0)	(5.0)	(6.2)	(1.1)	(0.2)	(6.4)
$\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}}$	23.4***	10.3***	3.1	7.4	5.1	3.2**	0.6**	2.3
$\times FinDep_c$	(5.9)	(3.5)	(5.0)	(5.4)	(6.5)	(1.2)	(0.2)	(6.5)
$\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}}$	-8.8***	-0.7	0.4	-9.0***	4.5***	1.6***	0.3*	2.8***
	(1.9)	(0.7)	(0.7)	(1.4)	(1.2)	(0.6)	(0.2)	(0.6)
$\frac{ST\ debt_{i,t}}{TA_{i,t-1}}$	-13.7***	-6.4***	-4.3***	-3.5***	-0.4	-0.7***	-0.1**	0.4
	(1.3)	(0.6)	(0.3)	(1.0)	(0.3)	(0.1)	(0.0)	(0.2)
$\frac{LT\ debt_{i,t}}{TA_{i,t-1}}$	-17.1***	-3.3***	-3.7***	-11.1***	-2.9***	-0.8***	-0.1***	-2.0***
	(2.6)	(0.8)	(0.3)	(1.9)	(0.5)	(0.1)	(0.0)	(0.3)
$lnTA_{i,t-1}$	-3.9***	-1.5***	-0.5***	-2.9***	0.6***	0.0	0.0	0.6***
	(0.4)	(0.1)	(0.1)	(0.3)	(0.1)	(0.0)	(0.0)	(0.1)
$\frac{OS_{i,t}}{TA_{i,t-1}}$	1.6	6.2***	5.4***	-5.8***	0.2	0.6***	0.1***	-0.4
	(1.4)	(0.8)	(0.6)	(1.3)	(0.3)	(0.1)	(0.0)	(0.2)
Adjusted R^2	0.296	0.102	0.065	0.281	0.115	0.050	0.006	0.102
Within R^2	0.076	0.050	0.024	0.051	0.034	0.012	0.001	0.031
N	135317	145472	145911	134729	145915	146021	146026	145955

Notes: The table show results from annual panel regressions. The sample period is 2001-2017. The dependent variables are described as the column headers (normalized by total assets at $t-1$), which are cash and cash equivalents, short-term financial instruments, accounts receivables and other receivables, and the sum of the three in local currency (LC) and foreign currency (FC). $FinDep_c$ is sectoral financial dependence ratio constructed as in Rajan and Zingales (1998). TA is total assets and OS is the cashflow from other sources. Regressions are restricted to firm-year observations with positive increase in debt level. Regressions without the restriction are reported in the Appendix C. All regressions include sector and year fixed effects. The coefficients are scaled up by 100 for presentation. The estimated beta can be interpreted as the amount of won increase per 100 won of debt proceeds. Standard errors in parentheses are clustered at the sector level. * p<0.1, ** p<0.05, *** p<0.01.

Next, we investigate if and how different trade exposure across sectors affects their carry trades and saving against FX risk when borrowing in short-term FC debt. We construct a sectoral measure of trade exposure using the sectoral input-output matrix information from the Bank of Korea.[19] For each sector c, we take the sum across years of total sectoral exports and total sectoral imports. We divide these terms by the sum across years total sector output (domestically produced sector output plus imported sector output) to get the export share of output and import share of output for each sector, capturing a long-run trade exposure of each sector:

$$ExportShare_c = \frac{\sum_{t=0}^{T} \text{sector export}_{c,t}}{\sum_{t=0}^{T} \text{sector output}_{c,t}} \text{ and } ImportShare_c = \frac{\sum_{t=0}^{T} \text{sector import}_{c,t}}{\sum_{t=0}^{T} \text{sector output}_{c,t}}.$$

We include the interaction terms of short-term FC debt and each of the above two variables:

$$\begin{aligned} \frac{y_{i,t}}{TA_{i,t-1}} = & \beta^{STFC} \frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} + \beta^{LTFC} \frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}} \\ & + \beta^{ST} \frac{STdebt_{i,t}}{TA_{i,t-1}} + \beta^{LT} \frac{LTdebt_{i,t}}{TA_{i,t-1}} + \gamma_1 \frac{OS_{i,t}}{TA_{i,t-1}} \\ & + \gamma_2 lnTA_{i,t-1} + \alpha + \alpha_c + \alpha_t + \varepsilon_{i,t} \\ & + \lambda_1 \frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} \times ExportShare_c + \lambda_2 \frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} \times ImportShare_c \end{aligned} \tag{7}$$

The regression results are reported in Table 9. The coefficients on the interaction terms, λ_1 and λ_2, are the key interests. In Columns (1)-(4), we see that none of the coefficients of LC liquid assets on the interaction term with an import share and an export share are significant. This finding indicates firms with more trade linkages do not conduct carry trade more than an average firm. On the other hand, we also see in Columns (5)-(8), there are some positive coefficients for λ_1, supporting that firms set aside higher FX risk buffers when firms are in an more export-oriented sector and borrow in short-term FC debt. In Columns (6) and (8), we observe an increase in FC cash and FC accounts receivables is higher when firms, in the sectors with high export exposure, borrow in short-term FC debt. Coefficients on the interaction term with an import share are estimated to be insignificant.

[19] Sector classification in the input-output matrix is different from the sector classification in the KISVALUE dataset. We match the sector manually and the matched outcomes are reported in the Appendix H. We use the input-output table in 2005 – 2011 to compute the sectoral trade exposure.

Table 9: FC Debt and Liquid Assets: Sectoral Export and Import Shares (Equation (7))

	Local Currency Liquid Assets				Foreign Currency Liquid Assets			
	Sum	Cash	Short-term FI	AR	Sum	Cash	Short-term FI	AR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}}$	10.4**	8.1***	7.9***	-5.2	3.4	2.3**	0.2	2.0
	(4.8)	(1.7)	(1.3)	(3.8)	(2.8)	(1.0)	(0.3)	(2.5)
$\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} \times ExportShare_c$	29.0	5.0	11.6	14.8	34.0***	4.4*	-0.9	32.8***
	(24.4)	(7.1)	(10.2)	(16.3)	(10.4)	(2.3)	(1.4)	(9.8)
$\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} \times ImportShare_c$	-1.8	-9.4	-2.7	14.9	25.8	0.3	2.3	18.6
	(25.7)	(8.1)	(5.5)	(20.7)	(21.5)	(4.9)	(1.6)	(17.3)
$\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}}$	-8.9***	-0.7	0.4	-9.0***	4.3***	1.6***	0.3*	2.7***
	(1.9)	(0.7)	(0.7)	(1.4)	(1.1)	(0.6)	(0.2)	(0.6)
$\frac{ST\ debt_{i,t}}{TA_{i,t-1}}$	-13.7***	-6.4***	-4.3***	-3.5***	-0.4	-0.7***	-0.1**	0.4
	(1.3)	(0.6)	(0.3)	(1.0)	(0.3)	(0.1)	(0.0)	(0.2)
$\frac{LT\ debt_{i,t}}{TA_{i,t-1}}$	-17.1***	-3.3***	-3.7***	-11.1***	-2.9***	-0.8***	-0.1***	-2.0***
	(2.6)	(0.8)	(0.3)	(1.9)	(0.5)	(0.1)	(0.0)	(0.3)
$lnTA_{i,t-1}$	-3.9***	-1.5***	-0.5***	-2.9***	0.6***	0.0	0.0	0.6***
	(0.4)	(0.1)	(0.1)	(0.3)	(0.1)	(0.0)	(0.0)	(0.1)
$\frac{OS_{i,t}}{TA_{i,t-1}}$	1.7	6.2***	5.4***	-5.8***	0.3	0.6***	0.1***	-0.4
	(1.4)	(0.8)	(0.6)	(1.3)	(0.3)	(0.1)	(0.0)	(0.2)
Adjusted R^2	0.296	0.102	0.065	0.281	0.117	0.050	0.006	0.104
Within R^2	0.076	0.050	0.024	0.051	0.036	0.012	0.002	0.033
N	135317	145472	145911	134729	145915	146021	146026	145955

Notes: The table show results from annual panel regressions. The sample period is 2001-2017. The dependent variables are described as the column headers (normalized by total assets at $t-1$), which are cash and cash equivalents, short-term financial instruments, accounts receivables and other receivables, and the sum of the three in local currency (LC) and foreign currency (FC). $ExportShare_c$ and $ImportShare_c$ are sectoral export and import share of output constructed from Bank of Korea data. TA is total assets and OS is the cashflow from other sources. Regressions are restricted to firm-year observations with positive increase in debt level. Regressions without the restriction are reported in the Appendix C. All regressions include sector and year fixed effects. The coefficients are scaled up by 100 for presentation. The estimated beta can be interpreted as the amount of won increase per 100 won of debt proceeds. Standard errors in parentheses are clustered at the sector level. * p<0.1, ** p<0.05, *** p<0.01.

Overall, we find evidence that firms in more financially dependent sectors and in more export exposed sectors on average accumulate more FX buffer, while firms in the former are also more active in carry trades. The two sectoral indices measure different dimensions of heterogeneity and could have different policy implications. Carry trade activities of financial dependent sectors could be alarming, but more FX risk buffers set aside by firms in exporting sectors could be reassuring.

5.2 Heterogeneity Pre- and Post-2008

The Global Financial Crisis (GFC) in 2008 resulted in a rise in volatility, a very low world interest rate environment, and disruptions in financial markets. Recent literature raises the concern about non-financial firms' participation in carry trades in the post GFC period.[20] In Table 10, we interact the debt variables in Equation (1) with a post-2008 dummy. By and large, all the empirical findings documented in the section above are present in both pre- and post-2008 period.

The coefficient of LC total liquid assets on short-term FC debt is more positive after 2008 so there is a larger portion of short-term FC debt directed towards carry trade activities. Interestingly, we find a negative coefficient of LC cash and a positive coefficient of short-term FI on the interact term, $\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} \times$ Post2008, indicating there is a switch of depositing assets from those with maturities of 3 months or less to 1 year or below.

The coefficient of foreign currency liquid assets on $\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} \times$ Post2008 is positive and significant for the sum of all three liquid assets but not significant for any individual FC liquid assets. On the other hand, the coefficient on $\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}} post2008$ is positive and significant for cash and short-term FI. This analysis indicates that there is also an increase in buffers against FX risk in the post-2008 period but it is weaker than the increase in carry trades.

[20] See Caballero et al. (2016) and Bruno and Shin (2017).

Table 10: FC Debt and Liquid Assets: Pre- and Post-2008

	Local Currency Liquid Assets				Foreign Currency Liquid Assets			
	Sum	Cash	Short-term FI	AR	Sum	Cash	Short-term FI	AR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}}$	11.4***	8.8***	7.1***	-2.0	10.4***	2.5***	0.5***	8.4***
	(2.8)	(1.3)	(1.0)	(2.3)	(1.4)	(0.7)	(0.2)	(1.3)
$\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}}$	5.1**	-2.3**	3.7***	1.8	3.7**	1.0	-0.1	2.5
$\times$Post2008	(2.5)	(0.9)	(1.3)	(1.9)	(1.7)	(0.6)	(0.2)	(1.7)
$\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}}$	-7.1***	-0.2	0.9	-7.5***	3.9***	1.0***	0.2	2.8***
	(2.2)	(0.9)	(0.9)	(1.6)	(1.0)	(0.4)	(0.2)	(0.7)
$\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}}$	-5.2**	-1.5	-1.7	-4.4**	1.3	1.3*	0.3***	0.1
$\times$Post2008	(2.4)	(1.1)	(1.2)	(1.9)	(1.1)	(0.7)	(0.1)	(0.8)
$\frac{ST\ \ debt_{i,t}}{TA_{i,t-1}}$	-9.2***	-5.6***	-2.8***	-0.6	-0.1	-0.3***	-0.1**	0.3
	(1.2)	(0.6)	(0.4)	(1.2)	(0.3)	(0.1)	(0.0)	(0.3)
$\frac{ST\ \ debt_{i,t}}{TA_{i,t-1}}$	-7.3***	-1.3*	-2.5***	-4.9***	-0.5*	-0.7***	-0.0	0.2
$\times$Post2008	(2.1)	(0.7)	(0.6)	(1.2)	(0.3)	(0.1)	(0.0)	(0.3)
$\frac{LT\ debt_{i,t}}{TA_{i,t-1}}$	-15.6***	-2.9***	-2.8***	-10.5***	-2.2***	-0.5***	-0.1***	-1.7***
	(1.7)	(0.6)	(0.3)	(1.5)	(0.4)	(0.1)	(0.0)	(0.3)
$\frac{LT\ debt_{i,t}}{TA_{i,t-1}}$	-2.3	-0.5	-1.3***	-1.0	-1.1***	-0.6***	-0.1***	-0.4
$\times$Post2008	(1.7)	(0.6)	(0.4)	(1.2)	(0.4)	(0.1)	(0.0)	(0.3)
$lnTA_{i,t-1}$	-3.9***	-1.5***	-0.5***	-2.9***	0.6***	0.0	0.0	0.6***
	(0.4)	(0.1)	(0.1)	(0.3)	(0.1)	(0.0)	(0.0)	(0.1)
$\frac{OS_{i,t}}{TA_{i,t-1}}$	2.2	6.3***	5.6***	-5.4***	0.3	0.6***	0.1***	-0.4*
	(1.4)	(0.8)	(0.6)	(1.3)	(0.3)	(0.2)	(0.0)	(0.2)
Adjusted R^2	0.296	0.102	0.066	0.282	0.115	0.051	0.006	0.102
Within R^2	0.077	0.051	0.025	0.052	0.034	0.013	0.001	0.032
N	134729	145472	145911	135317	145915	146021	146026	145955

Notes: The table show results from annual panel regressions. The sample period is 2001-2017. The dependent variables are described as the column headers (normalized by total assets at $t-1$), which are cash and cash equivalents, short-term financial instruments, accounts receivables and other receivables, and the sum of the three in local currency (LC) and foreign currency (FC). *TA* is total assets and *OS* is the cashflow from other sources. Regressions are restricted to firm-year observations with positive increase in debt level. Regressions without the restriction are reported in the Appendix C. All regressions include sector and year fixed effects. The coefficients are scaled up by 100 for presentation. The estimated beta can be interpreted as the amount of won increase per 100 won of debt proceeds. Standard errors in parentheses are clustered at the sector level. * p<0.1, ** p<0.05, *** p<0.01.

6 Other Uses of Debt Proceeds

In this section, we look at other common uses of bond proceed besides liquid assets, especially investment and dividend payouts. We run the same regression as Equation (1) but with $y_{i,t}$ as capital expenditures (CapEx) and dividend payouts (normalized by total assets at $t-1$). The regression estimates are reported in Table 11.

In Column (1), we see that an increase in debt in general is associated with an increase in investment. The coefficients on short-term debt, long-term debt, and long-term FC debt are all estimated to be positive and significant. However, the coefficient on short-term FC debt is negative and significant. This result indicates firms raising debt in ST FC are not mainly seeking external funds for investment purposes, reaffirming the carry trade hypothesis.

We also see consistent evidence of a reduction in dividend payouts when debt increases, except for short-term FC debt. The coefficients on short-term debt, long-term debt, and long-term FC debt are estimated to be negative and significant. These are consistent with the pecking order theory in corporate finance that firms uses internal funds first and then draw on external funds to finance investment projects. The coefficient on short-term FC debt is not significant and also positive. The stark difference in the result on short-term FC debt again highlights the carry trade motive behind short-term FC debt issuance.

Table 11: FC Debt, and Investment and Dividend

	CapEx	Dividend Payout
	(1)	(2)
$\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}}$	-4.3***	0.0
	(0.7)	(0.0)
$\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}}$	5.3***	-0.1**
	(2.0)	(0.0)
$\frac{ST\ debt_{i,t}}{TA_{i,t-1}}$	6.7***	-0.2***
	(0.7)	(0.0)
$\frac{LT\ debt_{i,t}}{TA_{i,t-1}}$	18.4***	-0.2***
	(1.6)	(0.0)
$lnTA_{i,t-1}$	-0.7***	0.1***
	(0.1)	(0.0)
$\frac{OS_{i,t}}{TA_{i,t-1}}$	-14.4***	0.4***
	(2.3)	(0.1)
Adjusted R^2	0.200	0.035
Within R^2	0.133	0.017
N	123816	146025

Notes: The table show results from annual panel regressions. The sample period is 2001-2017. The dependent variables are described as the column headers (normalized by total assets at $t-1$), which are capital expenditure (CapEx) and dividend payout. *TA* is total assets and *OS* is the cashflow from other sources. Regressions are restricted to firm-year observations with positive increase in debt level. Regressions without the restriction are reported in the Appendix C. All regressions include sector and year fixed effects. The coefficients are scaled up by 100 for presentation. The estimated beta can be interpreted as the amount of won increase per 100 won of debt proceeds. Standard errors in parentheses are clustered at the sector level. * p<0.1, ** p<0.05, *** p<0.01.

7 Dynamic Relationships of FC Debt and Liquid Assets

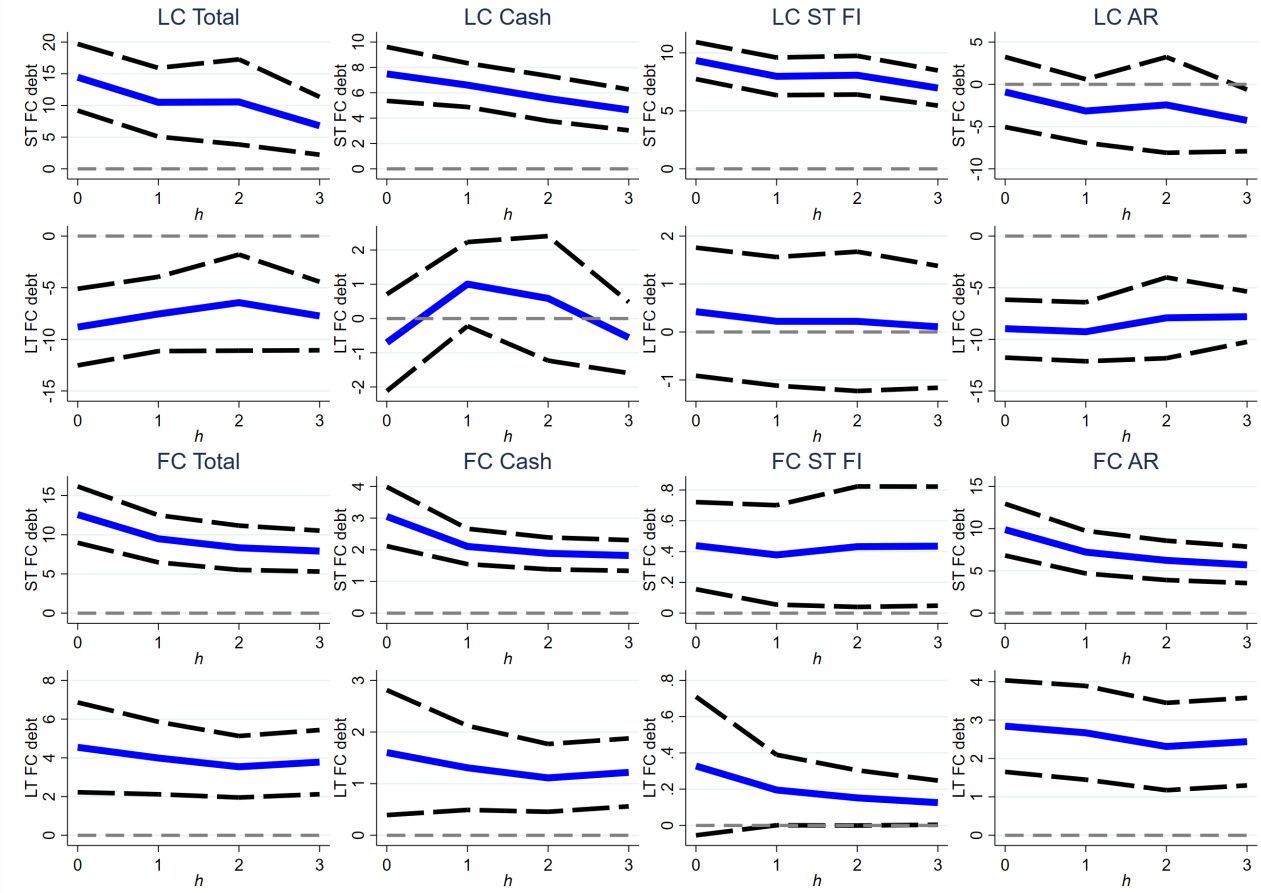
In this section, we investigate the longer-term effects of FC debt issuance. This analysis helps us to ease the concern that the increase in liquid assets is driven by a mechanical effect, where firms have not yet used the debt proceeds for other real purposes. We will see all the previous results hold when we examine the longer-horizon correlations. We estimate Equation (8) with a local projection method a la Jordà (2005).

$$\begin{aligned}\frac{y_{i,t+h}}{TA_{i,t-1}} = \quad & \beta^{STFC}\frac{ST\ FCdebt_{i,t}}{TA_{i,t-1}} + \beta^{LTFC}\frac{LT\ FCdebt_{i,t}}{TA_{i,t-1}} \\ & + \beta^{ST}\frac{ST\ debt_{i,t}}{TA_{i,t-1}} + \beta^{LT}\frac{LT\ debt_{i,t}}{TA_{i,t-1}} \\ & + \gamma_1\frac{OS_{i,t}}{TA_{i,t-1}} + \gamma_2 lnTA_{i,t-1} + \alpha + \alpha_c + \alpha_t + \varepsilon_{i,t},\end{aligned} \tag{8}$$

for $h = 0, 1, 2, 3$. We estimate up to 3 years because we have a sample of 17 years and the typical maturity of a debt contract is roughly 3 years.

Figures 4 display the impulse responses when the dependent variables are LC assets and FC assets, respectively. For each figure, each of the four columns considers the sum of the three assets, cash, short-term financial instruments, and accounts receivables and other receivables as the dependent variables, respectively. Each of the two rows plots the impulse responses when the regressors are short-term FC debt and long-term FC debt, respectively. In all figures, we can see that the sign of the coefficient at $h = 0$ is the same as the coefficients at $h = 1, 2$ and 3. This result indicates the association with liquid assets are persistent. For example, there is a long-term increase in FC cash when there is an increase in short-term FC debt. Therefore, it is not the case that the increase in FC cash is just a reflection of unused bond proceeds after a debt issuance.

Figure 4: FC Debt and Liquid Assets: Dynamic Relationship via Local Projections (Equation (8))



Notes: The table show results from annual panel regressions. The sample period is 2001-2017. The dependent variables are described as the column headers (normalized by total assets at $t-1$), which are cash and cash equivalents, short-term financial instruments, accounts receivables and other receivables, and the sum of the three in local currency (LC) and foreign currency (FC). The regression control for lagged log total assets and cashflow from other sources (normalized by total assets at $t-1$). Regressions are restricted to firm-year observations with positive increase in debt level. Regressions without the restriction are reported in the Appendix C. The coefficients are scaled up by 100 for presentation. The estimated beta can be interpreted as the amount of won increase per 100 won of debt proceeds. All regressions include sector and year fixed effects. 95% confidence interval from standard errors clustering at sector level are displayed as black dash lines.

8 Conclusion

With detailed Korean firm-level data, we find strong evidence that the currency and the maturity of debt matter for what firms do with their borrowing. We find that firms that borrow in foreign currency engage more in carry trades, especially when borrowing in short-term, and also exhibit stronger incentives to set aside some FC liquid assets as FX risk buffers. Furthermore, we document that listed firms participate significantly more in carry trade and set aside less FX risk buffers than non-listed firms. Lastly, we find firms that borrow more in short-term FC debt earn higher interest income, directly supporting carry trade motives behind issuing short-term FC debt.

We delve further into the incentives driving carry trade behavior and accumulation of FX risk buffers. Our analysis reveals that firms engage in more carry trades when the interest rate differential between South Korea and the United States widens. Firms opt for additional FX risk buffers when exchange rate volatility increases and if they operate in sectors whose sales are highly sensitive to the exchange rate fluctuations. In terms of heterogeneity, we find that the motives to participate in carry trades and set aside FX risk buffers are stronger in the post-2008 era, though both channels were also present in the pre-2008 period. Moreover, firms in financially dependent sectors engage more in carry trade, while firms in export-oriented sectors tend to accumulate more FX risk buffers.

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