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Abstract

I show that shocks to financial intermediaries that supply hedging instruments to corporations have real effects. I exploit a quasi-natural experiment in South Korea in 2010, where regulations required banks to hold enough capital for taking positions in foreign exchange derivatives (FXD). Using the variation in exposure to this regulation across banks, I find that the regulation caused a reduction in the supply of FXD, leading to a significant decline in exports for firms that held derivatives contracts with more exposed banks. These results indicate the crucial role of intermediaries in allocating risks through the provision of derivatives and establish a causal relationship between financial hedging and real economic outcomes.

Key words: real effects, macroprudential policy, international finance, derivatives hedging, FX risk management

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1 Introduction

Financial intermediaries play a crucial role in providing corporations with hedging instruments, such as derivatives, for managing risks. Shocks to intermediaries can significantly impact firms' risk management to the extent that the intermediaries transmit the shocks by reducing the supply of hedging instruments, and firms cannot find alternative hedging sources. Such shocks can, in turn, affect the real economic activities of firms, given the increasingly widespread and heavy use of derivatives among corporations, with notional values exceeding \$100 trillion in 2022, up from \$20 trillion in 2000. Therefore, it is critical to understand the real effects of financial shocks on intermediaries that supply corporate hedging instruments.

In this paper, I examine how shocks to financial intermediaries affect the supply of hedging instruments to corporations and, in turn, whether such shocks impact real economic activities. Exploiting a regulatory shock, I find evidence from intermediaries' provision of foreign exchange derivatives (FXD) to exporters. FXD can play a key role in managing the foreign exchange (FX) risk of exports. This is because exporters in countries that do not use the US dollar (USD) face substantial FX risk, since the majority of international trades are invoiced in USD,¹ and exchange rates are highly volatile.² Since exporters in small open economies constitute a significant mass of firms, the implications of FX hedges using derivatives can extend to the macroeconomic level.

To examine how regulatory shocks affect banks' supply of derivatives and the real economic activities of the firms that use them, I exploit a quasi-natural experiment in South Korea. In 2010, regulations required banks to hold enough capital for taking FXD positions. Using the variation in exposure to this regulation across banks, I find that the regulation caused a reduction in the supply of FXD because banks opted to decrease their FXD positions instead of raising equity due to costly financing. The reduction in the supply of hedging instruments led to a significant decline in exports for firms that held derivatives contracts with more exposed banks. These findings are relevant to other economies, given that increasingly many countries globally, including developed economies, have restrictions

¹The average export invoice share in US dollars or euros was 89% across 71 countries in 2019 based on the dataset constructed by [Boz et al. \(2020\)](#).

²Exchange rates for emerging markets are especially volatile, with annual volatilities as high as 120% per annum for some emerging market currencies during stress episodes ([Figure 1](#)).

on the financial sector’s open FX positions.³

This study makes direct contributions to the finance literature by examining the role of financial intermediaries in allocating risk through the provision of derivatives, an area overlooked in prior research on the role of financial intermediaries, which has thus far focused on allocating capital through the provision of credit. Moreover, it also establishes a causal relationship between financial hedging and real economic outcomes. While previous studies have explored the relationship between derivatives usage and firm value, few have established a causal link between financial hedging and real economic outcomes.⁴

Estimating whether and the extent to which financial intermediaries transmit regulatory shocks to firms through a reduction in the supply of derivatives presents significant challenges, as does assessing the real effects of corporate hedging using derivatives. First, regulatory shocks typically affect multiple institutions simultaneously, making it difficult to identify their causal effect through time-series analysis alone. To address this, it is crucial to examine similar financial institutions with varying levels of exposure to the regulation. Second, the economic forces driving the regulation may also directly influence firms’ demand for hedging. Therefore, changes in the hedging supply by financial intermediaries must be isolated from the changes in firms’ demand for hedging. Third, firms might be able to offset the reduction in the supply of hedging using derivatives by using alternative hedging strategies. Hence, it is critical to observe real outcomes at the firm level to assess the impact of the reduction in the supply of derivatives on real economic activity.

To address the challenges discussed above, I employ a quasi-natural experiment in South Korea. By exploiting the cross-bank heterogeneity in the impact of regulatory shocks on banks based on their ratio of FXD positions to equity, I construct a bank-specific measure of exposure to the regulation, addressing the first challenge. To address the second challenge, I hand-collect a unique dataset covering the details of FXD contracts held by all listed firms in South Korea. This allows me to control for changes in the demand for hedging by comparing derivatives contracts of similar firms provided by several banks. Finally, to address the third

³As of 2018, approximately three out of four countries, including developed economies, had restrictions on the financial sector’s open FX positions based on the IMF’s Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). See [Figure A.1](#) for the number of emerging markets and developing countries using such regulations over time.

⁴For example, [Gilje and Taillard \(2017\)](#) use a change in basis risk in the oil and gas industry and [Perez-Gonzalez and Yun \(2013\)](#) exploit the introduction of weather derivatives as exogenous shocks and find that the use of derivatives leads to an increase in firm value.

challenge, I examine the firm-level total hedging and exports to estimate the impact on the real economic activity of firms that had relationships with banks exposed to the regulation. My identification strategy is valid because the regulatory shock is plausibly exogenous to the demand for FXD hedging. This is supported by my finding that the regulatory shock to banks is not correlated with firms' demand for hedging.

To understand how the regulatory shock propagates to firms, I proceed in three steps. First, I evaluate bank-level responses following the imposition of the regulation. I compare banks constrained by the regulation (treatment group) to unconstrained banks (control group), both before and after the regulatory shock in a difference-in-differences (DiD) framework. I find that, following the regulatory shock, constrained banks reduced their FXD positions more than unconstrained banks, and the gap between the FXD positions of the two groups widened as regulations were tightened over time.⁵ These findings suggest that it is costly for banks to raise equity capital, and therefore, banks prefer to cut FXD positions to meet the regulatory requirement. In other words, the regulation as well as the banks' costly equity financing are frictions that banks are facing.

In the second step, I use contract-level FXD data observed during the six months before and after the regulation was imposed to estimate the transmission of the regulatory shock from banks to firms. I control for changes in the demand for hedging by examining hedging with constrained banks and hedging with unconstrained banks for *similar* firms, defined as those being in the same industry with similar characteristics. I find that exporters' hedging with constrained banks declined 47% more than their hedging with unconstrained banks. These results are robust after controlling for firms' industry–location–size fixed effects, addressing the concern that the results may be confounded by unobservable demand-related characteristics, and corroborating that the regulation caused a reduction in the *supply* of FXD.

In the third step, I conduct a firm-level analysis to understand how the regulatory shock affected the real decisions of firms. I define “exposed” firms as those whose counterparty bank for FXD was constrained. I then compare changes in exposed firms' FXD positions with changes in non-exposed firms. I find that the *total* hedging of exposed exporters fell

⁵The results remain robust when I replace the indicator variable, *Constrained*, with a continuous variable, *Shock*, defined as the percentage of its FXD position that a bank was required to reduce when the regulation was imposed.

40–45% compared with the total hedging of non-exposed exporters, and the effects were concentrated on *small firms*. This firm-level reduction in hedging implies that small firms were not able to offset the shock because switching counterparty banks is likely to be costly to them (e.g., because they borrow and/or have credit lines outstanding with the constrained banks).

Further, I examine whether the reduction in the supply of FXD affected firms' exports, which are the primary source of exposure to FX risk. I find that the impact was large for small firms that relied heavily on hedging using FXD. Firms that used to hedge at least 10% of their export sales with FXD, which I refer to as high-hedging firms, substantially reduced their exports. For a one-standard-deviation increase in a firm's exposure to the regulatory shock transmitted by banks, export sales fell by 18.9% more for high-hedging firms than for low-hedging firms.⁶

One may question whether the documented reduction in exports is due to firms' speculation instead of hedging. Specifically, it might be that the firms having contracts with banks exposed to the regulation were speculating that the USD would depreciate, causing a reduction in exports, and their FXD position was forced to decrease due to the reduction in supply. Had firms been speculating on both exports and FXD, a positive correlation between exports and the FXD before the shock would be expected. Yet, I find that the correlation was, in fact, strongly negative (-0.95). The net FXD positions of the exporters were short USD (paying off when the USD depreciates), while export sales invoiced in USD are better off when the USD appreciates. Therefore, it is unlikely that exporters were holding derivatives for speculation.

In addition, the exporters in the sample were exposed to substantial FX risk. The USD-KRW exchange rate is highly volatile, with annual volatilities as high as 120% per annum during stress episodes (Figure 1), and most exports are invoiced in USD. A simple decomposition exercise suggests that the sample exporters' variance of total sales is 6.7 times the variance of domestic sales. Moreover, firms' profits are a leveraged position on the exchange rate. A numerical exercise suggests that the profits of one of the top exporters fall

⁶While not directly comparable, this magnitude is broadly consistent with the literature on the real effects of hedging. For instance, Gilje and Taillard (2017) show that shareholder value for treated firms suffering from a relative reduction in their ability to hedge falls by 17% relative to control firms. In Chilean firms' context, Alfaro et al. (2021) find that a supply shock in FXD leads to a 20% decline in exports although the coefficient is not statistically significant.

by 10.7% for a 1% depreciation in the USD against the KRW. This implies that firms can experience staggering net losses due to FX risk. Given these risks, it is even more unlikely that exporters would speculate in a way that increases their exposure.

Having documented the evidence supporting the hedging channel, I examine two potential explanations for why the reduction in the supply of *hedging* leads to a decline in firms' exports.⁷ One explanation for the decline in exports is firms' strategic risk management. Froot et al. (1993) and Rampini and Viswanathan (2010) posit that firms hedge their risk exposure to avoid falling short on funds available for future investment. Building upon this insight, suppose that firms' export outcomes determine the size of internal funds available for future investment opportunities and that firms are exposed to exchange rate risk. If internal funds fall short, firms would have to rely on costly external financing. Assuming convex costs, firms would face higher expected external financing costs when the volatility of the internal funds is higher. Therefore, they have incentives to lower the volatility of internal funds by using hedging instruments or by reducing exports. When hedging becomes more costly, it is optimal for firms to reduce the underlying exposure, the exports, to lower the volatility of internal funds. Hence, a reduction in exports is a result of firms' active risk management decision to lower the volatility of internal funds. This mechanism predicts that, due to risk-taking incentives, when hedging becomes more costly, exporters with more internal funds are expected to reduce exports by more than those exporters with less.

An alternative explanation is that the decline in exports is an outcome of the realized risk of unhedged exposure following a failure in risk management. When firms fail to hedge, they are forced to cut their investment due to FX losses, which in turn leads to a decline in their output. Under this channel, high-cash firms are expected to reduce their exports by less than low-cash firms because their cash reserves can weather losses from reduced risk management.

I test the implications of the two potential explanations by investigating the cross-sectional effect of cash holdings on the decline in exports. I find that firms with higher cash holdings and high hedge ratios before the regulation reduced export sales and switched to the domestic market to a greater extent. This finding supports the first explanation and suggests that firms not only hedge risk exposure by using derivatives but also strategically

⁷A comprehensive general equilibrium model is beyond the scope of this paper; I leave it for future research.

reduce risk exposure when the means of hedging the risk becomes more costly.⁸

I perform several tests throughout the analyses to confirm the robustness of the results. First, the results are robust when including bank fixed effects in the bank-level analysis and when controlling for bank, firm, and contract characteristics in the contract-level and firm-level analyses. Additionally, in the contract-level analysis, firms' industry-location-size fixed effects are included to control for unobservable demand-related characteristics. Second, I analyze changes in FXD separately for foreign banks and confirm that the relative reduction in FXD of constrained banks was large and significant even among foreign banks, suggesting that the result is not driven by a difference in business models between foreign and domestic banks. Third, I estimate the impact of the regulation on banks' foreign currency lending and find no significant change in the share of foreign currency lending of constrained banks compared with that of unconstrained banks, helping rule out the potentially confounding effect of a global credit shock. Fourth, I conduct a placebo test to estimate the impact on firms' domestic sales and find it to be small and insignificant. This finding suggests that the decrease in export sales is due to a regulatory shock and not a systemic relationship between troubled firms and constrained banks. Fifth, I show that the decline in exports for exposed firms is only explained by cash when interacting with hedging, not by cash alone. This finding confirms that the hedging channel is the mechanism at work. Finally, I provide further evidence suggesting that the reduction in FXD positions resulted from a decrease in supply, rather than demand, by examining FXD pricing.

Overall, my results indicate that regulatory constraints imposed on financial intermediaries can lead to a decline in the supply of FXD. In turn, it can lead to a reduction in exports by affected firms because firms strategically reduce the underlying risk exposure when hedging becomes more costly. This has important implications: 1) intermediary frictions in FX markets can affect international trade, 2) derivatives are crucial for risk management, 3) firms actively manage their underlying risk exposure when derivatives become more costly, and 4) macroprudential FX regulations aimed at mitigating financial sector vulnerabilities can have adverse effects on the real economic outcomes of the nonfinancial sector.

⁸The result also helps rule out the speculation channel. If firms were using FXD for speculative purposes and the reduction in exports was driven by a decline in gains from the reduced speculative FXD positions, high-cash firms would be expected to reduce their exports by less than low-cash firms.

Contribution to the Literature This paper adds to the literature studying the role of intermediaries in financial markets. Prior research in the context of the FX market includes intermediary-based asset pricing models applied by Du et al. (2022) and Gabaix and Maggiori (2015), and empirical work by Cenedese et al. (2021), Du et al. (2018), Avdjiev et al. (2019), Fleckenstein and Longstaff (2018), and Ivashina et al. (2015) on intermediary constraints and CIP deviations. Liao and Zhang (2020) investigate the impact of institutional investors' hedging demand and intermediary constraints on exchange rate dynamics. This paper adds to the field by identifying a novel *hedging channel* through which frictions in the financial market can affect firms' real economic activities. My findings suggest that the frictions on the bank side come from the regulatory constraint combined with banks' costly equity financing, and the frictions on the firm side are related to relationship banking. In addition, I document that larger firms are better able to cope with the adverse effects of bank shocks in the derivatives market than smaller firms, similar to the findings of Khwaja and Mian (2008) in credit markets.

This paper contributes to the literature on the real implications of corporate hedging. Corporate finance theory provides rationales for hedging due to agency theoretic, capital market, asymmetric information, and tax frictions.⁹ Acharya et al. (2013) build an equilibrium model of commodity markets and show that producers experience limits to hedging when speculators are capital-constrained. On the empirical side, Alfaro et al. (2021) provide detailed documentation of FX risk exposures and hedging behaviors of Chilean firms and suggest the importance of hedging using derivatives. While many studies have found that hedging is associated with increases in firm values,¹⁰ only a few papers have identified the *causal* effects of hedging (e.g., Gilje and Taillard, 2017; Perez-Gonzalez and Yun, 2013). This paper adds to the literature by identifying the causal effect of hedging on exports and showing the importance of derivatives as hedging instruments. Furthermore, my findings

⁹For example, see Purnanandam (2008); Campbell and Kracaw (1987) for agency theoretic frictions, Froot et al. (1993); Rampini and Viswanathan (2010) for capital market frictions, DeMarzo and Duffie (2015) for asymmetric information frictions, and Smith and Stulz (1985); Leland (1998); Graham (2003) for tax frictions.

¹⁰Such findings are in the context of FX derivatives (e.g., Allayannis and Weston, 2015; Allayannis et al., 2012; Bartram et al., 2011; Graham and Rogers, 2002; Geczy et al., 1997), commodity derivatives (e.g., Rampini et al., 2014; Carter et al., 2006; Haushalter, 2000), and interest rate derivatives (e.g., Campello et al., 2011; Graham and Rogers, 2002). Other studies have documented less prominent effects (e.g., Mackay and Moeller, 2007; Jin and Jorion, 2006; Tufano, 1996; Guay and Kothari, 2003).

suggest that firms actively manage their underlying risk exposure when derivatives become more costly.

This paper also adds to the literature on macroprudential regulations. While some studies show the effectiveness of regulations (e.g., Acharya and Vij, 2020; Bruno et al., 2017; Ostry et al., 2012), others document unintended negative consequences (e.g., Aiyar et al., 2014; Cerutti et al., 2015; Reinhardt and Sowerbutts, 2015). I contribute by providing novel evidence that macroprudential FX regulations can have a negative effect on exports. This paper is also related to the work of Keller (2019), who examines the effects of a capital control shock in Peru that shifted risks from banks to firms through a credit channel. Additionally, this paper is related to the study by Ahnert et al. (2020), who find that macroprudential FX regulations cause firms to increase their issuance of FX debt. A key distinction in this paper is that I focus on the unintended consequences of the regulation reducing the supply of firms' hedging instruments.

Outline of the Paper The remainder of the paper proceeds as follows: Section 2 provides the economic context, rationale, and institutional details of the regulation. Section 3 describes the sample and data. Section 4 develops the empirical methodology, reports the results, and offers explanations for the findings. Section 5 presents robustness results. Section 6 concludes.

2 The Setting

This section provides context for the quasi-natural experiment by describing the economic environment leading up to the imposition of leverage-based FXD capital requirements on banks in South Korea in 2010. Additionally, the section discusses the rationale behind the regulation as well as its institutional details.

2.1 Economic Context

From 2000 to 2007, Korea had twin surpluses in its balance of payments. However, at the same time, Korea's total external debt increased and the short-term component of that debt rose substantially. Even after taking the huge accumulation of FX reserves into account, FX

liquidity—defined as FX reserves less short-term debt, scaled by GDP—had been deteriorating since 2005.^{11,12} This was related to the banking sector’s short-term external debt.

Figure 2 plots Korea’s gross foreign capital inflows by channels, foreign direct investment (FDI), stocks, bonds, and banks’ cross-border borrowings, and shows that the volatility of foreign capital flows was primarily driven by banking sector borrowing. Its rapid increase during 2006–2007 reversed dramatically during the global financial crisis (GFC). The outflow in the fourth quarter of 2008 was close to \$40 billion, or 4% of the country’s annual GDP.

The surge in the banking sector’s short-term borrowings in 2006–2007 could have been related to an increase in domestic credit demand. However, in Korea’s case, it was closely related to an increase in exporter hedging demand.

To illustrate the relationship between exporter hedging demand and the banking sector’s short-term cross-border borrowing, Figure 3 presents stylized FX positions of exporters and banks before the regulation. During 2006–2007, high global demand led exporters to have long-term USD receivables. To hedge FX exposure from these USD receivables, exporters sold large amounts of USD forwards to banks.¹³ The left panel of Figure 3 presents this structure of firms’ FX position.

Because banks purchased USD forwards from exporters, they were long USD forwards. The right panel of Figure 3 presents banks’ FX position. Had there been importer hedging demand matching that of exporters, banks could have covered long positions by selling USD forwards to the importers. However, importer hedging demand fell far short of exporter hedging demand for several reasons. First, importers’ FX liabilities are typically short-term and easier to predict. Second, it could be optimal for importers not to hedge when the central bank aggressively accumulates FX reserves, anticipating the reserves would be used to reduce currency depreciation (Acharya and Krishnamurthy, 2019). Third, the main importing sector in Korea is energy. In that sector, firms have the sufficiently large market power to pass FX risk to their customers through pricing (Kim, 2010).

As a result, the majority of banks’ FXD positions were derived from exporter hedging demand. Figure 4 shows that, during the first three quarters of 2007, exporters sold 24 billion USD in forwards to banks, which amounted to 65% of banks’ aggregate net USD

¹¹This measure of FX liquidity is suggested by Acharya and Krishnamurthy (2019).

¹²See Appendix IA.A for time-series plots of Korea’s balance of payments, total external debt, short-term external debt, FX reserves, and FX liquidity.

¹³See McCauley and Zuckunft (2008) and Ree et al. (2012) for further details.

forward position.

Given the shortage of natural USD forward buyers, banks needed to cover their long positions in USD forwards by constructing short positions in synthetic forwards. A short position in synthetic forwards is constructed by borrowing USD, converting USD to Korean Won (KRW) in the FX spot market, and investing in risk-free KRW-denominated bonds.¹⁴ Had banks matched the maturities of their short positions in synthetic forwards and their long positions in USD forwards, banks would have been hedged. However, banks left maturity mismatch unhedged.¹⁵ The right panel of [Figure 4](#) shows that 73% of USD that banks funded for their USD forwards was via short-term cross-border borrowing during the first three quarters of 2007.

As a result, although Korean firms and banks hedged their FX mismatches, the country as a whole was left with a substantial FX *maturity* mismatch, which made the financial system vulnerable. Korea suffered severely from a USD funding liquidity crisis during the GFC, as its banks were not able to roll over short-term external debt. The average KRW CIP basis—a measure of FX funding liquidity—was -300bps between 2007 and 2009.¹⁶ The KRW also depreciated rapidly and Korea nearly suffered a currency crisis.¹⁷

2.2 Regulation: FXD Position Limit

Korea introduced a macroprudential FX regulation in June 2010 that limited banks' FXD positions relative to capital:

$$\frac{|\text{FXD Position}|}{\text{Capital}} < \text{Regulatory Cap} \quad (1)$$

¹⁴See [Appendix IA.B](#) for illustration of cash flows.

¹⁵Foreign bank branches typically used short-term USD borrowings from their parent banks while their purchased USD forwards were long-term. Domestic banks' maturity mismatches were not as severe as those of foreign bank branches ([Ree et al., 2012](#)).

¹⁶See [Figure A.2](#) for the CIP basis over time. I define CIP deviation for maturity n at time t ($x_{t,t+n}$), as the difference between the USD rate ($y_{t,t+n}^{\$}$) and the USD rate implied by the forward exchange rate ($f_{t,t+n}$), spot exchange rate (s_t), and KRW rate ($y_{t,t+n}^{\text{₩}}$): $x_{t,t+n} = y_{t,t+n}^{\$} - (y_{t,t+n}^{\text{₩}} - \frac{1}{n}(f_{t,t+n} - s_t)) = \frac{1}{n}(f_{t,t+n} - s_t) - (y_{t,t+n}^{\text{₩}} - y_{t,t+n}^{\$})$. The spot and forward exchange rates are defined as the value of 1 USD in terms of KRW. The average for G10 currencies during the same period was -20.8bps with a maximum deviation of -63.1bps for Danish Krone ([Du et al. \(2018\)](#)).

¹⁷The USD appreciated 34% during 2008. See [Figure A.3](#) for the spot exchange rate over time. See [International Monetary Fund \(2012\)](#) for further details of the crisis.

Given that the banks' cross-border borrowing was closely linked to their FXD positions as discussed in subsection 2.1, the regulation seeks to induce banks to use more stable sources of funding and thereby lower the volatility of capital flows.

The FXD position is defined as the monthly average of the daily net aggregate delta-adjusted notional value of all FXD contracts a bank holds, including FX forwards, swaps, and options.¹⁸ Since the net FXD position is aggregated across all currencies, banks' FXD positions in a currency pair that does not involve KRW (for example, a EUR-USD pair) have virtually no effect on the constraint. A bank's equity capital base is defined as the sum of Tier 1 capital (paid-in capital) and Tier 2 capital (including borrowing longer than a year from its parent bank) in all currencies. The exchange rate for converting a KRW-denominated capital base to USD is the average of the exchange rate used for the previous year's calculation and the previous year's average exchange rate.

The limit (1) is placed on each bank, namely the absolute value of FXD position of a bank must be below a certain specified level relative to its equity capital at the end of the previous month. At the imposition, the regulatory cap was 50% for domestic banks and 250% for foreign banks. This regulatory cap was adjusted over time; the regulation was tightened in 2011 and 2012 and loosened in 2016 and 2020. (See Table 1 for the full details.) For my empirical analysis, the last change in 2020 is not included. According to the regulator's statements, the main underlying factors that led to adjusting the limit were the banking sector's aggregate short-term external debt and the USD funding liquidity condition.¹⁹

3 Data and Summary Statistics

3.1 Data Sources

I use three data sets for analysis: bank data, FXD contract data, and firm data. All data are publicly available. Bank FXD position data are hand-collected from bank financial statements. The rest of bank financial data are downloaded from the Korean Financial Statistics Information System managed by Korea's financial regulator, the Financial Supervisory Service.²⁰ FXD contract data of all listed nonfinancial firms are hand-collected from

¹⁸For non-USD FXDs, the notional values are converted to USD based on the day's exchange rate.

¹⁹See International Monetary Fund (2012) and Bruno and Shin (2014) for further details.

²⁰<http://efisis.fss.or.kr/fss/fsiview/indexw.html>

firm financial statements published on the Korean Data Analysis, Retrieval and Transfer (DART) System.²¹ DART is a repository of Korean corporate filings, from which disclosure filings of all Korean firms subject to external audit can be downloaded. The data source for firm-level financial data is TS2000, a commercial data aggregator managed by Korea Listed Companies Association. Market data, such as spot and forward exchange rates, as well as interest rates, are obtained from Bloomberg and Datastream.

3.2 Bank Data

I focus on 46 banks that were operating as of December 2009, the last reporting period before the imposition of FXD position limits.²² Among them, 29 are foreign banks and 17 are domestic banks. Banks' on-balance sheet FX positions (defined as foreign currency (FC) assets less FC liabilities), FXD positions, and FXD-position-to-capital (DPTC) ratios are observed on a monthly basis. Other financial variables of banks are observed quarterly. The sample period is from 2008 to 2018.

The size of the regulatory shock in aggregate was substantial. The constrained banks in aggregate needed to reduce their FXD position by about 15 billion USD, or approximately 40%.²³ The tightness of regulation differed across banks when it was introduced. To study the effect of the FXD position limit on banks, I exploit the cross-bank heterogeneity in the tightness of regulation. [Figure 5](#) compares the histograms of the DPTC ratios of foreign banks before and after the first announcement of the regulation. It shows that 14 foreign banks had DPTC ratios above the regulatory cap, and all of them except one managed to reduce their DPTC ratios below the cap after the regulation. [Figure 6](#) shows that two domestic banks with DPTC ratios above the regulatory cap reduced their DPTC ratios below the cap after the regulation. The heterogeneity in DPTC ratios is driven more strongly by its numerator, the FXD position.²⁴

[Table 2](#) reports bank summary statistics by whether the bank was constrained by the regulation as of December 2009. Most constrained banks were foreign, on average smaller,

²¹<https://englishdart.fss.or.kr/>

²²The list of full names of sample banks are in [Table IA.C.1](#).

²³[Appendix IA.D](#) reports each bank's assets, FXD position (*DerivPosition*), capital, DPTC ratio, size of derivatives positions in excess of the limit (*DerivExceeded*), and size of shock (defined as $DerivExceeded/DerivPosition$) as of December 2009, before the regulation.

²⁴The standard deviation of $FXDPosition/Asset$ is 0.19 and that of $Capital/Asset$ is 0.12.

and more leveraged with lower loan-to-assets ratios. The differences in these characteristics are statistically significant. Therefore, I control for such differences in my empirical analysis. I also run separate analyses for foreign banks and domestic banks.

3.3 FXD Contract Data

All nonfinancial firms in Korea have been required to disclose the details of their existing financial derivatives contracts since 1999 (Ban and Kim, 2004). I hand-collected the details of FXD contracts for the years 2009 and 2010. I focus on 148 firms that used FXD in both 2009 and 2010.²⁵ Of these, 132 firms fully disclosed their counterparty information, while 16 firms disclosed only that of their main counterparty.²⁶ Although I am not able to include those 16 firms (with large FXD market shares) in the contract-level analysis, I include them in the firm-level analysis.

An FXD contract is defined as a firm-bank pair. I aggregate all contracts for a single firm-bank pair in case a bank had multiple contracts with the same bank in the same year. The net FXD position is computed by aggregating the delta-adjusted notional of individual FXD contracts for a firm-bank pair. A positive net FXD position indicates a long position in USD or in a USD equivalent amount for a non-USD foreign currency, such as the EUR. While the delta of forwards, futures, and swaps is 1, the delta of each option needs to be calculated. The regulatory enforcement authorities use the Black-Scholes model to calculate the delta of options. I take a simplified assumption that the delta of every option contract is 0.5. With this assumption, a long position in a call and a short position in a put would result in a delta of 1, which is consistent with the delta of forwards. This assumption is conservative. Using the Black-Scholes delta would only make the results stronger.²⁷

To illustrate the calculation of net FXD position of a firm, suppose exporting firm A sold a USD forward with notional of \$100 and wrote a USD call option with notional of \$100 to bank B in the year 2009. In this case, the net FXD position of the firm-bank pair (A,B) in

²⁵Only about 19% of listed firms with non-zero FX gains or losses had non-zero FXD assets or liabilities.

²⁶The top 10 firms' market share of FXD usage (sum of FXD assets and FXD liabilities) is 88%, yet none of them report the full list of counterparties. This is because the regulator allows firms to disclose at the aggregate level, as opposed to the contract level, if: (1) the number of contracts is excessively large, and (2) the payoff structure is simple enough such that profit and losses from the contracts would be predictable, given future movements in the exchange rate. When firms report at the aggregate level, they typically do not disclose the full list of counterparties.

²⁷Most of the options are exotic options with a Black-Scholes delta between 0.7 and 0.9.

2009 is \$ -150 . The negative sign indicates that the firm would record a loss from its FXD trades with bank B if the USD appreciates.

The sample contains 251 contracts between 132 firms and 33 banks.²⁸ The contracts that do not involve KRW and the contracts without directional (buy or sell) information are excluded.²⁹ Roughly half of the contracts are firms taking long positions in foreign currency. In terms of pairs, the USD-KRW pair is the most common (86%). All contracts that involve KRW, but not USD, JPY, or EUR, are categorized as one group. Forwards are the most common type of contract, composing 53% of all contracts in the sample.

Table 3 reports contract-level summary statistics by whether the contract was “constrained.” A contract is “constrained” if the firm dealt with a constrained bank, that is, a bank that was required to reduce its DPTC ratio at the end of the 2009 calendar year. About 40% of the contracts are constrained and 60% are unconstrained. The characteristics (size, side, pair, and type) of constrained contracts are different in statistically significant ways from those of unconstrained contracts. Therefore, I control for contract characteristics in my analysis.

3.4 Firm Data

The contract-level data are aggregated at the firm level. Table 4 provides summary statistics on firm-level data by exposure.³⁰ A firm is classified as “exposed” if its main FXD counterparty bank in terms of the FXD notional is constrained. Exposed and non-exposed firms are similar in terms of all characteristics except FC liability share. The full-sample average net FXD position of firms is -8% of assets (or -10% of sales). This means on average, if the USD appreciates by one Won, firms make losses from their FXD positions equal to 8% of assets. This translates into a 20% net FXD–position–to–export–sales ratio, given the average export sales share of 47%.

To better understand firm hedging behavior, I categorize firms into net FXD buyers and net FXD sellers.³¹ The net FXD buyers are firms with a positive net FXD position. These

²⁸Thirteen banks in the bank data set do not have any FXD contracts with sample firms.

²⁹Non-KRW FXD contracts, such as those in a EUR-USD pair, do not affect banks’ FXD position limits and they compose only 4% of total contract notional.

³⁰For completeness, Table IA.E.2 shows summary statistics of the subsample excluding the 16 firms that disclosed only their main counterparty.

³¹Appendix IA.F provides the list of firms.

firms profit from their FXD trades when the USD appreciates. They are typically importers or firms with FC borrowings. They mostly use swaps that match the exact cash flows of their FC loans or the FC bonds they issued.³² Their mean FC liability hedge ratio, defined as the amount of FXD bought divided by FC liabilities, is 0.6. The correlation between FC liabilities and net FXD position is strongly positive at 0.78. This indicates that FXD buyers use FXD to *hedge* their FC liabilities, because the appreciation of USD increases their FC liability burden, but having a long position in FXD can offset this burden.

The FXD sellers are firms with a negative net FXD position, typically exporters. They primarily use forwards to hedge their export sales. Their mean export–hedge ratio, defined as FXD sold divided by export sales, is 0.6.³³ The correlation between export sales and net FXD position is strongly negative at -0.95, which suggests that FXD sellers’ primary purpose of holding FXD was also for *hedging* purposes. This is because the depreciation of USD reduces the value of USD-denominated export sales when converted to KRW, but having a short position in FXD can offset these losses.

Due to the transition of accounting standards from Korean Generally Accepted Accounting Principles to Korean International Financial Reporting Standards in 2010, many firms stopped reporting export sales in 2011. Thus, my main analysis on exports focuses on the change during 2009 and 2010.

4 Empirical Methodology and Results

The facts that the regulation was drawn in terms of the DPTC ratio and that not all banks exceeded the regulatory cap when it was implemented provide an identification strategy.

³²Firms may also use long positions in FXD to hedge imports. Although I do not observe firms’ imports (because Korean firms were not required to disclose them), firms’ long FXD positions were almost always exactly matched with the notional and the maturity of their FC debt, even when they had export sales and short FXD positions. This suggests that firms hedge gross positions rather than net positions, which is consistent with findings of [Alfaro et al. \(2021\)](#).

³³The hedge ratio of FXD sellers does not provide much information about whether firms used FXD for hedging or speculating because unearned revenues are not captured in sales. To be specific, a manufacturing firm had an export hedge ratio of 9.95, which may look like its FXD position served a speculative purpose. However, the firm received export orders for the next ten years and its FXD position was for hedging future USD cash inflows. Since the orders flow into the unearned revenue account until products are delivered, they do not affect sales. This kind of case makes it difficult to identify whether firms were hedging or speculating by simply looking at the hedge ratio.

By exploiting the cross-bank heterogeneity in the DPTC ratio, I estimate the impact of regulation on bank FXD positions from 2008 to 2018 with a difference-in-differences (DiD) estimator. Next, to disentangle bank hedging supply from firm hedging demand, I use FXD contract-level data for the years 2009 and 2010 and estimate the transmission of the regulatory shock from banks to firms. Lastly, I study the impact of the regulatory shock on the real outcomes of firms.

4.1 Impact of Regulations on Banks

This section studies the impact of the regulations on bank FXD positions and capital.³⁴ For the easiness of interpretation, I initially use a specification with a binary bank-level explanatory variable $Constrained_i$. Subsequently, I replace it with a continuous variable $Shock_i$ to further tighten the identification.

Since the regulation is enforced in terms of DPTC ratio, banks may manage their ratios by adjusting their FXD positions or their capital bases (or both). I show that banks primarily adjusted the former using the following baseline specification:

$$Y_{it} = \beta_0 + \beta_1 Constrained_i \times Regulation_t + \beta_2 Constrained_i + \gamma_t + \varepsilon_{it} \quad (2)$$

The outcome variable is either log of the absolute value of FXD holdings ($LogFXD$) or log of capital ($Log Capital$). $Constrained_i$ is a dummy variable that indicates whether the constraint was binding for bank i .³⁵

$Regulation_t$ captures the time variation in the overall tightness of the regulation. $Regulation_t$ is defined as the minimum FXD capital requirement (an inverse of the regulatory cap on the DPTC ratio); it is 0 before the regulation's imposition and higher values indicate a tighter regulatory constraint. Because the minimum FXD capital requirement is different for foreign banks and domestic banks, for the full sample regression, I construct $Regulation_t$ by taking either a simple average or a weighted average. $Regulation_t^{Avg}$ denotes the simple average and $Regulation_t^{W^{Avg}}$ denotes the weighted average, where the weight is the derivatives po-

³⁴I analyze the impact of regulations on FC liabilities and FC loans in the robustness analyses in [section 5](#).

³⁵The variable $Constrained_i$ is based on the time when regulation was first introduced. This is because the first imposition of the regulation was the main shock and subsequent shocks were only adjustments in the intensity of the regulation. Banks impacted by the first shock responded to subsequent shocks as if they were constrained even after adjusting their DPTC ratio well below the limit.

sitions. To account for the market share, I take the derivatives-position-weighted average. I collapse the bank-type- and time-specific *Regulation* to a time-series variable because the ratio of $Regulation_t^{DB}/Regulation_t^{FB}$ is a constant over time. In robustness analysis, I run the same analyses separately for foreign banks and domestic banks, and I show that the results are not driven by differences in characteristics or differential exposure to the GFC across foreign banks and domestic banks. I use official announcement dates rather than effective dates whenever the minimum FXD capital requirement is adjusted because banks may preemptively react to the regulation upon the announcements before the effective dates.³⁶

I include monthly time fixed effects γ_t to control for any potential trends. For some specifications, I add bank fixed effects δ_i to control for differences in time-invariant factors among banks:

$$Y_{it} = \beta_0 + \beta_1 Constrained_i \times Regulation_t + \delta_i + \gamma_t + \varepsilon_{it} \quad (3)$$

The sample period is from 2008 to 2018 and the frequency is monthly. I cluster standard errors by bank.

Figure 7 plots the aggregate FXD position, the normalized average FXD position by treatment, and $Regulation_t$. The top panel shows that following the imposition of the regulation, the aggregate position declined and remained low. The middle panel shows that the constrained banks reduced their FXD positions after the imposition of regulation relative to unconstrained banks. In addition, as the regulation gets tighter, shown in the bottom panel, the gap between the FXD position of constrained banks and that of unconstrained banks gets wider in the top panel.

Table 5 reports the regression results. The top panel results are based on the simple average minimum FXD capital requirement, $Regulation_t^{Avg}$. The main coefficient of interest is β_1 ; it is expected to have a negative sign for $LogFXD$ because constrained banks' FXD position relative to that of unconstrained banks is expected to decrease as the regulation gets tighter (reflected in a higher $Regulation_t$). The estimated β_1 coefficients in columns (1) and (2) show that the constrained bank FXD position is reduced by 60–62% more than

³⁶The first news article mentioning that regulators are considering introducing a regulation related to bank FXD positions was published about two weeks before the official announcement date on May 27, 2010. My results are robust to changing the imposition date from the official announcement date of June 13, 2010 to the first news date, May 27, 2010.

that of unconstrained banks per unit increase in $Regulation_t$.³⁷ In contrast, columns (3) and (4) show that the estimated β_1 coefficients are small and insignificant when the outcome variable is $LogCapital$. These results are robust to using the weighted average minimum FXD capital requirement, $Regulation_t^{W.Avg}$, as reported in the bottom panel of [Table 5](#).

The DiD specification requires the parallel trends assumption. To test for the assumption, I estimate the impact of the regulation with the following specification without $Regulation_t$:

$$Y_{it} = \beta_0 + \beta_1 Constrained_i + \beta_2 Post_t + \sum_t \lambda_t Constrained_i \times \gamma_t + \varepsilon_{it} \quad (4)$$

where Y_{it} is $LogFXD$ and $Post_t$ takes the value of 1 for the time period after the introduction of the regulation. In [Figure 8](#), I plot the monthly coefficient λ_t over time. It shows that λ_t is not significantly different from 0 before the regulation but turns negative after the imposition of regulation and declines further as the regulation gets tighter. The middle panel of [Figure 7](#), which plots the normalized average FXD position by treatment, also confirms that the trends were indeed parallel. It would be concerning if banks in the control group are indirectly affected by the regulation as firms substitute the banks in the treated group with the banks in the control group. However, in [subsection 4.2](#) and [subsection 4.3](#), I document that firms are typically unable to switch banks.

To sharpen the identification, I use the following specification by replacing the binary variable $Constrained_i$ with a continuous variable, $Shock_i$.

$$Y_{it} = \beta_0 + \beta_1 Shock_i \times Regulation_t + \delta_i + \gamma_t + \varepsilon_{it} \quad (5)$$

where $Shock_i$ is the percentage of bank i 's FXD position that was required to be reduced when the regulation was imposed. For some specifications, I control for the interaction between bank control variables and the $Regulation_t$ to ensure that the treatment is not confounded with the covariates. I find that the results remain robust based on this alternative specification ([Table B.2](#)).

In sum, the results from the bank-level analysis suggest that the constrained banks chose to reduce their FXD position instead of increasing their capital. Although it is not surprising that the DPTC ratio of constrained banks decreased after the regulation, the result that

³⁷ $1 - \exp(-0.913)$

banks reduced the DPTC ratio by adjusting their FXD position rather than their equity capital is not obvious. If equity financing is costly, banks would choose to reduce the DPTC ratio by cutting down their FXD positions rather than by increasing their equity capital.

4.2 Transmission of Shock to Firms

The previous section establishes that the regulation caused a reduction in the FXD position of banks. However, it remains unclear whether the observed relative reduction in hedging by firms that traded with constrained banks is due to an increase in the hedging demand of firms trading with unconstrained banks, or a decrease in the hedging supply from constrained banks. To illustrate the identification challenge, suppose that exporters predominantly trade FXD with constrained banks while non-exporters predominantly trade with unconstrained banks. If exporting opportunities were impaired during the GFC, the exporting firms that traded with constrained banks may have demanded less hedging than the firms that traded with unconstrained banks.

To address this problem, I use contract-level data to estimate the transmission of the regulatory shock from banks to firms. I examine the change in FXD hedging across contract relationships *within* the same industry and *within* groups of firms with similar characteristics. Since half of the sample firms have a single contract relationship, the firm fixed effects approach (e.g. Khwaja and Mian, 2008; Schnabl, 2012) would excessively reduce the sample size. Therefore, I estimate an OLS specification with controls for firm characteristics:

$$\Delta FXD_{i,j} = \alpha + \beta \text{Constrained}_i + \text{FirmControls}_j + \text{BankControls}_i + \text{ContractControls}_{i,j} + \varepsilon_{i,j} \quad (6)$$

The identification assumption is that the change in hedging demand is uncorrelated with the exogenous supply shock, conditional on observed characteristics. To strengthen the identification, I also control for industry-location-size fixed effects in some specifications.

The outcome variable is the change in the net FXD position of firm j with bank i (scaled by firm j 's assets) between 2009 and 2010. I winsorize the top 2% and bottom 2% of the scaled net FXD position to ensure that the results are not driven by outliers. Constrained_i is a dummy variable that takes the value of 1 if the contract is dealt with a constrained bank and 0 otherwise. Firm controls include log size, scaled net FXD position before the shock, FC liabilities share, and seven industry dummies. I also include contract and bank

characteristics to ensure that the results are not confounded by pre-shock differences in these characteristics. Bank controls include log size, loans-to-assets ratio, leverage ratio, and a foreign bank indicator variable. Contract controls include bank i 's share of firm j 's total FXD position, derivative type, and currency pair. The derivative type for contract (i, j) is the percentage of FXDs dealt between firm j and bank i classified as forwards, swaps, options, and futures. Similarly, currency pair is the percentage of FXDs categorized as USD-KRW pair, JPY-KRW pair, EUR-KRW pair, and other pairs involving KRW. All control variables are computed as of 2009, before the shock. I cluster standard errors at the bank level.

I estimate the transmission separately by the direction of FXD contracts. I define the exporter's FXD contract as the contract in which the firm takes a short position in foreign currency. I define the non-exporter's FXD contract as the contract in which the firm takes a long position in foreign currency. Non-exporters include importers as well as firms with FC liabilities. I classify sample contracts by their direction rather than by the exporting status of the firm because direction is what matters for constrained banks. From the perspective of constrained banks, either a reduction in exporter contracts or an increase in non-exporter contracts (or both) reduces bank long positions in FXD and therefore makes them less constrained. Since a decrease in bank long positions in FXD corresponds with an upward adjustment in firm net FXD position, the expected sign of β is positive for both exporter contracts and non-exporter contracts.

Table 6 shows the results. Column (1) reports the result for exporter contracts. The scaled net FXD position of contracts dealt by constrained banks increased 5.3% after the shock compared with contracts with unconstrained banks. Given that the pre-shock average scaled net FXD position of exporter contracts was -8% , the change translates into a 66% *reduction* in hedging.³⁸ Column (2) adds firm controls, bank controls, and contract controls. It shows that the relative reduction in hedging was 47%, which is economically significant. These results indicate that the regulation caused a reduction in the *supply* of hedging instruments for exporters.

Columns (3) and (4) of Table 6 show that the regulatory shock did not strongly affect non-exporter hedging. This is likely related to the reasons why importer hedging demand had been weak. Potential reasons include central bank puts, the market power of Korea's importing sector, and the relatively easier predictability of importer, as opposed to exporter,

³⁸The pre-shock average scaled net FXD position of the exporter contracts is presented in Table IA.E.1.

cash flows. I report the full sample results in columns (5) and (6) for completeness. In terms of magnitude, firms on average reduced their FXD hedging with constrained banks 45%, compared with their hedging with unconstrained banks.³⁹

Since the bank-specific tightness of regulation ($Shock_i$) is observed, I also use the following specification by replacing binary variable $Constrained_i$ in specification (6) with continuous variable, $Shock_i$:

$$\Delta FXD_{i,j} = \beta + \beta_{Shock} Shock_i + FirmControls_j + BankControls_i + ContractControls_{i,j} + \varepsilon_{i,j} \quad (7)$$

$Shock_i$ is the percentage of bank i 's FXD position that was required to be reduced when the regulation was imposed.⁴⁰ Table B.3 presents consistent results. Columns (1) and (2) show that the impact on exporter contracts remains large and significant. Column (2) shows that a one-standard-deviation increase in $Shock$ leads to a 2% increase in scaled net FXD position (corresponding to a 28% reduction in hedging) for exporter contracts.⁴¹ Columns (3) and (4) show that non-exporter contracts were not strongly affected.

I note that net option positions increased 8.6% relative to forwards in column (2) of Table 6. As the firm pre-shock net option position was negative, an increase in net position means a reduction in the use of options. This may be related to the fact that some firms' exotic option positions incurred huge losses during the GFC. To test whether option contracts are driving the main results, I use the same specifications without the option contracts and find that the results remain consistent (see Table B.4 and Table B.5). These results, which do not incorporate option contracts, also indicate the robustness of the analyses to the simplified assumption that the delta of options is 0.5.

All results are robust to replacing the dependent variable, assets-scaled FXD position, with sales-scaled FXD position (see Appendix IA.G).

Industry-Location-Size Fixed Effects

While I include a large number of bank, firm, and contract characteristics as well as industry fixed effects, one may be concerned that the results are confounded by unobservable demand-

³⁹The pre-shock average scaled net FXD position of the full sample is -2.9% (Table 3).

⁴⁰Bank-specific shocks are presented in Table IA.D.1.

⁴¹The standard deviation of $Shock$ is 17.5%.

related characteristics. Since half of the sample firms have single bank relationship, I do my best to address this concern by controlling for firms’ industry–location–size fixed effects that allows identifying time-varying cross-sectional bank FXD supply shocks using both single- and multi-bank firms, following Degryse et al. (2019) and others. I do not control for time fixed effects because the dependent variable has already been differenced. Table B.6 shows that the results are robust after controlling for the industry–location–size fixed effects for both the full sample and the sub-sample excluding the option contracts.

In summary, the results from the contract-level analysis suggest that the regulation caused a reduction in the *supply* of hedging, and the effect was particularly large for the exporter contracts.

4.3 Impact on Real Outcomes of Firms

This section uses firm-level data to estimate the impact of the FXD supply shock on firm-level FXD hedging and the real outcomes of firms.

Firm-level Reduction in Hedging

Before estimating the real effects of FXD hedging, I first test whether the regulatory shock caused a reduction in FXD hedging at the *firm-level*. If a firm can substitute unconstrained banks for constrained banks, firm-level hedging may not fall and consequently, the regulatory shock may have no effect on the real outcomes of firms. I use the following OLS specification:

$$\Delta Y_j = \beta_E \textit{Exposed}_j + \textit{FirmControls} + \varepsilon_j \tag{8}$$

for the full sample of 148 firms, including the 16 firms that do not fully disclose the list of their counterparties. ΔY_j denotes the change in firm-level FXD position (scaled by assets) between 2009 and 2010. The dummy variable $\textit{Exposed}_j$ is 1 if firm j ’s main bank is constrained and is 0 otherwise. The main bank is defined as the firm’s counterparty bank with the largest FXD position. The firm control variables are the same as those in the contract-level regressions. The identification assumption is that the change in hedging demand is uncorrelated with bank exposure, conditional on observables.

First, I report the effects on firm-level FXD positions by firm size. Table 7 presents the

results for the full sample. Columns (1) and (2) show that the net FXD position of exposed firms rose 43–47% relative to non-exposed firms, given that the pre-shock average scaled FXD position was -8.2% .⁴² Columns (3)–(6) show that the effects are large for small firms, but small and insignificant for large firms. These findings imply that firms were unable to offset the regulatory shock transmitted by banks, and smaller firms, in particular, had difficulty finding an alternative source of FXD hedging. This evidence aligns with previous studies in the credit market (e.g., [Khwaja and Mian, 2008](#)).

Second, I report the effects on firm-level FXD positions by the sign of net FXD positions of firms. This is because the net FXD positions rather than export sales are what matter for constrained banks. I define firms with negative net FXD positions as exporters and those with positive FXD positions as non-exporters.⁴³ [Table 8](#) reports the full sample results. Columns (1) and (2) show that exposed exporters reduced firm-level FXD hedging 40–45% relative to non-exposed firms, given that the pre-shock average scaled FXD position for exporters was -16% .⁴⁴ In contrast, columns (3) and (4) show that there was almost no effect on non-exporters.

To refine the identification, for the subsample of 132 firms that disclosed complete lists of their counterparties and notional amounts for each counterparty, I construct a continuous variable that measures firm exposure to the regulation. I use the following specification by replacing binary variable $Exposed_j$ in specification (8) with the continuous variable $Exposure_j$:

$$\Delta Y_j = \beta_{\bar{E}} Exposure_j + FirmControls + \varepsilon_j \quad (9)$$

where $Exposure_j$ is the notional weighted average shock of firm j 's counterparty banks. Under this specification, I find that small firms and exporters, in particular, with higher levels of exposure experienced a greater reduction in total hedging ([Table B.7](#) and [Table B.8](#)).

Overall, these results suggest that switching bank relationships in the FXD market is costly for firms. Some plausible reasons are related to the facts that FXDs are customized products and that banks typically bundle their services. In my sample, contracts are often

⁴²The pre-shock average scaled FXD position is presented in [Table 4](#).

⁴³Based on this classification, a firm with non-zero export sales may be classified as “non-exporter” if, for instance, the firm holds a large amount of FC debt and its main purpose of hedging is to address the FC debt exposure. Nonetheless, the correlation between export sales and net FXD position is 0.95.

⁴⁴The pre-shock average scaled FXD position of exporters is presented in [Table IA.E.3](#).

customized to meet firm-specific hedging demand in terms of maturity and payoff structure. In addition, for a given firm, its main bank in terms of FXD contracts typically coincides with its main bank in terms of loans. Another reason could be that unconstrained banks were reserving the remaining capacity for the future needs of their existing customers. In light of previous work showing the importance of bank-borrower relationships in the credit market (e.g. Beck et al., 2018; Liberti and Sturgess, 2018; Nakashima and Takahashi, 2018), it is plausible that the relationships are playing a key role in the FXD market as well.

The natural questions arising from the firm-level reduction in FXD hedging regard alternative hedging tools that firms can use. First, firms may enter FXD contracts with an offshore bank. However, I find that almost none of the firms that fully disclosed their counterparty banks switched to deal with an offshore entity. This is likely related to the reasons why firms were not able to substitute constrained banks with unconstrained banks within Korea, namely, a high degree of FXD product customization and bundling of FXD products with loan products. Another plausible explanation is the cost for foreign institutions to acquire information about Korean firms. It can be costly for a foreign entity to perform due diligence on Korean firms, especially smaller firms, to assess the credit risks associated with the FXD contracts. My finding that the firm-level hedging of small firms was affected much more than that of large firms is consistent with this explanation. Furthermore, covering KRW-involving-FXD position entails investment in KRW-denominated bonds, which imposes administrative costs on an offshore bank.⁴⁵

Second, firms may use other financial instruments. For instance, exporters may borrow USD and invest in KRW-denominated bonds to replicate the cash flows of a short position in USD forwards. I am not able to directly test the hypothesis because detailed data on firm FC borrowing and security holdings are not available. Yet, it is unlikely, given my finding that the exposed firms did not even substitute their forwards with futures. It suggests that firms tend to prefer dealing FXD with banks to dealing directly in the market, likely due to their limited knowledge and capacity regarding FXD trading.

Third, firms may adjust their risk exposure using nonfinancial instruments, such as operational hedging. While data limitations prevent me from testing this directly, previous studies (e.g. Allayannis et al., 2001) suggest that operational hedging is not an effective sub-

⁴⁵For instance, the investment procedure involves registration and setting up a custodian account. Moreover, income accrued from this investment is subject to withholding tax and capital gains tax.

stitute for financial risk management. For example, switching invoice currency to KRW or building plants in foreign countries to match income currency and cost currency is unlikely to be a low-cost alternative means of financial hedging.

Main Result: Impact on Firm Exports

Provided that the reduction in bank hedging supply primarily affected exporters (net FXD sellers), I confine the sample to exporters and examine the effect of the shock on their exports. I hypothesize that the impact would be larger for firms with higher export hedge ratios, and use the following specification to estimate the impact on exports:

$$\Delta Y_j = \beta_E Exposure_j + \beta_h HighHedge_j + \beta_{Eh} Exposure_j \times HighHedge_j + FirmControls + \varepsilon_j \quad (10)$$

The outcome variable is change in log export sales. $Exposure_j$ is the weighted average shock of firm j 's counterparty banks. $HighHedge_j$ is an indicator variable that takes the value 1 if firm j sold FXD equaling more than 10% of its export sales and is 0 otherwise. With this definition, about two thirds of FXD-selling firms that fully disclosed their counterparties are classified as high-hedge firms ($HighHedge = 1$). The results are robust to the choice of threshold, 10%. I show that the results are even stronger if I use a continuous variable: the hedge ratio itself. Still, I use the dummy variable to ensure that the results are not driven by outliers.⁴⁶ The firm controls are the same as those in the previous regressions. It is worth noting that the exchange rate is common for all firms. All exporters are better off when the USD appreciates and the analysis focuses on exporters only. Therefore, the exchange rate is not a confounding factor, as long as export sales sensitivity to the exchange rate has been controlled for. I control for the heterogeneous export sensitivity to the exchange rate by including pre-shock FX derivatives position.

Table 9 presents the results. The top panel specification uses the dummy variable, $HighHedge$, and the bottom panel specification uses the continuous variable, $Export Hedge Ratio$, which is defined as the amount of FXD sold divided by export sales. The impact of the regulatory shock on exports is substantial. Column (1) shows that for a one-standard-

⁴⁶If a firm receives export orders for the next few years and enters a FXD contract to hedge the exposure, its export-hedge ratio may exceed 1, as unearned revenues are not captured in sales. It is valid to classify such a firm as a $HighHedge$ firm, as it relies heavily on FXD hedging. However, the hedge ratio itself may not be a perfect measure of the ratio of hedging to the full underlying exposure.

deviation increase in *Exposure*, firm exports fall 17.1% for high-hedge firms and rise 5.7% for low-hedge firms. Therefore the differential effect is 22.8%. Between 2009 and 2010, the USD appreciated against KRW, and even with this favorable exchange rate movement for exporters, my results show that the exports fell for the firms that were more exposed to the regulatory shock and that relied more on FXD before the regulation. Column (2) adds firm controls and the differential result is largely unchanged; the differential effect is 18.9%. The bottom panel shows that the results are robust to replacing *HighHedge* variable with *ExportHedgeRatio*.^{47,48}

Additionally, I test whether the firms with high export hedge ratios reduce their firm-level FXD hedging given that they are more exposed to the regulatory shock. Table 10 shows that the change in the net FXD position for high-hedge firms was indeed large. The net FXD position moved up 6–6.7% more for high-hedge firms than for low-hedge firms, for a one-standard-deviation increase in *Exposure*. These translate into 50–56% reduction in hedging, given the pre-shock average net FXD position of -12% among fully disclosed exporters.⁴⁹

Further, as a placebo test to confirm that my results reflect the impact of the FXD supply shock, I estimate the impact on firm domestic sales. If the result on export sales is driven by a systemic relationship between troubled firms and constrained banks, one expects those troubled firms to experience declines in both domestic and export sales. However, in Table 11, I show that the change in domestic sales is small and insignificant, unlike that in export sales. This result confirms that the decline in exports is caused by the reduction in the supply of hedging instruments rather than by a systemic firm-bank relationship.

4.4 Potential Explanations

In this section, I investigate potential explanations for the decline in exports. I begin by addressing the concern that the results might be driven by firms’ speculative behavior rather than hedging activities. Then, I examine potential mechanisms that can explain the reduc-

⁴⁷I winsorize the top 2% and bottom 2% of the *ExportHedgeRatio* to ensure that the results are not driven by outliers.

⁴⁸Additionally, I find some evidence that the regulatory shock negatively affects exporter profitability, albeit the results are not statistically significant for some specifications. (See Table B.9, Table B.10, and Table B.11)

⁴⁹The pre-shock average net FXD/Asset is shown in Table IA.E.5.

tion in the supply of *hedging* leading to a decline in exports.

One may question whether the documented reduction in exports is due to firms' speculation instead of hedging. Specifically, it might be that the firms having contracts with banks exposed to the regulation were speculating that USD would depreciate, causing a reduction in exports, and their FXD position was forced to decrease due to the supply reduction. In this case, had firms been speculating on both exports and FXD, a positive correlation between exports and the FXD before the shock would be expected. However, I find that the pre-shock correlation was in fact strongly negative (-0.95). Furthermore, the net FXD positions of the exporters were short positions (paying off when the USD depreciates), while export sales invoiced in USD are better off when the USD appreciates. Therefore, it is unlikely that exporters were holding derivatives for speculation.

In addition, I document the following evidence corroborating the hedging channel:⁵⁰

1. Exporters in Korea face substantial FX risk due to the majority of trades being invoiced in USD, which is compounded by the highly volatile USD-KRW exchange rate shown in [Figure 1](#). During the Asian crisis, the annual volatility reached almost 120%, and during the GFC and COVID, it reached 70% and 20%, respectively.
2. In a simple decomposition exercise based on my sample exporters before the shock, I find that 85% of the variance of sales revenue is due to the variance of export sales (58%) and the covariance of export sales and domestic sales (27%). That is, exporters' total variance of sales is 6.7 times the variance of domestic sales.⁵¹
3. Exporters' profits are leveraged position on the exchange rate. To show this, I present a numerical example.

⁵⁰This is consistent with [Allayannis and Ofek \(2001\)](#) finding that firms use currency derivatives for hedging and their use significantly reduces exchange rate exposures firms face, and [Bartram \(2019\)](#) finding no evidence of corporate speculation with derivatives for firms, except for some firms using commodity price derivatives.

⁵¹Based on the fully disclosed sample of 74 firms before the shock, exporters' total variance of sales is 5 times the variance of domestic sales.

Case	Export Sales (USD million)	Exchange Rate	Export Sales (KRW billion)	Domestic Sales (KRW billion)	COGS (KRW billion)	Profit (KRW billion)
A Base level (Export Share 83%, Profit Margin 24%)	\$10,440	1,165	12,163	932	11,956	1,139
After a 1% depreciation of USD	\$10,440	1,153	12,041	932	11,956	1,018
						-10.68%
B Base level (Export Share 56%, Profit Margin 25%)	\$10,440	1,165	12,163	9,402	16,174	5,391
After a 1% depreciation of USD	\$10,440	1,153	12,041	9,402	16,174	5,270
						-2.26%
C Base level (Export Share 56%, Profit Margin 20%)	\$10,440	1,165	12,163	9,402	17,252	4,313
After a 1% depreciation of USD	\$10,440	1,153	12,041	9,402	17,252	4,191
						-2.82%

Exhibit 1: Stylized Example of the Impact of Exchange Rate on Profit

In Exhibit 1, the base export sales in USD are the same across three cases, but the export share and the profit margin differ. Case A is based on the balance sheet data of Samsung Heavy, one of the top exporters, as of 2009. It shows that a 1% of depreciation of USD is associated with a 10.7% decline in its profit. The leverage effect is greater if the export share is higher and the profit margin is lower. Case B takes the average export share of the sample firms, and case C takes the average export share and the average profit margin of the sample firms. Combined with the fact that the bottom 1 percentile daily return on the USD-KRW exchange rate was -2.1% for the pre-shock period, from 1990 to 2009, the exchange rate risk was indeed substantial for the exporters. A back-of-envelope calculation suggests that in a tail event, the profit falls by 22.4%, 4.7%, and 5.9% *per day* for cases A, B, and C, respectively. This implies that firms can have staggering losses due to exchange rate risk.

Given these risks, it is even more unlikely that exporters would speculate in a way that increases their exposure.

Having documented the evidence supporting the hedging channel, I examine two potential explanations for the reduction in the supply of *hedging* leading to a decline in firm exports. There can be multiple mechanisms that can explain my empirical findings, and it would certainly be interesting to build a full equilibrium model with exporting firms making joint decisions on invoicing currency, locations of production and sales, as well as FXD hedging and endogenous exchange rate in the presence of the aforementioned frictions in the FXD market, such as costly switching of the banking relationship. Yet, a complete characterization of this framework is beyond the scope of this paper.

One explanation for the decline in exports is firms' strategic risk management. [Froot et al. \(1993\)](#) and [Rampini and Viswanathan \(2010\)](#) posit that firms hedge their risk exposure to avoid falling short on funds available for future investment. Building upon this insight, suppose that firms' export outcomes determine the size of internal funds available for future investment opportunities, and they are exposed to exchange rate risk. If internal funds fall short, firms would have to rely on external financing with convex costs. Then, they would face higher expected external financing costs when the volatility of the internal funds is higher. Therefore, they have incentives to lower the volatility of internal funds by using hedging instruments or lowering export quantity. When hedging becomes more costly, it is optimal for firms to reduce the export quantity to reduce the volatility of internal funds. In [appendix section C](#), I elaborate on this mechanism and provide a numerical example.⁵² This mechanism is consistent with my empirical finding that exporters that were heavily relying on FXD hedging reduced their exports within a short time (six months) after the shock. It is also consistent with the finding that those exporters' domestic sales did not fall when hedging became less available.

This mechanism predicts that, when hedging becomes more costly, high-cash firms are expected to reduce exports by more than low-cash firms would, because high-cash firms can ensure through hedging that they always have enough internal funds even in a state with an unfavorable exchange rate. Therefore, they would reduce exports rather than maintain unhedged exports and risk a shortfall of internal funds. In contrast, low-cash firms would be willing to be exposed to FX risk rather than foregoing exports because they would never have enough internal funds without taking some risk. In other words, they would prefer to forego hedging so that they have enough internal funds at least in a state with a favorable exchange rate. Built on the numerical example, [Figure C.3](#) shows that an increase in hedging friction leads to a relatively greater decline in exports for high-cash firms compared to low-cash firms.

An alternative explanation for the decline in exports is that the decline in exports is an outcome of the realized risk of unhedged exposure following a failure in risk management. When firms fail to hedge, they are forced to cut their investment due to FX losses, which in turn leads to a decline in their output. Under this channel, high-cash firms are expected to reduce their exports by less because their cash reserves can weather the losses from failed

⁵²[Figure C.1](#) plots export quantity and hedging quantity as a function of hedging friction. [Figure C.2](#) plots expected firm value as a function of hedging friction.

risk management and allow them to maintain their output.

I test the implications of the two potential explanations by investigating the cross-sectional effect of cash holdings on the decline in exports by using the following specification:

$$\begin{aligned} \Delta Y_j = & \beta_E Exposure_j + \beta_h HighHedge_j + \beta_c Cash_j \\ & + \beta_{Eh} Exposure_j \times HighHedge_j + \beta_{Ec} Exposure_j \times Cash_j + \beta_{hc} HighHedge_j \times Cash_j \\ & + \beta_{Ehc} Exposure_j \times HighHedge_j \times Cash_j + FirmControls + \varepsilon_j \end{aligned} \quad (11)$$

where $Cash_j$ is cash and cash equivalent balance scaled by total assets before the regulation. Column (1) of Table 12 shows that β_{Ehc} is negative, which implies that firms with higher cash and a high hedge ratio (before shock) reduced export sales by more. Furthermore, column (2) shows that those firms switched to the domestic market to a greater extent. These findings support the first explanation and suggest that firms not only hedge risk exposure by using derivatives but also strategically reduce risk exposure when the means of financial hedging becomes more costly.

These results also help rule out the speculation channel. If firms were using FXD for speculation purposes and the reduction in exports was driven by a decline in gains from the reduced speculative positions in FXD, high-cash firms are expected to reduce their exports by less than low-cash firms.

Other Considerations A relevant question regarding my finding of the decline in exports is whether it is optimal for firms to reduce exports in the presence of potential reputation risk. Since any presence of reputation risk only suggests higher importance of hedging, it does not pose a threat to the identification. Moreover, reducing exports does not necessarily entail reputation risk. While it may be difficult for firms to alter the contracts that have already been made, they can still choose to downsize new export contracts going forward. Then, export sales can fall without the non-fulfillment of existing contracts. Furthermore, reputation concern is likely not the primary force driving export decisions, because some firms appeared to be willing to sacrifice their reputation for profits.⁵³ The fact that the most

⁵³As a supporting piece of evidence, based on a leading newspaper article, car manufacturers substantially *increased* export shares in the time of USD *appreciation* in 2022, letting the delivery of products delayed for domestic customers up two and half years. This is not a likely outcome when adjusting the exports is detrimental to the firm reputation. (<https://www.hankyung.com/economy/article/2022100609681>)

affected firms were small manufacturers, not large firms with established brand names, also makes it plausible that the cost related to reputation is lower than the benefit of reducing exports.

5 Robustness Results

To ensure that my results reflect the impact of the regulatory shock and not confounding factors, I conduct several additional robustness tests.

First, one potential concern is a confounding effect of non-random sorting of firm-bank relationships. Although firm-bank sorting is non-random, [Table 4](#) shows that key firm characteristics are not significantly different across exposed firms and non-exposed firms. This holds for the subset of firms that fully disclose their counterparty information as well as the subset of firms with net negative FXD positions.⁵⁴ [Figure A.4](#) shows low correlations between firm characteristics (export share, profitability, FC liability share, and firm size) and firm exposure to the regulatory shock. Nevertheless, I control for a large number of bank, firm, and contract characteristics to ensure that the results are not confounded by the differences in these characteristics throughout my analyses.

To corroborate that the results are not confounded by potentially systemic firm-bank relationships, I conduct an analysis using coarsened exact matching (CEM) (see [Blackwell et al., 2009](#)) based on FC liability share, the dimension along which the exposed and non-exposed firms differ with statistical significance. I coarsen the sample into five bins, considering the trade-off between keeping observations and the post-match similarity of FC liability share for the treatment and control groups. The top panel of [Table B.12](#) shows that the results remain similar. The interaction term is negative and significant for change in log exports, positive and significant for change in the net FXD position (scaled by assets), and small and insignificant for change in log domestic sales. The bottom panel of [Table B.12](#) shows that the results are robust even after matching firms on export share, profitability, and FC liability share.⁵⁵ I include export share as a matching variable to address an alternative hypothesis that exporters predominantly traded with foreign banks, which represent the majority of constrained banks. I also include profitability as a matching variable to address

⁵⁴See [Table IA.E.2–Table IA.E.5](#).

⁵⁵I coarsen the sample into three bins per matching variable.

an alternative hypothesis that troubled firms predominantly traded with constrained banks.

Second, one may be concerned about the difference in business models between foreign and domestic banks. Almost by construction, it is likely that foreign banks would suffer more from the regulation because they were more active in the FXD business than domestic banks. In fact, a few foreign banks closed in 2017, after the regulation was imposed.⁵⁶ However, it is noteworthy that only half (14 out of 29) the foreign banks in my sample were constrained when the regulation was imposed, and I find stronger results in the bank-level analysis when I restrict my sample to foreign banks (Table B.13a).⁵⁷ This finding suggests that my results are not driven by the differences in characteristics between foreign and domestic banks. In addition, the strong result within foreign banks suggests that my bank-level results are unlikely to be mainly driven by the GFC, which cannot explain the variation within foreign banks.

Third, one could worry that the result is confounded by a credit supply shock. Specifically, an alternative hypothesis is that constrained banks were in trouble during the GFC and therefore were more likely to suffer from the credit supply shock. However, the results that the constrained bank share of FC lending was not significant for the full sample (Table B.14), for foreign banks (Table B.15), and for domestic banks (Table B.16) corroborate that the mechanism at work is through the hedging channel rather than the credit channel.⁵⁸

Fourth, one may be concerned that holding a high cash balance is a substitute for hedging and the main result is driven by cash balance rather than hedging. However, when the high hedge dummy variable is replaced with the high cash dummy variable in specification (10), the coefficient on the interaction term is not significant (Table B.17). This is consistent with the mechanism that high cash firms have an incentive to hedge to ensure that they have enough cash even in a state with an unfavorable exchange rate. That cash alone fails to explain the decline in exports supports the hedging channel.

Lastly, I document additional suggestive evidence that the reduction in the FXD position was driven by a reduction in supply as opposed to a reduction in demand, by looking at the

⁵⁶Royal Bank of Scotland, Barclays, Goldman Sachs International Bank, and UBS

⁵⁷The bottom table of Table B.13 suggests that constrained domestic banks reduced their capital bases compared with unconstrained domestic banks. This result is driven by domestic banks with smaller FXD market shares. When the observations are weighted by bank FXD positions, domestic banks' adjustments in *LogCapital* are not significant.

⁵⁸For this analysis, closed banks are excluded due to data unavailability.

FXD pricing. If the reduction in the FXD position was driven by a reduction in supply, one would expect to see an increase in the price of FXD hedging. An increase in FXD hedging cost from the perspective of exporters corresponds to a decrease in USD forward prices since exporters are *sellers* of USD forwards. Put differently, constrained banks would lower forward prices to reduce their long positions. Since I do not observe firm-specific pricing on derivatives, I am not able to directly show that constrained banks lowered USD forward prices relative to unconstrained banks. Nevertheless, I show suggestive evidence that firms' forwards hedging costs increased after the regulation by comparing short-term and long-term CIP deviations. I define CIP deviation for maturity n at time t , $x_{t,t+n}$, as the difference between the USD rate ($y_{t,t+n}^{\$}$) and the USD rate implied by forward price ($f_{t,t+n}$), spot exchange rate (s_t),⁵⁹ and KRW rate ($y_{t,t+n}^{\text{₩}}$):

$$x_{t,t+n} = y_{t,t+n}^{\$} - \left(y_{t,t+n}^{\text{₩}} - \frac{1}{n}(f_{t,t+n} - s_t) \right) \quad (12)$$

CIP deviation, $x_{t,t+n}$, would likely fall or, equivalently, increase in magnitude as banks lower forward prices to reduce their long positions. Since forward positions are subject to the FXD position limit while synthetic forward positions are not, the shadow cost of the constraint would widen the wedge between the price of forwards and the price of synthetic forwards. In the cross-section of tenors of CIP, the regulation would likely affect long-term CIP deviation more than the short-term because bank long positions in USD forwards are concentrated in longer tenors. [Figure A.5](#) plots three-month and three-year CIP deviations. It shows that the three-year CIP deviation fell relative to the three-month CIP deviation, particularly after the first two announcements.

6 Conclusion

In this paper, I examine how shocks to financial intermediaries affect the supply of hedging instruments to corporations and, in turn, whether such shocks impact real economic activities. I exploit a quasi-natural experiment in South Korea at the bank level that can be traced through firms. By using cross-bank variation in the regulation's tightness, I show that the regulation caused a reduction in the supply of FXD, resulting in a substantial decline in

⁵⁹Value of 1 USD in terms of KRW; higher s_t means USD appreciation.

exports among small firms that heavily relied on hedging using FXD.

The results of this study highlight the crucial role that intermediaries play in risk allocation through the provision of derivatives, by finding evidence that intermediary frictions in FX markets can affect international trade. Additionally, this study establishes a causal relationship between financial hedging and the real economic activities of firms, implying that derivatives are crucial for firms' risk management. Furthermore, my findings suggest that macroprudential FX regulations aimed at discouraging risk-taking among financial intermediaries may have adverse effects on the real economy. These effects should be carefully considered in developing future policy that integrates financial, macroprudential, and trade toolkits, as suggested recently by the IMF (Basu et al., 2020).

Looking beyond this paper, there are multiple promising research directions to pursue. First, I anticipate that the literature on hedging will expand to provide verifiable insights into international trade and FX hedging. A fruitful avenue would be to consider factors such as firms' choices regarding currency invoicing, production and sales locations, and endogenous exchange rates. Second, future research could assess the welfare implications of the regulations designed to reduce risk-taking among financial intermediaries. While my analysis reveals that the regulation caused a reduction in exports, it does not provide a comprehensive welfare evaluation. These research directions could contribute to a deeper understanding of the relationship between FX hedging, international trade, and intermediary frictions.

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Figures

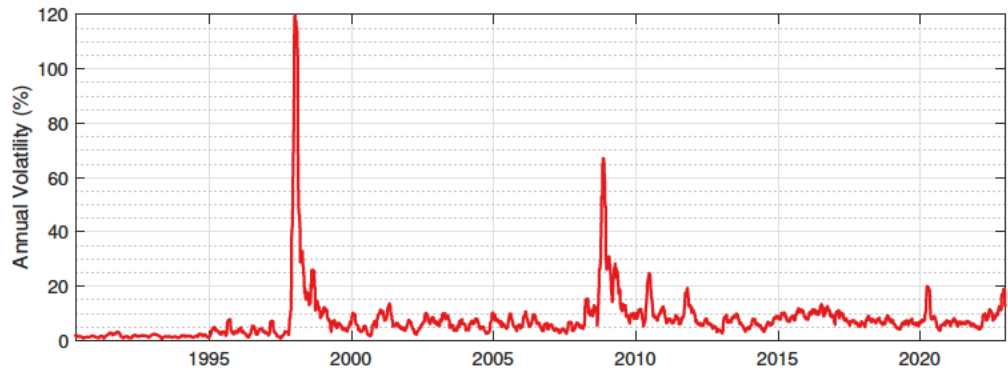


Figure 1: Volatility of USD-Korean Won Exchange Rate The annualized 30-day historical volatility of USD-KRW exchange rate.

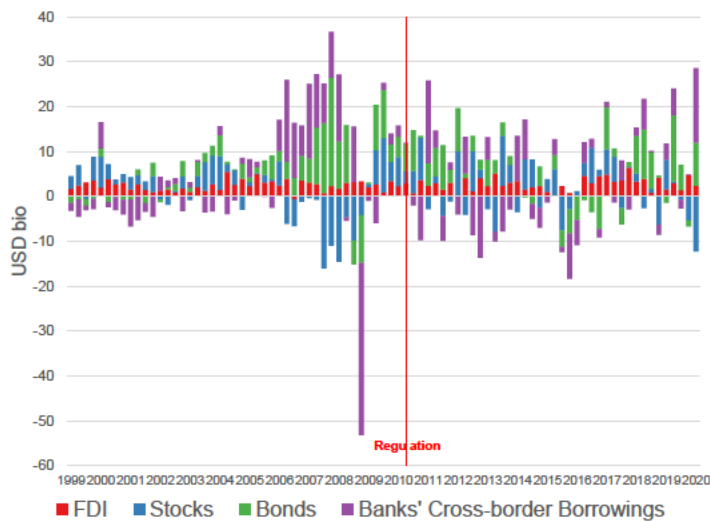


Figure 2: Gross Foreign Capital Inflows Korea's gross foreign capital inflows. The vertical line indicates the imposition of the regulation.

Firms (Exporters)			Banks		
<i>Long FC:</i>	<i>Short FC:</i>		<i>Long FC:</i>	<i>Short FC:</i>	
FC Receivables (Long-term)	FX Derivatives (Long-term) FC Loans	→	FX Derivatives (Long-term) FC Loans	FC Borrowing (Short-term) FC Deposits	<- Cross-border

Figure 3: **FX Positions of Exporters and Banks before the Regulation** The left panel illustrates the structure of the exporter FX position and the right panel illustrates the structure of the bank FX position prior to the regulation. Exporters had a long position in foreign currency (due to export sales) and hedged the exposure by taking short positions in FXD. As banks are firms' FXD counterparties, banks had a long position in foreign currency due to the FXD. Banks hedged the long exposure by foreign currency borrowing.

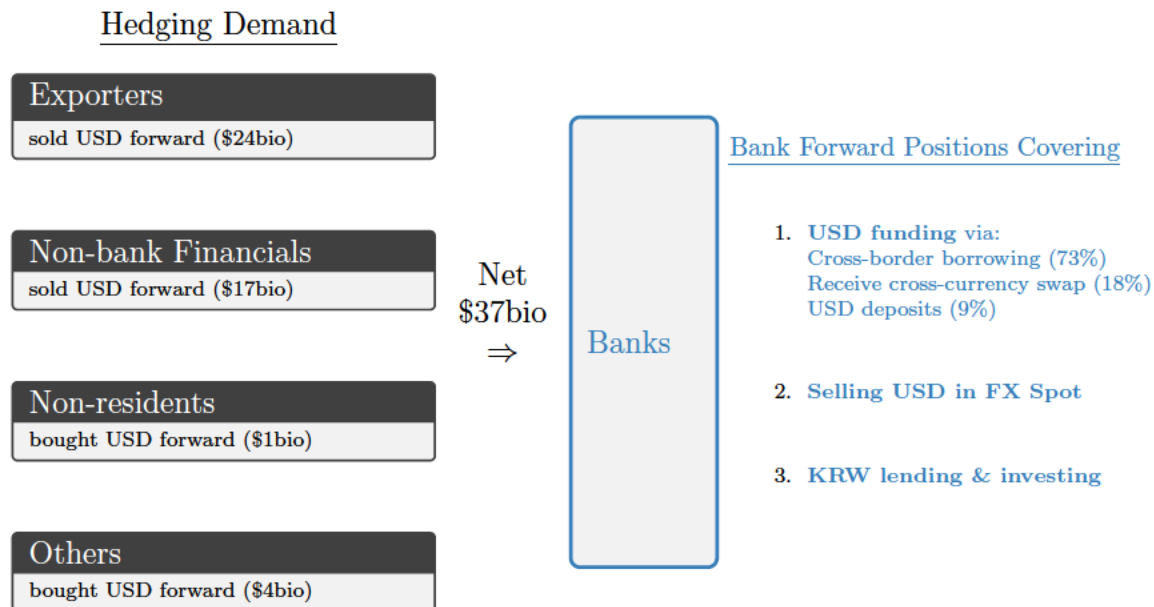
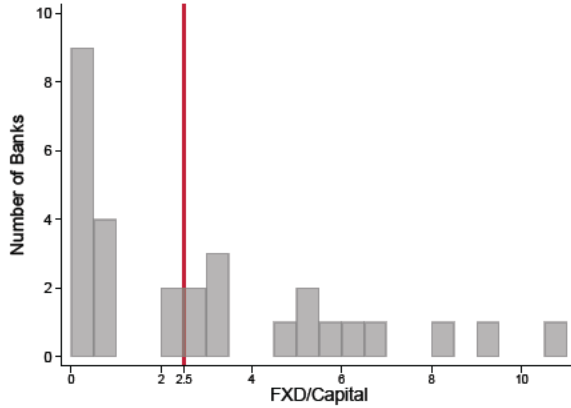
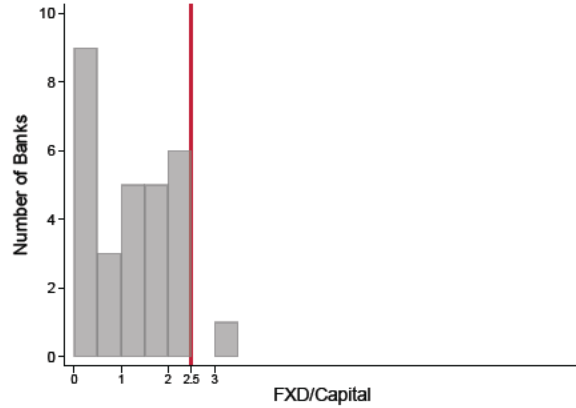


Figure 4: **FX Forward Hedging Demand and Bank Positions Covering** The left panel shows the amount of USD forwards each non-bank sector purchased from or sold to banks during the first three quarters of 2007. The right panel shows how banks covered the net long position of 37 billion USD in forwards. Source: [Bank of Korea \(2008\)](#)

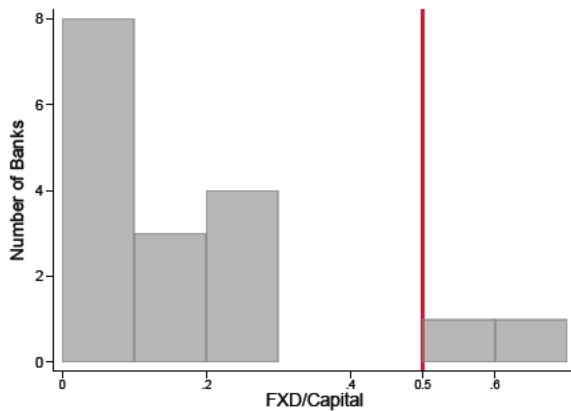


(a) Before Regulation (2009 Dec)

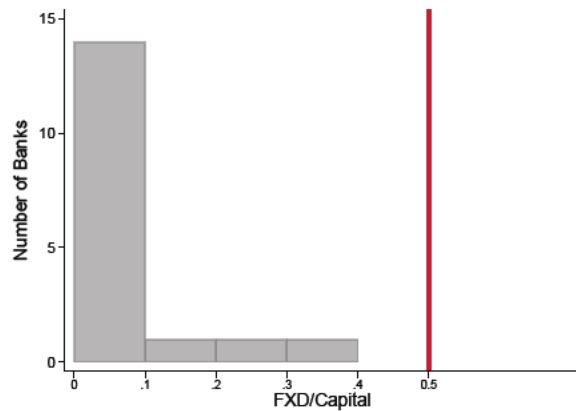


(b) After Regulation (2010 Dec)

Figure 5: **FXD Position to Capital Ratio, Before and After the Regulation (Foreign Banks)** The histogram of the FXD position to the capital (DPTC) ratio of foreign banks, six months before and six months after the first announcement of regulation. The vertical line indicates the regulatory cap on the DPTC ratio.



(a) Before Regulation (2009 Dec)



(b) After Regulation (2010 Dec)

Figure 6: **FXD Position to Capital Ratio, Before and After the Regulation (Domestic Banks)** The histogram of the FXD position to the capital (DPTC) ratio of domestic banks, six months before and six months after the first announcement of regulation. The vertical line indicates the regulatory cap on the DPTC ratio.

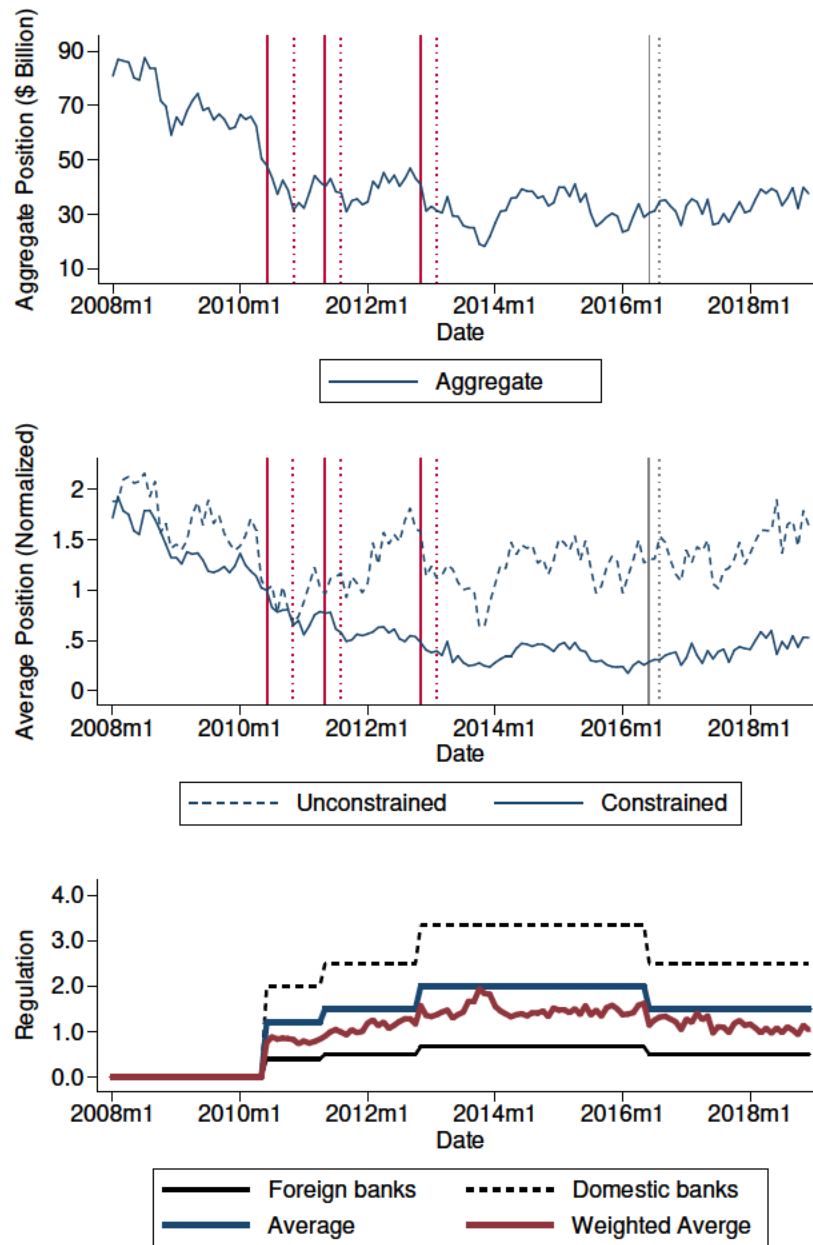


Figure 7: **FXD Position by Treatment** The top panel plots the aggregate FXD position. The vertical solid (dotted) lines indicate the announcement (effective) dates of the changes in the minimum FXD capital requirement. The middle panel plots the normalized average FXD position of constrained (solid) and unconstrained (dotted) banks. The average FXD positions are normalized such that they are 1 at the imposition of the regulation. The bottom panel plots the minimum FXD capital requirements. The blue line is the simple average and the red line is the weighted average minimum FXD capital requirements where the weight is FXD position.

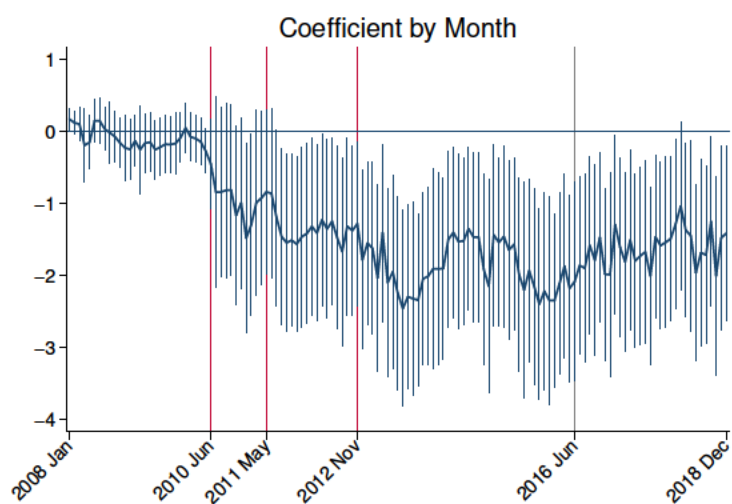


Figure 8: Coefficient by Month Plot of λ_t over time in the following specification: $Y_{it} = \beta_0 + \beta_1 \text{Constrained}_i + \beta_2 \text{Post}_t + \sum_t \lambda_t \text{Constrained}_i \times \gamma_t + \varepsilon_{it}$ where Post takes the value of 1 for the time period after the regulation (June 2010) and 0 otherwise. γ_t is the time dummy variable for each month. The vertical lines correspond to the adjustments of the regulatory cap. The first three vertical lines (in red) indicate tightening adjustments and the last vertical line (in grey) indicates a loosening adjustment.

Tables

Announced on	June 13, 2010	May 19, 2011	Nov 27, 2012	June 16, 2016	March 18, 2020
Effective from	Oct 31, 2010	July 31, 2011	Jan 31, 2013	July 31, 2016	March 19, 2020
Foreign Banks	250%	200%	150%	200%	250%
Domestic Banks	50%	40%	30%	40%	50%

Table 1: **FXD Position Limits over Time** The top two rows show the announcement dates and effective dates. The regulation was first announced on June 13, 2010. The bottom two rows show the historical changes in the regulatory cap on the ratio of FXD to capital. 250% means that a bank's FXD position is required to be lower than 2.5 times its capital.

	Full Sample		Constrained		Unconstrained		Difference	
	mean	sd	mean	sd	mean	sd	b	t
FXD (mio USD)	1,348	1,467	2,385	1,421	796	1,178	-1,589***	(-3.8)
Capital (mio USD)	2,726	4,317	971	1,275	3,662	5,046	2,691**	(2.8)
Asset (mio USD)	33,708	55,924	13,602	15,845	44,432	66,190	30,830*	(2.4)
FXD/Assets (%)	14	19	31	21	5	8	-26***	(-4.8)
Loans/Assets (%)	40	29	18	19	52	27	34***	(5.1)
Deposits/Assets (%)	20	28	10	20	26	30	16*	(2.1)
Equity/Assets (%)	7	4	5	2	7	4	2*	(2.3)
FC Loan Share (%)	44	41	67	40	34	38	-33*	(-2.2)
FC Liab Share (%)	18	23	13	16	20	26	8	(1.2)
Observations	46		16		30		46	

Table 2: **Bank Summary Statistics** All variables are computed as of December 2009 and are defined in the Appendix.

	Full Sample		Constrained		Unconstrained		Difference	
	mean	sd	mean	sd	mean	sd	b	t
Notional Net (USD mio)	18.0	77	30.1	92	10.2	64	-20	(-1.9)
FXDNet/Assets (%)	-2.9	9	-3.0	9	-2.9	8	0	(0.1)
Direction: Firm sells FC (%)	51.4	49	41.4	48	57.7	49	16*	(2.6)
Pair: USD-KRW (%)	86.2	32	95.5	17	80.2	37	-15***	(-4.4)
Pair: JPY-KRW (%)	11.4	30	1.5	11	17.8	36	16***	(5.3)
Pair: EUR-KRW (%)	1.8	10	1.6	8	2.0	11	0	(0.3)
Type: Forwards (%)	52.8	49	38.2	47	62.1	48	24***	(3.9)
Type: Swaps (%)	39.0	48	48.4	49	32.9	47	-16*	(-2.5)
Type: Options (%)	7.9	26	13.4	33	4.3	20	-9*	(-2.4)
Type: Futures (%)	0.4	6	0.0	0	0.7	8	1	(1.0)
Observations	251		98		153		251	

Table 3: **FXD Contract Summary Statistics** All variables are computed as of December 2009 and are defined in the Appendix. I define contract as a firm-bank pair.

	Full Sample		Exposed		Non-Exposed		Difference	
	mean	sd	mean	sd	mean	sd	b	t
Assets (USD mio)	2,371.130	6422.07	2,673.585	8728.05	2,202.391	4719.67	-471.19	(-0.36)
FXDNet/Assets	-0.082	0.19	-0.065	0.18	-0.091	0.20	-0.03	(-0.79)
Sales (USD mio)	1,936.725	4648.93	1,801.008	4534.04	2,012.440	4733.92	211.43	(0.27)
FXDNet/Sales	-0.097	0.28	-0.061	0.26	-0.118	0.30	-0.06	(-1.23)
Number of Banks	2.385	2.41	2.472	2.08	2.337	2.58	-0.13	(-0.35)
Log Size	26.804	1.83	26.836	1.76	26.786	1.87	-0.05	(-0.16)
Leverage	0.487	0.18	0.511	0.16	0.474	0.19	-0.04	(-1.26)
Gross Profit Margin	0.211	0.17	0.210	0.19	0.211	0.15	0.00	(0.02)
FC Asset Share	0.096	0.11	0.088	0.11	0.101	0.11	0.01	(0.66)
FC Liab Share	0.197	0.19	0.240	0.19	0.173	0.20	-0.07*	(-2.05)
Export Share	0.473	0.31	0.425	0.32	0.502	0.30	0.08	(1.38)
Export Hedge Ratio	0.409	0.71	0.435	0.72	0.393	0.71	-0.04	(-0.31)
FCL Hedge Ratio	0.485	2.11	0.803	3.41	0.300	0.50	-0.50	(-1.07)
Observations	148		53		95		148	

Table 4: **Firm Summary Statistics** All variables are computed as of December 2009 and are defined in the Appendix. Summary statistics of sub-samples are included in the Internet Appendix.

	(1)	(2)	(3)	(4)
	LogFXD	LogFXD	LogCapital	LogCapital
Constrained=1 x Regulation	-0.913*** (-3.18)	-0.967*** (-3.28)	0.0268 (0.33)	0.0262 (0.34)
Constrained=1	5.341*** (3.92)		-0.646 (-1.52)	
BankFE	N	Y	N	Y
TimeFE	Y	Y	Y	Y
N	5906	5906	5885	5885
Adj RSqr	0.109	0.802	0.0550	0.915

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(a) Based on Simple Average FXD Capital Requirement

	(1)	(2)	(3)	(4)
	LogFXD	LogFXD	LogCapital	LogCapital
Constrained=1 x Regulation	-1.207*** (-3.05)	-1.292*** (-3.17)	0.0203 (0.19)	0.0152 (0.15)
Constrained=1	5.312*** (3.91)		-0.631 (-1.49)	
BankFE	N	Y	N	Y
TimeFE	Y	Y	Y	Y
N	5906	5906	5885	5885
Adj RSqr	0.109	0.803	0.0550	0.915

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(b) Based on Weighted Average FXD Capital Requirement

Table 5: Impact on Bank FXD Position and Capital The regressions in this table examine the impact of the regulatory shock on the bank FXD position. The top panel uses $Regulation_t^{Avg}$, which takes 0 before the regulation and the **simple average** of foreign bank and domestic bank minimum FXD capital requirements. The bottom panel uses $Regulation_t^{W.Avg}$, which is the **weighted average** of the minimum FXD capital requirements, where the weight is the FXD position in each month. In either case, a higher value indicates tighter constraint. Columns (2) and (4) add bank fixed effects. The sample period is 2008–2019 on a monthly basis. Standard errors are clustered by bank. All variables are defined in the Appendix.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exporters	Exporters	Non-exporters	Non-exporters	Full Sample	Full Sample
Constrained	0.0529*** (3.66)	0.0374** (2.52)	0.00189 (1.00)	0.00317** (2.09)	0.0228** (2.28)	0.0129* (1.70)
Type Swaps		0.0114 (0.59)		-0.00114 (-0.15)		0.00511 (1.13)
Type Options		0.0862*** (4.48)		0 (.)		0.0992*** (6.38)
Type Futures		0.0111 (0.54)		0 (.)		0.00293 (0.34)
Pair EURKRW		0.0661 (1.20)		0 (.)		0.0469 (1.45)
Pair JPYKRW		-0.0188 (-1.29)		0.00658** (2.17)		0.00104 (0.15)
Pair XXXKRW		-0.00541 (-0.43)		-0.00207 (-0.18)		-0.000744 (-0.13)
FirmControls	N	Y	N	Y	N	Y
BankControls	N	Y	N	Y	N	Y
N	129	129	122	122	251	251
RSqr	0.0964	0.353	0.00419	0.125	0.0371	0.315

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Transmission of Regulatory Shock to FXD Hedging at the Contract Level The regressions in this table examine the impact of the regulatory shock on firm FXD contracts. I define contract as a firm-bank pair. The dependent variable is the change in net FXD position dealt between firm j and bank i between 2009 and 2010, scaled by assets. **Constrained _{i}** is 1 if the contract is dealt with a constrained bank and 0 if otherwise. Firm controls include log size, net FXD notional (scaled by sales) before the shock, foreign currency liability share, and seven industry dummies. Bank controls include log size, loans-to-assets ratio, leverage ratio, and a foreign bank indicator variable. Contract controls include bank i 's share of firm j 's total FXD notional, type, and currency pair. The omitted categories are forwards and USD-KRW pair. Standard errors are clustered at the bank level. All variables are defined in the Appendix.

	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample	Full Sample	Small	Small	Large	Large
Exposed	0.0352** (2.13)	0.0385** (2.43)	0.0608** (2.50)	0.0716** (2.49)	0.00838 (0.40)	0.00910 (0.52)
Constant	-0.00329 (-0.28)	0.0265 (0.17)	-0.00167 (-0.10)	-0.180 (-0.24)	-0.00487 (-0.28)	-0.260 (-0.98)
FirmControls	N	Y	N	Y	N	Y
N	148	148	74	74	74	74
RSqr	0.0253	0.0771	0.0743	0.186	0.00151	0.0237

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7: **Impact on Firm-level FXD Position by Firm Size, Full Sample** The regressions in this table examine the impact of the regulation on firm-level FXD positions. The outcome variable is change in firm j 's net FXD position scaled by assets. Independent variable *Exposed* is 1 if the firm's main FXD counterparty bank is constrained. Firm controls include log size, net FXD notional (scaled by sales) before the shock, foreign currency liability share, and seven industry dummies. All variables are defined in the Appendix.

	(1)	(2)	(3)	(4)
	Exporter	Exporter	Non-exporter	Non-exporter
Exposed	0.0640** (2.48)	0.0728*** (2.72)	-0.00226 (-0.39)	-0.00229 (-0.41)
Constant	-0.00302 (-0.17)	-0.0811 (-0.27)	-0.00380 (-1.24)	0.0451 (0.84)
FirmControls	N	Y	N	Y
N	92	92	56	56
RSqr	0.0510	0.113	0.00307	0.0798

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 8: **Impact on Firm-level FXD Position by Net FXD Position, Full Sample** The regressions in this table compare the impact of the regulation on the firm-level FXD positions of exporters and non-exporters. A firm is classified as an exporter (non-exporter) if it holds a negative (positive) net FXD position. The outcome variable is the change in firm j 's net FXD position scaled by assets. Independent variable *Exposed* is 1 if the firm's main FXD counterparty bank is constrained. Firm controls include log size, net FXD notional (scaled by sales) before the shock, foreign currency liability share, and seven industry dummies. All variables are defined in the Appendix.

	(1)	(2)
	LogExport	LogExport
High Hedge=1 \times Exposure	-0.228* (-1.94)	-0.189* (-1.81)
Exposure	0.0571 (0.77)	0.0956 (1.55)
High Hedge=1	0.136 (1.30)	0.0217 (0.24)
Constant	0.212*** (2.66)	-1.615 (-1.22)
FirmControls	N	Y
N	74	74
RSqr	0.0817	0.324

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

(a) High Hedge vs. Low Hedge Firms

	(1)	(2)
	LogExport	LogExport
Exposure \times Export Hedge Ratio	-0.196*** (-3.96)	-0.237** (-2.24)
Exposure	-0.0557 (-0.99)	-0.0530 (-0.83)
Export Hedge Ratio	0.0808 (1.29)	0.153** (2.12)
Constant	0.299*** (6.14)	-1.663 (-1.31)
FirmControls	N	Y
N	74	74
RSqr	0.228	0.464

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

(b) Continuous Hedge Ratio

Table 9: Impact on Export Sales The regressions in this table examine the impact of the regulation on exports. The outcome variable is the change in log export sales. Independent variable $Exposure_j$ is the weighted average shock of firm j 's FXD counterparty banks. The top panel uses $HighHedge_j$, which takes 1 if firm j sold amount of FXD is more than 10% of its export sales, and 0 if otherwise. The bottom panel uses $ExportHedgeRatio_j$, which is firm j 's sold amount of FXD divided by export sales. Firm controls include log size, net FXD notional (scaled by sales) before the shock, foreign currency liability share, and seven industry dummies. All variables are defined in the Appendix.

	(1)	(2)
	FXD/Asset	FXD/Asset
High Hedge=1 \times Exposure	0.0594*** (2.70)	0.0667*** (2.84)
Exposure	0.0124 (1.22)	0.0124 (1.16)
High Hedge=1	0.0418** (2.13)	0.0433** (2.15)
Constant	-0.00820 (-1.01)	-0.124 (-0.56)
FirmControls	N	Y
N	74	74
RSqr	0.215	0.319

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 10: **Impact on Firm-level FXD Position** The regressions in this table examine the impact of the regulation on the firm-level FXD position. The outcome variable is the change in firm j 's net FXD notional scaled by assets. All variables are defined in the Appendix.

	(1)	(2)
	LogDomesticSales	LogDomesticSales
High Hedge=1 × Exposure	-0.0372 (-0.37)	-0.00911 (-0.09)
Exposure	-0.00754 (-0.09)	0.000967 (0.01)
High Hedge=1	0.127 (1.44)	0.0932 (0.95)
Constant	0.0885 (1.24)	0.315 (0.35)
FirmControls	N	Y
N	74	74
RSqr	0.0353	0.118

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 11: **Impact on Domestic Sales as a Placebo Test** The regressions in this table examine the impact of the regulation on domestic sales. The outcome variable is the change in firm j 's log domestic sales. All variables are defined in the Appendix.

	(1)	(2)
	LogExport	ExpShare
High Hedge=1 \times Exposure \times Cash	-3.789** (-2.09)	-1.478*** (-3.68)
High Hedge=1 \times Exposure	0.0885 (0.64)	0.0665** (2.22)
High Hedge=1 \times Cash	-1.847 (-1.39)	-1.025*** (-3.37)
Exposure \times Cash	2.506 (1.63)	0.953** (2.54)
Exposure	-0.0177 (-0.21)	-0.0224 (-0.93)
High Hedge=1	0.0876 (0.66)	0.0422 (1.63)
Cash	2.931** (2.42)	1.055*** (3.61)
Constant	-2.553** (-2.19)	-0.625** (-2.60)
FirmControls	Y	Y
N	74	74
RSqr	0.421	0.525

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 12: Role of Internal Funds on Export Sales and Export Share The regressions in this table examine the impact of the regulation, hedge ratio, and internal funds (cash balance) on export sales and share of export sales. The outcome variable is export sales or share of export sales. Independent variable $Exposure_j$ is the weighted average shock of firm j 's FXD counterparty banks. $Cash_j$ is firm's pre-shock cash and cash equivalent balance scaled by total assets. Firm controls include log size, net FXD notional (scaled by sales) before the shock, foreign currency liability share, and seven industry dummies. All variables are defined in the Appendix.

Appendix

A Additional Figures

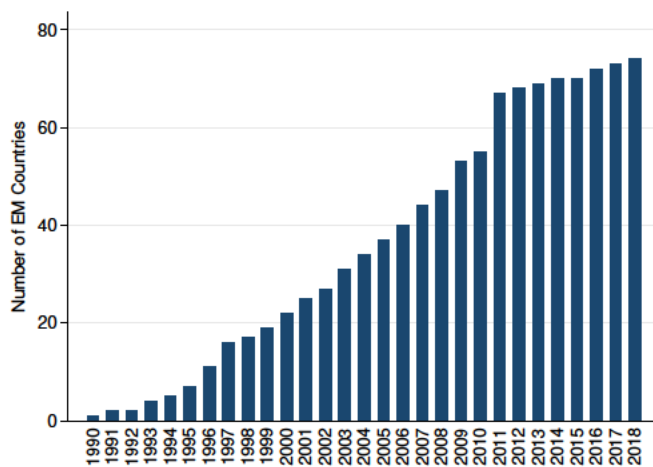


Figure A.1: Number of Countries using Macroprudential FX Regulations Source: IMF integrated Macroprudential Policy Database.

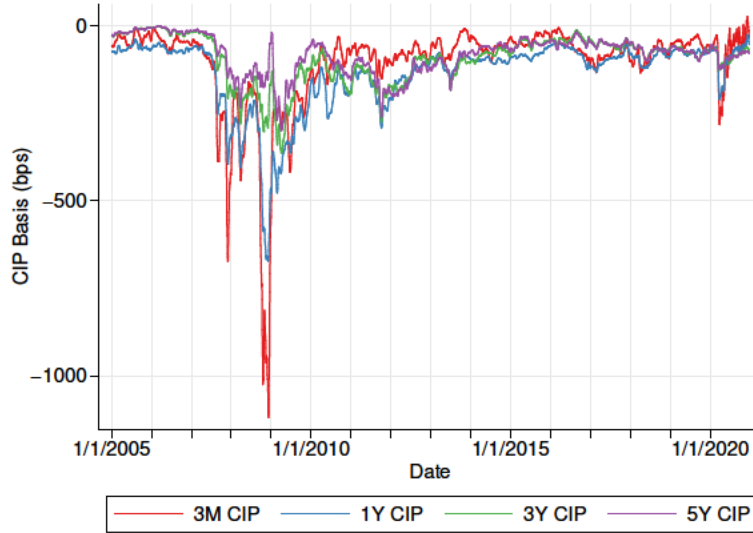


Figure A.2: **CIP Bases** 10-day moving average of daily CIP bases for different maturities. CIP basis at time t for maturity n is defined in equation (12).



Figure A.3: **Korean Won Exchange Rate** The exchange rate is defined as the value of 1 USD in Korean Won (KRW). A higher exchange rate indicates depreciation of the KRW.

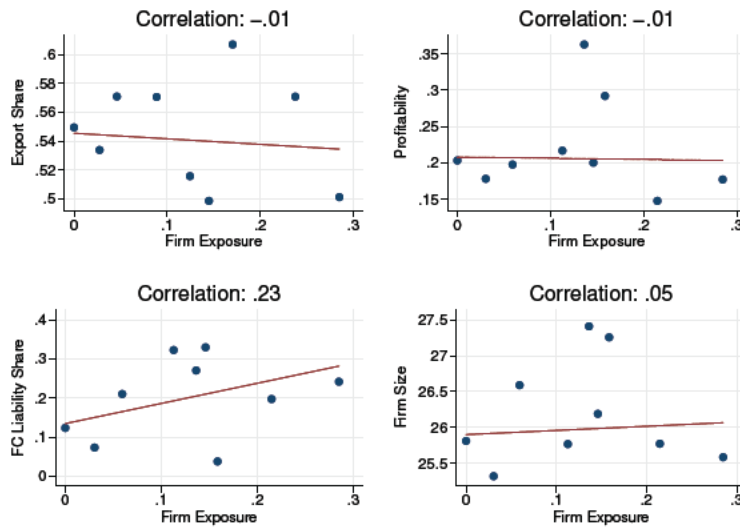


Figure A.4: Correlations between Firm Characteristics and Firm Exposure Binned scatter plots of firm characteristics (export share, profitability, FC liability share, and firm size) and firm exposure to the regulation.

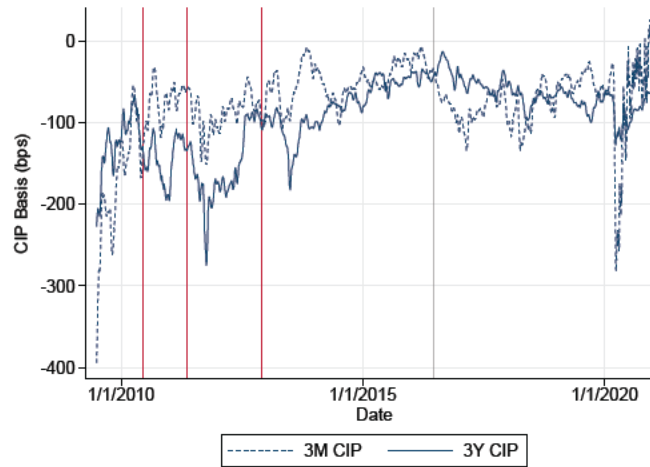


Figure A.5: CIP Deviations: Short-term and long-term 10-day moving average of 3-year (solid) and 3-month (dotted) USD-KRW CIP deviations where CIP deviation is defined in equation (12). The first three red vertical lines indicate tightening adjustments while the last grey vertical line indicates a loosening adjustment.

B Additional Tables

Variable	Definition
Bank-level Variables	
FXD	FXD position
Capital	Total bank capital
Asset	Total bank assets
FXD/Assets	FXD position as a share of assets
Loans/Assets	Bank loans as a share of assets
Deposits/Assets	Bank deposits as a share of assets
Equity/Assets	Bank equity as a share of assets
FC Loan Share	Bank's foreign currency loans as a share of loans
FC Liab Share	Bank's foreign currency borrowings as a share of borrowings
LogFXD	Natural logarithm of total FXD position
LogCapital	Natural logarithm of total capital
FXD/Capital	FXD position as a share of capital
$Constrained_i$	Indicator variable equal to one if bank i is constrained and zero otherwise
$Regulation^{Avg}$	Simple average regulatory capital requirement (Blue solid line in Figure 7)
$Regulation^{W Avg}$	Weighted average regulatory capital requirement (Red solid line in Figure 7)
FXD Contract-level Variables	
Notional Net	FXD position at the contract (firm-bank pair) level
FXDNet/Assets	Net FXD as a share of assets from the firm's perspective
Direction	FXD that firm sells to banks as a share of FXD
Pair: USD-KRW	FXD that involves USD-KRW as a share of FXD
Pair: JPY-KRW	FXD that involves JPY-KRW as a share of FXD
Pair: EUR-KRW	FXD that involves EUR-KRW as a share of FXD
Type: Forwards	FX forwards as a share of FXD
Type: Swaps	FX swaps as a share of FXD
Type: Options	FX options as a share of FXD
Type: Futures	FX futures as a share of FXD
$Constrained_{ij}$	Indicator variable equal to one if bank i is constrained and zero otherwise
$Shock_i$	Percentage of bank i 's FXD position that needed to be reduced on imposition of the regulation
Firm-level Variables	
Assets	Total firm assets
FXDNet/Assets	Firm's net FXD position as a share of assets
Leverage	Firm liabilities as a share of assets
Gross Profit Margin	Firm gross profit as a share of liabilities
FC Asset Share	Firm's foreign currency assets as a share of assets
FC Liab Share	Firm's foreign currency liabilities as a share of liabilities
Export Share	Firm's export sales as a share of sales
Export Hedge Ratio	Amount of FXD that firm sold as a share of its export sales
FCL Hedge Ratio	Amount of FXD that firm bought as a share of its foreign currency liabilities
Exposed	Indicator variable equal to one if the firm's main bank is constrained and zero otherwise
Exposure	Weighted average shock of the firm's FXD counterparty banks
HighHedge	Indicator variable equal to one if the firm's export hedge ratio is higher than 10%, zero otherwise
Cash	Firm's cash and cash equivalent as a share of assets

Table B.1: Variable Definitions

	(1)	(2)	(3)	(4)	(5)	(6)
	LogFXD	LogFXD	LogFXD	LogFXD	LogFXD	LogFXD
Shock x Regulation	-1.393*** (-2.96)	-1.443*** (-2.99)	-2.804*** (-2.95)	-1.776*** (-2.80)	-1.871*** (-2.85)	-3.662*** (-2.87)
Shock	8.431*** (3.63)	13.67*** (13.35)	18.95** (2.19)	8.322*** (3.59)	13.60*** (13.22)	18.64** (2.20)
Bank FE	N	Y	Y	N	Y	Y
Time FE	Y	Y	Y	Y	Y	Y
Bank Controls x Regulation	N	N	Y	N	N	Y
N	5906	5906	1718	5906	5906	1718
Adj RSqr	0.0732	0.801	0.838	0.0731	0.801	0.837

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B.2: Impact on Bank FXD Position based on Shock variable The regressions in this table examine the impact of the regulatory shock on the bank FXD position. Columns (1)-(3) use $Regulation_t^{Avg}$, which takes 0 before the regulation and the **simple average** of foreign bank and domestic bank minimum FXD capital requirements. Columns (4)-(6) use $Regulation_t^{WAvg}$, which is the **weighted average** of the minimum FXD capital requirements, where the weight is the FXD position in each month. In either case, a higher value indicates tighter constraint. Columns (2) and (5) add bank fixed effects. Columns (3) and (6) includes terms bank characteristics (size, loan-to-assets ratio, and leverage) interacted with $Regulation_t$. Because bank characteristics data are quarterly, the number of observations drops. The sample period is 2008–2019 on a monthly basis. Standard errors are clustered by bank. All variables are defined in the Appendix.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exporters	Exporters	Non-exporters	Non-exporters	Full Sample	Full Sample
Shock	0.0306*** (2.95)	0.0220*** (3.00)	0.00100* (1.73)	0.00161* (2.03)	0.00765 (1.46)	0.00482 (1.51)
Type Swaps		0.0159 (0.85)		-0.000985 (-0.13)		0.00598 (1.36)
Type Options		0.0865*** (4.49)		0 (.)		0.100*** (6.63)
Type Futures		0.00914 (0.45)		0 (.)		0.00298 (0.34)
Pair EURKRW		0.0562 (1.06)		0 (.)		0.0460 (1.43)
Pair JPYKRW		-0.0200 (-1.31)		0.00680* (1.93)		-0.000960 (-0.13)
Pair XXXKRW		-0.00860 (-0.76)		0.00465 (0.45)		0.00317 (0.44)
FirmControls	N	Y	N	Y	N	Y
BankControls	N	Y	N	Y	N	Y
N	129	129	122	122	251	251
RSqr	0.0820	0.350	0.00650	0.127	0.0174	0.313

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B.3: Transmission of Regulatory Shock to FXD Hedging at Contract Level using continuous variable, Shock The regressions in this table examine the impact of the regulatory shock on firm FXD contracts. I define contract as a firm-bank pair. The dependent variable is the change in the net FXD position dealt between firm j and bank i between 2009 and 2010, scaled by assets. **Shock _{i}** is the percentage of bank i 's FXD position that needed to be reduced when the regulation was imposed. Firm controls include log size, net FXD notional (scaled by sales) before the shock, foreign currency liability share, and seven industry dummies. Bank controls include log size, loans-to-assets ratio, leverage ratio, and a foreign bank indicator variable. Contract controls include bank i 's share of firm j 's total FXD notional, type, and currency pair. The omitted categories are forwards and USD-KRW pair. Standard errors are clustered at the bank level. All variables are defined in the Appendix.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exporters	Exporters	Non-exporters	Non-exporters	Full Sample	Full Sample
Constrained	0.0259*	0.0296*	0.00192	0.00326*	0.0121**	0.00927
	(1.96)	(2.06)	(0.99)	(2.00)	(2.12)	(1.28)
Type Swaps		-0.000369		-0.00110		0.00325
		(-0.02)		(-0.14)		(0.65)
Type Options		0		0		0
		(.)		(.)		(.)
Type Futures		0.0193		0		0.00604
		(0.85)		(.)		(0.72)
Pair EURKRW		0.0218		0		0.0218*
		(0.70)		(.)		(1.91)
Pair JPYKRW		-0.0182		0.00662**		-0.000000735
		(-1.08)		(2.17)		(-0.00)
Pair XXXKRW		0.000695		-0.00265		0.00137
		(0.05)		(-0.23)		(0.25)
FirmControls	N	Y	N	Y	N	Y
BankControls	N	Y	N	Y	N	Y
N	111	111	122	122	233	233
RSqr	0.0270	0.125	0.00415	0.125	0.0144	0.0566

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B.4: Transmission of Regulatory Shock to FXD Hedging, Excluding Option Contracts (1) The regressions in this table examine the impact of the regulatory shock on firm FXD contracts when **I exclude all option contracts from the data**. I define contract as a firm-bank pair. The dependent variable is the change in the net FXD position dealt between firm j and bank i between 2009 and 2010, scaled by assets. $Constrained_i$ is 1 if the contract is dealt with a constrained bank and 0 if otherwise. Firm controls include log size, net FXD notional (scaled by sales) before the shock, foreign currency liability share, and seven industry dummies. Bank controls include log size, loans-to-assets ratio, leverage ratio, and a foreign bank indicator variable. Contract controls include bank i 's share of firm j 's total FXD notional, type, and currency pair. The omitted categories are forwards and USD-KRW pair. Standard errors are clustered at the bank level. All variables are defined in the Appendix.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exporters	Exporters	Non-exporters	Non-exporters	Full Sample	Full Sample
Shock	0.0168** (2.34)	0.0183** (2.88)	0.00103* (1.71)	0.00169* (2.03)	0.00509** (2.11)	0.00363 (1.25)
Type Swaps		0.00435 (0.21)		-0.000947 (-0.12)		0.00391 (0.78)
Type Options		0 (.)		0 (.)		0 (.)
Type Futures		0.0171 (0.75)		0 (.)		0.00602 (0.71)
Pair EURKRW		0.0141 (0.48)		0 (.)		0.0210* (1.96)
Pair JPYKRW		-0.0187 (-1.07)		0.00687* (1.91)		-0.00135 (-0.17)
Pair XXXKRW		-0.00287 (-0.20)		0.00427 (0.41)		0.00421 (0.58)
FirmControls	N	Y	N	Y	N	Y
BankControls	N	Y	N	Y	N	Y
N	111	111	122	122	233	233
RSqr	0.0287	0.124	0.00638	0.127	0.0109	0.0551

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B.5: **Transmission of Regulatory Shock to FXD Hedging, Excluding Option Contracts (2)** The regressions in this table examine the impact of the regulatory shock on firm's FXD contracts when **I exclude all option contracts from the data**. I define contract as a firm-bank pair. The dependent variable is the change in the net FXD position dealt between firm j and bank i between 2009 and 2010, scaled by assets. $Shock_i$ is the percentage of bank i 's FXD position that needed to be reduced at the imposition of the regulation. Firm controls include log size, net FXD notional (scaled by sales) before the shock, foreign currency liability share, and seven industry dummies. Bank controls include log size, loans-to-assets ratio, leverage ratio, and a foreign bank indicator variable. Contract controls include bank i 's share of firm j 's total FXD notional, type, and currency pair. The omitted categories are forwards and USD-KRW pair. Standard errors are clustered at the bank level. All variables are defined in the Appendix.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exporters	Non-exporters	Full Sample	Exporters	Non-exporters	Full Sample
Shock	0.0202** (2.58)	0.00187* (1.94)	0.00576 (1.65)	0.0217** (2.47)	0.00225** (2.08)	0.00507 (1.42)
Type Swaps	-0.0102 (-0.34)	0.00455 (1.18)	0.0100** (2.18)	-0.00838 (-0.25)	0.00344 (0.62)	0.00597 (1.04)
Type Options	0.0893*** (4.88)	0 (.)	0.0999*** (8.34)	0 (.)	0 (.)	0 (.)
Type Futures	-0.0144 (-0.47)	0 (.)	-0.0119 (-0.82)	-0.0158 (-0.50)	0 (.)	-0.00980 (-0.70)
Pair EURKRW	0.0765* (1.86)	0 (.)	0.0436 (1.24)	0.0415 (1.25)	0 (.)	0.0255 (1.50)
Pair JPYKRW	-0.0288 (-1.25)	0.00850* (1.89)	-0.00696 (-0.77)	-0.0228 (-0.86)	0.00938* (2.02)	-0.00494 (-0.53)
Pair XXXKRW	-0.0123 (-0.47)	0.00169 (0.11)	-0.000316 (-0.02)	-0.000784 (-0.03)	0.00303 (0.20)	0.00866 (0.52)
Firm Controls	Y	Y	Y	Y	Y	Y
Bank Controls	Y	Y	Y	Y	Y	Y
I-L-S FE	Y	Y	Y	Y	Y	Y
N	129	121	250	111	121	232
RSqr	0.412	0.272	0.372	0.180	0.240	0.129

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B.6: Transmission of Regulatory Shock to FXD Hedging at Contract Level, after including Industry-Location-Size Fixed Effect The regressions in this table examine the impact of the regulatory shock on firm FXD contracts. I define contract as a firm-bank pair. The dependent variable is the change in the net FXD position dealt between firm j and bank i between 2009 and 2010, scaled by assets. **Shock _{i}** is the percentage of bank i 's FXD position that needed to be reduced when the regulation was imposed. Firm controls include log size, net FXD notional (scaled by sales) before the shock, and foreign currency liability share. The industry-location-size fixed effect is based on seven industry groups, five locations, and two size bins. Bank controls include log size, loans-to-assets ratio, leverage ratio, and a foreign bank indicator variable. Contract controls include bank i 's share of firm j 's total FXD notional, type, and currency pair. The omitted categories are forwards and USD-KRW pair. Standard errors are clustered at the bank level. Columns (1)-(3) are based on the full sample and columns (4)-(6) are after excluding all option contracts. All variables are defined in the Appendix.

	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample	Full Sample	Small	Small	Large	Large
Exposure	0.0270*** (3.45)	0.0304*** (3.86)	0.0367*** (2.83)	0.0379*** (3.13)	0.0174** (2.27)	0.0195*** (2.73)
Constant	0.0105 (1.39)	0.146 (1.26)	0.0190 (1.45)	-0.153 (-0.23)	0.00289 (0.37)	0.222 (1.12)
FirmControls	N	Y	N	Y	N	Y
N	132	132	66	66	66	66
RSqr	0.0687	0.164	0.0888	0.465	0.0537	0.154

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B.7: Impact on Firm-level FXD Position by Firm Size, Fully Disclosed Firms The regressions in this table examine the impact of regulation on firm-level FXD positions when I restrict the sample to firms that fully disclosed their FXD counterparty information. The outcome variable is the change in firm j 's net FXD position scaled by assets. Independent variable *Exposure* is the weighted average shock of the firm's FXD counterparty banks. Firm controls include log size, net FXD notional (scaled by sales) before the shock, foreign-currency liability share, and seven industry dummies. All variables are defined in the Appendix.

	(1)	(2)	(3)	(4)
	Exporter	Exporter	Non-exporter	Non-exporter
Exposure	0.0513*** (3.95)	0.0582*** (4.22)	0.00151 (0.45)	0.000738 (0.19)
Constant	0.0246** (2.10)	0.0183 (0.08)	-0.00564** (-2.05)	0.0591 (0.88)
FirmControls	N	Y	N	Y
N	82	82	50	50
RSqr	0.140	0.245	0.00502	0.0851

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B.8: Impact on Firm-level FXD Position by Net FXD Position, Fully Disclosed Firms The regressions in this table compare the impact of regulation on the firm-level FXD positions of exporters and non-exporters when I restrict the sample to firms that fully disclosed their FXD counterparty information. The outcome variable is the change in firm j 's net FXD position scaled by assets. A firm is classified as an exporter (non-exporter) if it holds a negative (positive) net FXD position. Independent variable *Exposure* is the weighted average shock of the firm's FXD counterparty banks. Firm controls include log size, net FXD notional (scaled by sales) before the shock, foreign currency liability share, and seven industry dummies. All variables are defined in the Appendix.

	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample	Full Sample	Exporter	Exporter	Non-exporter	Non-exporter
Exposed	-0.00508 (-0.42)	-0.00843 (-0.71)	-0.0202* (-1.74)	-0.0241* (-1.93)	0.0129 (0.56)	0.0112 (0.74)
Constant	0.00545 (0.81)	-0.200** (-2.36)	0.00250 (0.32)	-0.358*** (-2.99)	0.0110 (0.86)	-0.0658 (-0.57)
FirmControls	N	Y	N	Y	N	Y
N	148	148	92	92	56	56
RSqr	0.00129	0.0710	0.0274	0.225	0.00618	0.672

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B.9: Impact on Profitability by Net FXD Position, Full Sample The regressions in this table examine the impact of the regulation on firm profitability. The outcome variable is the change in gross profit margin. Independent variable *Exposed* is 1 if the firm's main FXD counterparty bank is constrained. Firm controls include log size, net FXD notional (scaled by sales) before the shock, foreign currency liability share, and seven industry dummies. All variables are defined in the Appendix.

	(1)	(2)	(3)	(4)	(5)	(6)
	Full Sample	Full Sample	Exporter	Exporter	Non-exporter	Non-exporter
Exposure	-0.00142 (-0.25)	-0.00336 (-0.49)	-0.00671 (-1.12)	-0.0119* (-1.72)	0.00120 (0.13)	0.00828 (0.85)
Constant	0.00236 (0.38)	-0.151 (-1.16)	-0.00824 (-1.33)	-0.349 (-1.48)	0.0185 (1.47)	-0.0227 (-0.15)
FirmControls	N	Y	N	Y	N	Y
N	132	132	82	82	50	50
RSqr	0.000302	0.0801	0.00886	0.173	0.000174	0.674

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B.10: **Impact on Profitability by Net FXD Position, Fully Disclosed Firms**

The regressions in this table examine the impact of the regulation on firm profitability when I restrict the sample to firms that fully disclosed their FXD counterparty information. The outcome variable is the change in gross profit margin. Independent variable $Exposure_j$ is the weighted average shock of firm j 's FXD counterparty banks. Firm controls include log size, net FXD notional (scaled by sales) before the shock, foreign currency liability share, and seven industry dummies. All variables are defined in the Appendix.

	(1)	(2)
	Profitability	Profitability
High Hedge=1 × Exposure	-0.00592 (-0.49)	-0.00557 (-0.48)
Exposure	-0.00374 (-0.40)	-0.00863 (-0.78)
High Hedge=1	-0.0110 (-0.86)	-0.00597 (-0.51)
Constant	0.000841 (0.09)	-0.365 (-1.50)
FirmControls	N	Y
N	74	74
RSqr	0.0240	0.202

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B.11: **Impact on Profitability** The outcome variable is the change in firm j 's gross profit margin. All variables are defined in the Appendix [Table B.1](#).

	LogExport	FXD/Asset	LogDomesticSales
Firm_highHR=1 × Exposure	-0.178* (-1.95)	0.0697** (2.08)	-0.197 (-1.54)
Exposure	0.125** (2.49)	0.0141 (0.68)	0.136 (1.17)
Firm_highHR=1	0.0495 (0.61)	0.0411 (1.06)	0.336** (2.41)
Constant	-0.295 (-0.17)	-0.548 (-1.55)	1.532 (1.37)
FirmControls	Y	Y	Y
N	68	68	68
RSqr	0.286	0.454	0.252

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

(a) Matching Based on FC Liability Share

	LogExport	FXD/Asset	LogDomesticSales
Firm_highHR=1 × Exposure	-0.191* (-1.73)	0.0614*** (2.66)	-0.0317 (-0.29)
Exposure	0.0746 (1.27)	0.0165 (1.49)	-0.000762 (-0.01)
Firm_highHR=1	0.0695 (0.71)	0.0291 (1.58)	0.104 (1.02)
Constant	-1.474 (-1.07)	-0.112 (-0.48)	0.705 (0.80)
FirmControls	Y	Y	Y
N	72	72	72
RSqr	0.312	0.323	0.0790

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

(b) Matching Based on FC Liability, Export Share, and Profitability

Table B.12: **Firm-level Impacts on Exporters after Coarsened Exact Matching** The top panel shows results after matching firms based on FC liability share only. The bottom panel shows results after matching firms based on FC liability share, export share, and gross profit margin. All variables are defined in the Appendix [Table B.1](#).

	(1)	(2)	(3)	(4)
	LogFXD	LogFXD	LogCapital	LogCapital
Constrained=1 x Regulation	-4.318*** (-2.88)	-4.551*** (-2.99)	-0.0418 (-0.14)	-0.0156 (-0.05)
Constrained=1	6.341*** (3.08)		0.123 (0.30)	
Constant	16.11*** (8.07)	21.04*** (50.75)	26.22*** (66.20)	25.81*** (179.85)
Bank FE	N	Y	N	Y
Time FE	Y	Y	Y	Y
N	3698	3698	3694	3694
Adj RSqr	0.155	0.760	0.0528	0.835

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(a) Foreign Banks

	(1)	(2)	(3)	(4)
	LogFXD	LogFXD	LogCapital	LogCapital
Constrained=1 x Regulation	-0.105 (-0.61)	-0.126 (-0.72)	-0.0659** (-2.51)	-0.0663** (-2.39)
Constrained=1	4.401** (2.38)		0.357 (0.86)	
Constant	17.24*** (9.07)	19.02*** (30.50)	28.60*** (69.51)	28.25*** (370.80)
Bank FE	N	Y	N	Y
Time FE	Y	Y	Y	Y
N	2208	2208	2191	2191
Adj RSqr	0.0528	0.875	0.0243	0.934

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

(b) Domestic Banks

Table B.13: Impact on Bank FXD Position and Capital of Foreign and Domestic Banks The regressions in this table examine the impact of the regulatory shock on the bank FXD position. The top panel is the result when I restrict the data to foreign banks. The bottom panel is the result when I restrict the data to domestic banks. Columns (2) and (4) add bank fixed effects. The sample period is 2008–2019 on a monthly basis. Standard errors are clustered by bank. All variables are defined in the Appendix.

	(1)	(2)	(3)	(4)
	FCLoanShr	FCLoanShr	FCLiabShr	FCLiabShr
Constrained=1 x Regulation	-0.0509 (-1.50)	-0.0495 (-1.52)	-0.0150 (-0.45)	-0.00923 (-0.29)
Constrained=1	0.299** (2.22)		-0.0253 (-0.36)	
Constant	0.344*** (4.69)	0.980*** (23.57)	0.292*** (5.11)	0.408*** (12.94)
BankFE	N	Y	N	Y
TimeFE	Y	Y	Y	Y
N	1523	1523	1680	1680
Adj RSqr	0.132	0.884	0.0886	0.787

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B.14: Impact on Bank FC Loans and FC Liabilities The regressions in this table examine the impact of the regulatory shock on the foreign currency shares of bank lending and borrowing. Columns (2) and (4) add bank fixed effects. The sample period is 2008–2019 on a quarterly basis. Standard errors are clustered by bank. All variables are defined in the Appendix.

	(1)	(2)	(3)	(4)
	FCLoanShr	FCLoanShr	FCLiabShr	FCLiabShr
Constrained=1 x Regulation	-0.165 (-1.45)	-0.117 (-1.03)	0.0304 (0.28)	0.0565 (0.53)
Constrained=1	0.211* (1.72)		-0.130 (-1.31)	
Constant	0.582*** (6.72)	1.007*** (15.87)	0.456*** (5.24)	0.456*** (11.36)
BankFE	N	Y	N	Y
TimeFE	Y	Y	Y	Y
N	914	914	1071	1071
Adj RSqr	0.154	0.785	0.173	0.782

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B.15: **Impact on Bank FC Loans and FC Liabilities, Foreign Banks** The regressions in this table examine the impact of regulation on the banks' foreign currency share of bank lending and borrowing, when I restrict the sample to foreign banks. All variables are defined in the Appendix [Table B.1](#).

	(1)	(2)	(3)	(4)
	FCLoanShr	FCLoanShr	FCLiabShr	FCLiabShr
Constrained=1 x Regulation	-0.00821 (-0.82)	-0.00859 (-0.86)	-0.00877* (-1.89)	-0.00906* (-1.99)
Constrained=1	0.0243 (0.58)		0.0272 (1.06)	
Constant	0.0666** (2.58)	0.0598*** (5.59)	0.0746*** (3.69)	0.0700*** (12.30)
BankFE	N	Y	N	Y
TimeFE	Y	Y	Y	Y
N	609	609	609	609
Adj RSqr	0.160	0.895	0.143	0.940

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B.16: **Impact on Bank FC Loans and FC Liabilities, Domestic Banks** The regressions in this table examine the impact of regulation on the bank foreign currency share of lending and borrowing when I restrict the sample to domestic banks. All variables are defined in the Appendix [Table B.1](#).

	(1)	(2)
	LogExport	ExpShare
Exposure	-0.00635 (-0.11)	0.0109 (1.08)
HighCash=1	0.242** (2.15)	0.0344 (1.52)
HighCash=1 × Exposure	0.00683 (0.06)	-0.0233 (-0.89)
Constant	-1.616 (-1.32)	-0.365 (-1.13)
FirmControls	Y	Y
N	74	74
RSqr	0.357	0.287

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table B.17: Placebo Test of Impact of Internal Funds on Export Sales and Export Share The regressions in this table examine the impact of the regulation and internal funds (cash balance) on export sales and share of export sales. The outcome variable is export sales or share of export sales. Independent variable $Exposure_j$ is the weighted average shock of firm j 's FXD counterparty banks. $HighCash_j$ takes value of 1 if the firm's pre-shock cash and cash equivalent balance scaled by total assets is in the top 50 percentile. Firm controls include log size, net FXD notional (scaled by sales) before the shock, foreign currency liability share, and seven industry dummies. All variables are defined in the Appendix.

C Export Hedging Mechanism

Consider the model of [Froot et al. \(1993\)](#) where a firm faces a two-period investment and financing decision.

1. In period zero, firm chooses export quantity q and size of hedging q_H .
2. The firm enters the first period with internal funds w (in local currency) at hand, and chooses investment expenditure I and external financing need $e = I - w$ to maximize the net expected profits:

$$P(w) = \max_I F(I) - C(e)$$

- (a) w is exposed to FX risk because export sales proceed is in foreign currency.

$$w = R(q) - C^q(q) + (\epsilon_0 - \epsilon)q_H - H(q_H)$$

- $R(q) = pq\epsilon$ is revenue function. Assume that all sales are export sales. p is in USD and ϵ is exchange rate (1 USD = ϵ Won). $pq\epsilon$ is export sales converted to local currency.
 - C^q is convex product cost function such that marginal cost increases in q . ($C'' > 0$).
 - $(\epsilon_0 - \epsilon)q_H$ is cash flow from hedging contract with linear payoff (e.g. forward). Consider exporter selling q_H USD forwards at the forward price of ϵ_0 per USD. Then the firm receives $\epsilon_0 q_H$ Won and pays q_H USD (= ϵq_H in Won). If firm hedges full exposure from export sales, $q_H = pq$.
 - H is hedging cost. Assume that marginal hedging cost increases in the size of hedging q_H .
- (b) On the investment side, net present value of investment expenditure is given by:

$$F(I) = f(I) - I$$

where $f' > 0, f'' < 0$.

- (c) On the financing side, there are deadweight costs $C(e)$ to the firm of external finance.
 $C_e \geq 0$
3. In the second period, the output from the investment is realized and outside investors are repaid.

Numerical Example

With a numerical example, I can show that firm chooses to reduce exports when the hedging supply falls. Consider:

$$\begin{aligned}C^q(q) &= \frac{c}{2}q^2 \\ H(q_H) &= \frac{h}{2}q_H^2 \\ F(I) &= I^{1/2} \\ C(e) &= \frac{k}{2}e^2\end{aligned}$$

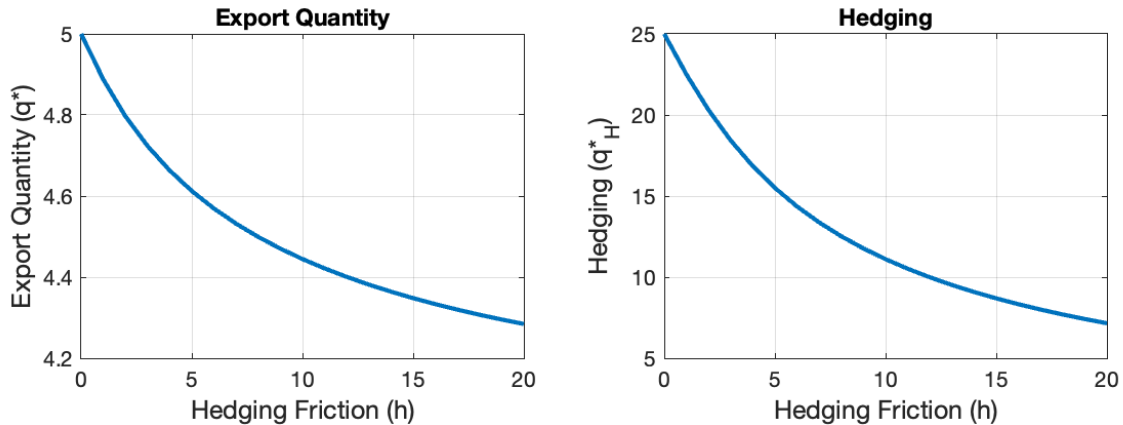


Figure C.1: **Export Quantity and Hedging Quantity as a Function of Hedging Friction**

When the supply of hedging falls, marginal cost is the same (at a given level of quantity) but the marginal benefit of producing a unit of exports goes down because of the FX risk exposure from the export sales. Therefore, it is optimal for the firm to reduce exports.

I can also show that the firm value (net expected profits, $E[P(w)]$) also falls as the hedging cost rises:

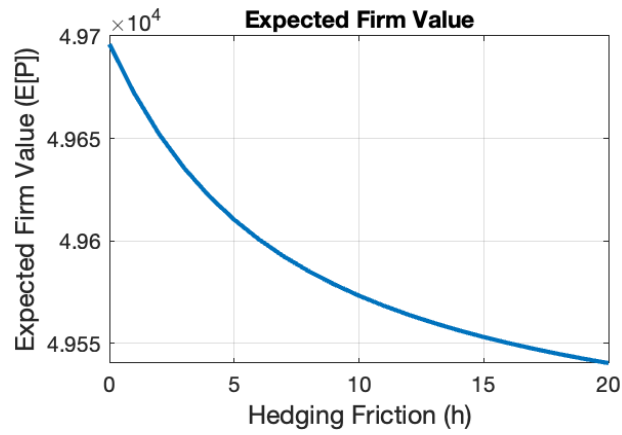


Figure C.2: **Expected Firm Value as a Function of Hedging Friction**

Comparing high cash firms and low cash firms, high cash firms are expected to reduce exports to a greater extent as the magnitude of hedging friction rises:

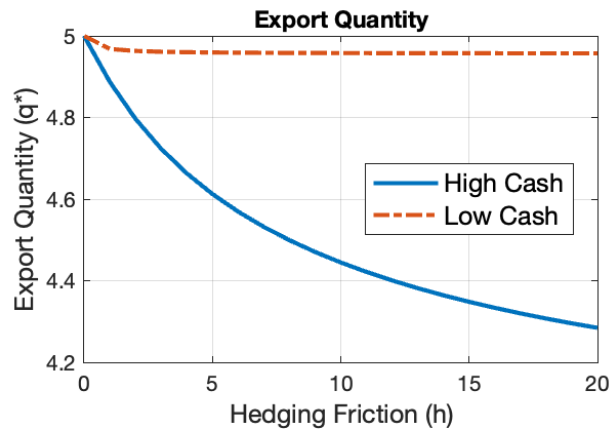


Figure C.3: **Reduction in Exports: High Cash Firms vs. Low Cash Firms**

Internet Appendix to “Real Consequences of Foreign Exchange Derivatives Hedging”

IA.A Background

This section presents the plots of Korea’s balance of payments, total external debt, short-term external debt, FX reserves, and FX liquidity.

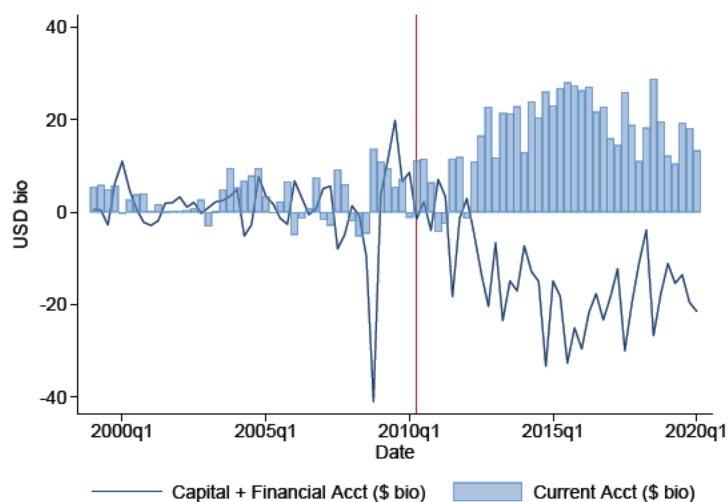


Figure IA.A.1: **Balance of Payments** Korea’s balance of payments. The vertical line indicates the imposition of the regulation.

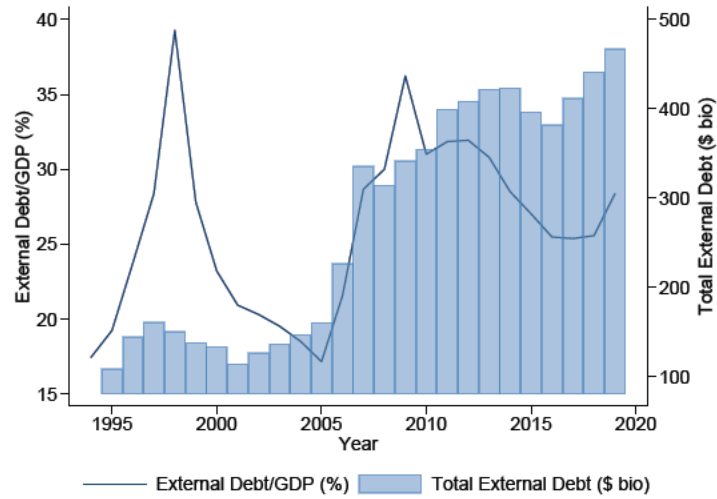


Figure IA.A.2: **Total External Debt** Korea's total external debt in billions of USD (bar) and external debt as a percentage of GDP (line).

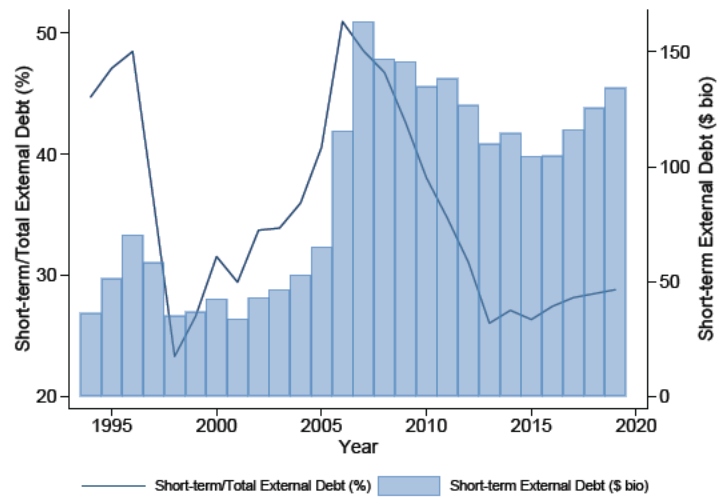


Figure IA.A.3: **Short-term External Debt** Korea's total short-term external debt in billions of USD (bar) and share of short-term external debt in percentage (line).

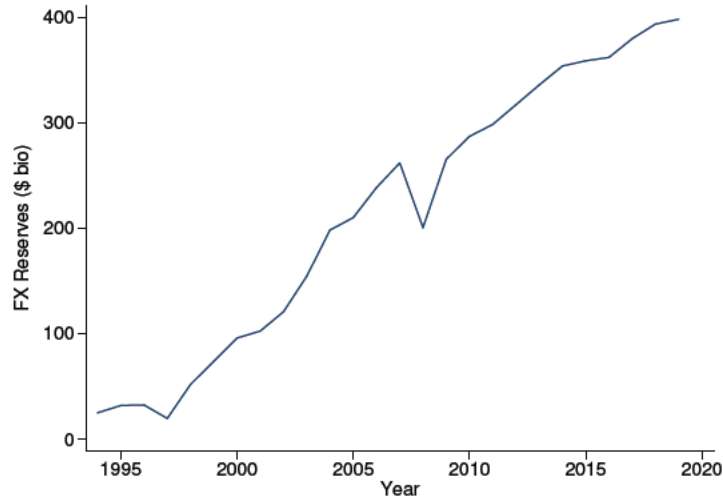


Figure IA.A.4: **FX Reserves** Bank of Korea's FX reserves in USD billion.

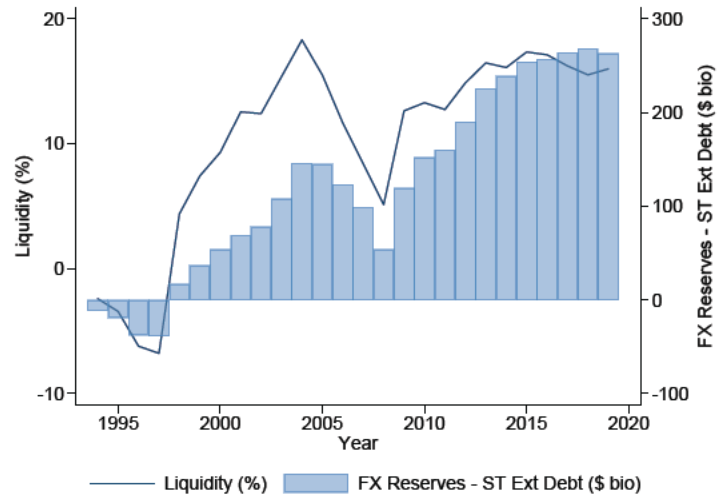


Figure IA.A.5: **FX Liquidity** Korea's FX reserves less short-term external debt in billions of USD (bar), and liquidity (line), defined as (FX Reserves - Short-term External Debt)/GDP.

IA.B Cash Flow Illustration

This section illustrates the cash flows from: an exporter's export sales in USD, FX forward contract between the exporter and a bank, and bank's trades to square the FX forward position.

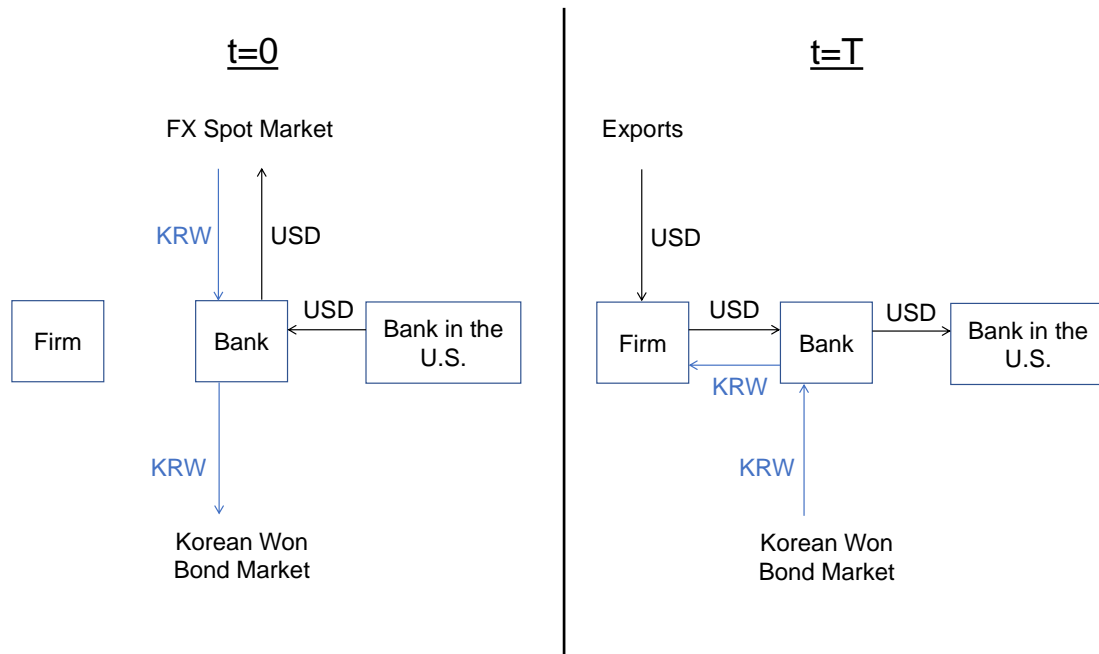


Figure IA.B.1: **Cash Flow Illustration** Consider the following transactions: (1) On $t = 0$ date, a firm (exporter) sells USD forward with maturity T to a bank. This does not involve any cash flows on $t = 0$ as it is a forward contract. On the same date, the bank borrows USD from its parent bank in the U.S., converts USD into KRW in the spot market, and buys KRW-denominated bonds. (2) At maturity $t = T$, the firm receives USDs from export sales and matches the USD amount of the forward contract. From the forward contract, the firm pays the USD and receives KRW. From the bank's perspective, it receives KRW from its investment in KRW-denominated bonds and pays KRW to the firm. The bank receives USD from the firm and pays USD back to its lender. If the maturity of bank's USD loan is T , then the bank is perfectly hedged.

IA.C Bank Names

	Bank	Full Name	Parent Country	Note
1	ANZ	Australia and New Zealand Bank	Australia	
2	BankComm	Bank of Communications	China	
3	BNP	BNP Paribas	France	
4	BNYMellon	BNY Mellon	US	
5	BOA	Bank Of America	US	
6	BOC	Bank Of China	China	
7	CCBC	China Construction Bank	China	
8	CIG	Credit Agricole Corporate and Investment Bank	France	
9	CS	Credit Suisse	Swiss	
10	DB	Deutsche Bank	Germany	
11	DBS	DBS	Singapore	
12	HSBC	HSBC	GB	
13	ICBC	Industrial and Commercial Bank of China	China	
14	ING	ING	Netherlands	
15	JPM	JP Morgan Chase	US	
16	Mellat	Mellat Bank	Iran	
17	MitsuiSumitomo	Mitsui Sumitomo	Japan	
18	Mizuho	Mizuho Bank	Japan	
19	MorganStanley	Morgan Stanley	GB	
20	MUFG	Mitsubishi UFJ	Japan	
21	Scotia	Scotia Bank	Canada	
22	SocGen	Societe Generale	France	
23	StateStreet	State Street	US	
24	UOB	United Overseas Bank	Singapore	
25	Yamaguchi	Yamguchi	Japan	
26	ABNRBS*	Royal Bank of Scotland	UK	RBS acquired ABN Amro in 2007 and RBS closed in 2014.
27	Barclays*	Barclays	UK	Closed in 2017.
28	GS*	Goldman Sachs International Bank	UK	Closed in 2017.
29	UBS*	UBS	Switzerland	Closed in 2017.
30	Busan	Busan Bank	Korea	
31	Citi	Cit bank Korea	Korea	
32	Daegu	Daegu Bank	Korea	
33	IBK	Industrial Bank of Korea	Korea	
34	Jeju	Jeju Bank	Korea	
35	Jeonbuk	Jeonbuk Bank	Korea	
36	KB	Kookmin Bank	Korea	
37	KDB	Korea Development Bank	Korea	
38	KEBHana	KEB Hana Bank	Korea	Hana bank before acquiring KEB in Feb 2012.
39	Kwangjoo	Kwangjoo Bank	Korea	
40	Kyongnam	Kyongnam Bank	Korea	
41	NH	Nonghyup Bank	Korea	
42	SH	Suhyup Bank	Korea	
43	Shinhan	Shinhan Bank	Korea	
44	StandChar	Standard Chartered Bank Korea	Korea	
45	Woori	Woori Bank	Korea	
46	KEB*	Korea Exchange Bank	Korea	Hana bank (KEBHana) acquired KEB in Feb 2012.

Table IA.C.1: Full Name of Sample Banks

IA.D Bank FXD Position before Regulation

Bank	Foreign	Assets	DerivPosition	Capital	DPTCRatio	DerivExceeded	Constrained	Shock	DPTARatio	CTARatio	DerivPosShare
UOB	1	1,601,133	1,292,500	122,000	11	987,500	1	0.76	0.81	0.08	0.02
Barclays*	1	11,670,373	2,525,772	277,580	9	1,831,821	1	0.73	0.22	0.02	0.04
StateStreet	1	2,077,924	823,084	102,148	8	567,715	1	0.69	0.4	0.05	0.01
CS	1	5,860,097	4,252,749	610,104	7	2,727,490	1	0.64	0.73	0.1	0.07
BNP	1	12,355,659	4,450,664	709,914	6	2,675,879	1	0.6	0.36	0.06	0.07
DBS	1	3,917,999	1,810,170	304,008	6	1,050,151	1	0.58	0.46	0.08	0.03
ANZ	1	4,190,502	1,185,243	220,920	5	632,943	1	0.53	0.28	0.05	0.02
BOA	1	7,201,784	1,796,047	358,225	5	900,485	1	0.5	0.25	0.05	0.03
MorganStanley	1	5,489,824	1,413,215	309,701	5	638,963	1	0.45	0.26	0.06	0.02
CIG	1	13,270,216	2,485,735	715,450	3	697,110	1	0.28	0.19	0.05	0.04
HSBC	1	20,617,534	5,994,277	1,972,932	3	1,061,948	1	0.18	0.29	0.1	0.1
ABNRBS*	1	7,155,556	1,470,707	489,208	3	247,686	1	0.17	0.21	0.07	0.02
ING	1	13,996,040	2,311,018	836,297	3	220,275	1	0.1	0.17	0.06	0.04
UBS*	1	5,095,065	1,141,340	443,393	3	32,857	1	0.03	0.22	0.09	0.02
Citi	0	44,900,564	2,982,505	4,264,960	1	850,025	1	0.29	0.07	0.09	0.05
StandChar	0	58,232,404	2,220,717	3,792,562	1	324,436	1	0.15	0.04	0.07	0.04
DB	1	9,893,187	1,942,116	821,928	2	-112,705	0	0	0.2	0.08	0.03
SocGen	1	6,284,281	1,211,031	563,549	2	-197,842	0	0	0.19	0.09	0.02
CCBC	1	1,276,478	160,987	168,333	1	-259,846	0	0	0.13	0.13	0
MUFG	1	8,464,476	912,865	986,416	1	-1,553,176	0	0	0.11	0.12	0.01
BNYMellon	1	1,124,330	103,472	142,688	1	-253,248	0	0	0.09	0.13	0
Scotia	1	1,008,951	61,785	113,939	1	-223,063	0	0	0.06	0.11	0
JPM	1	14,655,266	5,150,490	10,387,546	0	-20,818,374	0	0	0.35	0.71	0.08
Yamaguchi	1	117,378	20,306	54,831	0	-116,770	0	0	0.17	0.47	0
KEBHana	0	116,057,552	2,086,478	7,703,450	0	-1,765,247	0	0	0.02	0.07	0.03
KEB*	0	82,483,816	1,651,937	6,241,667	0	-1,468,896	0	0	0.02	0.08	0.03
Busan	0	26,102,380	403,293	1,804,721	0	-499,067	0	0	0.02	0.07	0.01
Woori	0	186,484,800	2,348,102	11,717,465	0	-3,510,631	0	0	0.01	0.06	0.04
KDB	0	104,773,424	2,529,950	12,961,896	0	-3,950,998	0	0	0.02	0.12	0.04
KB	0	219,698,320	2,071,910	15,240,589	0	-5,548,385	0	0	0.01	0.07	0.03
IBK	0	129,253,992	1,125,675	10,421,005	0	-4,084,828	0	0	0.01	0.08	0.02
Shinhan	0	168,008,736	1,098,607	11,709,110	0	-4,755,948	0	0	0.01	0.07	0.02
MitsuiSumitomo	1	4,826,040	79,700	1,045,047	0	-2,532,917	0	0	0.02	0.22	0
NH	0	156,517,472	832,138	11,855,901	0	-5,095,813	0	0	0.01	0.08	0.01
Daegu	0	23,864,670	40,901	645,505	0	-281,852	0	0	0	0.03	0
GS*	1	2,304,765	-5,726	187,500	0	-463,024	0	0	0	0.08	0
Kyongnam	0	17,481,136	32,240	1,238,000	0	-586,760	0	0	0	0.07	0
Kwangjoo	0	13,614,953	9,186	940,000	0	-460,814	0	0	0	0.07	0
SH	0	16,038,712	2,793	704,286	0	-349,350	0	0	0	0.04	0
Mizuho	1	5,995,878	-240	634,977	0	-1,587,202	0	0	0	0.11	0
Jeonbuk	0	6,192,970	0	229,462	0	-114,731	0	0	0	0.04	0
Jeju	0	2,526,683	0	180,000	0	-90,000	0	0	0	0.07	0
Mellat	1	2,615,603	0	82,812	0	-207,030	0	0	0	0.03	0
ICBC	1	2,110,354	0	582,500	0	-1,456,250	0	0	0	0.28	0
BankComm	1	1,763,835	0	253,333	0	-633,333	0	0	0	0.14	0
BOC	1	1,406,988	0	230,390	0	-575,974	0	0	0	0.16	0

Table IA.D.1: **Bank FXD Positions (As of December 2009)** *Foreign* is 1 if the bank is a foreign bank branch and 0 if otherwise. *Assets*, *DerivPosition*, and *Capital* are in 1,000 USD. *DPTCRatio* is derivatives-position-to-capital ratio. *DerivExceeded* is *DerivPosition* less the size (in 1,000 USD) of the derivatives position the bank is allowed to take. *Constrained* is 1 if the bank needs to reduce its DPTC ratio and 0 if otherwise. *Shock* is *DerivExceeded*/*DerivPosition*. *DPTARatio* is derivatives-position-to-assets ratio. *CTARatio* is capital-to-assets ratio. *DerivPosShare* is market share. * indicates closed banks. Full names and parent bank's country are listed in Table IA.C.1.

IA.E Summary Statistics of Subsamples

This section reports the summary statistics of subsamples.

	Full Sample		Constrained		Unconstrained		Difference	
	mean	sd	mean	sd	mean	sd	b	t
Notional Net (USD mio)	-19.8	41	-27.0	39	-16.6	41	10	(1.4)
FXDNet/Assets (%)	-7.9	10	-10.2	11	-6.9	9	3	(1.7)
Direction: Firm sells FC (%)	98.7	7	98.5	8	98.8	6	0	(0.2)
Pair: USD-KRW (%)	86.3	30	91.0	25	84.3	31	-7	(-1.3)
Pair: JPY-KRW (%)	9.3	25	2.6	16	12.3	28	10*	(2.5)
Pair: EUR-KRW (%)	3.5	14	3.9	13	3.4	15	-1	(-0.2)
Type: Forwards (%)	80.9	38	66.0	46	87.5	32	21**	(2.7)
Type: Swaps (%)	3.1	16	1.2	8	3.9	19	3	(1.1)
Type: Options (%)	15.3	35	32.7	46	7.5	25	-25**	(-3.3)
Type: Futures (%)	0.8	9	0.0	0	1.1	11	1	(1.0)
Observations	129		40		89		129	

Table IA.E.1: **FXD Contracts Summary Statistics (Exporters' Contracts)** Subsample of FXD contracts of the firms with negative net FXD position. All variables are computed as of Dec 2009 and are defined in [Table B.1](#). I define contract as firm-bank pair.

	Full Sample		Exposed		Non-Exposed		Difference	
	mean	sd	mean	sd	mean	sd	b	t
Assets (USD mio)	1,619.693	5947.10	2,277.264	8795.78	1,231.489	3287.01	-1045.78	(-0.80)
FXDNet/Assets	-0.056	0.14	-0.052	0.15	-0.058	0.13	-0.01	(-0.25)
Sales (USD mio)	1,208.244	3400.29	1,500.800	4455.40	1,035.530	2601.87	-465.27	(-0.67)
FXDNet/Sales	-0.058	0.21	-0.037	0.21	-0.071	0.21	-0.03	(-0.88)
Number of Banks	2.288	2.21	2.531	2.14	2.145	2.25	-0.39	(-0.98)
Log Size	26.471	1.61	26.623	1.63	26.381	1.60	-0.24	(-0.83)
Leverage	0.467	0.17	0.500	0.16	0.448	0.18	-0.05	(-1.74)
Gross Profit Margin	0.218	0.17	0.213	0.19	0.222	0.16	0.01	(0.29)
FC Asset Share	0.099	0.12	0.091	0.12	0.103	0.11	0.01	(0.56)
FC Liab Share	0.198	0.20	0.246	0.19	0.169	0.21	-0.08*	(-2.20)
Export Share	0.455	0.31	0.427	0.32	0.473	0.30	0.05	(0.79)
Export Hedge Ratio	0.357	0.68	0.385	0.67	0.339	0.70	-0.05	(-0.34)
FCL Hedge Ratio	0.295	0.46	0.314	0.45	0.283	0.47	-0.03	(-0.38)
Observations	132		49		83		132	

Table IA.E.2: **Firm Summary Statistics (Fully disclosed Firms)** Subsample of firms that fully disclosed their FXD counterparties. These firms' contracts are analyzed in the contract-level analysis (subsection 4.2). All variables are computed as of Dec 2009 and are defined in Table B.1.

	FullSample		Exposed		Non-Exposed		Difference	
	mean	sd	mean	sd	mean	sd	b	t
Assets (USD mio)	1,378.542	3554.30	1,325.730	3535.54	1,404.095	3591.85	78.37	(0.10)
FXDNet/Assets	-0.163	0.20	-0.164	0.18	-0.162	0.21	0.00	(0.06)
Sales (USD mio)	1,082.764	2722.87	1,071.161	2615.15	1,088.378	2794.43	17.22	(0.03)
FXDNet/Sales	-0.208	0.30	-0.184	0.25	-0.219	0.32	-0.03	(-0.58)
Number of Banks	1.859	1.14	1.833	1.05	1.871	1.19	0.04	(0.15)
Log Size	26.343	1.66	26.376	1.54	26.327	1.72	-0.05	(-0.14)
Leverage	0.487	0.19	0.500	0.17	0.481	0.20	-0.02	(-0.45)
Gross Profit Margin	0.199	0.14	0.210	0.19	0.194	0.12	-0.02	(-0.44)
FC Asset Share	0.131	0.12	0.124	0.12	0.135	0.12	0.01	(0.42)
FC Liab Share	0.166	0.21	0.205	0.19	0.148	0.21	-0.06	(-1.29)
Export Share	0.563	0.27	0.522	0.28	0.586	0.27	0.06	(1.00)
Export Hedge Ratio	0.595	0.79	0.661	0.81	0.558	0.79	-0.10	(-0.57)
FCL Hedge Ratio	0.413	2.69	1.011	4.55	0.103	0.48	-0.91	(-1.09)
Observations	92		30		62		92	

Table IA.E.3: **Firm Summary Statistics (Exporters)** Subsample of firms with negative net FXD position. It *includes* the firms that do not fully disclose their FXD counterparties. All variables are computed as of Dec 2009 and are defined in Table B.1.

	FullSample		Exposed		Non-Exposed		Difference	
	mean	sd	mean	sd	mean	sd	b	t
Assets (USD mio)	1,487.513	3745.06	1,325.730	3535.54	1,580.850	3891.48	255.12	(0.30)
FXDNet/Assets	-0.162	0.20	-0.164	0.18	-0.161	0.22	0.00	(0.08)
Sales (USD mio)	1,160.832	2869.75	1,071.161	2615.15	1,212.566	3030.44	141.41	(0.22)
FXDNet/Sales	-0.208	0.30	-0.184	0.25	-0.221	0.33	-0.04	(-0.57)
Number of Banks	1.817	1.03	1.833	1.05	1.808	1.03	-0.03	(-0.11)
Log Size	26.361	1.70	26.376	1.54	26.353	1.79	-0.02	(-0.06)
Leverage	0.477	0.19	0.500	0.17	0.464	0.19	-0.04	(-0.86)
Gross Profit Margin	0.204	0.14	0.210	0.19	0.200	0.12	-0.01	(-0.29)
FC Asset Share	0.130	0.12	0.124	0.12	0.134	0.12	0.01	(0.36)
FC Liab Share	0.178	0.22	0.205	0.19	0.163	0.23	-0.04	(-0.89)
Export Share	0.564	0.27	0.522	0.28	0.588	0.27	0.07	(1.04)
Export Hedge Ratio	0.597	0.80	0.661	0.81	0.560	0.80	-0.10	(-0.54)
FCL Hedge Ratio	0.457	2.84	1.011	4.55	0.118	0.53	-0.89	(-1.07)
Observations	82		30		52		82	

Table IA.E.4: **Firm Summary Statistics (Fully Disclosed Exporters)** Subsample of firms with negative net FXD position. It *excludes* the firms that do not fully disclose their FXD counterparties. All variables are computed as of Dec 2009 and are defined in [Table B.1](#).

	FullSample		Exposed		Non-Exposed		Difference	
	mean	sd	mean	sd	mean	sd	b	t
Assets (USD mio)	541.577	1589.81	529.287	1357.29	549.057	1730.51	19.77	(0.05)
FXDNet/Assets	-0.120	0.13	-0.141	0.14	-0.106	0.12	0.03	(1.08)
Sales (USD mio)	481.355	1218.33	521.483	1483.71	456.929	1041.86	-64.55	(-0.20)
FXDNet/Sales	-0.144	0.19	-0.146	0.15	-0.142	0.21	0.00	(0.10)
Number of Banks	1.878	1.05	1.893	1.07	1.870	1.05	-0.02	(-0.09)
Log Size	25.972	1.26	26.101	1.17	25.895	1.32	-0.21	(-0.70)
Leverage	0.454	0.18	0.482	0.16	0.437	0.19	-0.05	(-1.11)
Gross Profit Margin	0.210	0.15	0.218	0.19	0.206	0.12	-0.01	(-0.29)
FC Asset Share	0.134	0.13	0.127	0.13	0.137	0.13	0.01	(0.33)
FC Liab Share	0.183	0.22	0.215	0.20	0.164	0.24	-0.05	(-1.01)
Export Share	0.546	0.27	0.518	0.28	0.562	0.27	0.04	(0.67)
Export Hedge Ratio	0.519	0.78	0.574	0.75	0.486	0.80	-0.09	(-0.47)
FCL Hedge Ratio	0.097	0.44	0.143	0.47	0.067	0.43	-0.08	(-0.69)
Observations	74		28		46		74	

Table IA.E.5: **Firm Summary Statistics (Export Sales Analysis)** Subsample of firms with negative net FXD position. It *excludes* the firms that do not fully disclose their FXD counterparties and also excludes firms with missing export sales value in either 2009 or 2010. All variables are computed as of Dec 2009 and are defined in [Table B.1](#).

IA.F Net FXD Buying Firms and Selling Firms

This section presents the details of the full sample of 148 firms, grouped by the sign of net FXD position.

No	Stock	Firm	FullDisc	Industry
1	036460	KoreaGas	0	Gas and Electricity
2	030200	KT	1	IT and Tele-communication
3	096770	SKInnov	0	Manufacturing
4	004170	SSG	1	Retail
5	015760	Kepco	1	Gas and Electricity
6	023530	LotteShop	1	Retail
7	004990	LotteHoldings	1	Science and Technology
8	011170	LotteChem	1	Manufacturing
9	097950	CJCheil	0	Manufacturing
10	071320	KoreaHeat	1	Gas and Electricity
11	051910	LGChem	0	Manufacturing
12	069960	HyundaiDept	1	Retail
13	010950	SOil	1	Manufacturing
14	000210	Daelim	1	Construction
15	001120	LGIntl	1	Retail
16	009830	HanhwaSol	1	Manufacturing
17	011780	Kumho	1	Manufacturing
18	003490	KoreanAir	1	Transportation and Shipping
19	011930	Shinsung	1	Manufacturing
20	069620	Daewoong	1	Manufacturing
21	007070	GSRetail	1	Retail
22	006280	GreenCross	1	Manufacturing
23	003030	SeahSteel	1	Science and Technology
24	001790	DaehanSugar	1	Manufacturing
25	004000	LotteFineChem	1	Manufacturing
26	002350	NexenTire	1	Manufacturing
27	000070	Samyang	0	Science and Technology
28	006120	SKDiscovery	0	Science and Technology
29	009200	Moorim	1	Manufacturing
30	010060	OCI	1	Manufacturing
31	058650	SeahHoldings	1	Manufacturing
32	049770	DongwonFB	1	Manufacturing
33	090350	NorooPaint	1	Manufacturing
34	001810	MoorimSP	1	Manufacturing
35	084010	DaehanSteel	1	Manufacturing
36	006840	AKHoldings	1	Science and Technology
37	004140	Dongbang	1	Transportation and Shipping
38	117580	DaesungEnergy	1	Gas and Electricity
39	014190	Wonik	1	Retail
40	002840	Miwon	1	Manufacturing
41	005990	MaeilHoldings	1	Manufacturing
42	067830	Savezone	1	Retail
43	000320	Noroo	1	Science and Technology
44	060540	SAT	1	Manufacturing
45	004710	HansolTech	1	Manufacturing
46	155660	DSR	1	Manufacturing
47	014160	Daeyoung	1	Manufacturing
48	010660	Hwacheon	1	Manufacturing
49	166090	HanaMaterials	1	Manufacturing
50	059090	MiCo	1	Manufacturing
51	003160	DI	1	Manufacturing
52	084870	TBH	1	Manufacturing
53	041650	Sangsin	1	Manufacturing
54	033320	JCHyun	1	Retail
55	013520	Hwaseung	1	Manufacturing
56	049480	Openbase	1	IT and Tele-communication

Table IA.F.1: **Net FXD Buyers (“Non-exporters”)** The list of name, stock ticker, and industry of the firms with *positive* net FXD position as of December 2009. *FullDisc* is 1 if the firm fully disclosed its FXD counterparties.

No	Stock	Firm	FullDisc	Industry	No	Stock	Firm	FullDisc	Industry
1	9540	HyundaiHeavy	0	Manufacturing	47	53620	Taeyang	1	Manufacturing
2	10140	SamsungHeavy	0	Manufacturing	48	9160	Simpac	1	Manufacturing
3	42660	DaewooShip	0	Manufacturing	49	67310	HanaMicron	1	Manufacturing
4	42670	DoosanInfra	0	Manufacturing	50	78890	KaonMedia	1	Manufacturing
5	10620	HyundaiMipo	0	Manufacturing	51	79950	Invenia	1	Manufacturing
6	34020	DoosanHeavy	0	Manufacturing	52	36930	Joosung	1	Manufacturing
7	82740	HSDEngine	0	Manufacturing	53	109740	DSK	1	Manufacturing
8	6360	GSCons	0	Construction	54	29460	KC	1	Manufacturing
9	77970	STXEngine	0	Manufacturing	55	7630	PolusBioPharm	1	Retail
10	36890	JinSungTEC	1	Manufacturing	56	66110	Hanp	1	Manufacturing
11	97230	HanjinHeavy	0	Construction	57	7860	Seoyon	1	Science and Technology
12	21050	Seowon	1	Manufacturing	58	79980	Huvis	1	Manufacturing
13	660	SKHynix	1	Manufacturing	59	86450	DongkookPharm	1	Manufacturing
14	720	HyundaiCons	1	Construction	60	49830	Seungil	1	Manufacturing
15	83650	BHI	1	Manufacturing	61	19490	Hitron	1	Manufacturing
16	10120	LS	1	Manufacturing	62	20150	IljinMaterials	1	Manufacturing
17	10130	KoreaZinc	1	Manufacturing	63	27970	Seha	1	Manufacturing
18	5850	SL	1	Manufacturing	64	46310	BGTNA	1	Manufacturing
19	53660	Hyunjin	1	Manufacturing	65	54540	SamyoungMT	1	Manufacturing
20	4060	Segye	1	Retail	66	66310	QSI	1	Manufacturing
21	12800	Daechang	1	Manufacturing	67	33530	Sejong	1	Manufacturing
22	54950	JVM	1	Manufacturing	68	8970	DongyangPipe	1	Manufacturing
23	13570	DY	1	Science and Technology	69	99320	Satrec	1	Manufacturing
24	68790	DMS	1	Manufacturing	70	43340	EssenTech	1	Manufacturing
25	150	Doosan	1	Science and Technology	71	53450	Sekonix	1	Manufacturing
26	91090	SewonCellon	1	Manufacturing	72	1250	GSGlobal	1	Retail
27	11790	SKC	1	Manufacturing	73	5670	Foodwell	1	Manufacturing
28	9440	KCGreen	1	Science and Technology	74	49550	Inktec	1	Manufacturing
29	65130	TopEngi	1	Manufacturing	75	31980	PSK	1	Manufacturing
30	79960	DongyangENP	1	Manufacturing	76	30720	DongwonFish	1	Agriculture and Fishing
31	23810	Infac	1	Manufacturing	77	51360	Tovis	1	Manufacturing
32	5950	IsuChem	1	Manufacturing	78	500	GaonCable	1	Manufacturing
33	122900	IMarket	1	Retail	79	92460	HanlaIMS	1	Manufacturing
34	27580	Sangbo	1	Manufacturing	80	23960	SCEngi	1	Construction
35	35150	Baiksans	1	Manufacturing	81	45100	HanyangENG	1	Science and Technology
36	95500	MiraeNano	1	Manufacturing	82	7980	Pacific	1	Manufacturing
37	34730	SK	1	Science and Technology	83	24800	YoosungTnS	1	Transportation and Shipping
38	16800	Fursys	1	Manufacturing	84	41910	Estech	1	Manufacturing
39	14830	Unid	1	Manufacturing	85	52710	Amotech	1	Manufacturing
40	37070	Paseco	1	Manufacturing	86	70590	HansolInticube	1	IT and Tele-communication
41	47310	PowerLogics	1	Manufacturing	87	65950	Welcron	1	Manufacturing
42	89030	TechWing	1	Manufacturing	88	19540	IljiTech	1	Manufacturing
43	11300	Seongan	1	Manufacturing	89	92600	NCN	1	Manufacturing
44	11760	HyundaiCorp	1	Retail	90	105740	DKLok	1	Manufacturing
45	43150	Vatech	1	Manufacturing	91	59100	Icomponent	1	Manufacturing
46	44340	Winix	1	Manufacturing	92	18880	Hanon	1	Manufacturing

Table IA.F.2: **Net FXD Sellers (“Exporters”)** The list of name, stock ticker, and industry of the firms with *negative* net FXD position as of December 2009. *FullDisc* is 1 if the firm fully disclosed its FXD counterparties.

IA.G FXD Contract Level OLS: FXD Scaled by Sales

This section reports the results of the contract level analysis when the outcome variable is scaled by sales instead of by assets.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exporters	Exporters	Non-exporters	Non-exporters	Full Sample	Full Sample
Constrained	0.0649*** (4.68)	0.0344** (2.17)	0.00718 (1.51)	0.00437 (1.22)	0.0291*** (2.86)	0.00807 (1.10)
Type Swaps		0.0106 (0.50)		-0.000135 (-0.01)		0.00255 (0.33)
Type Options		0.137*** (3.69)		0 (.)		0.150*** (4.66)
Type Futures		0.0253 (1.10)		0 (.)		0.0208* (2.01)
Pair EURKRW		0.0511* (1.96)		0 (.)		0.0276* (1.76)
Pair JPYKRW		-0.0505* (-2.12)		0.0104 (1.05)		-0.0123 (-0.95)
Pair XXXKRW		0.0105 (0.58)		0.0315** (2.36)		0.0111 (1.30)
FirmControls	N	Y	N	Y	N	Y
BankControls	N	Y	N	Y	N	Y
N	129	129	122	122	251	251
RSqr	0.0841	0.461	0.0162	0.449	0.0333	0.435

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table IA.G.1: **FXD Contract level OLS** $\Delta FXD_{i,j} = \alpha + \beta \text{Constrained}_b + \text{FirmControls}_j + \text{BankControls}_i + \text{ContractControls}_{i,j} + \varepsilon_{i,j}$ The dependent variable is the change in the net FXD notional dealt between firm j and bank b , **scaled by sales**. Bind_b is 1 if the contract is dealt with a binding bank. Firm controls include log size, net FXD notional (scaled by sales) before the shock, foreign currency liability share, and seven industry dummies. Bank controls include log size, loans-to-assets ratio, leverage ratio, and a foreign bank indicator variable. Contract controls include bank b 's share of firm j 's total FXD notional, type, and currency pair. The omitted categories are forwards and USD-KRW pair. Standard errors are clustered at the bank level.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exporters	Exporters	Non-exporters	Non-exporters	Full Sample	Full Sample
Constrained	0.0272* (1.94)	0.0281* (1.76)	0.00442 (0.97)	0.00329 (0.88)	0.0146*** (3.12)	0.00722 (1.05)
Type Swaps		-0.00475 (-0.21)		-0.00635 (-0.56)		-0.00582 (-0.73)
Type Options		0 (.)		0 (.)		0 (.)
Type Futures		0.0275 (1.54)		0 (.)		0.0179** (2.68)
Pair EURKRW		0.0487 (1.54)		0 (.)		0.0317*** (2.97)
Pair JPYKRW		-0.0296 (-1.25)		0.0152 (1.65)		-0.00292 (-0.28)
Pair XXXKRW		0.00655 (0.37)		0.0181 (1.19)		0.00329 (0.40)
FirmControls	N	Y	N	Y	N	Y
BankControls	N	Y	N	Y	N	Y
N	111	111	122	122	233	233
RSqr	0.0290	0.109	0.00719	0.322	0.0186	0.0714

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table IA.G.2: **FXD Contract level OLS** $\Delta FXD_{i,j} = \alpha + \beta Constrained_i + FirmControls_j + BankControls_i + ContractControls_{i,j} + \varepsilon_{i,j}$ **FX Options contracts are excluded.** The dependent variable is change in net FXD notional scaled by sales.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exporters	Exporters	Non-exporters	Non-exporters	Full Sample	Full Sample
Shock	0.0360*** (3.07)	0.0179** (2.15)	0.00252 (1.63)	0.000285 (0.18)	0.00894 (1.54)	0.000922 (0.26)
Type Swaps		0.0136 (0.66)		-0.0000924 (-0.01)		0.00318 (0.41)
Type Options		0.138*** (3.69)		0 (.)		0.151*** (4.77)
Type Futures		0.0244 (1.07)		0 (.)		0.0212* (2.00)
Pair EURKRW		0.0418 (1.58)		0 (.)		0.0272* (1.84)
Pair JPYKRW		-0.0522* (-2.10)		0.00739 (0.77)		-0.0159 (-1.27)
Pair XXXKRW		0.00906 (0.54)		0.0374** (2.64)		0.0145 (1.59)
FirmControls	N	Y	N	Y	N	Y
BankControls	N	Y	N	Y	N	Y
N	129	129	122	122	251	251
RSqr	0.0654	0.458	0.0111	0.447	0.0131	0.434

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table IA.G.3: **FXD Contract Level OLS** $\Delta FXD_{i,j} = \alpha + \beta_{Shock} Shock_i + FirmControls_j + BankControls_i + ContractControls_{i,j} + \varepsilon_{i,j}$ The dependent variable is the change in the net FXD notional dealt between firm j and bank b , **scaled by sales**. $Shock_b$ is the percentage of bank b 's FXD position that needed to be reduced at the imposition of the regulation. Firm controls include log size, net FXD notional (scaled by sales) before the shock, foreign currency liability share, and seven industry dummies. Bank controls include log size, loans-to-assets ratio, leverage ratio, and foreign bank indicator variable. Contract controls include bank b 's share of firm j 's total FXD notional, type, and currency pair. The omitted categories are forwards and USD-KRW pair. Standard errors are clustered at the bank level.

	(1)	(2)	(3)	(4)	(5)	(6)
	Exporters	Exporters	Non-exporters	Non-exporters	Full Sample	Full Sample
Shock	0.0182** (2.61)	0.0177** (2.36)	0.00156 (1.01)	0.000781 (0.46)	0.00612*** (2.86)	0.00199 (0.65)
Type Swaps		-0.0000793 (-0.00)		-0.00627 (-0.54)		-0.00527 (-0.67)
Type Options		0 (.)		0 (.)		0 (.)
Type Futures		0.0253 (1.44)		0 (.)		0.0181** (2.66)
Pair EURKRW		0.0414 (1.41)		0 (.)		0.0309*** (3.07)
Pair JPYKRW		-0.0300 (-1.23)		0.0139 (1.54)		-0.00494 (-0.46)
Pair XXXKRW		0.00289 (0.15)		0.0235 (1.45)		0.00592 (0.67)
FirmControls	N	Y	N	Y	N	Y
BankControls	N	Y	N	Y	N	Y
N	111	111	122	122	233	233
RSqr	0.0331	0.109	0.00481	0.321	0.0141	0.0699

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table IA.G.4: **FXD Contract level OLS** $\Delta FXD_{i,j} = \alpha + \beta_{Shock} Shock_i + FirmControls_j + BankControls_i + ContractControls_{i,j} + \varepsilon_{i,j}$ **FX Options contracts are excluded.** The dependent variable is the change in the net FXD notional dealt between firm j and bank b , scaled by sales.