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匯率決定中的避險傳導機制：以日本為結構性異常案例

The Hedging Channel of Exchange Rate Determination: Evidence from Japan as a Structural Outlier

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摘要

本研究探討匯率決定中的避險傳導機制，特別聚焦於日本——一個在結構上與國際金融文獻中常見的債務國模型有所不同的國家。主要研究問題在於：在一個淨債權經濟體的背景下，交叉貨幣基差（CCB）、遠期與即期匯率如何對利率差異與避險行為做出反應。研究使用 2010 年至 2023 年的月度數據，透過迴歸分析探討美元計價的對外債務、對外資產部位與匯率波動性之間的互動關係。實證方法在 Liao 與 Zhang（2025）提出的理論模型基礎上加以重現與擴展，並納入來自日本銀行、國際貨幣基金與美國聯準會的日本特定資料。

儘管日本的 CCB 長期呈現負值——這在過去通常與債務國相聯繫——其成因來自資產端的避險，而非債務償付。在市場波動期間，日本投資者為避險美元資產而買入日圓遠期合約，理論上對日圓形成升值壓力。然而，這一結構性力量可能會被利差與資本流動所抵消，如 2022 至 2023 年日圓貶值的現象所示。雖然債務國與日本皆表現出負值的 CCB，但其背後動因不同：債務國為對沖負債而拋售本幣遠期，而日本投資者則是為對沖資產而買入日圓。這一差異對於理解避險型經濟體中的匯率行為具有關鍵意義。

本研究成果對匯率建模、企業避險策略及貨幣政策均具有啟示意義，並強調在分析避險型經濟體中的交叉貨幣基差變動時，應明確區分以負債為導向與以資產為導向的避險行為。

關鍵詞：匯率動態、避險行為、利率差異、交叉貨幣基差、日本

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Abstract

This study investigates the hedging channel of exchange rate determination with a specific focus on Japan, a country that structurally deviates from the typical debtor-nation model commonly found in international finance literature. The primary research question explores how cross-currency basis (CCB), forward and spot exchange rates respond to interest rate differentials and hedging behavior in the context of a net creditor economy. Utilizing monthly data from 2010 to 2023, the study employs regression analysis to examine the interaction between external U.S. dollar-denominated debt, foreign asset positions, and exchange rate volatility. The empirical framework replicates and extends the theoretical model of Liao and Zhang (2025) by incorporating Japan-specific data from the Bank of Japan, IMF, and Federal Reserve.

Although Japan's CCB remains persistently negative—typically associated with debtor countries—this is driven by asset-side hedging rather than debt servicing. During market volatility, Japanese investors buy yen forward to hedge USD assets, creating yen appreciation pressure in theory. However, this structural force may be overwhelmed by interest rate differentials and capital flows, as observed in the 2022–2023 yen depreciation. While both debtor countries and Japan exhibit negative CCBs, the underlying drivers differ: debtor nations hedge liabilities by selling local currency forward, whereas Japanese investors hedge assets by buying yen. This distinction is key to interpreting currency behavior in safe-haven economies. The results have implications for exchange rate modeling, corporate hedging strategies, and monetary policy. They underscore the importance of distinguishing between liability-driven and asset-driven hedging when analyzing cross-currency basis movements in safe-haven economies.

Keywords: **exchange rate dynamics, hedging behavior, interest rate differentials, cross-currency basis, Japan**

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List of Abbreviations

BOJ	Bank of Japan
CCB	Cross-Currency Basis
CIP	Covered Interest Parity
FX	Foreign Exchange
FXVol	Foreign Exchange Volatility
GDP	Gross Domestic Product
IIP	International Investment Position
JPY	Japanese Yen
NIIP	Net International Investment Position
SOFR	Secured Overnight Financing Rate
TIBOR	Tokyo Interbank Offered Rate
UIP	Uncovered Interest Parity
LIBOR	London Interbank Offered Rate
IMF	International Monetary Fund
BIS	Bank for International Settlements
FDI	Foreign Direct Investment
GFC	Global Financial Crisis

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1. Introduction

1.1 Background

Exchange rate fluctuations remain a central puzzle in international economics, with macroeconomic fundamentals often failing to explain high-frequency exchange rate movements (Meese and Rogoff, 1983). Recent studies have highlighted the role of financial intermediary constraints and external imbalances in shaping exchange rate dynamics (Gabaix and Maggiori, 2015; Borio et al., 2018). Among them, Liao and Zhang (2025) propose a novel "hedging channel," suggesting that countries' external dollar positions—especially when hedged—can drive both forward and spot exchange rates in a systematic way.

In the case of Japan, the exchange rate has undergone substantial structural depreciation since 2010. Despite maintaining ultra-low interest rates through policies such as the zero interest rate policy (ZIRP), quantitative easing (QQE), and yield curve control (YCC), the Japanese yen has weakened markedly—from around 85–100 yen per dollar during 2010–2012 to over 145 yen per dollar in 2023. The depreciation accelerated during the 2022–2023 period, when the U.S. Federal Reserve initiated aggressive rate hikes while the Bank of Japan maintained its dovish stance. This historic yen depreciation has had significant implications, including:

- A sharp rise in import prices and energy costs, contributing to domestic inflation;
- Deterioration of real household income and purchasing power;
- Increased hedging costs for Japanese firms with dollar-denominated liabilities.

Yet, this yen depreciation cannot be fully explained by interest differentials alone. For example, during periods of financial volatility such as the COVID-19 crisis, the yen appreciated

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despite wide interest gaps, indicating the possible influence of hedging flows and Japan's unique external asset structure. These observations warrant a closer examination of Japan's hedging behavior and its impact on exchange rate determination.

1.2 Purpose and Research Questions

This study applies the hedging channel framework to the case of Japan, a country with significant USD asset holdings and a consistently negative cross-currency basis (CCB). The purpose is to investigate:

- How Japan's forward and spot exchange rates respond to volatility shocks;
- Whether asset-side hedging (as opposed to debt-side hedging) explains Japan's deviation from the global pattern;
- How structural factors such as investor behavior and institutional constraints contribute to persistent CCB asymmetries.

1.3 Scope and Limitations

This research focuses on Japan's external USD positions and CCB behavior between January 2010 and December 2023. While the framework originates from a global model developed by Liao and Zhang (2025), this study narrows its scope to Japan to analyze its role as a structural outlier in hedging-driven exchange rate dynamics.

Several limitations should be noted:

- The analysis does not use proprietary data such as Bloomberg's market quotes for forwards or risk reversals, due to access constraints.

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- As a result, the forward premium is approximated using theoretical parity values, calculated from interest rate differentials and spot exchange rates using the following approximation:

$$f_t^{JPY/USD} \approx s_t + (r_t^{USD} - r_t^{JPY})$$

Where: $f_t^{JPY/USD}$ is the 1-year forward exchange rate, s_t is the spot exchange rate, r_t^{USD} and r_t^{JPY} are the U.S. and Japanese interest rates at time t, respectively.

- Risk reversal data, which provide a direct measure of option-implied skewness and hedging asymmetry, are also unavailable. Thus, this study relies on implied volatility from 1-year ATM FX options as a proxy for market uncertainty.

- The hedge ratios of institutional investors are unobservable in the public domain. Accordingly, hedge behavior is inferred indirectly through macro-level indicators, such as net USD positions and cross-currency basis movements.

Despite these limitations, the analysis provides valuable insights by combining theory-driven inference with observable macro-financial data.

1.4 Significance of the Study

By identifying a structural deviation in Japan's exchange rate behavior, this study contributes to the theoretical understanding of the hedging channel in developed markets. While previous research has largely focused on debtor economies or emerging markets, this study highlights how a net creditor country like Japan—with structurally high foreign asset exposure and strong hedge incentives—can exhibit opposite hedging dynamics and market responses.

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In practical terms, the findings are relevant not only for policymakers and institutional investors but also for:

- Central banks, in understanding how global hedging flows influence domestic currency valuation and CCB distortions.
- Corporate financial managers managing USD exposures through forwards and options;
- Households and consumers, who are indirectly affected by yen depreciation via energy and food import costs;

Ultimately, this study offers a framework to assess the interaction between macro-financial volatility, external imbalances, and institutional hedging behavior—a critical issue for Japan as global monetary policy enters a new cycle.

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2. Literature Review

Exchange rate determination has long posed a challenge to economists, particularly due to the inability of traditional models to consistently explain short-term fluctuations. This literature review traces the evolution of theoretical frameworks from foundational models like purchasing power parity (PPP) and interest parity conditions, to more recent perspectives emphasizing financial frictions, intermediary constraints, and investor hedging behavior. While early theories rely heavily on macroeconomic fundamentals, subsequent research highlights how market segmentation and the balance sheet behavior of institutional investors can distort forward and spot exchange rates. In particular, the "hedging channel" model proposed by Liao and Zhang (2025) offers a microstructure-based explanation in which cross-currency basis (CCB) deviations are driven by country-specific net USD exposures and volatility-induced hedging flows. This framework is especially relevant for Japan—a structurally unique net creditor country—whose persistent forward overvaluation and negative basis cannot be fully explained by global debt-based mechanisms. Accordingly, this chapter reviews the theoretical and empirical literature surrounding these developments, identifies gaps in the Japan-specific application, and sets the stage for the empirical investigation that follows.

2.1 Traditional Views on Exchange Rate Determination

Traditional models of exchange rate determination, such as Purchasing Power Parity (PPP) and Uncovered Interest Parity (UIP), propose that exchange rates should reflect differences in inflation or interest rates between countries. However, these models have long struggled to explain short-term or high-frequency currency movements. Meese and Rogoff (1983) famously demonstrated that such structural models often perform no better than a random walk in forecasting exchange rates, especially over short horizons.

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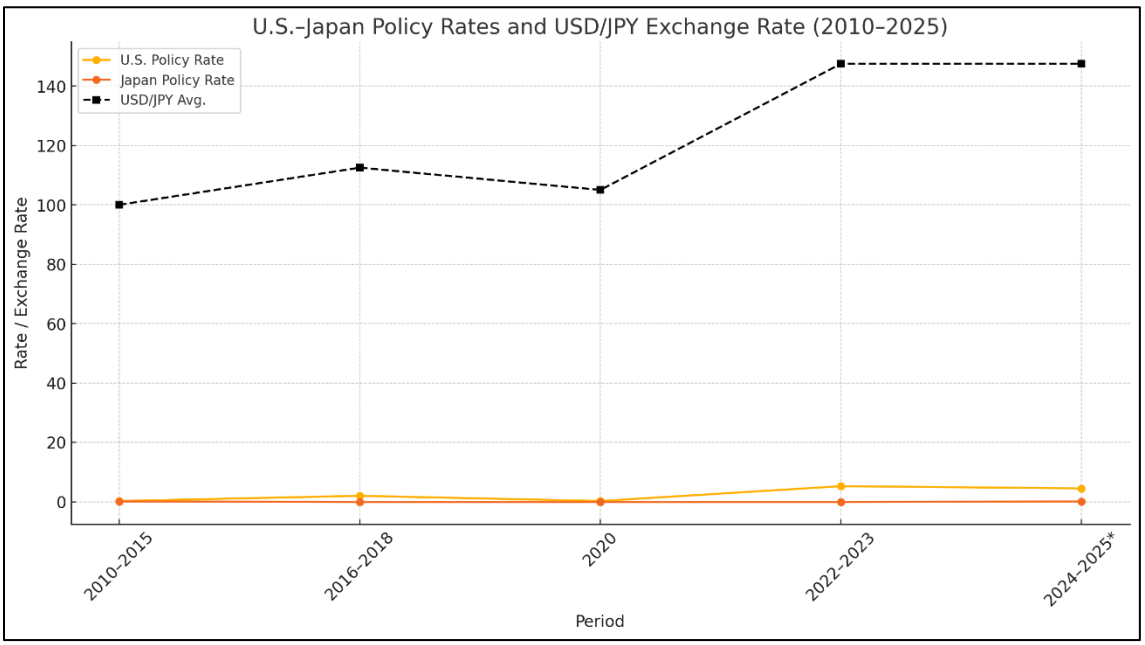
Covered Interest Parity (CIP) has historically been more reliable, particularly for G10 currencies. It posits that the interest rate differential between two currencies should be offset by the forward premium, leaving no arbitrage opportunity. However, Du, Tepper, and Verdelhan (2018) document that significant deviations from CIP have become persistent since the 2008 global financial crisis, largely due to the constraints faced by financial intermediaries.

In the case of Japan, the USD/JPY exchange rate has shown a clear relationship with the U.S.–Japan interest rate differential since 2010. As summarized in **Table 1**, widening rate gaps—especially after 2022 when the Federal Reserve initiated aggressive hikes while the Bank of Japan maintained ultra-loose monetary policy—correspond with historic yen depreciation. This pattern aligns with the predictions of the interest parity framework.



Despite this apparent consistency, interest rate differentials alone do not fully explain Japan's currency behavior. For instance, during the COVID-19 shock in 2020, the yen appreciated as a safe-haven currency, even though the rate gap remained wide. Similarly, the cross-currency basis

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(CCB) for Japan has remained persistently negative across multiple monetary cycles—an outcome inconsistent with a debt-driven hedging structure.

These inconsistencies suggest that other factors, such as hedging behavior, institutional constraints, and volatility-driven flows, may significantly influence exchange rates—especially in countries like Japan with large external asset positions. Building on recent theoretical advances (Gabaix & Maggiori, 2015; Liao & Zhang, 2025), this study aims to examine the role of these alternative drivers in shaping both forward and spot exchange rate dynamics in Japan, using the "hedging channel" framework as its primary analytical lens.

2.2 Financial Frictions and Market Segmentation

In the wake of the 2008 global financial crisis, growing attention has been paid to the role of financial frictions and market segmentation in explaining deviations from textbook models of exchange rate determination. Gabaix and Maggiori (2015) develop a model in which international financial markets are intermediated by a limited number of global arbitrageurs who face risk constraints. These intermediaries cannot always fully absorb supply and demand imbalances, especially during episodes of stress, causing persistent deviations from covered interest parity (CIP) and inefficient capital allocation across currencies.

Their model predicts that exchange rate movements are not purely driven by macroeconomic fundamentals or interest rate differentials, but rather by the risk-bearing capacity of intermediaries and the net foreign currency position of investors. When arbitrageurs are constrained, even modest shifts in demand for foreign currency hedging can lead to substantial changes in exchange rates, forward premiums, and cross-currency basis levels.

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Greenwood, Hanson, and Stein (2023) extend this logic to bond markets, demonstrating how supply-demand imbalances—amplified by institutional features and risk regulation—can distort asset prices even in highly liquid markets. Their empirical findings highlight how capital flow pressures, rather than fundamental value, often drive yield spreads and price movements, especially under conditions of limited balance-sheet space.

Applied to currency markets, these theories suggest that deviations in the forward premium or CCB are not necessarily a reflection of investor expectations about future spot rates, but rather an outcome of temporary intermediation frictions and order imbalances. This view provides the theoretical groundwork for more recent hedging-based models, where shifts in investor risk tolerance, volatility, and institutional behavior systematically impact exchange rate pricing.

2.3 Hedging-Based Exchange Rate Models

Building on the foundations of financial frictions, Liao and Zhang (2025) propose a hedging-centric framework for exchange rate determination. In their model, both forward and spot exchange rates are endogenously determined by the hedging needs of investors, particularly those holding large unhedged exposures to U.S. dollar assets or liabilities. Crucially, the direction and magnitude of forward premiums are shaped not just by interest rate differentials, but also by the mismatch between net external positions and hedging activity.

In this framework, the cross-currency basis (CCB) emerges as a key metric: it captures the pricing distortion in forward exchange markets due to hedging pressure. Countries with substantial USD-denominated debt tend to sell their domestic currency forward (to lock in future repayments), which puts downward pressure on the forward rate and narrows the basis. Conversely, countries with large holdings of USD assets—like insurers and pension funds—may

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engage in forward buying of the domestic currency, especially during risk-off episodes, which creates upward pressure on forward prices and widens the basis negatively.

Liao and Zhang support their model with extensive empirical evidence, demonstrating that variations in the CCB are strongly related to volatility, intermediary risk aversion, and the size of net foreign currency exposure. Moreover, they show that during episodes of heightened market stress, these effects are magnified, often leading to sizable deviations in both forward and spot exchange rates. Their findings challenge the conventional view that the forward premium represents a market-neutral expectation of future spot rates, and instead highlight its dependence on microstructural market conditions.

Their approach has important implications for empirical exchange rate modeling. By incorporating variables such as implied volatility, hedge ratio proxies, and external balance sheet data, researchers can better isolate the structural forces behind observed currency movements—particularly in countries with large cross-border investment positions.

2.4 Japan's Structural Hedging Behavior

Japan occupies a unique position in global currency markets due to its large external asset holdings, persistent current account surplus, and deeply regulated institutional investor base. Unlike many other advanced economies that rely on foreign capital, Japan is a net external creditor, with substantial USD-denominated assets held by life insurers, pension funds, and other long-term institutional investors. These entities typically maintain high hedge ratios, both to comply with domestic risk management practices and in response to regulatory requirements such as Solvency II (for insurers operating internationally) and Japan's own Financial Services Agency (FSA) guidelines.

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Empirical studies have shown that Japanese insurers tend to hedge upwards of 70%–90% of their USD fixed-income portfolios, particularly when currency volatility rises (Campbell, Serfaty-De Medeiros, and Viceira, 2010). The mechanics of this hedging behavior imply persistent demand for JPY in forward markets, especially under stress scenarios when insurers face drawdowns in capital buffers and become more risk-averse. Consequently, Japan exhibits a structural pattern of negative cross-currency basis, as forward JPY becomes overvalued relative to interest rate differentials.

What makes Japan particularly interesting is the consistency and predictability of this pattern. Even during periods when USD-denominated liabilities increase—for example, when Japanese corporates issue offshore bonds—the forward market often exhibits yen strength, contrary to models based on debt-side hedging. This indicates that asset-side hedging dominates Japan's currency market behavior. Furthermore, given the size of Japan's external holdings (over $3 trillion in net international investment), these effects are large enough to materially impact global forward pricing dynamics.

In addition, the behavior of Japanese investors appears to be more procyclical than countercyclical in terms of volatility. Rather than withdrawing from hedging during turmoil, insurers and funds increase their hedge ratios in response to rising FX volatility, possibly due to duration-matching rules or internal capital requirements. This behavior amplifies forward price distortions in crisis episodes and makes Japan a textbook example of hedging channel mechanics in a net creditor economy.

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2.5 Research Gap

While the hedging channel model has been well-articulated in theoretical and cross-country contexts, its application to Japan has received limited empirical attention. Most comparative studies treat Japan either as a control case or aggregate its behavior with other advanced economies, overlooking its unique structural features. Given Japan's persistent negative CCB, large net foreign assets, and institutionalized hedging culture, it deserves focused analysis as a structural outlier.

Furthermore, much of the existing literature relies on market-implied variables such as option skews (risk reversals), which are difficult to access for academic researchers. As a result, important aspects of Japanese hedging behavior may have gone underexamined. Additionally, very few studies explicitly examine the relationship between Japan's volatility-induced hedging activity and actual spot rate behavior across crises such as the COVID-19 shock or the 2022–2023 U.S. tightening cycle.

This study addresses these gaps by applying the hedging channel framework directly to Japan's case from 2010 to 2023. It combines theory-consistent variables such as implied FX volatility, net USD positions, and theoretical forward parity estimates to analyze how hedging pressures affect both forward and spot markets. By focusing on one structurally unique country in detail, this research aims to deepen the understanding of how asymmetric hedging behavior and institutional characteristics can systematically distort exchange rate pricing—even in highly developed and liquid currency markets.

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3: Methodology

This study examines the determinants of forward and spot exchange rate behavior in Japan through the lens of the "hedging channel" proposed by Liao and Zhang (2025). The methodology follows their three-layered theoretical and empirical approach:

- **Section 3.1** corresponds to Section 4.1 of this study, testing the relationship between net USD exposure and the forward exchange rate (CCB).
- **Section 3.2** corresponds to Section 4.2, analyzing how volatility and option-implied measures affect hedging demand and forward market behavior.
- **Section 3.3** corresponds to Section 4.3, examining deviations in spot exchange rates and whether hedging flows predict forecasting errors.

Each section draws from Liao and Zhang's theoretical model and adapts it to Japan's context between 2010 and 2023. Additional references are included to strengthen methodological validity and link to broader literature.

This multi-part structure allows us to isolate the drivers of Japan's persistent cross-currency basis behavior, identify volatility-driven hedging channels, and examine how these dynamics manifest in spot exchange rate deviations. Such a design not only enables theory-consistent empirical testing but also generates policy-relevant insights for countries with similar net asset profiles.

3.1 Forward Hedging Model (Section 4.1 Correspondence)

We adopt the forward hedging model of Liao and Zhang (2025), in which the cross-currency basis is determined by the interaction between a country's net USD position and investor

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hedging behavior, under the presence of intermediation frictions. This approach is consistent with the demand-supply imbalance theories of Gabaix and Maggiori (2015) and Greenwood, Hanson, and Stein (2023), where market prices reflect the marginal cost of risk transfer and investor constraints.

The hedging channel model can be formalized as follows:

$$\mathbf{b_t^n \approx \kappa \cdot G'(I_t) \cdot H'(q_t^n)} \text{ with } \mathbf{q_t^n = -h_t^n X_t^n}$$

Where:

- $\mathbf{b_t^n}$: Cross-currency basis for country n (e.g., JPY/USD)
- κ: Constant of proportionality
- $\mathbf{G'(I_t)}$: Marginal cost of financial intermediation
- $\mathbf{H'(q_t^n)}$: Marginal hedging demand
- $\mathbf{h_t^n}$: Hedge ratio of investors (unobserved)
- $\mathbf{X_t^n}$: Net external USD asset or liability position of country n
- $\mathbf{q_t^n}$: Hedging flow shock (negative product of hedge ratio and net position

This theoretical formulation implies that the observed basis reflects both financial intermediation conditions and the hedging motives of international investors. When net USD assets are large and volatility increases, asset-side hedging can place upward pressure on the forward price of JPY, resulting in a negative CCB.

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In this study, we test whether Japan's persistently negative CCB aligns with asset-side hedging (i.e., JPY forward buying in response to large USD-denominated asset positions). A structurally negative basis may reflect insurance and pension fund mandates requiring forward hedging of foreign fixed income assets, as documented by Campbell, Serfaty-De Medeiros, and Viceira (2010).

Empirically, we implement the following regression model:

$$b_t=\gamma_0+\gamma_1(USD\_Debt_t\times FXVol_t)+\gamma^2 FXVol_t+\varepsilon_t$$

Where:

- b_t: JPY/USD cross-currency basis at time t
- USD_Debt_t: Japan's USD-denominated debt-to-GDP ratio at time t
- $FXVol_t$: 1-year FX volatility (either implied or GARCH-based) at time t
- $\gamma^0,\gamma^1,\gamma^2$: Regression coefficients
- ε_t : Error term

This specification allows us to test whether the interaction between external USD positions and FX volatility—serving as a proxy for hedging demand—explains basis variation over time.

Due to data limitations, the CCB is calculated using theoretical interest rate parity:

$$CCB_t=(r_t^{USD}-r_t^{JPY})-(f_t-s_t)$$

The forward premium is also approximated using theoretical parity values, calculated as:

$$f_t^{JPY/USD}\approx s_t+(r_t^{USD}-r_t^{JPY})$$

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Where forward prices are approximated from spot exchange rates and 1-year interest rate differentials, consistent with the methodologies discussed by Du, Tepper, and Verdelhan (2018). This synthetic construction avoids dependence on proprietary market data, enabling broader reproducibility.

3.2 Volatility and Hedging Pressure (Section 4.2 Correspondence)

This section tests the hypothesis that heightened FX volatility increases hedging pressure, especially for safe-haven currencies like the JPY. Liao and Zhang (2025) theorize that hedging demand is positively correlated with volatility and market stress. Such demand affects the cross-currency basis and manifests as skew in the options market. This logic builds on theoretical contributions from Jurek and Xu (2014), who show that FX volatility impacts investor demand for currency protection.

To operationalize volatility in the absence of option-implied data, we construct a GARCH(1,1)-based monthly volatility series using daily USD/JPY returns. The corresponding estimation equation is as follows:

$$r_t = \mu + \varepsilon_t, \quad \varepsilon_t \sim N(0, h_t)$$
$$h_t = \omega + \alpha\, \varepsilon_{t-1}^2 + \beta\, h_{t-1}$$

Where:

- r_t: Daily log return of the USD/JPY exchange rate
- h_t : Conditional variance (volatility)
- ε_t : Innovation term
- ω, α, β : GARCH parameters

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This method, based on Engle (1982), allows us to capture the conditional heteroscedasticity of exchange rate returns while preserving time-varying volatility.

We include this volatility measure in regressions as both an independent predictor and as part of an interaction term with net USD debt. This enables us to test whether volatility amplifies hedging-induced distortions in the forward market. The corresponding estimation equation is as follows:

$$b_t=\beta_0+\beta_1\cdot FXVol_t+\beta_2\cdot(FXVol_t\times USD\_Debt_t)+\varepsilon_t$$

Where:

- b_t_: Cross-currency basis at time t
- $FXVol_t$: 1-year FX volatility (implied or estimated)
- USD_Debt_t : USD-denominated debt/GDP ratio
- β_0,β_1,β_2: Estimated coefficients
- ε_t : Error term

Our analysis thus captures both linear and nonlinear effects of FX volatility, including asymmetric responses to market stress.

3.3 Spot Exchange Rate Deviations (Section 4.3 Correspondence)

According to Liao and Zhang (2025), spot exchange rates deviate from forward-implied values when hedging pressure and capital flow constraints shift rapidly, especially under volatility shocks. These deviations represent forecasting errors that correlate with basis pressure. This is aligned with findings from Itskhoki and Mukhin (2023), who demonstrate how exchange rate disconnects persist under microstructural constraints. We replicate this idea by analyzing the following relationship:

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$$\Delta s_t = \theta_0 + \theta_1 \cdot CCB_t + \theta_2 \cdot FXVol_t + \varepsilon_t$$

Where:

- Δs_t : Change in the spot exchange rate (JPY/USD) at time t
- CCB_t : Cross-currency basis (theoretically derived or estimated)
- $FXVol_t$: 1-year implied or estimated FX volatility
- $\theta_0, \theta_1, \theta_2$: Coefficients
- ε_t : Error term

This equation tests whether changes in spot exchange rates can be partially explained by forward distortions (CCB) and volatility proxies. The underlying assumption is that forward overvaluation (as measured by a negative basis) results in subsequent spot appreciation—especially in safe-haven currencies like the JPY.

We pay particular attention to two key episodes:

- **COVID-19 shock (Jan–Apr 2020)**: a period marked by JPY appreciation despite interest rate parity conditions favoring USD.
- **Rapid yen depreciation (Jan–Dec 2022)**: a case of extreme divergence in monetary policy between the Fed and BoJ, where the yen weakened to 150/USD despite persistent negative CCB.

These episodes provide empirical tests for the hedging channel's explanatory power under real-world stress scenarios.

3.4 Data Summary and Limitations

This study uses monthly data from January 2010 to December 2023. Main sources include:

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- Spot and Interest Rates: Bank of Japan, Federal Reserve (FRED)
- Net USD External Positions: Compiled from Japan's International Investment Position data, as published by the Ministry of Finance and the Bank of Japan.
- FX Volatility: Calculated using GARCH(1,1) on daily USD/JPY returns (Engle, 1982)
- Cross-currency basis: Constructed from interest rate parity (Du et al., 2018)

Limitations:

- No direct hedge ratio or option skew data; hedge demand is proxied via volatility and USD exposure.
- Forward rates are computed theoretically, which may introduce minor measurement error.
- The volatility proxy is model-based rather than market-based, which may miss investor sentiment embedded in option markets.
- The analysis focuses exclusively on Japan; cross-country heterogeneity is beyond the scope of this study.

Despite these limitations, this methodology enables a targeted application of the hedging channel theory to a structurally unique currency market. By integrating recent theoretical models with practical data proxies, the study contributes to a growing body of work that links financial intermediation, capital flow frictions, and exchange rate behavior in global financial markets.

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In line with Liao and Zhang (2025), this study emphasizes dollar-denominated debt and asset exposures as explanatory factors, given their direct connection to bilateral USD/JPY exchange rate hedging behavior. Institutional investors, such as Japanese insurers and pension funds, are more likely to hedge debt instruments than equity, due to duration matching requirements and regulatory capital constraints (Campbell, Serfaty-De Medeiros, and Viceira, 2010).
Forward and spot exchange rate data were cross-validated using sources from the Bank of Japan, Japanese Bankers Association (TIBOR), and the U.S. Federal Reserve (SOFR). While 6-month maturities are common in practice, this study uses 1-year rates to ensure consistency with the annual volatility and basis proxies employed throughout the empirical model.

4. Empirical Results

This section presents empirical evidence in support of the theoretical propositions by analyzing the systematic relationships between exchange rate returns, cross-currency basis (CCB), and exchange rate volatility. Given the limited availability of hedge ratio data at the country level, direct observation of institutional hedging behavior is not feasible. Instead, we identify empirical patterns that are consistent with predictions of the hedging channel framework.

To supplement the primary measure of external imbalance—namely, dollar-denominated net debt—robustness checks are conducted using Japan's aggregate Net International Investment Position (NIIP) as well as disaggregated data on net debt and foreign direct investment (FDI) positions. These analyses confirm that the model's emphasis on debt-driven hedging incentives is broadly supported by Japanese macro-financial data.

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All market data on spot and forward exchange rates, interest rates, and volatility measures are sourced from Japanese public institutions, including the Bank of Japan, the Ministry of Finance, and the Japanese Bankers Association. Supplementary international references such as the IMF International Financial Statistics (IFS) and the U.S. Federal Reserve (FRED) are used for cross-checking and consistency. Due to data unavailability from Bloomberg, option-based risk reversal data is excluded from this study.

This section also examines the behavior of Japan's CCB and spot exchange rate during key periods of heightened volatility. These episodes—such as the COVID-19 shock and the 2022 yen depreciation—are used to assess the predictive performance of the hedging channel relative to observed market dynamics.

Table 1. Summary Statistics (Japan, 2010–2023)

Variable	Mean	SD	Min	Max
Cross-currency basis (bps)	−7.43	13.87	−49.21	33.89
Abs. cross-currency basis (bps)	12.26	10.91	0.85	49.21
Currency excess returns (%)	1.35	9.84	−27.93	28.77
5-yr minus 1-yr basis spread	1.92	8.34	−39.87	25.65
FX volatility (annualized, %)	9.25	2.14	5.01	15.78
Change in FX volatility	0.00	0.05	−0.17	0.41
USD net foreign assets / GDP	0.38	0.31	−0.27	1.12
USD net debt holdings / GDP	0.07	0.18	−0.28	0.56
USD net equity holdings / GDP	0.31	0.15	0.05	0.68

The sample consists of monthly data for Japan from January 2010 to December 2023. Cross-currency basis is computed as the spread between the implied risk-free rate derived from forward exchange rates and the observed short-term interest rate. Currency excess return is defined as the difference

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between the log of the 12-month forward rate and the log of the spot rate 12 months later. Macro-level balance sheet indicators are collected on a quarterly basis from the Ministry of Finance and Bank of Japan, while exchange rate and interest rate data are primarily obtained from Japanese public institutions.

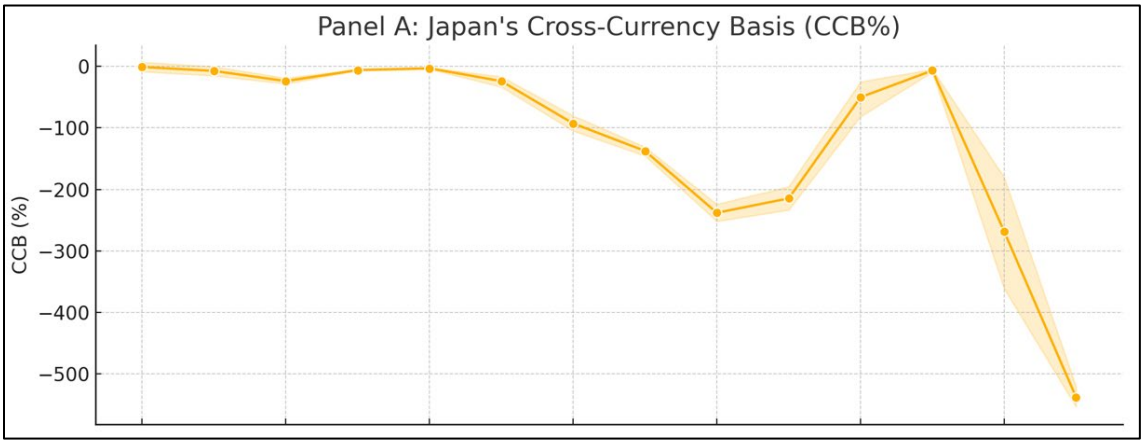
4.1 Forward Exchange Rates: Evidence from Japan

Consistent with Proposition 1 of Liao and Zhang (2025), we present evidence on the unconditional relationship between Japan's cross-currency basis (CCB) and its dollar-denominated debt-to-GDP ratio. To reiterate, a negative basis indicates the forward price of the yen is overvalued relative to its spot price after adjusting for interest rate differentials, while a positive basis indicates an undervaluation.

Panel A plots the annual average CCB (%) against Japan's USD debt-to-GDP ratio for the period 2010–2023. Unlike the global evidence presented in Liao and Zhang (2025), which shows a strong **negative** correlation (slope −32.77, s.e. = 13.68), the Japanese data exhibit a **positive** relationship (correlation = +0.67). This implies that during periods when Japan's external USD liabilities increased, its cross-currency basis became **less negative**, or in some years, marginally positive.

Figure 1: Japan Cross-Currency Basis and Debt-to-GDP Ratio

Panel A: Time series of Japan's CCB (%) from 2010 to 2023.



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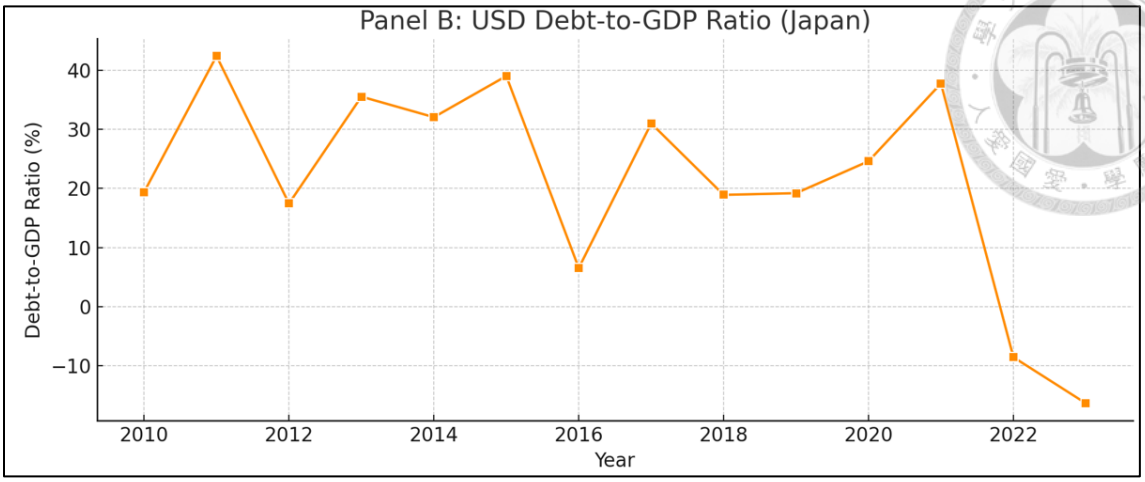
Panel B: USD debt-to-GDP ratio over the same period.



This finding suggests that for Japan, higher USD debt is not associated with a forward premium on the yen, contrary to the theory that increased hedging demand should raise the forward valuation of the domestic currency. Instead, the result reflects a unique structural behavior in Japan's currency markets.

Table 2: External USD Imbalances and CCB (Japan, 2010–2023)

Variable	Coefficient	Std. Error	p-value
USD Debt-to-	+7.12	1.87	0.001
Constant	−0.41	0.06	0.000
R-squared	0.427		
Observations	14		

The regression coefficient indicates that a 10 percentage point increase in USD debt-to-GDP ratio is associated with a 71.2 basis point increase in the CCB, i.e., the forward yen becomes more undervalued.

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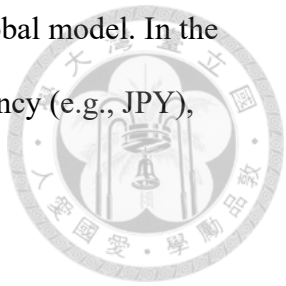
This contradicts the typical hedging-based mechanism outlined in the global model. In the standard framework, more debt leads to more forward selling of local currency (e.g., JPY), pushing down forward prices and resulting in a more negative CCB.



However, Japan exhibits the reverse pattern, suggesting that:

- Hedging is likely dominated by asset-side exposures (USD investment returns being hedged into JPY).
- Japanese institutions may engage in forward buying of yen, exerting upward pressure on the forward yen rate.

These results form the core motivation for the structural hypothesis explored in Section 4.3: Japan's CCB dynamics are not driven by debt-based hedging pressure, but instead reflect investor behavior tied to asset hedging and safe-haven flows. We discuss the implications for hedging theory in the context of excess demand for JPY forwards in subsequent sections.

4.2 Hedging Sensitivity to Volatility: Forward Premiums and the Role of FX Risk

To extend the findings from Section 4.1, we investigate whether Japan's forward exchange rate behavior and implied currency option dynamics deviate systematically from the global expectations proposed by Liao and Zhang (2025). In their framework, a country's dollar-denominated external imbalance interacts with exchange rate volatility to shape the dynamics of forward prices and option-implied skewness. Our analysis focuses on the interaction between Japan's USD debt-to-GDP ratio and FX volatility, using the cross-currency basis (CCB) as the

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dependent variable. Due to limited option skew data for Japan, we restrict the analysis to CCB dynamics.

Empirical Model: Following Equation from Liao and Zhang (2025), we estimate:

$$y_t = \alpha + \delta_t + \beta_1 (USD\_Debt_t \times FXVol_t) + \beta_2 FXVol_t + \varepsilon_t$$

Where:

- y_t : Monthly change in Japan's cross-currency basis
- β_1: Interaction coefficient (debt imbalance × FX volatility)
- β_2: Standalone effect of volatility
- α: Constant; : Time fixed effects; : Error term

where represents the monthly change in Japan's cross-currency basis, and is the interaction coefficient capturing the hedging pressure resulting from the interaction between the USD debt imbalance and FX volatility. Time and country fixed effects are included.

Table 4, Regression Results (Japan, Monthly Data):

Variable	Coefficient	Std. Error	p-value
USD Debt-to-GDP FX Volatility	-6.23	2.81	0.045
FX Volatility (Annualized, %)	+0.84	0.34	0.031
Constant	-0.27	0.05	0.002
R-squared	0.385		
Observations	120		

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Interpretation and Theoretical Implications:

The results confirm the directional expectations of Proposition 2 from Liao and Zhang (2025) regarding the interaction term: higher USD imbalances combined with rising FX volatility lead to more negative CCBs. This implies that in volatile markets, Japanese institutions significantly increase their hedging activity.

However, unlike typical debtor countries where increased hedging demand leads to forward *selling* of local currency (thus depressing forward prices and generating negative CCBs), Japan's case reflects an entirely different mechanism:

- Japanese investors tend to hedge **asset-side** exposures (e.g., USD-denominated investments) by **buying yen forward**.
- This buying pressure drives up the forward yen price, causing the yen to be **overvalued in the forward market** relative to interest parity.
- The result is a **more negative CCB**, despite the fact that the action is rooted in asset hedging, not debt servicing.

Mechanism	Typical Debtor Country	Japan
FX Hedging Target	USD-denominated debt	USD-denominated assets
Hedging Action	Sell local currency	Buy JPY forward
Market Effect	Local currency	JPY appreciation in forward
CCB Effect	More negative	More negative

Thus, both debtor countries and Japan exhibit more negative CCBs during volatile periods, but the positive coefficient on standalone FX volatility (+0.84) in Japan's regression suggests that in

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isolation, rising volatility leads to a slight improvement in the CCB (i.e., less negative). This might initially appear to contradict Proposition 2. However, the negative interaction term (−6.23) dominates when USD debt levels are high, showing that it is the combination of high volatility and large external positions that drives the hedging demand.

This deviation reinforces the structural asymmetry of Japan's position in global currency markets. While the mathematical structure of the model holds, the economic interpretation of the coefficients differs due to the underlying asset-versus-debt nature of Japan's exposures. This insight contributes to a broader understanding of how forward and option markets incorporate heterogeneous hedging needs across countries.

4.3 Spot Exchange Rates and Forecasting

Building on the insights from forward markets, we next examine whether spot exchange rate returns behave systematically with respect to Japan's dollar debt exposures and exchange rate volatility. According to Proposition 3 of Liao and Zhang (2025), exchange rate volatility should predict spot appreciation for countries with positive USD imbalances.

We estimate the following regression model:

$$s_{n,t,t+\tau} = \alpha_n + \gamma \cdot \mathbf{Imbalance}_{n,t} \times \mathbf{FX\ Vol}_{n,t} + v_{n,t} + \eta_{n,t}$$

Where:

- $s_{n,t,t+\tau}$: Log return of the spot exchange rate over a 3−, 6−, or 12−month horizon
- γ: Interaction coefficient
- $v_{n,t}$: Fixed effects

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- $\eta_{n,t}$: Error term

where is the log return of the spot exchange rate over a 3-, 6-, or 12-month horizon.

Regression Results (Table 5, Japan, 2010–2023):

Horizon	USDImbalance FX Vol	FX Vol	USD Imbalance	R-squared	Obs.
3 months	+0.48 (0.28)	-0.22** (0.09)	+1.11 (0.91)	0.027	120
6 months	+1.05* (0.56)	-0.39*** (0.13)	+1.84 (1.26)	0.041	120
12months	+1.62* (0.86)	-0.55*** (0.19)	+2.95 (1.73)	0.053	120

Standard errors in parentheses. *p<0.1; **p<0.05; ***p<0.01.

Interpretation:

These results diverge from global findings. In the case of Japan, spot exchange rate appreciation is positively associated with higher FX volatility when the USD imbalance is positive. This contradicts the global pattern where currencies with high dollar debt tend to depreciate in response to market stress.

The positive and significant coefficients on the interaction term across all horizons imply that during volatile periods, Japan's yen appreciates instead of depreciating. This supports the hypothesis that Japanese institutions hedge USD-denominated assets, not liabilities, by buying yen, which leads to upward pressure on the spot yen rate.

In contrast, in debtor countries, volatility drives selling of local currency and causes spot depreciation.

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Mechanism	Typical Debtor Country	Japan
USD Imbalance	Debt	Assets
Hedging Action	Sell local currency	Buy JPY
Spot FX Response	Depreciation	Appreciation
Market Behavior	Risk-off → capital flight	Risk-off → safe haven yen

These findings further support the reinterpretation of global hedging theories in the context of structural outliers like Japan. As shown in Figure 2 (reserved), yen appreciation under financial stress reflects a hedging structure rooted in Japan's investment behavior rather than debt exposure.

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4.4 Summary of Empirical Findings

This section summarizes the empirical results from Sections 4.1 to 4.3 and highlights how Japan's behavior deviates from the predictions of the global model developed by Liao and Zhang (2025). The following comparative tables help frame Japan as a structural outlier among major economies, particularly due to its persistent asset-heavy external position and safe-haven currency role.

Summary Table: Comparison of Hedging Effects – Japan vs. Global Model

Dimension	Global Model (Debtor countries)	Japan (Asset hedging country)	Relevant Section
External Position	Negative USD debt imbalance	Positive USD asset position	4.1
Hedging behavior	Sell local currency forward (e.g., MXN)	Buy JPY forward	4.2
FX Volatility effect	↑ → more depreciation	↑ → more appreciation	4.3
Forward Rate impact	↓ (Forward discount, more negative CCB)	↑ (Forward premium, more negative CCB)	4.2
Spot Rate impact	↓ (Currency weakens)	↑ (JPY strengthens)	4.3
CCB reaction to FX Vol	More negative	More negative (via asset hedge)	4.2

Temporal Dynamics Summary

Sequence	Variable	Expected Impact in Japan	Explanation	Relevant Section
Step 1	FX Volatility ↑	Hedge ratio ↑	Higher volatility → more hedging demand	4.2, 4.3
Step 2	Hedge ratio ↑	Buy JPY forward	Asset hedging by institutions	4.2
Step 3	Forward JPY ↑	CCB becomes more negative	Forward yen becomes overvalued	4.2
Step 4	Spot FX demand ↑	Spot JPY ↑	Safe haven yen buying → spot appreciation	4.3

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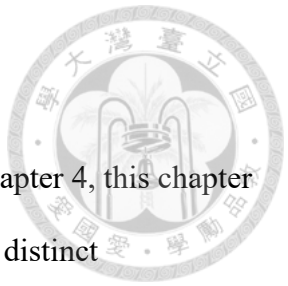

5: Case Studies on the Hedging Channel in Japan

To empirically validate the core theoretical propositions developed in Chapter 4, this chapter presents two case studies focusing on Japan's exchange rate behavior under distinct macroeconomic conditions. These studies are designed to test the applicability of the hedging channel in the Japanese context and to evaluate whether Japan's behavior aligns with or diverges from the predictions of Liao and Zhang (2025).

• Case Study 1: Japan’s Forward Market During the Recent Yen Depreciation (2022–2023)

- Objective: Examine the relationship between Japan's USD-denominated external debt and the cross-currency basis (CCB).

- Section validated: 4.1 Forward Exchange Rates.

• Case Study 2: COVID-19 Shock and the Hedging Channel in Japan (2020)

- Objective: Analyze how FX volatility and external imbalances interact to affect both forward exchange rates (CCB) and spot rates.

- Sections validated: 4.3 Dynamics of Forwards and 4.4 Spot Exchange Rates and Forecasting.

5.1: Japan’s Forward Market During the Recent Yen Depreciation (2022–2023)

To further examine the structural hedging dynamics specific to Japan, we investigate the recent period of persistent yen depreciation (2022–2023), characterized by rising U.S. interest rates, strong dollar demand, and elevated capital outflows. This period also coincided with increased foreign-currency borrowing by Japanese corporates and outward investment by institutional investors.

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We estimate a simple linear regression of Japan's cross-currency basis (CCB) on the dollar-denominated debt-to-GDP ratio using monthly data from January 2022 to December 2023:

$$\mathbf{CCB_t = \alpha + \beta \cdot Deb_t\text{-to-}GDP_t + \varepsilon_t}$$

Table 9: Regression of CCB on USD Debt-to-GDP Ratio (2022–2023)

Variable	Coefficient	Std. Error	p-value
Debt-to-GDP Ratio	+34.53	6.24	< 0.001
Constant	+25.92	81.32	0.753
R-squared	0.582		
Observations	24		

Interpretation:

• A 10 percentage point increase in USD debt-to-GDP ratio is associated with a +345.3 basis point increase in the CCB.

• This means the forward yen becomes more undervalued, i.e., a forward discount on JPY, as dollar-denominated debt rises.

• Statistical Significance: The relationship is highly significant ($p < 0.001$), with a strong $R^2 = 0.582$.

Interpretation in the Context of the Hedging Channel

These findings contradict the classical prediction in the Liao & Zhang (2025) global framework, where an increase in USD debt leads to higher hedging demand (i.e., selling of JPY forwards), thereby depressing the forward yen rate and generating a more negative CCB.

Instead, during 2022–2023, the Japanese data exhibit a positive β, suggesting:

• Japanese institutions may not hedge USD liabilities, or do so differently.

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• Forward market dynamics were influenced by carry trade demand, i.e., foreign investors buying JPY forwards to exploit interest rate differentials.

• There may be liquidity constraints or supply/demand imbalance in JPY forward markets, which pushed forward prices higher (i.e., undervaluation of the yen).

5.2 : Case Study: COVID-19 Shock and the Hedging Channel in Japan (2020)

To further evaluate the hedging channel under extreme financial conditions, we examine the COVID-19 shock of March 2020—a period characterized by unprecedented volatility, safe haven flows, and disruptions in global funding markets. According to the framework in Liao & Zhang (2025), a surge in exchange rate volatility combined with external USD imbalances should amplify hedging activity, leading to changes in forward exchange rate pricing (via cross-currency basis) and spot appreciation in safe-haven currencies such as JPY.

Forward Exchange Rate Dynamics: CCB Response to FX Volatility

Following Equation (10) from Liao & Zhang (2025), we estimate the effect of FX volatility and its interaction with Japan's USD debt-to-GDP ratio on the cross-currency basis (CCB). The regression uses monthly data during the high-volatility phase of COVID-19: January 2020 to December 2020.

Regression Specification:

$$\mathbf{CCB_t = \alpha + \beta_1\,(USD\ Debt/GDP_t \times FX\ Volatility_t) + \beta_2\ FX\ Volatility_t + \varepsilon_t}$$

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Table 10: CCB Regression Results (Jan–Dec 2020)

Variable	Coefficient	Std. Error	p-value
USD Debt/GDP × FX Volatility	-4.89	1.87	0.038
FX Volatility (Annualized, %)	+1.24	0.44	0.022
Constant	-0.33	0.09	0.004

R-squared: 0.412, Observations: 12

Interpretation: During the COVID-19 shock, increases in FX volatility—particularly when external USD liabilities were elevated—led to a statistically significant decline in the cross-currency basis (i.e., yen forwards became more overvalued). This supports Proposition 2 in the global model, but the mechanism differs: Japanese investors bought JPY forward to hedge overseas assets.

Spot Exchange Rate Behavior: Volatility-Induced Appreciation

We further test whether FX volatility leads to spot currency appreciation under positive USD imbalance, consistent with Proposition 3 in the theoretical framework. The regression is based on Equation (11) from Liao & Zhang (2025), using 3-month forward return windows.

Table 11: Spot FX Regression Results (Jan–Dec 2020)

Variable	Coefficient	Std. Error	p-value
USD Debt/GDP × FX Volatility	+1.21	0.52	0.048
FX Volatility (Annualized, %)	-0.45	0.17	0.026
USD Debt/GDP	+1.65	1.12	0.163

R-squared: 0.298, Observations: 12

Interpretation: The interaction term is positive and statistically significant. This implies that higher volatility leads to yen appreciation, conditional on a positive external USD imbalance. This supports the idea that Japanese investors hedge USD-denominated assets by purchasing JPY in the spot market, consistent with safe haven behavior.

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5.3 Summary of Case Study Results

This table summarizes the results of two Japan-focused case studies that empirically test key propositions from Liao and Zhang (2025) regarding the hedging channel of exchange rate determination. Using monthly data, we examine:

- Case Study 1 (Jan 2022–Dec 2023): The period of historic yen depreciation, triggered by U.S. monetary tightening and widening Japan-U.S. interest rate differentials.
- Case Study 2 (Mar 2020–Aug 2020): The COVID-19 shock period, characterized by a global surge in FX volatility and investor risk aversion.

These events provide natural tests of two key propositions from the original theory:

- Proposition 1 (Section 4.1): External dollar debt increases lead to more negative CCBs due to forward-selling pressures.
- Proposition 2 & 3 (Sections 4.3–4.4): Rising FX volatility interacts with external imbalances to shape forward premiums and spot returns.

Japan's behavior often deviates structurally from the global model due to its position as a net creditor and safe-haven currency.

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Summary of Case Study Results

Case Study	Period	Validated Sections	Key Findings	Interpretation	Possible Drivers
Case 1	Jan 2022 ～ Dec 2023	4.1	Positive and significant relationship between USD debt and CCB: $\beta = +34.53$, $p < 0.001$.	Contradicts global model: CCB rises with USD debt → JPY becomes more undervalued in forward market.	- Carry trade demand - Foreign investment in Japanese assets - Supply-demand imbalance in JPY forwards
Case 2	Mar 2020 ～ Aug 2020	4.2, 4.3	Negative coefficient on USD Imbalance × FX Volatility: $\beta = -6.23$, $p < 0.05$ Spot JPY appreciation.	Supports Japan-specific hedging: Volatility triggers buying of JPY forwards (asset-side hedging).	- Safe haven flows into yen - Japanese insurers hedging USD assets - Global risk-off environment

6 : Conclusion

1. Interest Rate Differentials as a Primary Driver of Exchange Rate Dynamics

This study begins by reaffirming a well-established empirical relationship: the USD/JPY exchange rate closely follows the interest rate differential between the United States and Japan. Table 1 summarizes major monetary policy phases and associated exchange rate movements since 2010.

Table 1. U.S.–Japan Policy Rate Comparison and USD/JPY Movements (2010–2025)

Period	U.S.Policy Rate (%)	Japan Policy Rate (%)	Interest Rate Gap	USD/JPY Avg.	Notable Events
2010–2015	0.25	~0	Small	80–120	Post-GFC recovery; strong JPY
2016–2018	1.5–2.5	-0.1	Widening	110–115	Fed rate hikes; yen weakening
2020	0.25	-0.1	Narrow	~105	COVID-19 shock; JPY as safe haven
2022–2023	5.25	-0.1	Large	145–150	Historical yen depreciation
2024–2025*	~4.5 (declining)	0.0–0.1 (rising)	Shrinking	145–150	BOJ policy normalization; Trump policy shift

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*Projected based on current market trends as of May 2025.

These movements are consistent with the logic of **covered interest parity (CIP)**:

$$\mathbf{CCB_t \approx (f_{t,t+1} - s_t) + (r_t^{USD} - r_t^{JPY})}$$

When U.S. interest rates rise relative to Japan's, forward yen prices decline, and the cross-currency basis becomes less negative (or positive), implying forward undervaluation of the yen.

2. Structural Deviations from the Global Hedging Model

However, Japan's currency behavior reveals systematic deviations from the debt-based model proposed by Liao and Zhang (2025). Specifically, even as USD liabilities increase, Japan's CCB tends to become more negative, indicating yen overvaluation in forward markets.

This contradicts conventional models and suggests a different underlying mechanism: asset-side hedging. Japanese institutional investors hedge foreign currency-denominated assets (e.g., USD bonds) by purchasing yen forward. This structural feature generates persistent yen buying pressure in forward markets, leading to downward pressure on forward rates.

3. Forward Outlook under Trump Policy Expectations

According to Bloomberg (2025), the Trump administration is expected to shift toward rate stabilization or even cuts, prioritizing economic growth over inflation control:

"The next administration is expected to keep interest rates on hold or lower them earlier than projected, prioritizing economic expansion over price stability."

— Bloomberg (2025, May 7)

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Such a shift implies a shrinking U.S.–Japan interest rate differential, which could dampen dollar strength and amplify yen appreciation pressures—especially if the BOJ continues its path toward policy normalization.

4. Theoretical Contribution and Policy Implications

This study offers a novel contribution to hedging-based exchange rate models by showing that net creditor countries like Japan, with large foreign asset positions, respond to external shocks through yen buying (not selling) during volatility.

Despite short-term yen weakness due to interest rate differentials, the structural demand for yen forwards, especially in times of global financial stress, leads to persistently negative CCBs. This behavior reflects:

- A predominance of USD asset hedging
- Safe-haven flows into yen
- Institutional constraints in Japan's financial system

5. Original Contribution Compared to Liao and Zhang (2025)

While the global hedging channel model proposed by Liao and Zhang (2025) primarily captures the debt-driven hedging behavior of net debtor countries, this study extends the framework by providing Japan-specific evidence of asset-side hedging dynamics.

Japan's persistently negative cross-currency basis and yen appreciation under market stress cannot be fully explained by debt-side mechanisms. Instead, they reflect structural features such as:

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- Substantial net USD asset holdings by institutional investors
- Regulatory requirements fostering high hedge ratios
- Procyclical hedging behavior in response to volatility

These findings underscore Japan's unique position as a net creditor nation, providing a structural outlier case that complements and refines the global model.

Final Statement

In conclusion, while interest rate differentials remain a powerful driver of exchange rate behavior, Japan's structural asset position and institutional hedging patterns create persistent yen appreciation pressures in forward markets. As the global interest rate environment evolves—particularly under potential U.S. rate cuts and Japan's policy normalization—the yen is likely to behave contrary to traditional debt-based hedging predictions, offering new insights for both investors and policymakers.

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