An Empirical Investigation of Interest Rate Differentials and Long-Term Movements of AUD/NZD and USD/NZD

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A dissertation submitted to Auckland University of Technology in partial fulfilment of the requirements for the degree of Bachelor of Business (Honours)

2025

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Abstract

This research examines the validity of Uncovered Interest Parity (UIP) for New Zealand's two most critical currency pairs, AUD/NZD and USD/NZD, over the 2015Q3–2025Q2 period. To the best of the author's knowledge, this is the first empirical analysis to specifically test a state-dependent UIP framework on the New Zealand dollar, explicitly interacting interest-rate differentials with global risk (VIX) to capture time-varying risk premia. The empirical strategy employs forward-looking, backward-looking, and expectations-based specifications, alongside the VIX-augmented framework. For AUD/NZD, the results suggests that the cross-rate is anchored by fundamental economic linkages, reflecting New Zealand's close ties to Australia through free trade agreements and shared commodity export cycles. In contrast, USD/NZD exhibits no stable long-run equilibrium, behaving instead as a risk-sensitive asset driven by global sentiment rather than interest-rate differentials. In the short run, standard UIP fails for both pairs, consistent with the "forward premium puzzle," where high-yield currencies often appreciate rather than depreciate. While the VIX-augmented regression yields limited statistical significance, qualitative evidence confirms that uncertainty shocks (such as COVID-19) temporarily decouple exchange rates from fundamentals. These results are subject to key data limitations identified in this study, specifically the smoothing effect of quarterly data and the lack of survey-based expectations data for the AUD/NZD pair. Ultimately, this study provides updated evidence that UIP transmission in a small open economy is regime-dependent. The results suggest that while AUD/NZD allows for passive hedging strategies based on long-run mean reversion, whereas USD/NZD requires active risk management to mitigate exposure to global volatility shocks.

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Attestation of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor used artificial intelligence tools or generative artificial intelligence tools (unless it is clearly stated, and referenced, along with the purpose of use), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Dat Minh Van

24 November 2025

Acknowledgements

I would like to extend my deepest appreciation to Dr Rahul Sen, for his guidance, encouragement, and invaluable insights throughout this dissertation. His expertise in international economics sharpened the direction of my work, while his thoughtful feedback deepened my understanding of exchange-rate dynamics and the wider policy context surrounding my research.

Thank you for being a constant presence throughout this journey, steady when the path was uneven, encouraging when the work felt heavy, and patient when I needed direction the most. When I doubted myself, you reminded me to keep going. When deadlines felt overwhelming, you grounded me. When I was tired, you lifted my perspective.

Through every chapter, every revision, every late-night moment of uncertainty, you were there.

Supportive. Encouraging. Reassuring.

Your mentorship has been instrumental to my development as an emerging researcher in macroeconomics. This dissertation carries your influence on every page, and I am deeply grateful for the way you helped me rise each time I felt myself falling.

List of Abbreviations

ADF = Augmented Dickey–Fuller unit-root test

AIC = Akaike Information Criterion

ARDL = Autoregressive Distributed Lag model

AUD = Australian dollar

CBOE = Chicago Board Options Exchange

COVID-19 = Coronavirus disease 2019

ECM = Error Correction Model

Fed = Federal Reserve System (U.S. Central Bank)

FRED = Federal Reserve Economic Data

FX = Foreign Exchange

GFC = Global Financial Crisis

HAC = Heteroskedasticity and Autocorrelation Consistent

IMF = International Monetary Fund

KPSS = Kwiatkowski-Phillips-Schmidt-Shin (unit root test)

NZD = New Zealand dollar

OCR = Official Cash Rate

OECD = Organisation for Economic Co-operation and Development

PP = Phillips–Perron unit-root test

RBA = Reserve Bank of Australia

RBNZ = Reserve Bank of New Zealand

SOEs = Small Open Economies

Q = Quarter

UIP = Uncovered Interest Parity

USD = United States dollar

VAR = Vector Autoregression

VIX = CBOE Volatility Index

Chapter 1: Introduction

1.1 Background and Motivation

Interest rates and exchange rates are two of the most important variables for policymaking, especially in a macroeconomic context. Small open economies, such as New Zealand and Australia, operate under inflation-targeting monetary policy frameworks, where the policy rate and exchange rate channels are central. The components involve factors such as export competitiveness, import prices, and inflation, which operate through a crucial channel in the formulation of monetary policy. A central theoretical framework that brings together these variables is Uncovered Interest Parity (UIP), which determines that expected exchange rate changes offset the difference between domestic and foreign interest rates. While the Uncovered Interest Parity (UIP) condition ensures investors earn no excess returns from holding foreign currency assets, its empirical failure remains a central issue. This failure leads directly to the forward premium puzzle[1], which motivates further research. This dissertation will review the existing literature on UIP and examine its application to AUD/NZD and USD/NZD exchange rates, highlighting the role of these empirical mechanisms in responding to structural breaks that shape UIP.

Over the past four decades, empirical research and testing on UIP (Fama, 1984; Froot & Thaler, 1990) show that running regressions on the exchange rate in correlation to interest rate differentials. Empirical tests often yield slope coefficients near zero or even negative, a phenomenon known as the 'forward premium puzzle,' which implies predictable excess returns for investors. In addition to UIP, Engel (1996) and Sarno & Taylor (2002) argue that its empirical failures can be explained by factors such as time-varying risk premia, differences in

[1] The forward premium puzzle refers that currencies with higher interest rates tend not to depreciate as Uncovered Interest Parity (UIP) predicts and often appreciates instead, generating systematic excess returns for investors who borrow in low-interest-rate currencies and invest in high-interest-rate currencies as noted in Fama (1984), Froot and Thaler (1990), and Engel (1996)

information across investors, market frictions, and limits to arbitrage that prevent returns from equalizing immediately.

Recent work on UIP has reframed it as state-dependent rather than unconditional, because these conditions depend on many factors, such as interest-rate differentials and exchange rates. Studies would therefore have to consider their risk, liquidity, arbitrage deviation, and funding constraints in order to align with the interests of investors and policymakers. Aziz's (2024) model underpins UIP conditions in the measure of capital-account openness, suggesting that financial openness governs the attribution of capital controls to global "push" and domestic "pull" factors (Cerdeiro & Komaromi, 2019). However, in the context of advanced, fully liberalized economies such as New Zealand, Australia, and the United States, capital-account openness exhibits slight variation in state-dependent UIP testing, as capital controls contribute to both "push" and "pull" factors. VIX[2] plays a similar role in conditioning UIP deviations.

Although it operates through risk appetite rather than institutional openness, it still provides a more tractable and stable conditioning variable, with the ability to capture shifts in global risk sentiment and liquidity conditions that play a significant role currencies such as AUD and NZD. Given the capital control limitations due to the yearly frequency, the VIX aligns better with this study, as it has a broader literature on how it responds to different types of UIP deviations and uncertainty. New Zealand and Australia are small, open, inflation-targeting economies with freely floating exchange rates; their currencies (NZD, AUD) are heavily traded and widely used in carry trades. Despite being highly liquid, they are commodity-linked and sensitive to global risk sentiment, making it a central component of international financial flows and carry trade strategies. UIP deviations flow directly into monetary policy transmission under the inflation-

[2] The VIX is the Chicago Board Options Exchange (CBOE) implied-volatility index on the S&P500 and is widely used as a market-based measure of global risk appetite. For example, Kalemli-Özcan and Varela (2022) document that UIP premia via the US dollar co-move with global risk perception, while Gole, Perego, and Turcu (2024) and related work find that uncertainty measures such as the VIX help explain time variation in UIP deviations across advanced and emerging economies.

targeting frameworks of the RBNZ and RBA due to their freely floating exchange mechanisms. For policymakers, this is very important because persistent UIP deviations affect the exchange rate channel of the policy rate, allowing for pass-through prices and shaping expectations tailored to monetary policy frameworks and the credibility of central banks in small open economies.

Standard *de jure* openness indices such as Chinn-Ito's KAOPEN; Quinn-Toyoda; FKRSU[3] exhibit minimal variation for New Zealand and Australia, as both economies have maintained fully liberalized capital accounts (KAOPEN = 1.0) throughout the sample period. This lack of variation makes them unsuitable proxies for quarterly friction. Hence, capital controls indices limit the power of testing the UIP under a quarterly frequency when considering currency pairs. Moreover, over the past decade, major exogenous shocks, including the COVID-19 pandemic and the Russia-Ukraine war, have led to regime shifts in volatility. The common study on structural breaks (Zivot & Andrews, 1992) and "second moment" shocks (Bloom, 2009) show that significant events that cause economic destruction can temporarily alter interest rate differentials in exchange rate regimes, further highlighting the conditional specification of the UIP model.

Given the well-documented empirical failure of standard UIP, simply re-estimating the basic equation is insufficient; understanding why this parity condition fails in a modern context requires evaluating a multi-specification approach. This requires multiple methods to test whether exchange rates react with a delay (backward-looking), whether investors' forecasts are biased (expectations-based), or whether global risk acts as a friction that breaks the relationship (state-dependent). Furthermore, given the potential for structural breaks and mixed integration

[3] De jure financial-openness indices measure legal restrictions on cross-border capital movements. For example, the Chinn–Ito (KAOPEN) index, based on IMF AREAER data, assigns higher scores to countries with fewer capital-account restrictions; New Zealand and Australia have KAOPEN = 1.0 (fully liberalised) since the early 1990s. The Quinn–Toyoda and FKRSU indices apply alternative coding to the same IMF data but yield similarly flat series for advanced economies

orders in small samples, robust econometric techniques such as ARDL bounds testing are essential to distinguish genuine economic relationships from spurious correlations. By systematically evaluating these four conditions, this study can help close the gap whether parity failures in the NZD are due to market inefficiencies, irrational expectations, or limits to arbitrage during crisis periods.

1.2 Objectives

1.2.1 Research Objectives

This study employs the Uncovered Interest Parity (UIP) condition as the core foundational framework to examine whether it holds for AUD/NZD and USD/NZD exchange rates surrounding New Zealand, given its status as a small open economy. UIP correlates expected rate changes with both short- and long-term interest rate differentials and remains central in international finance, given the variation of empirical anomalies observed with this methodology. The debut of UIP testing began with Fama (1984) and Froot & Thaler (1990), who experimented with regressions of exchange rate changes on interest differentials, often yielding coefficients near zero or negative, which showed excess returns and inherent strategies to the forward premium puzzle. Similar surveys and models (Engel, 1996; Lewis, 1995; Sarno & Taylor, 2002) have acknowledged these failures, which are linked to risk premia, heterogeneous information, and market frictions that exhibit instantaneous arbitrage.

To explore further conditions on UIP, a line of literature focuses on capital account openness. Chinn and Ito (2006) demonstrate that the benefits of liberalization depend on institutional quality, with openness facilitating the market to meet government thresholds. Moreover, Cerderio and Komaromi (2019) illustrate that financial openness conditions of capital flows refer to both "push" and domestic "pull" factors, meaning that the UIP mechanism is regime-dependent. Studies, such as those by Gole, Perego, and Turcu (2024), on 60 OECD countries demonstrate the de jure openness of advanced economies. However, small, advanced, open economies like New Zealand and Australia exhibit slight within-country variation (a common trait of first-world economies). This lack of variation limits their suitability for quarterly empirical work. Studies that generate structural breaks and external shocks, such as Zivot & Andrews (1992) and Bloom (2009), show that significant events such as the 2008 GFC alter persistence and volatility that temporarily weaken the conditions under UIP. These insights determine whether interest rate differentials affect time-varying friction proxies, such as realised FX volatility, as well as break dummies (e.g., COVID-19).

In summary, prior research helps to understand the justification of the UIP framework, which supports conditional, state-dependent testing. The gap in past studies is addressed by unexplored research on AUD/NZD and USD/NZD exchange rates, tailored to small open economies such as New Zealand, in response to the United States. With additional modifications to UIP and replacing flat de jure openness with market-state functions, it will explicitly account for external breaks over 2015-2025 using quarterly data. The Aziz (2024) methodology will be the preferred approach for further UIP testing in the New Zealand-Australia-U.S. context, aiming to help resolve the gaps in the literature.

This study will examine long-run currency movement driven by interest rate differentials under open economy conditions between New Zealand, Australia, and the U.S. The results will inform policymakers, investors, and market participants about when interest differentials contain information about NZD movements and whether openness alters that linkage. Despite UIP remaining a foundational equilibrium condition, its empirical methodology depends on different types of factors that arbitrage operates on, by tailoring a conditional UIP to a small open economy like New Zealand and the potential exposures to global cycles. This dissertation offers policy-relevant insights into how interest rate differentials respond and dictate exchange-rate movements.

1.2.2 Research Questions

This dissertation will further adopt four related research questions.

RQ1: Do current interest rate differentials serve as unbiased predictors of future exchange rate depreciation for the AUD/NZD and USD/NZD pairs?

RQ2: Do exchange rate adjustments lag behind interest rate changes, or do interest rate differentials react endogenously to past exchange rate movements?

RQ3: Does the failure of UIP persist when replacing rational expectations with survey-based forecasts, implying that deviations are driven by risk premia rather than irrational expectations?

RQ4: Does the relationship between interest rate differentials and exchange rates change significantly during periods of high global volatility (state-dependence), such as the COVID-19 pandemic?

Additionally, a quarterly frequency is employed, as it is more suitable for monetary policy decisions and exchange rate reporting in small open economies. It helps smooth short-term volatility, which is often more pronounced at daily or monthly frequencies. Over this time period, the primary objective is to capture complete monetary-policy cycles, including pre- and post-COVID regimes, the Russian-Ukrainian war, and the impacts of these events on inflation, as well as their connections to global risk conditions worldwide. A 10-year span will hopefully close the gap and bring new evidence on UIP for New Zealand's two most policy-relevant exchange rates, implementing a state-dependent UIP that is developed for advanced, fully liberalised economies, market-state frictions, and reducing de jure capital controls. Finally, the integration of structural breaks will help separate long-run tendencies from short-run disruptions and justify the rationale of the UIP mechanism when it weakens.

1.3 Methodological justification

This study employs the Uncovered Interest Parity (UIP) framework with state-dependent modifications as the primary methodological approach to analyse exchange rate dynamics between New Zealand, Australia, and the United States of America. The data used will be at a quarterly frequency, ranging from 2015Q3 to 2025Q2, examining whether interest rate differentials can help predict the next-quarter change in the spot exchange rate. This will be empirically examined using three complementary UIP specifications: forward-looking, backward-looking, and expectations-based. These specifications will provide different perspectives on how interest rate differentials influence exchange rate dynamics. The preferred methodology follows Aziz (2024), whose specialisation borders UIP literature, which is long known to link short-term interest rate differentials with expected exchange rate dynamics, and incorporates adjustments from Fama (1984) and Engel (1996).

To help understand the three standard UIP specifications that are incorporated with the preferred state-dependent model. The forward-looking UIP [4]is the classic theoretical prediction that the interest differential equals the expected depreciation, whereas the backward-looking UIP addresses evidence of time-varying risk premia and delayed portfolio adjustments (Froot & Thaler, 1990; Engel, 1996). Finally, the expectations-based UIP incorporates the role of survey expectations, which are based on what the population expects, taking into account inflation factors, as per Beckmann and Reitz (2020). Together, these three approaches provide an empirical and approachable structured way to test whether UIP holds under different assumptions, before extending to the preferred Aziz (2024) conditional framework.

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[4] The forward-looking Uncovered Interest Parity (UIP) condition states that the expected rate of depreciation of the exchange rate equals the interest-rate differential between two countries. Formally, UIP implies that $E_t(s_{t+1}) - s_t = i_t - i_t^* + u$ where s_t is the logarithm of the spot exchange rate and $i_t - i_t^*$ denotes the domestic–foreign short-term interest-rate differential (Fama, 1984).

This dissertation will be based on the Uncovered Interest Parity (UIP) condition, utilizing a theoretically grounded framework widely applied in international financial research and policy. The preferred methodology follows Aziz (2024), who extends recent UIP literature by incorporating interaction terms between the interest rate differential and time-varying friction proxies. To help understand the three standard UIP specifications incorporated with the preferred state-dependent model, this study includes interaction terms with proxies such as the VIX, the broad U.S. equity market, and FX volatility. This approach promotes the specification for conditional testing of UIP under different market states. The extension captures the presence of limits to arbitrage, investor risk aversion, and liquidity constraints. A second justification for the preferred Aziz (2024) model is that it will be suited to account for the role of macroeconomic shocks and structural breaks.

Exchange rate movements are influenced not only by policy and interest rate differentials but also by exogenous external factors, such as global risk sentiments and major event disruptions, including the COVID-19 pandemic. This study considers New Zealand minus the corresponding foreign short-term rate (United States for USD/NZD and Australia for AUD/NZD).

Other applied time-series econometric models, such as unit root and Engle-Granger models, are used to assess stability/spikes around the COVID-19 pandemic and the Russia-Ukraine war, to evaluate further whether financial openness conditions the UIP relationship holds under state dependence via VIX, the broad dollar index, and FX volatility. Incorporating structural breaks and risk interaction terms will help further evaluate the model by distinguishing between long-run equilibrium forces and short-run deviations from the UIP. Furthermore, it helps identify how exchange rates can help fully liberalised small open economies like NZ, and adjust differently across stressed periods, and how fundamental analysis addresses UIP validity within a New Zealand-Australia-U.S. context.

Overall, this study provides new evidence on state-dependent UIP framework on the New Zealand dollar over the 2015-2025 period in relation with Australia and the U.S. Thus, there is little evidence on how global risk frictions condition the response of exchange rate dynamics to modern structural breaks.

1.4 Organization

The following chapters of this dissertation are organised as follows.

Chapter 2 reviews the literature on Uncovered Interest Parity (UIP) and related exchange-rate models that have been tested under similar modifications. It outlines the classical UIP framework, including the forward premium puzzle and its relation to incorporating limits to arbitrage, capital account openness, information frictions, and state-dependent behaviour, with particular significance for small open economies such as New Zealand and Australia.

Chapter 3 explores the data and empirical methodology employed in this dissertation. The financial series are presented at a quarterly macroeconomic frequency for all economies, encompassing interest rates, exchange rates, global risk indicators, and survey-based expectations. This chapter details the data sources, transformations, and frequency alignment. Then it outlines the econometric framework, including unit-root tests and cointegration analysis employing both the Engle-Granger and Autoregressive Distributed Lag (ARDL) bounds testing approaches. It further details the forward-looking, backward-looking, and expectations-based UIP specifications, as well as the preferred time-varying friction model that incorporates volatility measures and structural breaks.

Chapter 4 presents the empirical results and corresponding visualisations of the study. It reports the estimated forward, backward, and expectations-based UIP regressions for

AUD/NZD and USD/NZD, as well as the outcomes from the VIX-augmented UIP model. Aside from reporting the time-series properties, statistical significance, and magnitude of estimated coefficients, the chapter illustrates these findings through time-series plots of interest-rate differentials, exchange-rate depreciation, and fitted values. It examines how these align with theoretical predictions and how the UIP relationship evolves in the long run, particularly the aftereffects of significant uncertainty, such as the COVID-19 Pandemic, and how deviations appear to be regime-dependent.

Chapter 5 discusses the policy implications of the empirical findings on investors and central banks, interpreting the failure across all UIP specifications and assessing the limited attributes of interest-rate differentials in predicting NZD movements. It also examines the relationship between risk premia and currency movements in small open economies, as well as how these factors influence monetary policies and investment decisions for different groups.

Finally, **Chapter 6** concludes and summarizes the main findings of this study – highlighting the contributions of understanding UIP in a New Zealand context in relation to bilateral exchange rates with Australia and the U.S. This chapter discusses further limitations of the analysis and suggest further ideas for future research and implications, including potential extensions to alternative measures of frictions and higher-frequency or cross-country settings.

Chapter 2: Literature Review

2.1 Introduction

The **Uncovered Interest Parity (UIP)** represents the expected rate of depreciation of the domestic currency as equal to the nominal interest rate differential between domestic and foreign assets, so that expected returns are equalized and there are no arbitrage profits. The UIP model underpins exchange rate modelling, monetary policy transmission, and capital flow dynamics. Despite its theoretical appeal, however, UIP has persistently failed empirical validation – a violation that constitutes well-documented forward premium puzzle (Fama, 1984). This section further emphasises why UIP breaks down and examines whether it holds under specific conditions, particularly for small open economies like New Zealand and Australia, which may respond differently to volatile interest rates and external shocks. Stephens (2004) and Pham (2015) focus on floating exchange rates, such as AUD/NZD and USD/NZD, which have exhibited significant currency cycles since the 1980s. Policy makers and investors have relied on models to examine behaviours through UIP relationships.

This study extends their work by testing UIP under capital controls and structural breaks, examining UIP in both developed and emerging markets (Aziz, 2024; Fernández et al., 2016). Shocks, such as the COVID-19 pandemic, may have caused structural breaks in exchange rate movements, as demonstrated in empirical models by Bloom (2009) and Zivot & Andrews (1992). Taking expectations into account within small open economies, Coibion & Gorodnichenko (2012) and Candia et al. (2021) use survey data to measure macroeconomic and inflation expectations, showing how information rigidities and imperfect updating can be modelled empirically. These approaches motivate using survey-based expectations in UIP tests, rather than assuming perfectly informed rational expectations. Froot and Thaler (1990) have emphasized the forward premium puzzle, contrary to the UIP, where currencies with higher interest rates do not depreciate enough to eliminate excess returns. They believe that informational frictions, limits to arbitrage, and slow portfolio adjustment can generate "delay overshooting", so exchange rates respond with lags to policy shocks.

2.2 UIP Theory Breakdown

2.2.1 Forward-looking

Stephens (2004) highlights the forward-looking Uncovered Interest Rate Parity (UIP) as the capital market analogue to PPP. The forward-looking UIP can be expressed as the following:

$$E_t(s_{t+1}) - s_t = i_t - i_t^* + u \quad (1)$$

where

s_t = is the logarithm of the spot exchange rate (per unit of foreign currency)

i_t = domestic rate

i_t^*= an equivalent foreign interest rate

E_t denotes an expectation at time t,

u = the risk premium associated with holding New Zealand dollar assets

Under UIP, if the New Zealand interest rate exceeds the US interest rate ($i_t > i_t^*$), then the expected change in the log NZD/USD rate, $E_t[s_{t+1} - S_t]$, should be positive, meaning the NZD is expected to depreciate relative to the USD. A higher New Zealand interest rate would make NZD assets more attractive, including capital inflows and an immediate NZD appreciation, while UIP predicts that this will be offset over time by an expected depreciation. Stephens (2004) acknowledges this, noting that the risk premium u captures real-world deviations from theoretical UIP, and may explain its frequent empirical failures. While Uncovered Interest Parity (UIP) is mainly represented in its forward-looking expression, many studies emphasize backward-looking formulations due to the predictivity and unobservability of market expectations. Aziz (2024) presents a comprehensive test of UIP in this backward-looking context, focusing on critical real-world interactions, such as capital controls and exchange rate regimes, within the empirical framework.

2.2.2 Backward-looking UIP

Aziz (2024) shows the backward-looking UIP core empirical model, using an ex-approach where actual exchange rate changes are run in regressions on lagged interest rate differentials:

$$s_{t+1} - s_t = \alpha + \beta(i_{t-1} - i^*_{t-1}) + \epsilon_t \qquad (2)$$

where

$s_{t+1} - s_t$ is the change in the log spot exchange rate (log depreciation of domestic currency)

i_{t-1} & i^*_{t-1} = are lagged domestic and foreign interest rates, respectively,

β = captures the sensitivity of exchange rate changes to interest rate differentials,

α = is a constant term

ϵ_t = error term

Assuming equation (2) holds under UIP and that β = 1 and $\alpha = 0$ are expected. Following Aziz (2024), the interest rate differential enters lagged $(i_{t-1} - i^*_{t-1})$ to ensure the regressors are known at the time expectations are formed and these deviations aligns with both Fama (1984) and Engel (1996) find that empirical estimates of β are negative and significant, implying that currencies with high interest rates tend to appreciate rather depreciate, in contrast to UIP predictions. Burnside et al. (2007) imply the phenomenon of the 'forward premium puzzle', which represents a significant deviation from uncovered interest parity, while violating the no-arbitrage condition. The existence of profitable carry trade opportunities offered in decentralized FX markets (market makers) raises forward rates in response to informed order flow, creating a bias where high-interest-rate currencies systematically appreciate without relying on risk-based models (Burnside et al, 2007).

Aziz (2024) acknowledges this empirical failure to account for real-world frictions not captured by the canonical model, such as capital controls, exchange rate regime interventions, and investor risk premia. With additional augmentations to the model by interacting the interest differential with a capital control index, more conditional UIP testing is achieved under different degrees of capital mobility and exchange rate flexibility (Aziz, 2024).

Engel (1996) extends this analysis by surveying potential explanations for the forward premium puzzle by identifying two primary candidates – time-varying risk premia and expectational errors. These two suggest forward rates set compensation for currency risk and implying market participants may form biased or inefficient forecast. An example where Engel (1996) show that peso can be bias towards forward rates even under rational expectations. The backward-looking UIP model offers more practical and policy-driven framework than forward-looking UIP because of its empirical testing and more efficient in small open economies such as New Zealand and Australia despite the fact they rely on capital flow dynamics and exchange rate regimes.

In an Australia and New Zealand context, the RBNZ has conducted multiple studies on how UIP relates to local exchange rates, which directly motivates the use of a backward-looking framework. Early work by Stephens (2004) and Munro (2005) found that strict forward-looking UIP was not supported for the NZD/USD pair over the 1992 to 2003 period. Instead, they found that high short-term interest rates in New Zealand were associated with continued NZD strength, which is consistent with carry-trade excess returns rather than the depreciation implied by theory. While later studies such as Burnside (2011) confirmed that exchange rate responsiveness shifted under the OCR regime, the literature has not yet addressed the structural shifts of the last decade. A significant gap remains regarding the post-2015 era, which is a period defined by near-zero interest rates, the COVID-19 shock, and the rapid tightening cycle.

This dissertation fills that gap by testing whether the backward-looking failures identified in the early 2000s persist in this modern and highly volatile regime.

2.2.3 Expectations-based UIP

Having explored forward-looking and backward-looking UIP frameworks, expectations-based UIP explicitly incorporates survey-based or fundamental-driven expectations. These models can vary compared to the classical UIP. The expected depreciation offsets the interest rate differential is the sensitivity of exchange rate changes to the interaction term $E_t[\Delta s_{t+1}] = i_t - i_t^*$ [5] as this approach mitigates the strong informational assumptions required to account for real-world frictions, such as sticky, noisy, or adaptive processes that lead to persistent forecast deviations.

A foundation for modelling expectation-based UIP methodology involves regressing survey-implied expected depreciation towards the interest rate differential as follows:

$$E_t[\Delta s_{t+1}] = \alpha + \gamma(i_t - i_t^*) + \epsilon_t \qquad (3)$$

where estimates significantly different from the theoretical null of $\alpha = 0$ and $\gamma = 1$ indicate a rejection of the UIP hypothesis - consistent with the forward premium puzzle (Froot & Frankel, 1989).

Coibion and Gorodnichenko (2012) show that survey expectations of inflation and macro variables are subject to information rigidities and have applied this framework to New Zealand – documenting sticky and noisy expectations for domestic inflation and macro variable, while Candia et al (2021) uses a similar approach for U.S. firms only. However, with Beckmann and Reitz (2020), they have extended this application with consensus economics survey data for ten currencies (including NZD) and find information rigidities (sticky and noisy expectations)

[5] The identity $E_t[\Delta s_{t+1}] = i_t - i_t^*$ is standard in UIP analysis (Engel, 2014; 2016). The use of survey-based expectations to relax rational-information assumptions and capture sticky or noisy expectations follows Coibion and Gorodnichenko (2012), and has been adapted in FX UIP studies (e.g., Frankel and Froot, 1989).

rather than unbiased rational forecasting. They explicitly include NZD/USD in their Consensus Economics dataset and show that survey-based exchange rate expectations for the New Zealand dollar display information rigidities and generate returns around major events. Candia et al (2021) extend this approach to U.S firm inflation expectations. These methods motivate the use of survey-based exchange rate expectations to be tested in an expectations-based framework, rather than assuming perfect rational expectations. Employing Kalman filter and Bayesian VAR techniques, they provide strong evidence of expectation smoothing and predictable disagreement, particularly for small open economies like New Zealand, where professional forecasters exhibit persistent biases (Beckmann & Reitz, 2020).

Engel et al. (2014) support expectations by incorporating macroeconomic fundamentals to evaluate UIP for exchange rate expectations. PPP and Taylor rule fundamentals can help forecast exchange rates, as they outperform random walk benchmarks at longer horizons and focus on the inclusion of the NZD in the successful long-sample panel. Similarly, Molodtsova and Papell (2009) have also considered this approach, incorporating inflation, output gaps, and interest rate smoothing to predict short-term exchange rate changes for 12 currencies. Their results show that heterogeneous Taylor rule models with smoothing and a constant significantly outperform random walk benchmarks for AUD, consistent with central bank behaviour under the Taylor principle, where U.S inflation increases lead to exchange rate appreciation. Both studies find strong predictability for small open economies like Australia, and compared to New Zealand, the results are very similar given they are both commodity-exporting countries.

Together, these studies can hypothesize expectation-based UIP models with measures on exchange rate dynamics, particularly when analysing survey forecasts or monetary fundamentals. They are particularly well-suited for analysing small open economies, such as New Zealand, where sticky expectations and commodity-driven factors influence the USD/NZD and AUD/NZD, aligning with the Reserve Bank of New Zealand's (RBNZ) policy responses. However, a key limitation is that the majority of expectations-based UIP literature focuses on major currency pairs (such as USD/EUR or USD/JPY). Empirical evidence for small open economies like New Zealand remains scarce. This dissertation addresses this gap by applying the survey-based framework to the NZD, utilising consensus forecast data to determine if expectational errors drive parity deviations within a small open economy context.

2.3 UIP Small Open Economies (NZ Context)

New Zealand is a small, open economy with a freely floating exchange rate since March 1985 and no exchange controls, which leaves it relatively exposed to external shocks and global cycles (Reserve Bank of New Zealand; IMF, 2025). Major global economies such as the U.S. and China tend to have a comparative advantage in global financial markets, often due to greater monetary autonomy, trade agreements, and direct influence on global interest rates and capital flows. Studies such as Stephens (2004), Aziz (2024), and Engel et al. (2014) have shown that the Uncovered Interest Parity (UIP) condition often performs differently in SOEs.

While theoretical assumptions such as capital mobility, rational expectations, and interest rate parity are generally met, empirical evidence consistently reveals persistent deviations. This illustrates the performance of UIPs in SOEs and in New Zealand; they are more sensitive to global risk sentiments, trade fluctuations, and different investor behavioural expectations. Given our objective is to understand New Zealand's UIP in response to the AUD and USD pairs, there are some limitations to consider when analysing larger economies, such as the transparency of monetary policy, exchange rate fluctuations, and the conditions of the UIP. To some extent, UIP is often amplified by speculative capital flows and responses to international data, contributing to technical analysis that exceeds fundamental analysis.

Evidence before 2014 has shown past relationships between the USD/NZD and AUD/NZD exchange rate movements and macroeconomic fundamentals, as examined in long-run specifications such as GDP differentials, commodity prices, and interest rate spreads (Tsolakidou, 2017). Based on empirical applications of the cointegration-error term, the results show that the NZD/USD is more responsive to both long-term fundamentals and short-run adjustments, with the model outperforming a random walk forecast after the 2008 crisis. Complementing this, Gole, Perego, and Turcu (2024) work with a panel of 60 countries and measure interest rate differentials against the U.S., using the USD as the base in their setup. During periods of high uncertainty, UIP deviations widen for emerging and developing economies, but narrow for advanced-economy currencies. This suggests that high-risk-period investors rebalance away from high-yield, high-risk emerging market currencies towards safer advanced-economy currencies, which is relevant for AUD and NZD. Their empirical results show that securities for both exchange rates (AUD/USD & NZD/USD) - especially during global stress (e.g., the 2008 global crisis)- are more attractive when UIP deviations are easing.

New Zealand would be an ideal location for examining Uncovered Interest Parity (UIP) because it fully adopted a floating exchange rate system in 1985. Market forces drive the NZD, and the country features flexible central bank interventions. The Reserve Bank of New Zealand primarily focuses on inflation-targeting objectives, which involve setting goals to reshape interest rate expectations. In terms of transparency with AUD and USD, New Zealand, with its small economy, means interest rate patterns are more likely to be higher and more volatile. This hypothesis is that the NZD attracts significant capital flows and creates a rich environment for UIP testing relationships.

Gole, Perego, and Turcu (2024) provides cross-country evidence that directly supports using global risk to model state-dependent UIP deviations and using monthly data for 60 advanced and emerging/developing economies over 1995M1-2023M3. They show that uncertainty changes UIP performance across groups, such as it widens for EMDE countries but shortens for advanced-economy currencies. Orellana and Pino (2021) include New Zealand among 45 economies in their gravity-panel model linking long-term interest-rate differentials to expected exchange-rate changes and find that UIP holds mainly among developed economies. Ismailov and Rossi (2018) also incorporated New Zealand within their studies of panel along with emerging markets and show that deviations from UIP are smaller in low-uncertainty periods.

Together, these studies demonstrate that UIP relationships for New Zealand mainly behave similar to other small developed open economies like Singapore or Switzerland given the countries done in these studies are policy-driven for testing parity conditions given by the exchange rates.

2.4 Preferred UIP methodology

Following Aziz (2024), while keeping the traditional UIP, but replace the de jure capital-openness term with a **time-varying proxy for limits-to-arbitrage**,

$$s_t - s_{t-1} = \mu + \delta(i_{t-1} - i^*_{t-1}) \times ka_{t-1} + \varepsilon_t \tag{4}$$

and allowing for conditional testing of UIP under different market regimes as this empirical model used to test the AUD/NZD and USD/NZD exchange rates can be expressed as:

$$s_t - s_{t-1} = \mu + \beta(i_{t-1} - i^*_{t-1}) + \delta(i_{t-1} - i^*_{t-1}) \times Fric_{t-1} + \gamma' Z_{t-1} + \varepsilon_t \tag{5}$$

Where:

$s_t - s_{t-1}$ is the change in log spot exchange rate (quarterly)

μ is the constant intercept term

β is the sensitivity of exchange rate changes to the interaction term

$i_{t-1} - i^*_{t-1}$ is the lagged short-rate differential

$Fric_{t-1}$ is a time-varying friction proxy capturing state-dependent arbitrage costs: baseline = VIX

γ' is the vector of coefficients for the macroeconomic controls

δ is the sensitivity of exchange rate changes to the interaction term

Z_{t-1} are controls (inflation and output-gap differentials; terms-of-trade)

ε_t is the error term

Based on the redefined Aziz (2024) model, the predicted and expected coefficient signs depend on the exchange-rate definition. If s_t is defined as log (NZD per foreign currency[6]) so that $\Delta s_t > 0$ denotes NZD depreciation, UIP implies $\beta > 0$. The interaction coefficient δ captures state dependence: the marginal effect of the interest differential is $\beta + \delta Fric_{t-1}$. Under a limits-to-arbitrage interaction, higher frictions (VIX) weaken the UIP mechanism, so δ is expected to have the opposite sign to β, pushing $\beta + \delta Fric_{t-1}$ toward zero as uncertainty rises. The controls Z_{t-1} are included because exchange-rate theory links fundamentals to currency values: higher domestic inflation differentials tend to predict depreciation, stronger domestic output-gap differential tend to support the currency via policy/real-return channels (Taylor-rule fundamentals), and improvements in New Zealand's terms of trade to tend to appreciate the NZD through higher export income and demand for NZD.

Although Aziz (2024) used the Chinn-lto index (k_{t-1}) to measure capital control frictions, this study adopts the CBOE Volatility Index (VIX) instead. This modification addresses the limitations of capital control indices in quarterly data, where legal barriers often remain static and fail to capture sudden shifts in market sentiment. While the Aziz (2024) model focuses on de jure frictions-the legal and regulatory "laws" that restrict capital. Albagli et at. (2024) highlights that global uncertainty shocks are the primary driver of high-frequency exchange rate discounts, as they prompt investors to exit high-yield currencies regardless of interest rate spreads. Furthermore, Kalemli-Özcan and Varela (2021) show that in small open economies such as Australia and New Zealand, UIP deviations are largely explained by time-varying risk premia rather than explicit institutional capital barriers. This insight is highly relevant to this study, given that our empirical framework specifically analyses the transmission of global risk shocks. Interacting the interest rate differential with the VIX, this model treats global risk as a

[6] $s_t$denotes the log spot exchange rate quoted as the domestic price of foreign currency (e.g., NZD per USD). Under this convention, an increase in $s_t$implies a depreciation of the domestic currency, so $\Delta s_t = s_t - s_{t-1} > 0$ represents domestic-currency depreciation (and $\Delta s_t < 0$ appreciation).

functional friction to test if the parity relationship breaks down specifically when markets are volatile.

Why adjust the model specification?

This specification captures risk-based frictions via VIX rather than de jure capital controls, which are essentially constant for NZ, AU, and the U.S. Evidence shows that NZ, AU, and the U.S. are fully developed due to advanced economies with flat, annual capital-openness series and incomplete updates post-2022 (IMF, 2024; World Bank, 2024). A de jure index, therefore, adds little identifying variation from 2015 to 2025; however, Aziz's (2024) logic does follow through. Nevertheless, market-state variables incorporate the necessary frictions to align with the available data. To better align with our empirical testing and consistency, Chinn and Ito (2006) demonstrate that openness matters through institutions and market depth, and Cerdeiro and Komaromi (2019) show that openness (extending market states) conditions the sensitivity of flow to global "push" and domestic "pull" factors. Empirically, $\delta \neq 0$ indicates that the involvement of interest-rate differential to the exchange rate is state-dependent, where risk/liquidity friction rises, indicating that higher VIX leads to stronger USD, higher FX vol, and arbitrage weakens and UIP deviations persist ($\delta < 0$).

Bruno and Shin (2015) illustrate the international risk-taking channel that when global financial conditions ease, central banks expand leverage and cross-border lending – altering currency risk premia and reinforcing the state-dependent nature of exchange-rate adjustments. The incorporation of a state-dependent uncovered interest parity (UIP) framework, particularly global volatility (VIX) in relation to the unconditional UIP puzzle, where high-interest currencies, particularly in OECD countries, tend to appreciate rather than depreciate as predicted by standard UIP. Recent studies have shown that UIP deviations are highly systematic in relation to measures of global risk, and the VIX is widely used for testing uncertainty and investor risk aversion.

Kalemli-Özcan and Varela (2021) demonstrate that the UIP premium co-moves strongly with global risk measures, such as the VIX, across advanced OECD currencies, suggesting that risk sentiment is a key driver of time-varying UIP deviations. These economies illustrate investor demand when global risk tolerance is low, reflecting greater excess returns. Benigno, Benigno, and Nisticò (2012) explain that volatility shocks alter exchange rate dynamics by promoting hedge motives, where higher volatility leads to depreciation of riskier currencies. Hence, why does VIX behaviour align with the forward premium puzzle, where high-yield currencies tend to earn excess returns over long samples, even though they may experience sharp depreciations in high-uncertainty episodes. To support this statement, Albagli et al. (2024) empirically extend the UIP by examining the types of shocks associated with events. They demonstrate this by showing that U.S. monetary policy has provided dollar appreciations consistent with the UIP.

In contrast, VIX-driven uncertainty shocks generate more substantial UIP violations, which disproportionately drive up the USD, highlighting why the VIX function represents state-dependent friction. This is due to its proximity to capturing global shifts in risk appetite, which determines whether interest differentials predict changes in exchange rate movements or if the arbitrage weakens - putting this into the context of a small, open economy, such as New Zealand and Australia. The three studies in this section demonstrate that the VIX conditioning variable can effectively capture the tightening and loosening of arbitrage that underpins UIP deviations, as predicted by the Aziz (2024) model.

2.5 Structural Breaks, External Shocks and UIP

Structural breaks and external shocks, ranging from geopolitical conflicts to global financial crises, can trigger significant shifts in financial time series, fundamentally altering the market. These major circumstances raise assumptions about parameter stability and can implicitly impact investment behaviour, monetary policies, and foreign exchange markets. The technical analysis of structural breaks helps treat major events as fixed and exogenous risk. Zivot and Andrews (1992) have simulated this by allowing breakpoints to be estimated endogenously, thereby allowing for more accurate detection of regime shifts in FX and interest rates.

External shocks are frequently correlated with spikes in uncertainty, which are referred to as second-moment shocks that trigger changes in market behaviour. Bloom (2009) models these as spikes in macroeconomic uncertainty and with these shocks in FX behaviour. It prompts firms to delay investment and hiring due to the increased real-option value of waiting, and a rapid rebound and occasional overshoots in activity follow this. Bloom (2009) explains that the relationship in the FX market and uncertainty shocks often lead to flight-to-safety flows, which are promoted by volatility and shifts in exchange rate expectations. This impact affects the stability of parity conditions, such as the UIP. Empirical evidence from Chunga and Yu (2024) suggests that the Russia-Ukraine war in 2022 caused statistically significant structural breaks in Malawian FX returns and volatility. Based on their findings, the results indicate that this event is statistically significant, suggesting that uncertainty can affect market efficiency.

The Bai-Perron test (Bai & Perron, 2003) was conducted, and based on the structural breaks, a significant break in returns occurred between 2014m3 and 2017m10, along with the volatility series experiencing two further breaks during 2015. In response to shocks, the Malawian FX market exhibited weak-form inefficiencies due to persistent volatility and long-memory effects, with exchange rate overshooting and forward rates losing predictive power. In relation to exchange rates, uncertain events can deviate from a random walk, creating opportunities for arbitrage. These studies reveal a pattern consistent with the failure of the forward rate unbiased hypothesis. Structural breaks and external shocks matter because they can change the risk premium, monetary-policy reaction functions, and investor risk appetite, so it becomes time-varying rather than constant. For small open economies such as New Zealand, studies by Zivot and Andrews (1992), Bloom (2009), and Chunga and Yu (2024) suggest that structural breaks and external shocks, including COVID-19 and the Russia–Ukraine conflict, have altered the responsiveness of the exchange rate to interest rate differentials and weakened UIP stability. If the true relationship shifts across regimes (normal risk conditions vs crisis), then estimating a single full-sample UIP regression can mechanically generate UIP "failures" even when UIP holds in some regions. Break tests such as Zivot and Andrews (1992) and Bai-Perron (2003) are therefore directly relevant to UIP testing because they help identify when the UIP parameters have changed and allow the UIP restrictions to be assessed within more homogeneous regime. The NZD, paired with AUD and USD, will be split into pre- and post-shock sample regimes to help capture changes explicitly, such as detecting breakpoints and ensuring subsequent UIP estimations account for structural changes induced by external shocks.

2.6 ARDL bounds testing

To further complement the UIP specifications, the autoregressive distributed lag (ARDL) bounds-testing approach as a cointegration framework to help assess the robustness over the post-2015 sample data. The ARDL bounds-testing approach developed by Pesaran, Shin, and Smith (2001), to test situations whether the order of integration of regressors is uncertain. This empirical test is critical in exchange-rate applications since pre-testing for unit roots can be fragile and limited in small sample.

Within the ARDL framework, three specifications and studies have motivated the use of ARDL bounds testing, especially for small sample sizes within a small open economy context where the validity of Uncovered Interest Parity (UIP) is central to understanding exchange rate determination. First, Narayan (2004) demonstrates that bounds testing critical values differ in small samples, highlighting finite-sample risks when interpreting long-run elasticities for USD/NZD and AUD/NZD models to ensure that rejections of UIP are statistically robust. Second, ARDL accommodates mixtures of I(0) and I(1) regressors, mitigating the risk of bias from incorrect unit-root classification and avoiding ‘pre-test’ uncertainty, which is critical as interest rate spreads often exhibit different integration properties than exchange rates (Pesaran, Shin, & Smith, 2001). Third, ARDL embeds an error-correction representation, enabling the simultaneous estimation of short-run dynamics and the long-run equilibrium relationship required to test the parity condition, indicating how the “speed of adjustment” and deviations from parity are corrected following shocks.

Empirically, Lily, Kogid, Mulok, and Asid (2012) have utilized the ARDL bounds testing approach to revisit the Uncovered Interest Parity hypothesis, reporting the existence of a significant long-run relationship between interest rate differentials and exchange rates. In the New Zealand context, Brennan, Castaing, and Jacobs (2025) utilize an ARDL bounds-testing framework to estimate the long-run pass-through from the trade-weighted exchange rate to tradables inflation. Their work highlights the empirical utility of this error-correction methodology for modelling macroeconomic dynamics in a small open economy. Overall, ARDL bounds testing has been successfully applied to evaluate uncovered interest parity relationships directly, reinforcing the methodological consistency of using error-correction logic to test UIP hypotheses based on these studies in correlation to a small open economy context.

2.7 Gaps in the literature

Despite the extensive literature on Uncovered Interest Parity (UIP), several important gaps remain, particularly within the context of small open economies like New Zealand and Australia, as well as the relationship between UIP and large open economies, such as the United States of America. Historically, forward-looking UIP has been empirically shown to exhibit failures, particularly in advanced and emerging markets (Fama, 1984). While other alternative frameworks, such as backward-looking (Aziz, 2024) and expectations-based UIP (Beckmann & Reitz, 2020), have attempted to modify these failures, the puzzles remain unsolved. Despite the uncertainties, the need for additional testing will help further justify the UIP model, such as incorporating recent global shocks and structural changes.

The first gap that limits the use of the Aziz (2024) model is the incorporation of capital-control measures using de jure financial openness indices, such as the Chinn-Ito (KAOPEN) index, derived from the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (International Monetary Fund [IMF], n.d.). The available data was updated prior to 2022 and is only reported annually. Thus, this provides limited temporal variation for fully liberalized economies within New Zealand, Australia, and the U.S. Empirically, the data offer little explanatory power when testing quarterly UIP models over the 10 years between 2015 and 2025. To overcome this limitation, while still considering the Aziz (2024) model in practice, this study utilizes the VIX variable as a market-based indicator of financial frictions and market conditions, aligning with fundamental analysis for the AUD/NZD and USD/NZD exchange rates.

Within a New Zealand context, empirical evidence and work on UIP are limited, as New Zealand interest rates have fallen drastically compared to many other nations, particularly in relation to major currencies such as USD, AUD, EUR, or JPY. Existing studies often end prior to 2015-2018, and significant global events, such as the COVID-19 pandemic, the Russian-

Ukrainian war, and high inflation expectations (following the pandemic recovery), remain unexplored. The weak evidence of post-COVID analysis represents a key gap, and over the last five years, we have seen reserve banks make sharp policy adjustments to recover from the effects of COVID-19. Prior to 2020, modern central banks in New Zealand and Australia had not operated under pandemic-induced constraints, meaning the specific transmission of shocks during a global health crisis remains empirically untested in the UIP literature.

Another gap, besides UIP failures and recent historical data, is that methodological limitations limit the scope of these applications to small open economies, such as New Zealand and Australia. The relation between interest rate differentials and financial openness has rarely been tested within these small open economy settings. These policies have relevance because they depend on cross-border capital flows and these studies have assumed stable relationships over time but limited to structural break tests (Zivot & Andrews, 1992; Chunga & Yu, 2024) suggests that recent shocks such as COVID-19 or Russian-Ukraine war can regime shifts in exchange rate dynamic and the options of testing UIP under these frameworks remain limited or relatively unexplored.

A further gap lies within a New Zealand context, where high-frequency expectations-based evidence for the USD/NZD exchange rate remains limited. Although survey-based expectations have been used extensively for major currency, past literature on USD/NZD is severely restricted due to the limitability of horizons, frequency mismatches and consensus forecast that mask heterogeneity in expectations.

The final gap lies in how political and uncertainty-driven shocks are attributed to UIP and how structural break methodologies show significant disruptions in tests. These tests overlook volatility factors such as general elections, changes in monetary and fiscal policies, or trade disputes. In a U.S. context, the tariff measures during 2018-2019 illustrated global uncertainty, fluctuations in imports and exports, and weakened high-yield currencies such as AUD and NZD (Bremner et al., 2020). These risks are tailored to volatility indices such as VIX, which capture global shifts in risk sentiment and investor aversion. Hence, few studies limit the examination of how VIX-related uncertainty conditions UIP deviations in small open economies, such as New Zealand and Australia, leaving a gap in understanding how these exchange rates respond to NZD and AUD under different global risk regimes.

To address these unexplored gaps, testing Uncovered Interest Parity (UIP) for AUD/NZD and NZD/USD over 2015-2025, and utilizing forward, backward, and expectation-based models, will explicitly account for capital controls and identify any structural breaks. While literature from the 2000s and 2010s consistently rejected UIP, this research shifts the focus from whether parity holds to why it fails. Specifically, it distinguishes between irrational expectations and risk limits to isolate the drivers of deviations in small open economies like New Zealand and Australia. The preferred model will explicitly incorporate risk-based frictions and identify any potential structural breaks to help capture major events, such as COVID-19 and the Russia-Ukraine war, in relation to interest rates and exchange rate fluctuations. Researchers often rely on model-based proxies or random-walk benchmark errors when using expectation-based UIP. This study will provide an appropriate framework for expectations based UIP (USD/NZD only) within a contemporary post-2015 sample to eventually address the gap where expectations-based evidence for USD/NZD remains limited in small open economies. Weighing market-state friction (VIX) against capital controls will favour this study for time-varying global uncertainty events, which prove to better influence interest rate differentials compared to Chinn-Ito (KAOPEN) indexes. Splitting the samples into pre- and post-COVID subperiods will help provide updated evidence on UIP in small open economies. These findings are expected to benefit policymakers, investors, and multinational firms, who are primary stakeholders within the AUD/NZD and USD/NZD exchange rate regimes, by revealing whether deviations are driven by global risk rather than domestic policy inefficiencies.

Chapter 3 – Data and Methodology

This chapter describes the data and methodology used to test Uncovered Interest Parity (UIP) for New Zealand's two main currency pairs specifically AUD/NZD and USD/NZD. The outline begins with a quarterly dataset ranging from policy interest rates, exchange rates, and measures of global financial risk. It then sets out with four UIP specifications ranging from forward-looking, backward-looking, expectations-based, and a state-dependent UIP model redefined from Aziz (2024) allowing the effect of interest-rate differentials to vary with global risk conditions. Finally, the chapter also illustrates the time-series testing strategy, including unit-root and cointegration tests and structural break analysis, to see if UIP is robust to non-stationarity and regime changes.

The data in this study is measured in a quarterly frequency and have been sourced from the Reserve Bank of New Zealand (RBNZ), the Reserve Bank of Australia (RBA), the Federal Reserve of Saint Louis (FRED), and Refinitiv Workspace covering quarterly observations from 2015Q3 to 2025Q2. The dataset consists of nominal exchange rates (in logs), short-term policy interest rates, and proxies for global financial risk and capital-flow frictions. Theoretically, the CBOE Volatility Index (VIX) is used to capture time-varying global uncertainty, while a separate dummy variable captures the extraordinary market conditions associated with the COVID-19 pandemic era (2020Q1-2021Q4). Subsequently, survey-based expectations are available only for the USD/NZD pair and are used in the expectations-based UIP specification. The absence of comparable survey data for AUD/NZD is treated as a limitation in this study.

3.1 Data

Table 3.1. Variable definitions

Variable Name	Symbol	Description	Source	Transformation
AUD/NZD exchange rate	$S_{AUD/NZD}$	NZD per AUD bilateral spot rate	Refinitiv Workspace / RBNZ	log; first difference $\Delta \ln S$
USD/NZD exchange rate	$S_{USD/NZD}$	NZD per USD bilateral spot rate	Refinitiv Workspace / RBNZ	log; first difference
NZ policy rate	i_{NZ}	Official Cash Rate (short-term policy rate)	Refinitiv Workspace / RBNZ	Level (adjusted to quarterly basis)
AU policy rate	i_{AU}	Reserve Bank of Australia cash rate	Refinitiv Workspace / RBA	Level (adjusted to quarterly basis)
US policy rate	i_{US}	Federal Funds Rate / short-term benchmark	Federal Reserve / FRED	Level (adjusted to quarterly basis)
Interest-rate differential (NZ–AU)	$i_{NZ} - i_{AU}$	UIP spread for AUD/NZD pair	Derived	Difference of quarterly rates
Interest-rate differential (NZ–US)	$i_{NZ} - i_{US}$	UIP spread for USD/NZD pair	Derived	Difference of quarterly rates
Expected depreciation (USD/NZD)	$E_t[\Delta s_{t+1}]$	Survey-based exchange-rate expectations	RBNZ / Consensus Economics	first difference; USD/NZD only
Global risk	VIX	CBOE Volatility Index (global risk aversion)	CBOE / FRED	Natural log; Standardised (z-score)
COVID dummy	D_{COVID}	Equals 1 for 2020Q1–2021Q4	Constructed	binary
Exchange-rate depreciation	Δs_t	Quarterly log change in exchange rate	Derived	$\Delta \ln S$

3.2 Variable Construction

This subsection outlines how the variables used in the empirical analysis are constructed from the raw data. All exchange-rate series are expressed in natural logarithms, and quarterly log changes are used to measure depreciation. Interest-rate differentials follow definitions implied by the forward-looking, backward-looking, expectations-based, and Aziz (2024) UIP specifications. Dummy variables and friction proxies are included to capture structural shifts and state-dependent behaviour.

Exchange-rate transformations

The bilateral AUD/NZD and USD/NZD exchange rates are converted to natural logarithms, and quarterly depreciation is defined as the log difference as follows:

$$s_t = ln(S_t) \tag{6}$$

$$\Delta s_t = s_t - s_{t-1} \tag{7}$$

Because S_t is quoted as NZD per unit of foreign currency, a positive Δs_t corresponds to a depreciation of the NZD against the foreign currency.

Interest-rate differentials

Interest-rate spreads follow the classical UIP formulation:

NZ-AU differential: $spread_{NZ,AU,t} = i_{NZ,t} - i_{AU,t}$ (8)

NZ-US differential: $spread_{NZ,US,t} = i_{NZ,t} - i_{US,t}$ (9)

Dummy variables

COVID-19 Dummy: A binary variable equal to 1 for 2020Q1 – 2021Q4 and 0 otherwise, capturing the COVID shock period

This dummy variable allows the models to account for the unpredictable policy and volatility environment during the pandemic period.

Expectations variable

Survey-based expected depreciation: Exchange-rate expectations are available only for the USD/NZD pair from RBNZ/Consensus.

Expected depreciation is computed as follows:

$$E_t[\Delta s_{t+1}] = E_t[s_{t+1}] - s_t \qquad (10)$$

Global risk proxy (VIX)

CBOE Volatility Index (VIX): To proxy time-varying global financial risk and limits to arbitrage, the preferred methodology uses the Cboe Volatility Index (VIX). The VIX measures market expectations of near-term (30-day) volatility implied by the S&P 500 (SPX) option prices. VIX data is obtained from FRED and converted to quarterly frequency. Let VIX_d denote the daily index level on trading day d within quarter t. The quarterly VIX series is initially constructed as follows:

$$VIX_t^{avg} = \frac{1}{D_t}\sum_{d\in t} VIX_d \qquad (11a)$$

Where D_t is the number of trading days in quarter t. To ensure comparability across time and to interpret the global risk proxy in standard deviation units, the quarterly VIX series is standardised as:

$$VIX_t = \frac{\ln\left(VIX_t^{avg}\right) - \mu}{\sigma}, \qquad (11b)$$

Where μ and σ are the sample mean and standard deviation of the log VIX. In the preferred Aziz (2024) state-dependent UIP specification (Equation 16), this standardised global risk measure is used as the friction proxy and enters the model with a one-quarter lag ($Fric_{t-1} = VIX_{t-1}$) to capture delayed transmission of global uncertainty shocks to the exchange rate.

3.3 Econometric Specification (UIP models)

Four econometric frameworks are estimated to evaluate different conditions of UIP: a standard forward-looking UIP regression (Fama, 1984; Engel, 2014), a backward-looking specification with lagged interest-rate differentials (Froot & Thaler, 1990; Aziz, 2024), an expectations-based UIP regression that uses survey exchange-rate forecasts (Frankel & Froot, 1989; Coibion & Gorodnichenko, 2012; Beckmann & Reitz, 2020), and a state-dependent UIP model following Aziz (2024) that allows the effect of interest-rate differentials to vary with global risk conditions.

Forward-looking UIP:

Under uncovered interest parity, expected depreciation equals the nominal interest-rate differential (Fama, 1984; Engel, 2014):

$$E_t[\Delta s_{t+1}] = i_t - i_t^* \qquad (12)$$

Empirically, this is implemented by regressing depreciation on the interest-rate differential:

$$\Delta(s_{t+1}) = \alpha + \beta(i_t - i_t^*) + \epsilon_{t+1} \qquad (13)$$

Hypotheses: Under strict UIP with rational expectations and a constant risk premium, the intercept is zero and the slope equals one:

$$H_0: \alpha = 0, \beta = 1$$

Deviations from this benchmark indicate UIP failure:

$$H_1: \beta \neq 1 \frac{and}{or} \alpha \neq 0$$

A negative estimated β is consistent with the forward premium puzzle documented in the UIP literature (Fama, 1984).

Alternative Hypothesis ($\boldsymbol{H_1}$: $\boldsymbol{\beta < 1}$ $\boldsymbol{or}$ $\boldsymbol{\beta < 0}$): UIP fails. A coefficient significantly less than 1 (or negative) indicates the presence of a time-varying risk premium or expectational errors, often leading to the forward premium puzzle where high-interest currencies appreciate rather than depreciate.

This model examines the contemporaneous relationship between quarterly exchange-rate depreciation and interest-rate differential.

Backward-looking UIP:

Specification A: Delayed Market Reaction (Investor Focus) Following the literature (Froot & Thaler, 1990; Aziz, 2024), we first test if exchange rates respond to interest rate differentials with a delay. This tests the "delayed overshooting" hypothesis where investors react slowly to policy changes.

$$\Delta s_t = \alpha + \beta(i_{t-1} - i_{t-1}^*) + \epsilon_t \qquad (14a)$$

Hypothesis: A significant implies that past interest rate spreads have predictive power for current depreciation.

Specification B: Policy Feedback (Central Bank Focus). To ensure that the relationship is not driven by endogenous central bank reactions, we also test a "reverse causality" specification. This examines whether the Reserve Bank adjusts interest rates in response to past exchange rate movements (e.g., raising rates to stabilize a falling currency).

$$(i_t - i_t^*) = \alpha + \gamma(\Delta s_{t-1}) + \epsilon_t \qquad (14b)$$

Where $(i_t - i_t^*)$ is the current interest-rate differential (Dependent Variable) and Δs_{t-1} is the exchange rate depreciation from the *previous* quarter (Independent Variable). Gamma (γ) captures the policy feedback (e.g., does the RBNZ raise rates if the NZD fell last quarter?)

Hypotheses:

Null Hypotheses ($\boldsymbol{H_0}$: $\gamma = 0$**)**: No policy feedback. Interest rate spreads do not systematically react to past exchange rate movements.

Alternative Hypothesis ($\boldsymbol{H_1}$: $\gamma \neq 0$**)**: Policy feedback exists. The central bank systematically reacts to past depreciation.

Hypotheses: This specification tests whether information from the previous quarter's interest differential has predictive power for current exchange rate changes:

Null Hypotheses ($\boldsymbol{H_0}: \boldsymbol{\beta} = \mathbf{0}, \boldsymbol{\alpha} = \mathbf{0}$): Lagged interest rate differentials contain no predictive information for current exchange rate depreciation. This is consistent with the efficient market hypothesis where past public information is already fully priced in.

Alternative Hypothesis ($\boldsymbol{H_1}: \boldsymbol{\beta} \neq \mathbf{0}$): Lagged spreads significantly predict exchange rate movements. This suggests that the transmission of monetary policy to exchange rates occurs with a delay, or that carry trade profitability persists over time due to limits to arbitrage.

This model introduces lagged spreads and lagged exchange-rate changes to capture risk-premium persistence and market adjustments.

Expectations-based UIP:

This model is estimated for USD/NZD only and follows the survey-based UIP approach in Frankel and Froot (1989), Coibion and Gorodnichenko (2012), and Beckmann and Reitz (2020). It is needed because the theoretical UIP condition is formulated in terms of expected depreciation and by regressing survey-based expected depreciation on the interest-rate differential, this model tests whether agents exchange-rate expectations themselves embed the information implied by UIP or whether UIP failure rise because expectations are distorted, noisy or sticky.

$$E_t[\Delta s_{t+1}] = \alpha + \gamma(i_t - i_t^*) + \epsilon_t \tag{15}$$

Hypotheses: This specification tests whether survey-based expectations[7] align with the theoretical interest parity condition:

Null Hypotheses ($\boldsymbol{H_0: \gamma = 1, \alpha = 0}$): Rational Expectations UIP holds. Market participants fully incorporate interest rate differentials into their exchange rate forecasts, implying no systematic bias.

Alternative Hypothesis ($\boldsymbol{H_1: \gamma \neq 1}$): Expectations deviations. A slope coefficient differing from unity suggests that investor expectations are "sticky" or subject to information rigidities, meaning they do not adjust one-for-one with changes in interest rate spreads.

This model incorporates survey-based forecasts to relax the assumption of fully rational expectations, allowing UIP deviations to be examined in the context of imperfect and potentially noisy expectation formation.

Aziz (2024) model (preferred methodology): Augmented UIP model estimated

$$\Delta s_t = \mu + \beta(i_{t-1} - i_{t-1}^*) + \delta(i_{t-1} - i_{t-1}^*) \times Fric_{t-1} + \gamma' Z_{t-1} + \varepsilon_t \tag{16}$$

This preferred model shows the interaction between the interest-rate differential and global-risk indicators (VIX), following the state-dependent UIP framework in Aziz (2024). It allows

[7] The identity $E_t[\Delta s_{t+1}] = i_t - i_t^*$ is standard in UIP analysis (Engel, 2014; 2016). The use of survey-based expectations to relax rational-information assumptions and capture sticky or noisy expectations follows Coibion and Gorodnichenko (2012), and has been adapted in FX UIP studies (e.g., Frankel and Froot, 1989).

the risk premium to vary across high and low-uncertainty regimes and to reflect potential capital-flow frictions.

Hypotheses: The key test in this augmented framework concerns the interaction coefficient which captures the state-dependent nature of the relationship:

Null Hypotheses ($\boldsymbol{H_0: \delta = 0}$): The relationship between interest spreads and exchange rates is constant (linear). Global risk conditions (VIX) do not systematic alter the effectiveness of the UIP mechanism.

Alternative Hypothesis ($\boldsymbol{H_1: \delta \neq 0}$): The relationship is state-dependent. A significant interaction term confirms that limits to arbitrage weaken the link between domestic policy rates and the exchange rate.

This model incorporates the VIX interaction to identify if the New Zealand dollar's sensitivity to interest rate differentials (in conjunction with Australia and United States) decouples when global financial markets become volatile.

3.4 Time-Series Testing Strategy (ADF, PP, Engle-Granger, breaks)

Standard diagnostic tests are conducted such as augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests to confirm the integration properties, while Engle-Granger cointegration tests assess long-run relationships within the series. Zivot-Andrews and Bai-Perron procedures identify structural breaks, and Newey-West robust standard errors correct for heteroskedasticity and autocorrelation. These tests are to ensure the suitability of the econometric models and avoid spurious regression.[8]

[8] **Spurious regression** can arise when non-stationary (e.g., random-walk) series are regressed on each other, producing high R^2 and statistically significant coefficients even when the variables are unrelated. This motivates unit-root and cointegration testing before interpreting long-run relationships (Granger & Newbold, 1974).

3.4.1 Unit-Root Tests (ADF and PP)

Two complementary tests are applied to assess whether each variable is stationary or integrated of order one as follows:

- **Augmented Dickey-Fuller (ADF)** test
- **Phillips-Perron (PP)** test

The ADF and PP tests share the null hypothesis of a unit root: H_0: the series is non-stationary (I(1)) against H_1: the series is stationary (I(0)). While ADF and PP tests share a unit-root null hypothesis, alternative tests such as KPSS reverse the null to stationarity. Given the limited sample size and the subsequent use of cointegration testing, ADF and PP are sufficient for classifying integration properties.

Both tests are applied to:

- Log exchange rates s_t
- Interest-rate differentials $(i_t - i_t^*)$

Each test includes an intercept, and a trend term is included where visual inspection indicates a deterministic trend

Lag lengths for ADF tests are selected, while PP tests use Newey-West bandwidth selection

The testing objective is not to evaluate economic meaning but to classify each series I(0) or I(1), which determines whether cointegration testing is required

3.4.2 Cointegration Testing (Engle-Granger Two-Step Procedure)

If both the exchange rate s_t and the interest-rate differential $(i_t - i_t^*)$ are found to be I(1), long-run UIP requires testing for a potential cointegrating relationship.

The Engle-Granger (1987) two-step method is used:

Step 1: Long-run regression

$$s_t = \alpha + \beta(i_t - i_t^*) + \varepsilon_t \qquad (17)$$

Step 2: Unit-root test on residuals

An ADF test (without trend) is applied to the residual series: In the Engle-Granger residual-based test, the null hypothesis is no cointegration, (H_0: $\hat{\varepsilon}_t$ has a unit root) against the alternative of cointegration (H_1: $\hat{\varepsilon}_t$ is stationary). Rejecting the H_0 implies a stable long-run relationship consistent with long-run equilibrium between the exchange rate and the interest-rate differential. If the residuals are stationary, the variables are cointegrated and UIP is consistent with a long-run relationship; failure to reject the unit-root null implies no evidence of cointegration.

3.4.3 Structural Break Test (Zivot-Andrews and Bai-Perron)

To account for potential regime changes, especially around the COVID-19 period and episodes of global financial stress. Structural-break tests [9]are conducted, and two types of tests are applied as follows: These tests are applied to the log exchange-rate series s_t and interest-rate differentials $(i_t - i_t^*)$, recognising that neglected breaks can lower the power of unit-root tests and bias long-run relationship testing (Perron, 1989).

(a) Zivot-Andrews (1992) single-break test

Zivot and Andrews (1992) propose an endogenous single-break unit-root test that allows for one structural break in the intercept. Equation (17) accommodates changes in both the level and the slope of the trend function. The general augmented regression is:

$$\Delta y_t = \mu + \beta t + \alpha y_{t-1} + \theta DU_t(\tau) + \gamma DT_t(\tau) + \sum_{j=1}^{k} C_j \, \Delta y_{t-j} + \epsilon_t, \tag{18}$$

where y_t denotes the series being tested, and the terms $DU_t(\tau)$ and $DT_t(\tau)$ capture structural shifts occurring at potential break date τ. These are defined as:

$$DU_t(\tau) = 1(t > \tau), DTt(\tau) = (t - \tau)1(t > \tau) \tag{19}$$

[9] Shifts in the mean or trend, often associated with major economic or policy events. An example in Zivot and Andrews (1992) and Bai and Perron (1998, 2003) explicitly allow for endogenous breakpoints tests for structural breaks

and k is the lag length chosen to address serial correlation. The break date τ is selected endogenously by searching over breakpoints and choosing the τ that yields the most evidence against the unit-root null (Zivot & Andrews, 1992).

The hypotheses are:

- H_0: The series contains a unit root with no structural break ($\alpha = 0$).
- H_1:The series is trend-stationary with one structural break in intercept and trend ($a < 0$).

(b) Bai-Perron (1998, 2003) multiple-break tests

Bai and Perron (1998, 2003) extend break testing to allow for multiple unknown breakpoints in a linear model. The standard multiple-break framework is:

where m is the number of breaks, $\{T_1, \ldots, T_m\}$ are the unknown break dates, and the coefficients β_j are allowed to change across regimes.

$$y_t = \mu_j + u_t, t = T_{j-1} + 1, \ldots, T_j, j = 1, \ldots, m + 1. \qquad (20)$$

The hypotheses are:

- $\boldsymbol{H_0}$**:** no structural breaks ($m = 0$)
- $\boldsymbol{H_1}$**:** one or more breaks ($m \geq 1$)

These multiple-break tests [10]are useful for exchange rates and interest-rate spreads, which may undergo multiple regime changes across the sample (e.g., COVID-19 responses, tightening cycles, and volatility spikes). In this study, the break dates identified by Zivot–Andrews and Bai–Perron are used to help interpret instability in UIP relationships and to motivate the inclusion of the COVID dummy and time-varying frictions in the preferred Aziz (2024)

[10] Structural break techniques prevent parameter instability across the volatile 2015–2025 sample period, ensuring estimated cointegration parameters reflect true, regime-consistent economic behaviour rather than statistical averages distorted by major external shocks (e.g., COVID-19).

specification. The economic interpretation of detected breakpoints is discussed alongside the main UIP results in the following chapter.

3.4.4 ARDL Bounds Testing (Cointegration Framework)

To robustly test for a long-run relationship in small samples where the order of integration may be mixed (I(0) and I(1)), this study employs the Autoregressive Distributed Lag (ARDL) bounds testing approach (Pesaran et al., 2001). This involves estimating the conditional Error Correction Model (ECM) as follows

$$\Delta lnS_t = \alpha + \sum_{i=1}^{p-1} \gamma_i \, \Delta lnS_{t-i} + \sum_{j=0}^{q-1} \beta_j \, \Delta Spread_{t-1} + \lambda_1 \, lnS_{t-1} + \lambda_2 \, Spread_{t-j} + \varepsilon_t \quad (21)$$

Where Δ is the difference operator, α is the drift term, and the terms λ_1 and λ_2 represent the long-run level relationship between the exchange rate and the interest rate differential. The terms with summation signs capture the short-run dynamics.

Hypotheses: The Bounds Test performs a joint significance test (F-test) on the lagged level variables to determine if a stable long-run equilibrium exists.

Null Hypotheses (H_0 :$\lambda_1 = \lambda_2 = 0$): No level relationship. There is no cointegration between the exchange rate and interest rate differentials, implying no long-run parity anchor.

Alternative Hypothesis (H_1:$\lambda_1 \neq 0 \cup \lambda_2 \neq 0$): A level relationship exists (Cointegration). The variables move together in the long run, and deviations from equilibrium are corrected over time.

This model incorporates an error-correction mechanism to simultaneously estimate short-run volatility and the long-run "speed of adjustment" back to equilibrium, providing a robust test of parity conditions in a small open economy context.

This chapter has broken down the empirical framework necessary requirement to test the validity of Uncovered Interest Parity for the USD/NZD and AUD/NZD currency pairs utilizing dataset spanning from 2015Q3 to 2025Q2. After reviewing the standard UIP frameworks such as forward, backward and expectations-based UIP, the methodology moves beyond simple linear tests by incorporating backward-looking dynamics, survey-based expectations, and the VIX-augmented Aziz (2024) model to account for the risk-based frictions [11]implications towards a small open economy context. The use of macro-financial timeseries and ARDL bounds testing to address the risks of small-sample bias and mixed integration levels, with structural breaks tests allow the model to identify shifts in market regimes. This rigorous foundation prepares the study for Chapter 4, where these specifications are estimated and visualized to determine how domestic policies and global risks (shocks) drive New Zealand's exchange rate behaviour.

[11] Nonlinearities are controlled for via the Aziz (2024) interaction specification, where exchange rate sensitivity to interest differentials is conditionally scaled by the time-varying VIX proxy to capture state-dependent capital frictions.

Chapter 4: Empirical Results

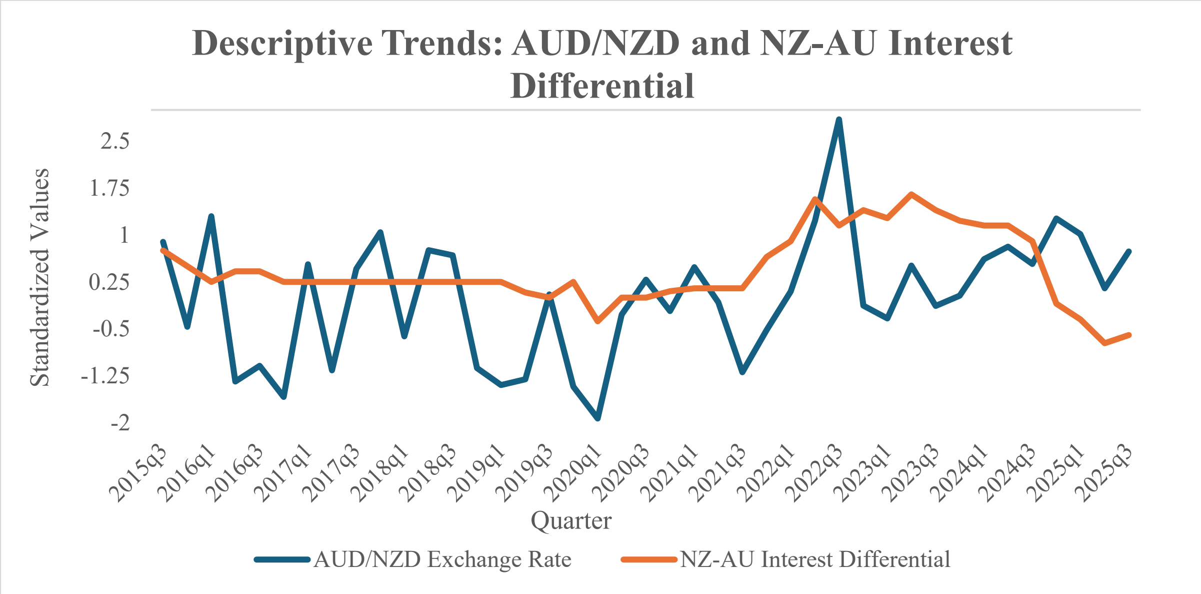
This chapter presents the empirical results of the Uncovered Interest Parity (UIP) tests for the AUD/NZD and USD/NZD exchange rates over the sample period from 2015Q3 to 2025Q2. The objective in this chapter is to evaluate whether interest-rate differentials serve as unbiased predictors of future exchange rates movements and to determine if global risk factors (proxied by the VIX) account for deviations from parity in a small open economy context.

The empirical analysis proceeds in four stages, following the methodology outlined in Chapter 3. First, Section 4.1 provides a descriptive analysis of the trends in exchange rates and interest rates. Second, section 4.2 assesses the time-series properties of the data using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. Third, section 4.3 through 4.5 examining the long-run relationships through Engle-Granger and Autoregressive Distributed Lag (ARDL) as a robustness. Finally, sections 4.6 and 4.7 estimate the short-run dynamics and cumulating around the preferred Aziz (2024) UIP model as an extension to the standard UIP framework.

4.1 Descriptive Statistics and Graphs

4.1.1 Descriptive trends: AUD/NZD & NZ-AU spread

Figure 4.1 Descriptive trends: AUD/NZD & NZ-AU Interest Differential



Source: Author's calculations using data from Refinitiv Workspace, Reserve Bank of New Zealand (RBNZ), and Reserve Bank of Australia (RBA).

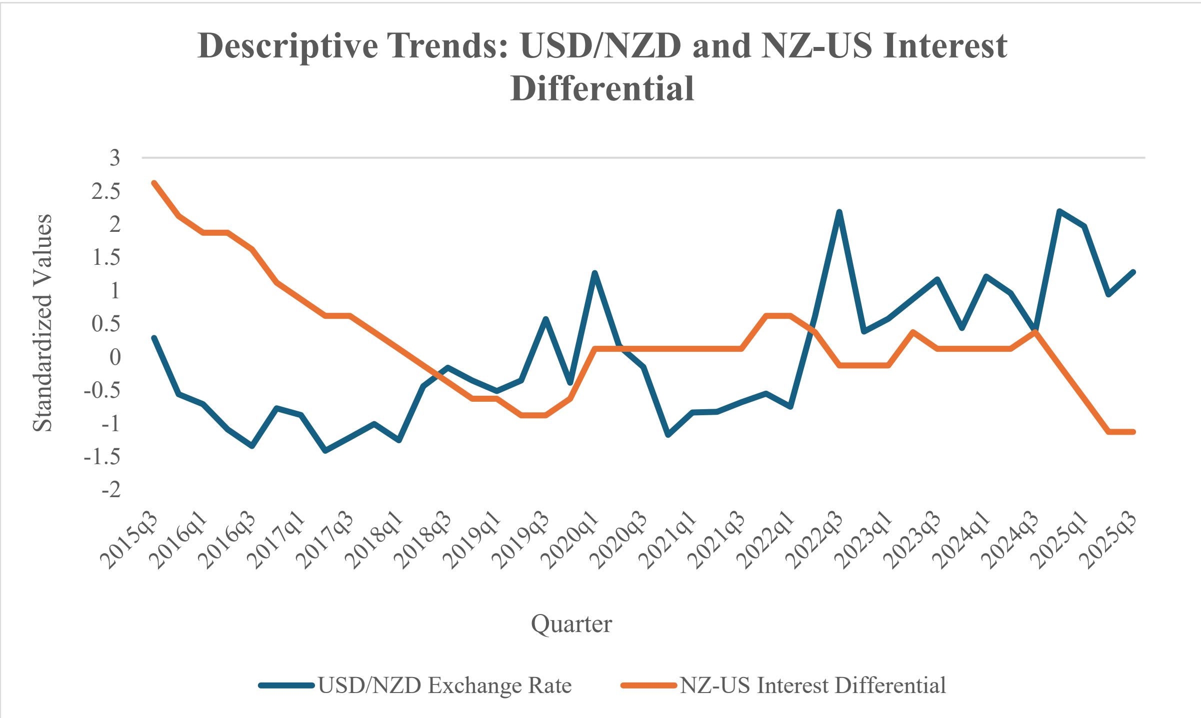
Figure 4.1 presents the descriptive trends between the standardised AUD/NZD exchange rate and the NZ-AU short-term interest rate differential from 2015Q3 to 2025Q2. The two series exhibit a generally weak and unstable relationship, with both series fluctuating only at specific periods which strongly suggests that external influences dominate in this sample. Between 2015 and 2019, the exchange rate fluctuated sharply while the interest rate differential remained relatively steady, suggesting that short-run parity is limited.

Around 2020, both variables became more volatile as an external shock caused by the COVID-19 pandemic disrupted financial markets and monetary policy settings across both countries. Due to monetary policy responses, exchange rate adjustments reflected uncertainty and shifts in liquidity. In the post-pandemic period (2022-2023), the NZ-AU spread increases noticeably as central banks began lifting interest rates to combat rising inflation, while exchange rates became more bullish. Despite the bullish movements, the duration and direction of changes do not consistently align with the interest rate spread, indicating that other factors, such as market sentiment and commodity price shifts, have impacted the movements of these exchange rates in a small open economy.

By 2024-2025, the interest differential drops, causing a big trough as policy rates in New Zealand plummet aggressively compared to Australia, while the exchange rate remains relatively volatile. Overall, the trend suggests that the relationship between the NZ-AU spread and the AUD/NZD exchange rate is weak and unstable over time. This provides valuable background for our preferred methodology to test whether interest-rate differentials hold and explain short-run exchange rate changes.

4.1.2 Descriptive trends: USD/NZD & NZ-US spread

Figure 4.2 Descriptive Trends: USD/NZD and NZ-US Interest Differential



Source: Author's calculations using data from Refinitiv Workspace, Reserve Bank of New Zealand (RBNZ), and Federal Reserve Economic Data (FRED).

Figure 4.2 shows the descriptive trends between the standardised USD/NZD exchange rate and the NZ-US short-term interest rate differential from 2015Q3 to 2025Q2. The two series exhibit a weak and uneven relationship, with both series fluctuating occasionally in this sample. Between 2015 and 2018, the NZ-US spread declined steadily as the United States raised its interest rates more sharply than New Zealand, while the exchange rate fluctuated independently, with limited signs of co-movement. This highlights that the relationship between the exchange rate and the policy-rate gap was minimal.

Around 2020, both lines became more volatile as uncertainty caused by the COVID-19 pandemic created a significant global external shock, prompting central banks to make policy adjustments. Despite these disruptions, the NZ-US spread remains relatively flat, reflecting simultaneous rate cuts implemented by both the Federal Reserve and the Reserve Bank of New Zealand to stabilise economic conditions. During the post-pandemic period (2022-2023), the spread remains stable as both economies shifted towards similar monetary policies; however, the exchange rate continues to vary sharply, which strongly suggests that external influences, such as the strength of the US dollar, are important drivers of USD/NZD movements.

By 2024-2025, the NZ-US spread falls into negative territory as US policy rates remain higher for longer, whereas the USD/NZD exchange rate remains volatile with no clear trend indication. Overall, this figure highlights a weak and inconsistent relationship between the US interest rate differential and the USD/NZD exchange rate. With the preferred methodology, we test whether policy cycles and global shocks influence both variables and whether the UIP holds for a small open economy like New Zealand compared to the top global giant, the U.S.

4.2 Unit-root and stationary tests

To formally test for stationarity, employing the Augmented Dickey-Fuller (ADF) test based on the following regression specification including a constant and linear trend:

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \sum_{i=1}^{k} \delta_i \Delta y_{t-i} + \varepsilon_t \tag{22}$$

Where Δ is the difference operator, y_t is the log exchange rate, and t is the time trend. The parameter of interest is γ. The specific hypothesis tested are:

Null hypothesis $(\boldsymbol{H_0}: \boldsymbol{\gamma} = \boldsymbol{0})$: The series contains a unit root (non-stationary). Equivalently, this implies the autoregressive coefficient $p = 1$.

Alternative Hypothesis $(\boldsymbol{H_1}: \boldsymbol{\gamma} < \boldsymbol{0})$: The series is stationary around the deterministic trend. Equivalently, this implies the autoregressive coefficient $p < 1$.

4.2.1 ADF & PP tests for exchange rates

Augmented Dickey–Fuller (ADF) / Phillips–Perron (PP) unit-root

Table 4.1. ADF unit-root test results for AUD/NZD & USD/NZD

Series (log)	*Deterministic terms*	*Lags*	*Test statistic Z(t)*	*1% CV*	*5% CV*	*10% CV*	*Mackinnon p*
$ln\, S_{AUD/NZD}$	Trend + Intercept	4	-3.224	-4.279	-3.556	-3.214	0.0798
$ln\, S_{USD/NZD}$	Trend + Intercept	4	-2.777	-4.279	-3.556	-3.214	0.205

Notes: ADF null H_0: series has a unit root (non-stationary). More negative test statistics indicate stronger evidence against H_0. Mackinnon $p-$values are reported. Tests include a linear trend and four lags of the first difference; this reduces the effective sample to $N = 36$ (from 40 quarterly observations).

Table 4.2. PP unit-root test results for AUD/NZD & USD/NZD

Series (log)	*Deterministic terms*	*NW Lags*	*PP Z(t)*	*1% CV*	*5% CV*	*10% CV*	*Mackinnon p*
$ln\, S_{AUD/NZD}$	Trend + Intercept	4	-5.277	-4.242	-3.540	-3.204	0.0001
$ln\, S_{USD/NZD}$	Trend + Intercept	4	-4.573	-4.242	-3.540	-3.204	0.0011

Notes: PP null H_0: unit root. More negative Z(t) indicates stronger evidence against H_0. Newey-West bandwidth lags reported. Stata also reports z(rho); we focus on Z(t), which is standard for comparison with ADF. Mackinnon $p-$values are reported. Tests include a linear trend and Newey-West bandwidth of 4; Quarterly data $N = 40$ (all 40 quarterly observations are used).

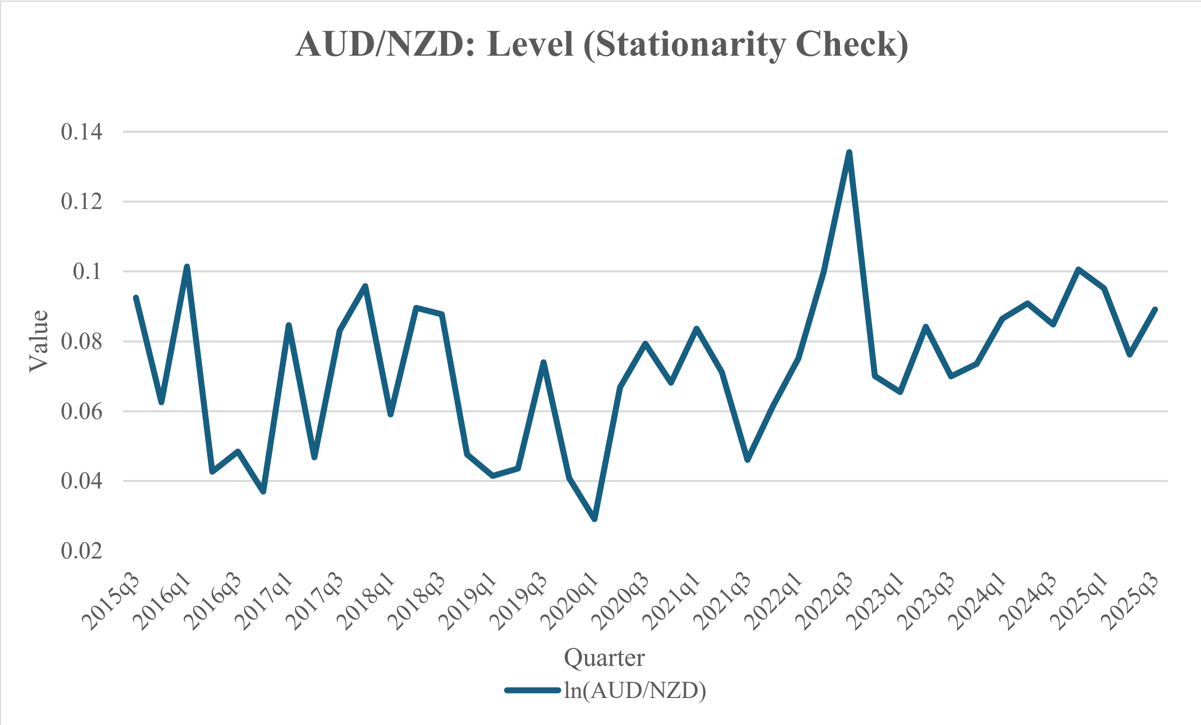
Source: Author's estimations using data from Refinitiv Workspace, RBNZ, RBA, and FRED.

Table 4.1 and 4.2 report the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit-root test based on the logged exchange-rate series ($\ln S_{AUD/NZD}$, $\ln S_{USD/NZD}$) along with their corresponding interest-rate differentials. The purpose is to determine whether each series is stationary in levels or requires differencing prior to short-run UIP estimation (Dickey & Fuller, 1979; Phillips & Perron, 1988). Both variables are tested to understand applied levels with quarterly data from 2015 Q3 to 2025 Q2.

For the ADF tests (Table 4.1), the t-statistic for $\ln S_{AUD/NZD}$ (-3.224, p = 0.0798) and $\ln S_{USD/NZD}$ (-2.777, p = 0.205) are greater than the 5% critical value (-3.556), so the null of a unit root cannot be rejected at the 5% level, despite $\ln S_{AUD/NZD}$ is borderline stationary at the 10% critical value. The PP tests (Table 4.2) provide somewhat stronger evidence against a unit root. For $\ln S_{AUD/NZD}$, the PP Z(t) statistic is -5.277 with a p-value of 0.0001, and for $\ln S_{USD/NZD}$, the PP Z(t) statistic -4.573 with a MacKinnon p-value of 0.0011. In both cases the t-statistic are more negative than the 1% critical value, leading to rejection of the unit-root null hypothesis.

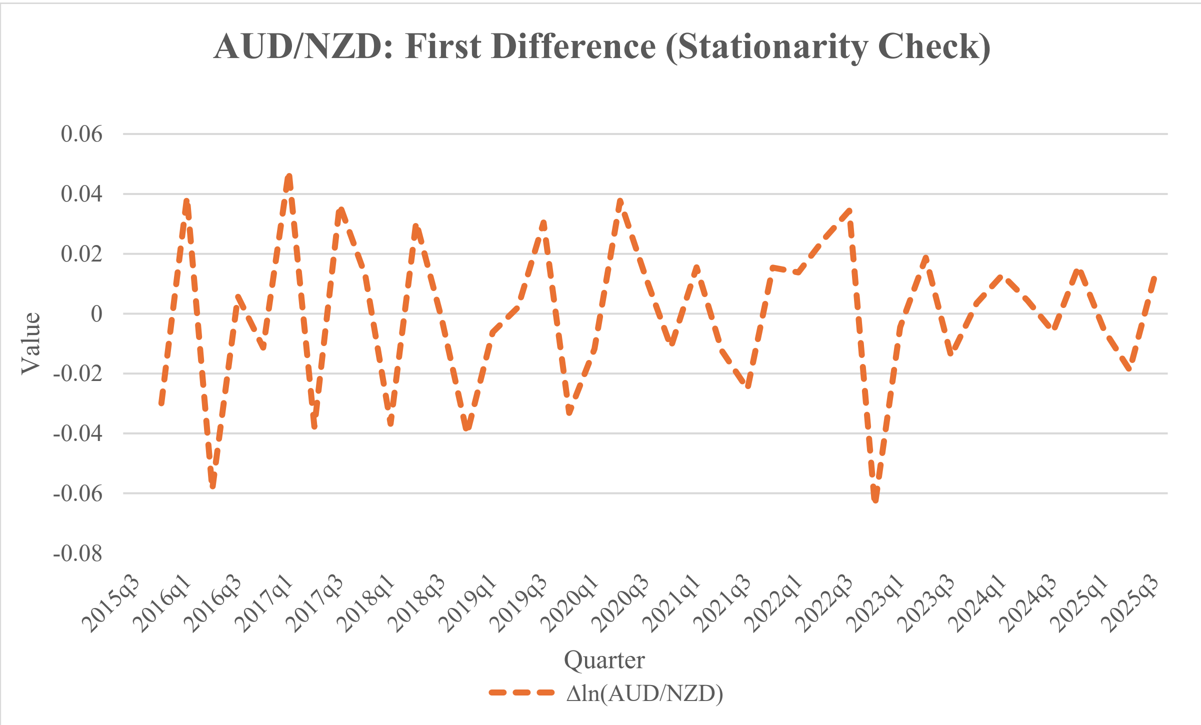
Taken together, these results give mixed evidence: the ADF with trend fails to reject a unit root at the conventional 5% level, while the PP trend strongly rejects it. With the sample only consisting to 40 observations, the conservative approach of treating a series I(1) is in line with standard UIP practice.

Figure 4.3 AUD/NZD: Level (Stationarity Check)



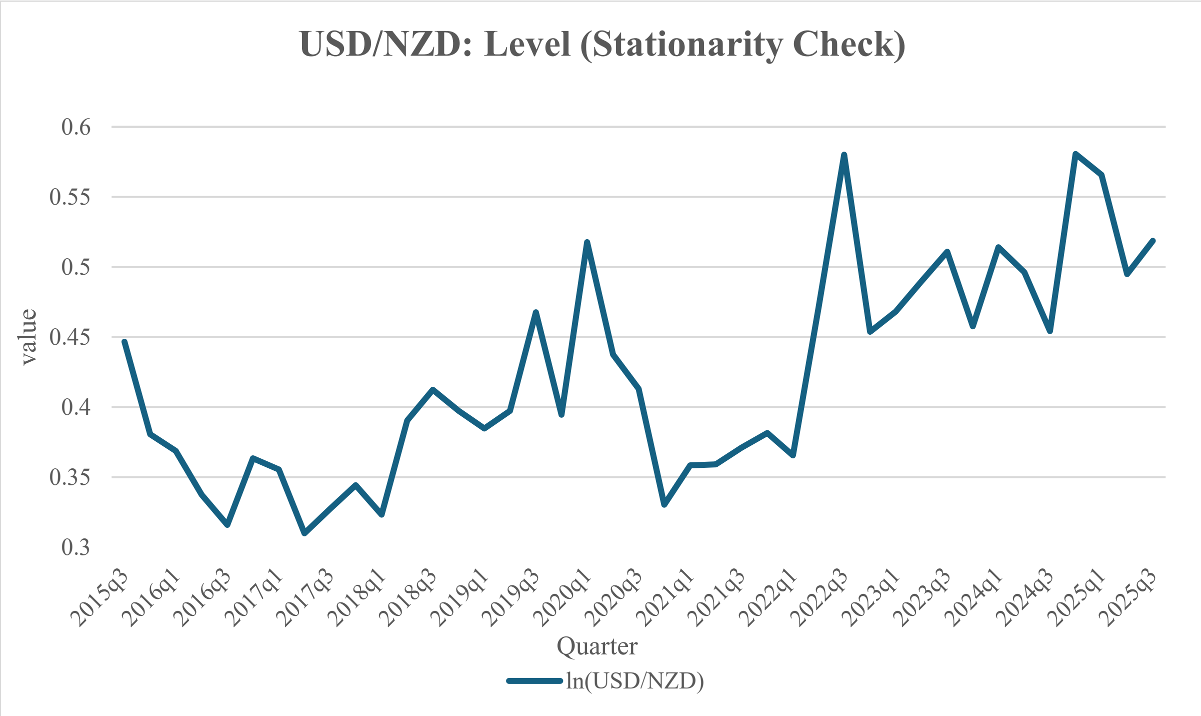
Source: Author's estimations using data from Refinitiv Workspace, RBNZ and RBA.

Figure 4.4 AUD/NZD: First Difference (Stationarity Check)



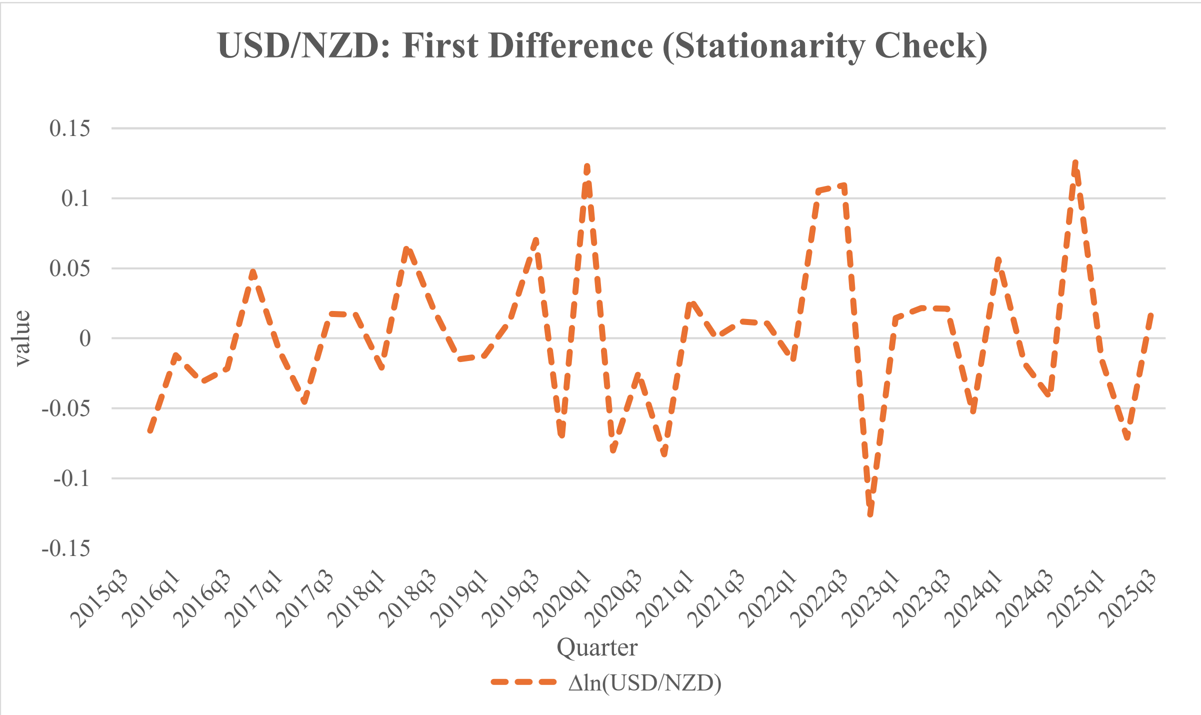
Source: Author's estimations using data from Refinitiv Workspace, RBNZ and RBA.

Figure 4.5 USD/NZD: Level (Stationarity Check)



Source: Author's estimations using data from Refinitiv Workspace, RBNZ and FRED.

Figure 4.6 USD/NZD: First Difference (Stationarity Check)



Source: Author's estimations using data from Refinitiv Workspace, RBNZ and FRED.

Figures 4.3 to 4.6 provides an illustration of stationarity diagnostics for the log exchange-rate levels and their first differences. Separating the series into level and first-difference helps visualise the persistence in levels versus mean reversion in changes.

Figure 4.3 plots ln(AUD/NZD) in levels as the series suggests that persistent movements does not show clear mean-reverting behaviour over the 10-year sample, which is visually consistent with the ADF evidence in Table 4.2 that fails to reject a unit root at conventional levels. In contrast, Figure 4.4 plots Δln(AUD/NZD) showing the first-difference series fluctuates around zero with no sustained trend, consistent with stationarity in changes and supporting the standard interpretation that the exchange rate is more appropriately modelled in first differences for short-run dynamics.

Figure 4.5 plots ln(USD/NZD) in levels as this series suggests that there is clearer persistence and shifting levels across the sample, again suggesting non-stationarity in levels and aligning with the ADF results in Table 4.2. Figure 4.6 presents Δln(USD/NZD) showing the first difference series, which fluctuates around zero with larger quarterly movements, suggesting that differencing removes the persistent component present in levels.

Overall, figures 4.3-4.6 supports exchange rates as a I(1)-type processes, motivating the subsequent use of first-difference specifications for short-run UIP estimation, while cointegration testing is required for assessing whether any stable long-run relationship is significant.

4.3 Cointegration analysis

This section tests whether a long-run (level) relationship exists between the log exchange rate and the corresponding interest-rate differentials using the Engle-Granger two-step cointegration procedure (Engle & Granger, 1987). The approach first estimates the long-run equilibrium equation:

$$lnS_t = B_0 + B_1(Spread_t) + u_t \quad (23)$$

In the second step, testing the estimated residuals ($\hat{u}_t$) for stationarity using ADF specification without a constant or trend:

$$\Delta\hat{u}_t = \gamma\hat{u}_{t-1} + \sum_{i=1}^{k} \delta_i \, \Delta\hat{u}_{t-i} + \varepsilon_t \quad (24)$$

Hypotheses: The specific hypotheses for this residual-based test concern the parameter γ:

Null hypothesis: (H_0: $\gamma = 0$): The residuals are non-stationary (unit root). This implies no cointegration exists.

Alternative hypothesis: (H_1: $\gamma < 0$): The residuals are stationary. This implies cointegration exists (a stable long-run relationship).

4.3.1 AUD/NZD Engle-Granger results

Engle–Granger cointegration test (AUD/NZD Pair)

Table 4.3 Engle–Granger cointegration test results for AUD/NZD

Dependent variable: ln $S_{AUD/NZD,t}$

Regressor	*Coef.*	*Std. Err.*	*t*	*p*	*95% CI*
$spread_{NZ,AU,t}$	0.0089	0.0059	1.50	0.142	[-0.0031, 0.0209]
Constant	0.0688	0.0043	16.05	0.000	[0.0601, 0.0774]
	$N = 40$, $R^2 = 0.054$, *ADJ.* $R^2 = 0.0302$, $F(1,39)$= *2.25,* $p = 0.1419$				

Panel B. ADF test on residuals (no constant/trend; 4 lags)

Statistic	*Value*
ADF $Z(t)$	-2.584
Critical values (1%, 5%, 10%)	-3.675, -2.969, -2.617
Mackinnon p *- value*	0.096

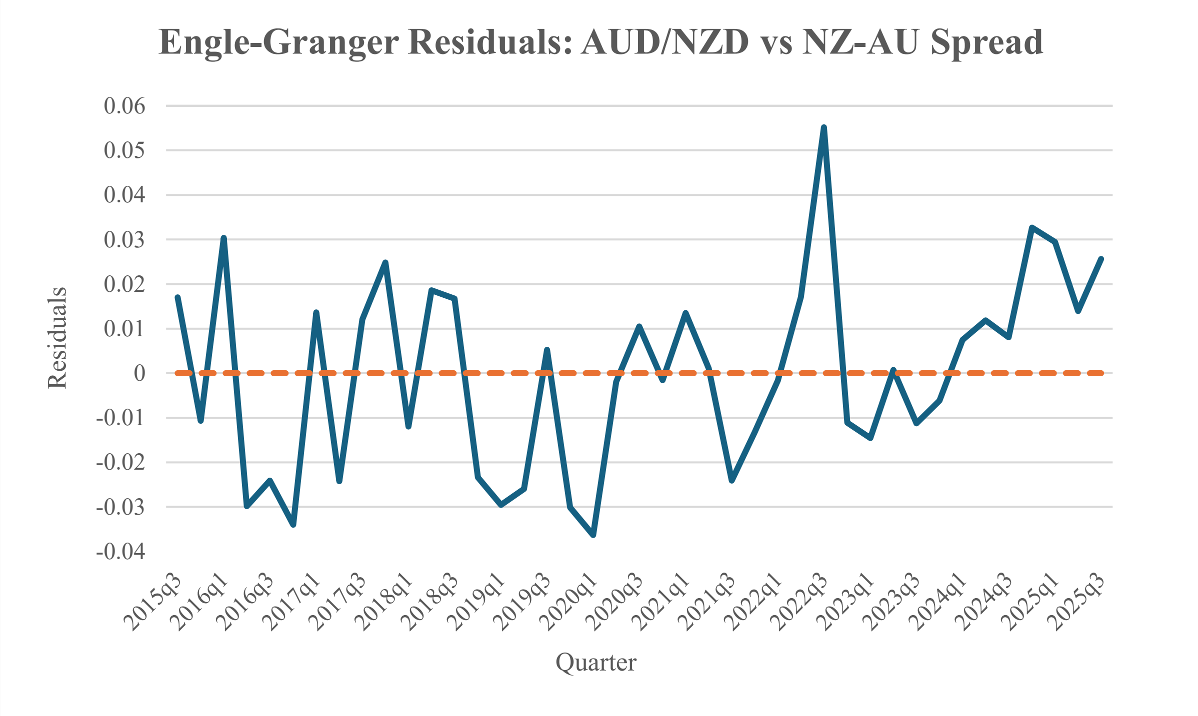
Decision: *Fail to reject a unit root* $\hat{u}_t$ *at 5% (reject at 10%). => **No cointegration at 5%** between* $ln\, s_{AUD/NZD}$ *and the NZ-AU interest rate spread over this sample.*

Source: Author's estimations using data from Refinitiv Workspace, RBNZ and RBA.

Table 4.3 reports the Engle-Granger two-step cointegration test for the AUD/NZD pair. Regressing the log exchange rate on the NZ-AU interest-rate spread yields a slight positive slope (0.0089) but indicates it is statistically insignificant ($p = 0.142$), with an $R^2 = 0.05$.

The second step (Panel B) undergoes an ADF test on the residuals ($Z(t) = -2.584$) failing to reject the null of a unit root at the 5% level ($p = 0.096$). Consequently, we strictly interpret this as no evidence of cointegration between $Ln\, S_{AUD/NZD}$ and the NZ-AU interest-rate differential. This suggests at most a short-run relationship, with no evidence of a stable long-run parity condition.

Figure 4.7 Engle-Granger Residuals: AUD/NZD vs NZ-AU Spread



Source: Author's estimations using data from Refinitiv Workspace, RBNZ and RBA.

Figure 4.7 provides a visualisation of the Engle-Granger results for the AUD/NZD pair, where the residuals tend to fluctuate erratically around the zero mean with no consistent reversals. This is mainly due to the recovery from the COVID-19 pandemic, especially after 2020, when deviations became more persistent, consistent with the visual patterns. The results $(Z(t) = -2.584), p = 0.096)$, confirm that the estimated equilibrium errors remain non-stationary, suggesting that there is no evidence of long-run cointegration between ln S_{AUD/NZD} and the NZ-AU interest differential, with only short-run interactions observed over the sample period.

4.3.2 USD/NZD Engle-Granger results

Table 4.4 Engle–Granger cointegration test results for USD/NZD

Engle–Granger cointegration test (USD/NZD Pair)

Dependent variable: $\ln S_{USD/NZD,t}$

Regressor	*Coef.*	*Std. Err.*	*t*	*p*	*95% CI*
$spread_{NZ,US,t}$	-0.0356	0.0131	-2.72	0.010	[-0.0621, -0.0091]
Constant	0.4307	0.0114	37.76	0.000	[0.4077, 0.4538]
	$N = 40$, $R^2 = 0.160$, *ADJ.* $R^2 = 0.138$, $F(1,39)$= *7.41*, $p = 0.0097$				

Panel B. ADF test on residuals (no constant/trend; 4 lags)

Statistic	*Value*
ADF $Z(t)$	-1.364
Critical Values (1%, 5%, 10%)	-3.675, -2.969, -2.617
Mackinnon $p-value$	0.5995

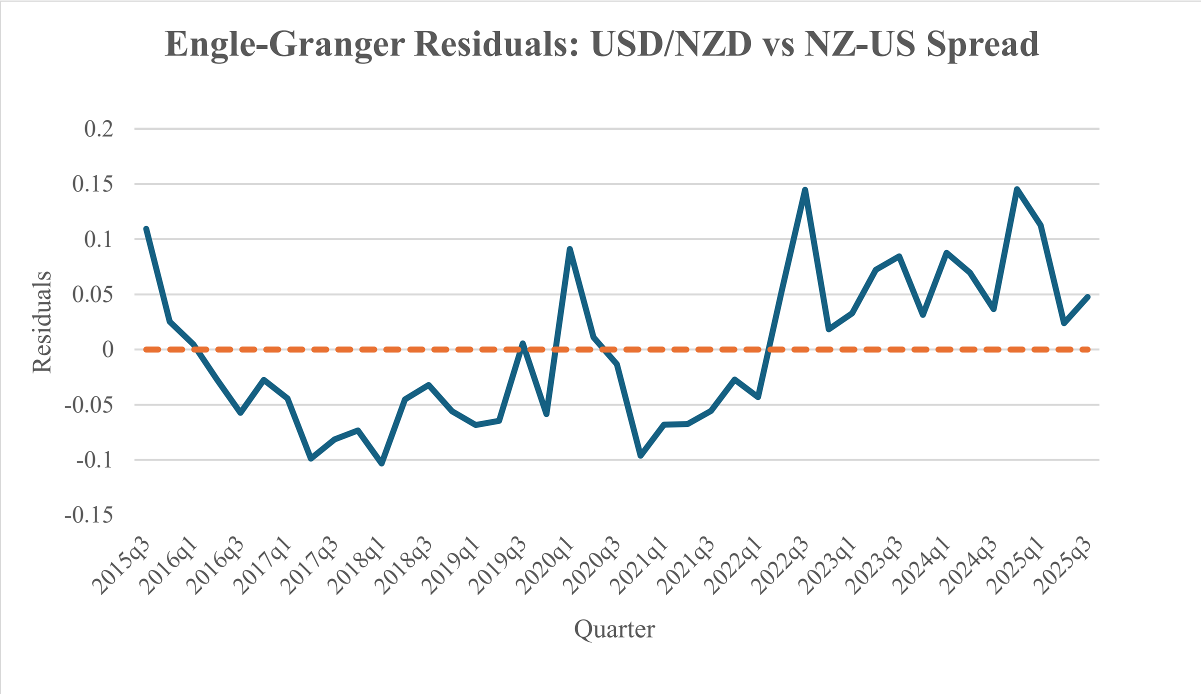
Decision: *Fail to reject a unit root* $\hat{u}_t$ *at 10% and 5% levels. => **no cointegration** between* $\ln s_{USD/NZD}$ *and the NZ-US interest-rate spread over this sample.*

Source: Author's estimations using data from Refinitiv Workspace, RBNZ and FRED

Table 4.4 reports the corresponding results for the USD/NZD pair under Engle-Granger two-step cointegration test. Unlike AUD/NZD, the slope coefficient (-0.0356) is negative and statistically significant ($p = 0.010$), suggesting that high NZ-US interest-rate spreads are correlated with an appreciation of the NZD (bullish). Consequently, the residual-based ADF statistic (-1.364) and p-value ($p = 0.600$) fails to reject the null of a unit root. Therefore, although there is a significant short-run correlation, the residuals remain non-stationary, implying no stable long-run cointegration relationship.

The Engle-Granger for both AUD/NZD and USD/NZD show non-stationary levels and an absence of cointegration, in line with studies such as Chinn & Meredith (2004), and Aziz (2024). This justifies shifting to first-difference specifications and a focus on short-run UIP dynamics.

Figure 4.8 Engle-Granger Residuals: USD/NZD vs NZ-US Spread



Source: Author's estimations using data from Refinitiv Workspace, RBNZ and FRED.

Figure 4.8 provides a visualisation of the Engle-Granger results for the USD/NZD pair, as the residuals tend to fluctuate erratically from zero, exhibiting large and persistent deviations from zero. Between 2021 and 2024, there is little to no evidence to return towards equilibrium due to the residual-based ADF result (Z = –1.364, p = 0.601), which fails to reject the unit-root hypothesis. Overall, these movements in this figure help illustrate that the relationship between USD/NZD and the NZ-US interest-rate differential is unlikely to revert to the mean in the long run, due to the behaviour and absence of cointegration, and supports a short-run dynamic consistent with UIP theory.

4.4 ARDL Cointegration Testing

To robustly test for a long-run relationship in small samples, we employ the Autoregressive Distributed Lag (ARDL) bounds testing approach (Pesaran et al., 2001). This involves estimating the conditional Error Correction Model (ECM):

$$\Delta lnS_t = \alpha + \sum_{i=1}^{p-1} \gamma_i \, \Delta lnS_{t-i} + \sum_{j=0}^{q-1} \beta_j \, \Delta Spread_{t-j} + \leftthreetimes_1 \, lnS_{t-1} + \leftthreetimes_2 \, Spread_{t-1} + \varepsilon_t \quad (25)$$

Where the terms $\leftthreetimes_1$ and $\leftthreetimes_2$ represent the long-run level relationship.

Hypotheses (Bounds Test): The Bounds test performs a joint significance test (F-test) on the lagged level variables. The null and alternative hypotheses are:

Null Hypothesis ($\boldsymbol{H_0}$: $\lambda_1 = \lambda_2 = 0$): No level relationship (no cointegration)

Alternative Hypothesis ($\boldsymbol{H_1}$: $\boldsymbol{\lambda_1} \neq 0 \cup \leftthreetimes_2 \neq 0$): A level relationship exists (cointegration).

Table 4.5 ARDL(1,0) Error-Correction Form (AIC-selected)

Dependent variable: $\Delta \ln(S)_t$ (quarterly log depreciation)
Model: ARDL(1,0) in EC form, selected by AIC with maxlags(4)
(Std. errors in parentheses)

Variables	*AUD/NZD*	*USD/NZD*
Adjustment term (ECT):Log exchange rate (ln_fx_{t−1})	−0.6667*** (0.1575)	−0.3478** (0.1340)
Long-run coefficient: spread_nz	0.0094 (0.0085)	−0.0533 (0.0440)
Constant	0.0460*** (0.0115)	0.1522** (0.0575)
Observations	37	37
R-squared	0.346	0.166
Adj. R-squared	0.307	0.117
Sample	2015Q3–2025Q2	2015Q3–2025Q2

Notes: Standard errors are in parentheses. ln_fx_[t-1] denotes the log exchange rate $(t-1)$*, which serves as the error correction adjustment term. spread_nz denotes the interest differential (long-run coefficient). Significance levels:*
** $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.*

Table 4.6 ARDL Bounds Test for Cointegration (Pesaran–Shin–Smith, Case 3)

Bounds test output	*AUD/NZD*	*USD/NZD*
F-statistic	8.978	3.388
t-statistic	−4.233	−2.596
Decision (10%)	Reject H_0 (cointegration)	Do not reject H_0
Decision (5%)	Reject H_0 (cointegration)	Do not reject H_0
Decision (1%)	Reject H_0 (cointegration)	Do not reject H_0
Conclusion	Cointegration present	No cointegration

Notes: H_0: no level relationship. Critical values and approximate p-values reported by Stata (Kripfganz & Schneider finite-sample bounds).

Source: Author's estimations using data from Refinitiv Workspace, RBNZ, RBA and FRED.

4.4.1 ARDL Estimation Results

Table 4.5 reports the AIC-selected ARDL (1,0) error-correction (EC) specifications for AUD/NZD and USD/NZD, estimated over a sample of N = 37 between 2016Q3 – 2025Q3.

For AUD/NZD, the EC form shows a negative and highly significant adjustment term (ECT = -0.6667, $p < 0.001$). However, the estimated long-run spread coefficient remains statistically insignificant (0.0094, $p = 0.272$), suggesting that even where a level relationship is detected, the long-run UIP slope is imprecisely estimated and provides minimal support for a strong correlation in interest-differential in channels.

For USD/NZD, the EC term is also negative and significant under standard critical values (*ECT* = -0.3478, $p = 0.014$). However, as shown in the subsequent Bounds test, standard p-values can be misleading when testing for cointegration in mixed I(0)/I(1) environments, requiring the use of non-standard critical value bounds.

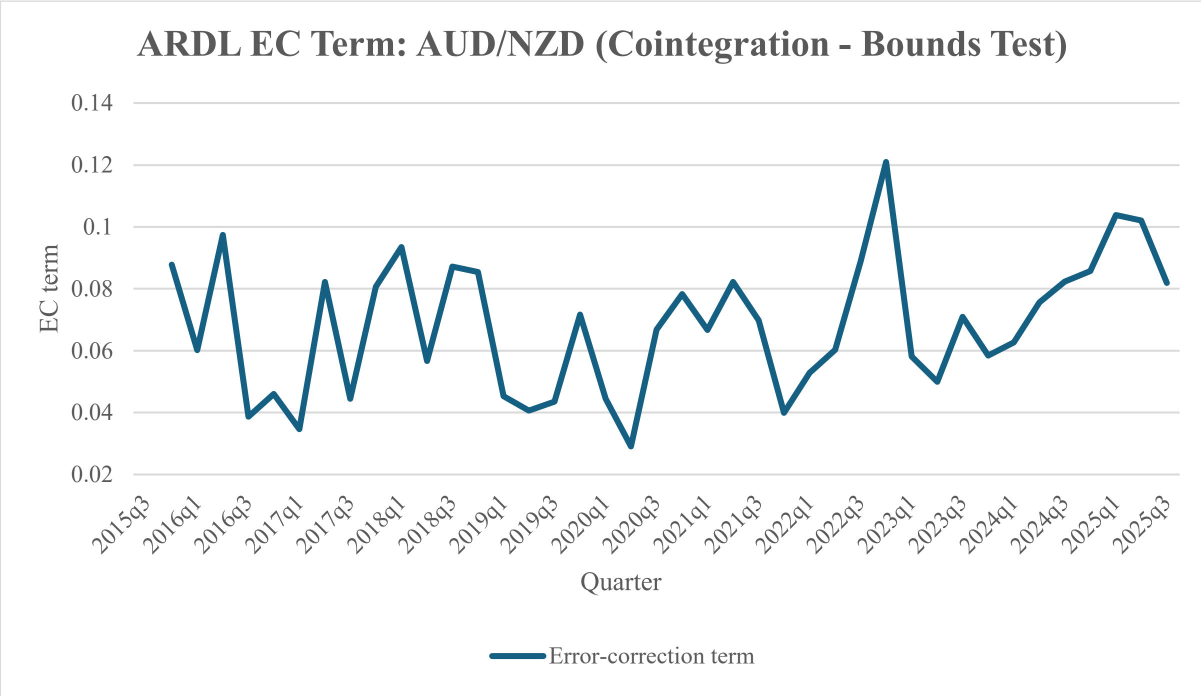
To test whether a stable long-run level relationship exists between the logged exchange rate and the relevant interest-rate spread, we execute the Pesaran-Shin-Smith bounds testing procedure.

4.4.2 Bounds Test Verification

Table 4.6 presents the Pesaran-Shin-Smith bounds test (case 3) outcomes. The Bounds test for USD/NZD fails to reject the null of no level relationship (F = 3.388; t = -2.596) as this does not reject at 10%, 5% and 1% suggesting that there is no cointegration between ln_fx_usd and the NZ-US spread over the sample. For AUD/NZD, the results differ as the bounds test strongly rejects the null of no level relationship (F = 8.978; t = -4.233) and does reject at 10%, 5% and 1% implying evidence of cointegration between ln_fx_aud and the NZ-AU spread within the ARDL framework.

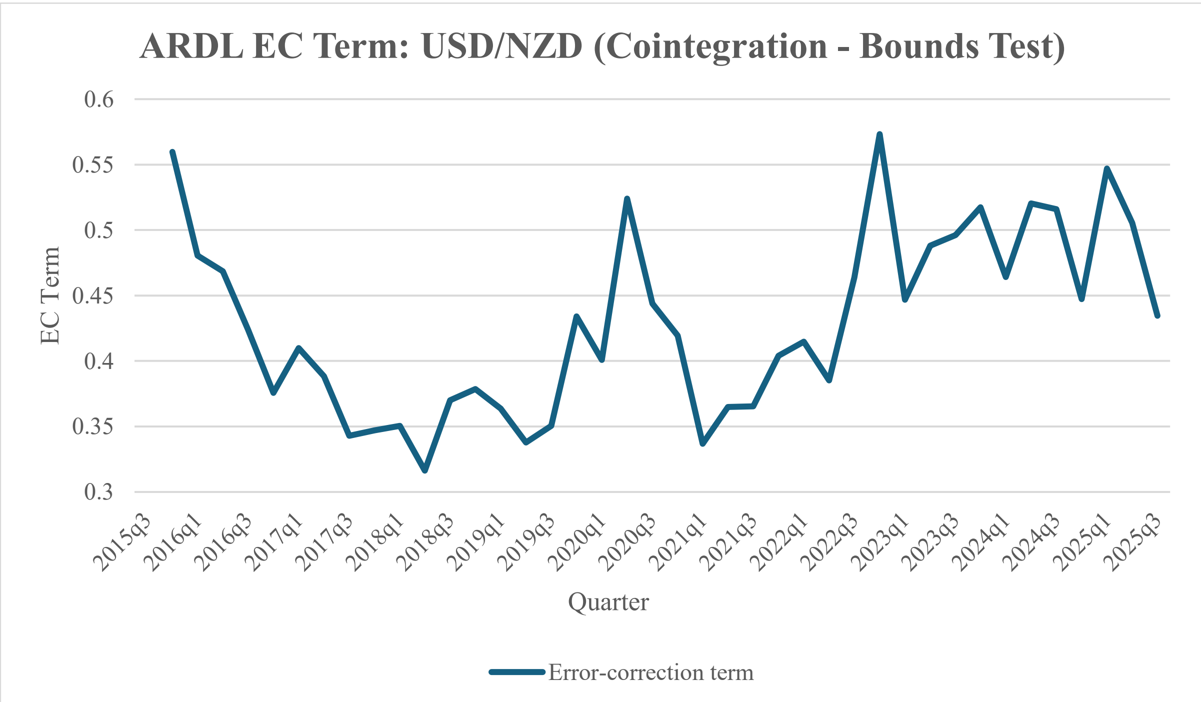
Overall, Tables 4.5 and 4.6 tell us that a long-run conclusion: USD/NZD shows no evidence of cointegration, while AUD/NZD displays bounds test-evidence of a level relationship but with an insignificant long-run spread coefficient. These long run results remain consistent that short-run evidence in which interest rate differentials provide limited explanatory power for quarterly NZD depreciation of a sample size of 37 – motivating these studies focus on short-run UIP specifications and state-dependence.

Figure 4.9 ARDL Cointegration Test: AUD/NZD EC Term



Source: Author's estimations using data from Refinitiv Workspace, RBNZ, and RBA.

Figure 4.10 ARDL EC Term: USD/NZD (Bounds test does not support cointegration)



Source: Author's estimations using data from Refinitiv Workspace, RBNZ, and FRED.

4.4.3 Error Correction (Visualisation)

Figure 4.9 explains the ARDL error-correction (EC) term for AUD/NZD, illustrating the estimated deviation from the implied long-run component under the AIC-selected ARDL (1,0) error-correction form. The EC term remains bounded over the sample and fluctuates around a relatively stable range, with noticeable deviations followed by subsequent reductions. As seen in Tables 4.6 and Tables 4.7 the mean-reverting behavioural shows the adjustment coefficient is negative and highly significant (ECT = -0.6667), implying relatively fast correction of disequilibria, and the bounds test strongly rejects the null of no level relationship. Overall, the bounds-test result and the EC-term support the stable long-run relationship for AUD/NZD within the ARDL framework.

Figure 4.10 shows the corresponding EC term for USD/NZD; however, the results show more persistent deviations and does not display clear and systematic mean reversion back toward zero across several sub-periods. This is because in Table 4.7, where the bounds test fails to reject the null hypothesis of no level relationship for USD/NZD, hence the EC-term plot should be viewed as a diagnostic representation of implied disequilibrium dynamics, rather than conformation of cointegration compared to AUD/NZD. Overall, the evidence in figure 4.10 show that USD/NZD does not exhibit a stable long-run relationship with the NZ-US interest-rate spread over the sample period in this ARDL framework.

4.5 Short-run UIP estimates

Having established the integration properties and cointegration evidence, we now estimate the short-run dynamic relationships. This section tests whether the standard forward-looking Uncovered Interest Parity (UIP) condition, which poses that interest-rate differential should perfectly predict the subsequent exchange rate depreciation.

The estimated specification is:

$$\Delta S_{t+1} = \alpha + \beta(i_t - i_t^*) + \varepsilon_{t+1} \qquad (26)$$

Where ΔS_{t+1} is the realized depreciation of the NZD in the following quarter $(s_{t+1} - s_t)$ and $(i_t - i_t^*)$ is the current interest-rate differential.

Hypothesis (H_0: $\beta = 1, \alpha = 0$): Uncovered Interest Parity holds (high-interest rates predict equal depreciation). [12]

Alternative Hypothesis (H_1: $\beta \neq 1$): Deviations from parity (UIP puzzle).

4.5.1 Forward-Looking UIP

Forward-Looking UIP Regressions

Table 4.7. Forward-looking UIP regression results for AUD/NZD & USD/NZD

	AUD/NZD ($\Delta s_{\_\{t+1\}}$)	*USD/NZD* ($\Delta s_{\_\{t+1\}}$)
Interest-Rate Differential $i_t - i_t^*$	0.0002 (0.0044)	-0.0067 (0.0077)
Constant α	-0.0002 (0.0032)	0.0037 (0.0057)
Observations	40	40
F-stat (NW)	0.00	0.76
p (model)	0.961	0.389
95% CI of β	[-0.0086, 0.0090]	[-0.0224, 0.0089]
SEs	Newey–West (lag=3)	Newey–West (lag=3)

Notes: Dependent variable is next-quarter log depreciation $\Delta s\_t + 1$. *Coefficients reported with Newey – West standard errors in parentheses. Sample: quarterly,* $N = 40$

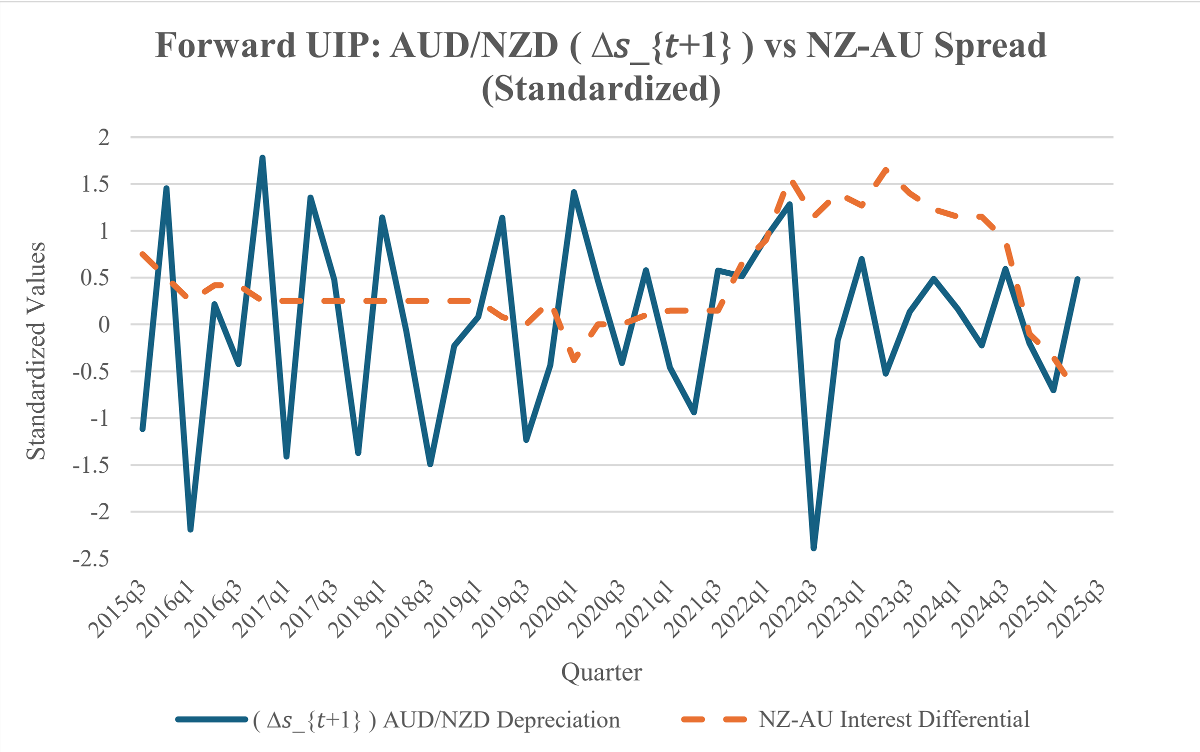
Source: Author's estimations using data from Refinitiv Workspace, RBNZ, RBA and FRED.

Table 4.7 illustrates regressions for both AUD/NZD and USD/NZD pairs using forward-looking UIP as the baseline model, consistent with previous empirical UIP regressions. Quarterly data from 2015Q3 to 2025Q2, along with Newey-West standard errors (lag = 3), are applied to illustrate the correlation between the movements and interest rate differentials between these countries. The coefficient on the interest-rate differential is negative for

[12] In empirical literature (e.g., Fama, 1984), a common finding is $\beta < 0$, known as the "forward premium puzzle," where high-interest currencies tend to appreciate rather than depreciate.

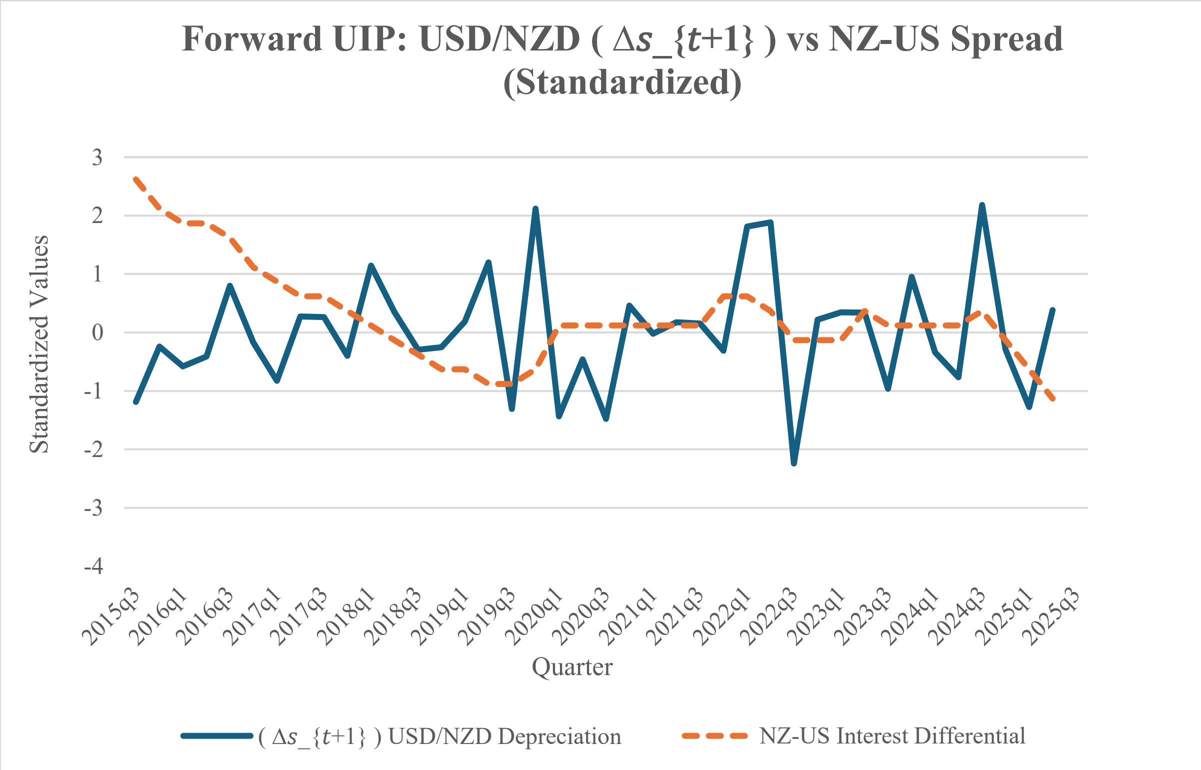
USD/NZD ($\beta = -0.0067$) and near zero for AUD/NZD ($\beta = 0.0002$), with p-values of 0.39 and 0.96, respectively. While the negative sign is consistent with the direction of the "forward premium puzzle" often found in major currency pairs, the coefficients are statistically indistinguishable from zero ($p > 0.05$). Consequently, we reject the strict UIP null hypothesis, confirming that interest differentials have no predictive power for exchange rate movements (e.g the interest-rate differential has no predictive content for next-quarter depreciation). In both cases, the R^2 is near zero, confirming that interest differentials alone explain a negligible portion of short-run exchange rate volatility. Neither estimate is statistically different from zero, which proves that interest-rate differentials cannot forecast the next-quarter depreciation.

Figure 4.11 Forward UIP: AUD/NZD (Δs_{t+1}) vs NZ-AU Spread (Standardized)



Source: Author's estimations using data from Refinitiv Workspace, RBNZ, RBA and FRED.

Figure 4.12 Forward UIP: USD/NZD (Δs_{t+1}) vs NZ-US Spread (Standardized)



Source: Author's estimations using data from Refinitiv Workspace, RBNZ and FRED.

Figure 4.11 plots the forward-looking Uncovered Interest Parity (UIP) relationship between the next-quarter change in the AUD/NZD exchange rate (ΔS_{t+1}) and the NZ-AU short-rate differential from 2015Q3 to 2025Q2. The blue line represents the quarterly depreciation of the NZD against the AUD (the quarterly change in AUD/NZD), while the orange line represents the NZ-AU interest rate spread. Theoretically, Stephens (2004) explains that both series should move in the same direction because when a base-currency (New Zealand) interest rate exceeds the quote-currency (Australia) rate, investors expect the NZD to depreciate in the following period. In this case, positive NZ-AU spreads should be associated with expected NZD depreciation, implying a positive co-movement between the two variables.

Visually, the relationship from 2015Q3 to 2019Q3 appears highly unstable and regime-dependent. Both lines fluctuate close to zero, indicating steady market conditions with modest interest rate differentials and limited divergence. The COVID-19 shock (2020Q1 – 2021Q4) introduces pronounced volatility as the NZ-AU spread drops and then rebounds following aggressive policy interventions set by central banks. The corresponding spikes and troughs reflect short-term dislocations in which exchange-rate movements were driven more by uncertainty and liquidity constraints rather than by interest rate fundamentals, consistent with evidence that the COVID-19 pandemic generated unprecedented financial-market volatility and large VIX spikes. This pattern is supported by Bloom (2009) and Chunga and Yu (2024), who argue that heightened global uncertainty can temporarily weaken the UIP linkage in small open economies.

Following the pandemic, the RBNZ and RBA embarked on a monetary-tightening phase between 2022 and 2023, rapidly raising policy rates in response to persistent inflationary pressures driven by post-pandemic supply disruptions and higher global commodity prices, which had escalated prior to Russia's invasion of Ukraine. During this period, the NZ-AU spread often peaks in positive territory, implying that UIP would predict NZD depreciation (an increase in AUD/NZD). Instead, the AUD/NZD rate frequently moves in the opposite direction, with episodes of NZD appreciation. This divergence is consistent with the forward premium puzzle proposed by Fama (1984) and Engel (1996), who stated that currencies with higher yields tend to appreciate rather than depreciate. Although there is some partial realignment from 2023 onwards, the pattern remains inconsistent with a stable forward UIP relationship.

Figure 4.12 plots the forward-looking Uncovered Interest Parity (UIP) relationship between the next-quarter change in the USD/NZD exchange rate (ΔS_{t+1}) and the NZ-US short-rate differential from 2015Q3 to 2025Q2. The blue line represents the depreciation of the NZD against the USD in the next quarter, while the orange dashed line represents the interest-rate spread between New Zealand and the United States. Visually, the two series display only weak co-movement, suggesting that the forward-looking UIP relationship is fragile and unstable, with exchange-rate changes only slightly related to short-term interest-rate spreads. Theoretically, when New Zealand's interest rates surpass those of the United States, investors should expect the NZD to depreciate against the USD in the following quarter, implying a positive co-movement between spreads and depreciation similar to the AUD case (Stephens, 2004).

However, the graph demonstrates that this relationship does not hold consistently over 10-year sample. From 2015 to 2019, the NZ-US spread declined slowly, while the USD/NZD depreciation fluctuated around zero, indicating a weak connection between interest-rate differentials and exchange-rate adjustments. The COVID-19 period (2020Q1 – 2021Q4) is an example of intense volatility, characterized by large spikes and troughs in ΔS_{t+1}, while the spread remains relatively flat following rapid policy easing by the Federal Reserve and the RBNZ. This pattern is consistent with studies such as Bloom (2009) and Chunga and Yu (2024), which suggest that the COVID-19 pandemic caused extreme financial market volatility. Additionally, global uncertainty and liquidity effects can disrupt the movements between interest rates and exchange rates in small open economies.

During the post-pandemic period from 2022 to 2023, central banks responded to the global surge in inflation, driven by reopening demand, supply-chain disruptions, and higher energy and food prices associated with the war in Ukraine, as well as measures to tighten monetary policy. The NZ-US spread hovers near zero for most of this tightening phase, yet the USD/NZD exchange rate indicates large movements in both directions. This suggests that investors' expectations and risk premia were influenced more by global financial conditions and the USD's safe-haven role than by small changes in bilateral short-rate spreads, in line with the forward premium puzzle as proven by Fama (1984) and Engel (1996). The fluctuations in 2023-2024 indicate that the USD/NZD exchange rate became increasingly sensitive to global risk sentiment and liquidity conditions, rather than domestic interest-rate differentials alone.

Overall, the forward UIP fails empirically for both AUD/NZD and USD/NZD pairs, being consistent with the literature on global evidence based on the forward-premium puzzle. The results suggest that if New Zealand interest rates are high, they do not systematically predict whether the NZD will appreciate or depreciate.

4.5.2 Backward-Looking UIP

This section examines the "backward-looking" UIP where this specification tests whether past exchange rate movements drive current interest rate differentials.

The estimated equation is:

$$(i_t - i_t^*) = \alpha + \gamma(\Delta s_{t-1}) + \epsilon_t \qquad (27)$$

Where $(i_t - i_t^*)$ is the current interest-rate differential (Dependent Variable) and Δs_{t-1} is the exchange rate depreciation from the *previous* quarter (Independent Variable). Gamma (γ) captures the policy feedback (e.g., does the RBNZ raise rates if the NZD fell last quarter?)

Hypotheses:

Null Hypothesis ($\boldsymbol{H_0}$: $\gamma = 0$): No policy feedback. Interest rate spreads do not systematically react to past exchange rate movements.

Alternative Hypothesis ($\boldsymbol{H_1}$: $\gamma \neq 0$): Policy feedback exists (central banks adjust spreads based on past currency performance).

Table 4.8. Backward-looking UIP regression for AUD/NZD & USD/NZD

Backward-Looking UIP Regressions

Table 4.8: Backward-looking UIP regression for AUD/NZD & USD/NZD

	AUD/NZD ($Spread\_\{t\}$)	*USD/NZD* ($Spread\_\{t\}$)
Past depreciation ΔS_{t-1}	0.688 (2.249)	-1.267 (1.846)
Constant α	0.457***(0.163)	0.218 (0.208)
Observations	39	39
F-stat (NW)	0.09	0.47
p (model)	0.762	0.497
95% CI of γ	[-3.869, 5.244]	[-5.006, 2.472]
SEs	Newey–West (lag=3)	Newey–West (lag=3)

Notes: Dependent variable is the interest-rate differential ("spread") at time t. *Regressor is the* ***past*** *quarterly log depreciation* ΔS_{t-1}. *Coefficients shown with Newey-West standard errors in parentheses.* $* \ p < 0.10, ** \ p < 0.05, *** \ p < 0.01$

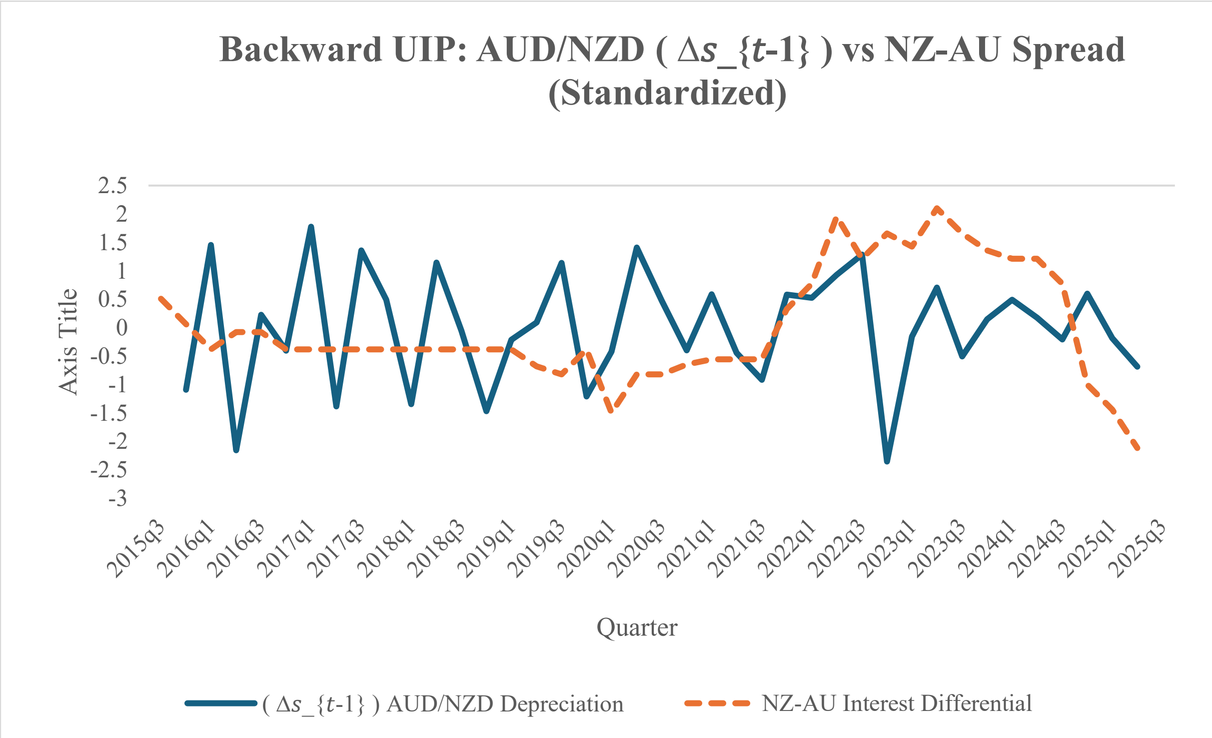
Source: Author's estimations using data from Refinitiv Workspace, RBNZ, RBA and FRED.

Table 4.8 illustrates the regressions for both AUD/NZD and USD/NZD pairs using a backward-looking UIP specification. Compared to the forward-looking UIP, the current interest-rate spread here reflects the depreciation of the previous quarter, serving to determine if the deviations observed earlier are caused by endogenous policy reactions

For AUD/NZD, the coefficient on past depreciation is positive ($\gamma = 0.688$) but statistically insignificant ($p = 0.76$). This implies that the RBNZ and RBA do not systematically alter the bilateral interest spread in response to the previous quarter's exchange rate movements. The constant term is highly significant ($\alpha = 0.457, p < 0.01$), indicating a structural average positive spread over the sample.

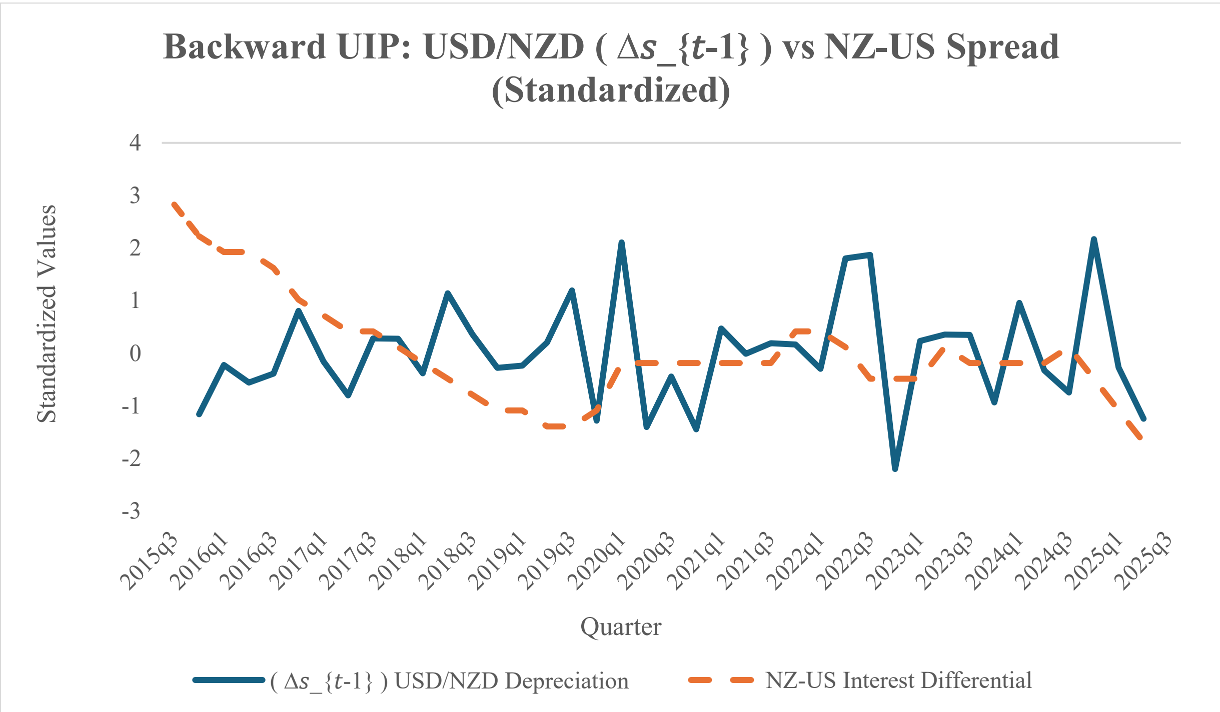
For USD/NZD, the coefficient is negative ($\gamma = -1.267$) and also statistically insignificant ($p = 0.497$). This confirms that the NZ-US spread acts independently of past currency fluctuations. Contextually, the significant standard errors indicate there is no systematic feedback from past exchange-rate movements to the interest-rate difference between the two pairs. Consequently, for both pairs, we fail to reject the null hypothesis (H_0); there is no statistical evidence that interest-rate differentials are determined by backward-looking exchange rate feedback.

Figure 4.13 Backward UIP: AUD/NZD ($\Delta s\_\{t\text{-}1\}$) vs NZ-AU Spread (Standardized)



Source: Author's estimations using data from Refinitiv Workspace, RBNZ and RBA.

Figure 4.14 Backward UIP: USD/NZD ($\Delta s\_\{t\text{-}1\}$) vs NZ-US Spread (Standardized)



Source: Author's estimations using data from Refinitiv Workspace, RBNZ and FRED.

Figure 4.13 illustrates the backward-looking Uncovered Interest Parity (UIP) relationship between the NZ-AU short-rate differential (orange dashed line) and the lagged change in the AUD/NZD exchange rate (ΔS_{t-1}) over the 2015Q3-2025Q2 period. Compared to the forward-looking case, the interest-rate spread is expected to adjust in response to past exchange rate movements if the UIP holds. Both series should exhibit a positive co-movement, reflecting the predictive role of lagged depreciation of future rate adjustments.

The graph illustrates a weakly correlated and time-varying relationship. Between 2015 and 2019, both series fluctuate around zero with only brief periods where they appear to move together before separating again. This suggests that past exchange-rate changes have only a limited influence on interest rate differentials, which supported by Engel's (1996) argument that UIP deviations can arise from forecasting errors and risk premia that vary over time, rather than from stable parity conditions.

During the COVID-19 period (2020Q1-2021Q4), both lines fluctuated more frequently, indicating that reserve banks from both countries adjusted their monetary policies in response to earlier volatility and external shocks. However, despite the pandemic recovery, the link weakens: the NZ-AU interest rate spreads rise sharply while lagged depreciation remains unpredictable. These movements suggest that changes in exchange rates and policy rates began to fluctuate independently of one another. Beyond the 2024Q4 to 2025Q2 period, the NZ-AU spread trends downward. At the same time, past depreciation stabilizes near zero, indicating a possible regime shift driven by global financial tightening and external shocks, such as higher global inflation and commodity price pressures. In line with Aziz's (2024) backward-looking UIP model, small open economies can perform poorly under UIP because New Zealand and Australia face liquidity constraints, capital-flow frictions, and gradual policy adjustments. Overall, Figure 4.13 shows that parity relationships tend to weaken in periods of uncertainty and become more stable when these conditions ease.

Figure 4.14 illustrates the relationship between NZ-US interest rate spread and lagged USD/NZD depreciation under the backward-looking framework. As in Aziz (2024), past exchange-rate movements are expected to influence interest-rate differentials if reserve banks or investors respond to earlier currency changes. This implies that previous NZD depreciations should be associated with wider NZ-US spreads if UIP expectations hold in a backward-looking sense.

Between 2015 and 2019, the trend of the NZ-US spread is downward, while the USD/NZD depreciation fluctuates around zero, suggesting that interest-rate adjustments are mainly independent of past exchange-rate behavior. Engel (1996) argues that the backward-looking UIP often fails because risk premia and information rigidities evolve, disrupting the linkage between lagged depreciation and current interest rates. During the COVID-19 period (2020Q1-2021Q4), both series were more volatile but remained mostly disconnected: the flat spread reflects that both economies rapidly cut rates to the effective lower bound, while sharp swings in lagged depreciation show that the USD continued to move with global risk sentiment rather than domestic fundamentals (Bloom, 2009).

Following the pandemic, from Q2 2022 onwards, both central banks began implementing monetary-tightening policies in response to the global surge in inflation, driven by reopening demand, supply-chain disruptions, and higher energy and food prices. The NZ-US spread stabilizes near zero while exchange-rate movements remain unpredictable, indicating that past depreciation offered little predictive value for current spreads. Beyond the 2024Q4 to 2025Q2 period, the NZ-US spread turns negative as US interest rates remain relatively high, further weakening the UIP linkage. Overall, Figure 4.14 suggests that the backward-looking UIP condition for USD/NZD is fragile and inconsistent, and is influenced more by global uncertainty and the USD's safe-haven role than by lagged parity effects.

4.5.3 Expectations-Based UIP

Expectations-Based UIP *(USD/NZD only)*[13]

Table 4.9 Expectation-Based UIP regression for USD/NZD

	USD/NZD ($E_{t[\Delta s_{\{t+1\}}]}$)
Interest-Rate Differential $i_t - i_t^*$	-0.135(0.087)
Constant α	0.377**(0.138)
Observations	40
F-stat (NW)	2.44
p (model)	0.126
95% CI of γ	[-0.310, 0.040]
SEs	Newey–West (lag=3)

*Notes: Dependent variable is the **expected** next-quarter depreciation* $E_t[\Delta S_{t+1}]$ *(survey-based)* **.** *Regressor is the contemporaneous interest-rate differential. Coefficients shown with Newey–West standard errors in parentheses.* * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Source: Author's estimations using data from Refinitiv Workspace, RBNZ *and FRED.*

This section explains the assumption of rational expectations by using New Zealand survey-based data to test the "Expectations-Based" UIP condition. This specification tests whether market participants expect exchange rates to adjust according to interest differentials.

The estimated equation is:

$$E_t[\Delta s_{t+1}] = \alpha + \gamma(i_t - i_t^*) + \varepsilon_t \qquad (28)$$

Where $E_t[\Delta s_{t+1}]$ is the survey-based expected depreciation of the USD/NZD exchange rate provided by RBNZ Consensus Economies.

[13] Survey-based exchange-rate expectations are available only for the USD/NZD pair through Consensus Economics, which is why the expectations-based UIP model is estimated solely for this currency pair. This follows standard practice in the literature when expectations data are limited (e.g., Beckmann & Reitz, 2020; Coibion & Gorodnichenko, 2012).

Hypotheses:

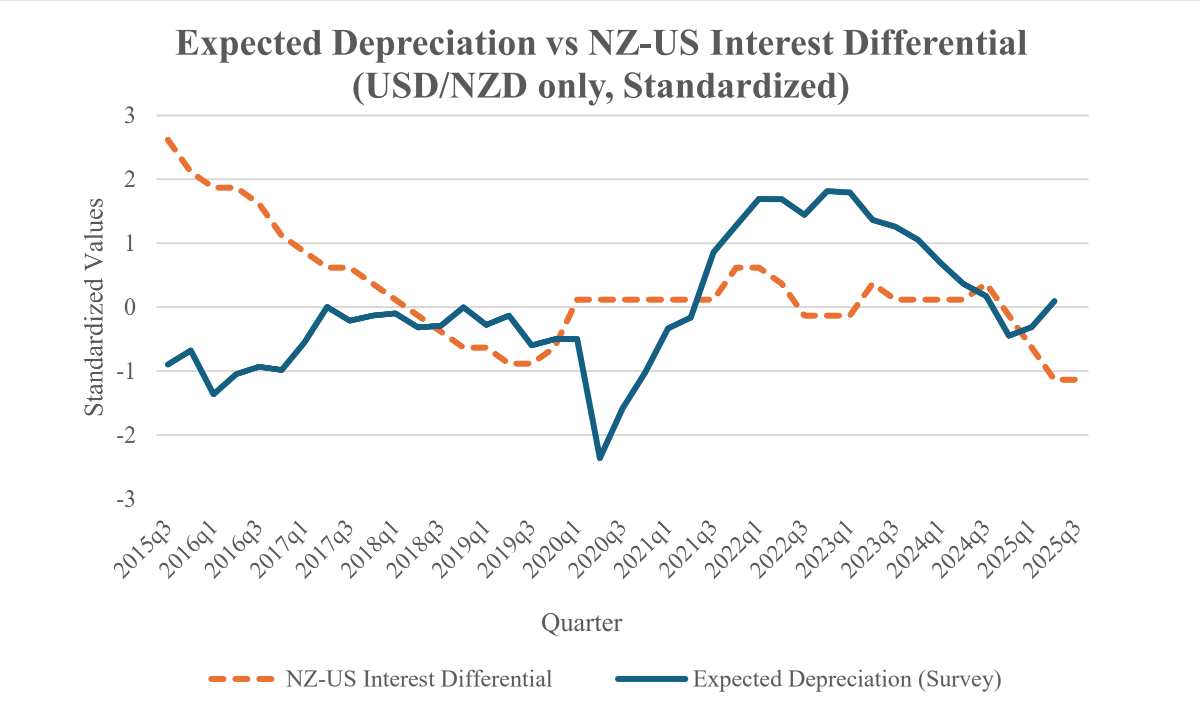
Null Hypothesis ($H_0: \gamma = 1$): Investors fully incorporate interest differentials into their forecast.

Alternative Hypothesis ($H_1: \gamma < 1$): Investors under-react to interest differentials, or expectations are sticky/noisy.

Table 4.9 presents the expectation-based UIP results using survey data on expected depreciation only for USD/NZD. The estimated $\gamma(-0.135, p = 0.13)$ is negative but not statistically significant, whereas the intercept ($\alpha = 0.377$, $p < 0.01$), the constant is positive and significant. These results imply that market participants (on average) expect a mild NZD depreciation even when interest-rate differentials are near 0, aligning with the consistent literature that the presence of a risk or information-rigidity premium. In this regression, the constant represents the time-varying risk premium (or natural risk premium). A significant positive intercept indicates that, on average, survey respondents consistently expect the NZD to depreciate by approximately 0.38% per quarter more than what is implied by the interest differential.

This confirms the presence of a structural risk premium required by investors to hold New Zealand dollar assets, independent of the interest rate spread. Based on these observations and results, it is suggested that expectations adjust only partially to interest-rate information, which aligns with the existing literature on sticky or noisy information (Beckmann & Reitz, 2020). The RBNZ closely tracks policy-rate differentials because they shape market and firm expectations of USD/NZD movements under the UIP framework. In its forecasting process, central banks aim to maintain credible and well-anchored expectations, ensuring that survey-based forecasts do not diverge substantially from macroeconomic fundamentals.

Figure 4.15 Expected Depreciation vs NZ-US Interest Differential (USD/NZD only, Standardized)



Source: Author's estimations using data from Refinitiv Workspace, RBNZ and FRED.

Figure 4.15 visualizes the expected depreciation time series against the NZ-US spread. Before 2020, expectations pointed to a gradual recovery, with both expected depreciation and the NZ-US spread expected to consolidate. The onset of the COVID-19 pandemic generated a sharp downturn in both series, reflecting rapid policy easing and a deterioration in economic conditions. The pandemic shock caused a sharp divergence. The blue line (expectations) is consistently lower than the orange line, reflecting the "risk premium" identified in the regression constant, driven by global risk sentiment rather than monetary policy. Between Q1 2022 and Q2 2023, global monetary conditions tightened in response to the post-pandemic surge in inflation and higher prices for energy and food.

The co-movement between expected depreciation and the NZ-US spread quickly scatters, which is consistent with the weak slope estimated in the expectations-based UIP regressions. This divergence indicates that survey-based expectations adjusted more slowly than actual policy movements, consistent with the presence of information rigidities and sticky expectations described by Beckmann and Reitz (2020) for exchange rate forecasts and Coibion and Gorodnichenko (2012) for inflation expectations.

During the 2022-2023 period, when both the Federal Reserve and the RBNZ implemented rapid monetary tightening, survey participants appear to have underestimated the persistence of higher US interest rates, leading to forecast errors and delayed revisions in expected NZD depreciation. Theoretically, Coibion and Gorodnichenko, 2012 explain that agents update information infrequently and gradually. Consequently, expectations respond unexpectedly to new shocks and policy changes, generating predictable forecasts and deviations rather than the immediate adjustment implied by full-information rational expectations.

4.6 State-dependent UIP (Preferred VIX model)

4.6.1 Baseline Lagged-Spread UIP Regression

The following regression estimates the traditional short-run UIP relationship using the one-quarter-lagged interest-rate differential and NZD depreciation. This specification provides whether policy-rate spreads contain predictive information for NZD movements before incorporating the VIX risk-based friction.

Table 4.10 Baseline lagged-spread UIP regression results for AUD/NZD and USD/NZD

Dependent variable: Δs_t(quarterly log depreciation)

Variables	*AUD/NZD*	*USD/NZD*
Lagged interest-rate differential - Lagged spread ($L.spread_t$)	0.00021 (0.00436)	-0.0067 (0.0077)
Constant	-0.00018 (0.00321)	0.00365 (0.00574)
Observations	40	40
F-statistic (NW)	0.00	0.76
Prob > F	0.961	0.389
SEs	Newey-West (lag = 3)	Newey-West (lag = 3)

Notes: Standard errors in parentheses. L.spread$_t$ is the lagged short-rate differential between the New Zealand OCR and the corresponding foreign policy rate (US Federal Funds Target Rate or RBA cash rate). HAC standard errors use Newey–West corrections with lag length 3.

Source: Author's estimations using data from Refinitiv Workspace, RBNZ, RBA and FRED.

Before estimating the full state-dependent model with interaction terms, we first estimate a baseline "lagged" specification. This tests whether past interest-rate differentials contain any predictive information for future exchange rate movements before accounting for global risk frictions. The estimated specification is:

$$\Delta s_t = \alpha + \beta(i_{t-1} - i_{t-1}^*) + \varepsilon_t \qquad (29)$$

Where Δs_t is the current quarterly depreciation and $(i_{t-1} - i_{t-1}^*)$ is the interest-rate differential lagged by one quarter.

Hypotheses:

Null Hypothesis ($\boldsymbol{H_0}$: $\boldsymbol{\beta = 0}$): Lagged interest rate spreads have no predictive power for current exchange rate depreciation.

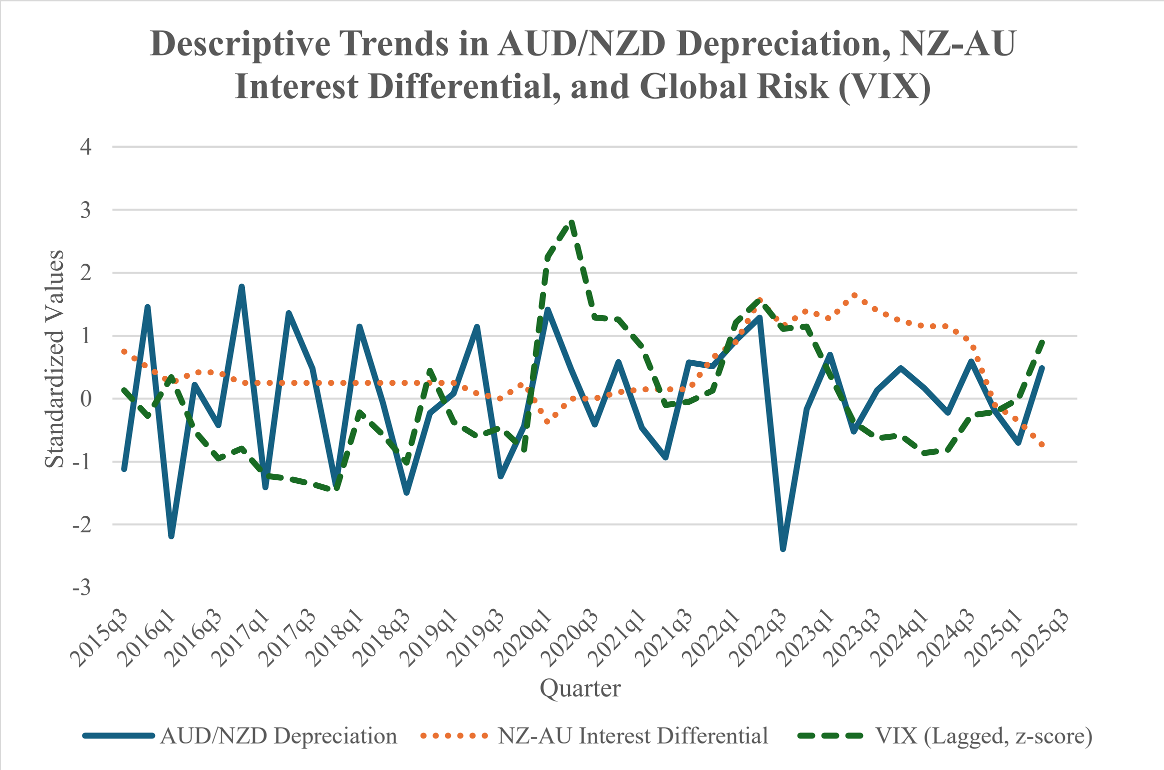
Alternative Hypothesis ($\boldsymbol{H_1}$: $\boldsymbol{\beta \neq 0}$): Lagged spreads significantly predict exchange rate movements.

Table 4.10 tests the traditional short-run UIP relationship for both currency pairs, AUD/NZD and USD/NZD. The results yield small and statistically insignificant slope coefficients.

The lagged interest-rate differential is 0.00021 with a p-value of 0.961 for AUD/NZD, while the USD/NZD estimate is -0.0067 with a p-value of 0.389. In both scenarios, the confidence intervals span values near zero, and the Newey-West F-statistics (0.76 and 0.00) indicate almost no explanatory power. The results show that interest-rate differentials alone do not predict short-run NZD depreciation, even when allowing for a one-quarter lag in monetary transmission.

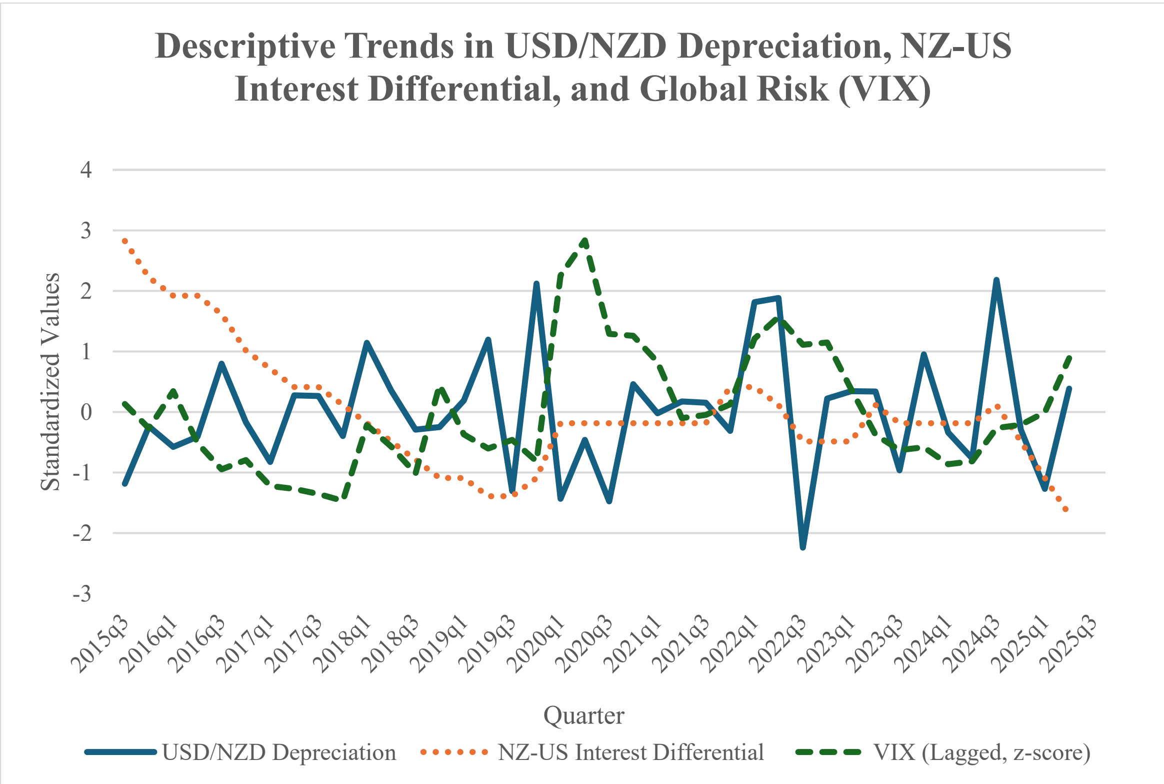
The baseline specification provides limited performance to an extent, where it is necessary to extend the model to include an additional risk-based friction as a motivation. The following subsection introduces lagged domestic interest rates as part of a transitional UIP framework.

Figure 4.16 Descriptive Trends in AUD/NZD Depreciation, NZ-AU Interest Differential, and Global Risk (VIX)



Source: Author's estimations using data from Refinitiv Workspace, RBNZ, RBA, and Cboe Options Exchange (CBOE).

Figure 4.17 Descriptive Trends in USD/NZD Depreciation, NZ-US Interest Differential, and Global Risk (VIX)



Source: Author's estimations using data from Refinitiv Workspace, RBNZ, FRED and Cboe Options Exchange (CBOE).

Figure 4.16 illustrates the descriptive trends of the standardised AUD/NZD depreciation (blue line), the lagged NZ-AU interest differential (orange), and the lagged VIX (green dashed). The chart draws attention to periods of heightened global risk, particularly during the COVID-19 pandemic (2020-2021) and the subsequent tightening phase (2022-2023). During these periods, the typical relationship between spreads and exchange rates appears disrupted. Specifically, large depreciations in the AUD/NZD (drops in the blue line) often align more closely with spikes in the VIX than with the relatively stable interest rate spreads. This observation suggests that uncertainty shocks can temporarily dominate interest-rate-driven movements. This behaviour is informed by Benigno, Benigno, and Nisticò (2012) and Kalemli-Özcan and Varela (2021), who demonstrate that risk aversion and volatility shocks create a demand for safe assets, amplifying deviations from UIP in small open economies by prompting investors to shift towards lower-risk currencies.

Figure 4.17 plots the corresponding trends for the USD/NZD pair. The pattern here is even more distinct: strong spikes in the VIX during the COVID-19 pandemic coincide with pronounced fluctuations in USD/NZD depreciation, while the NZ-US interest-rate differential remains relatively flat. This visual disconnect suggests that interest-rate differentials alone cannot explain the magnitude of NZD movements against the USD during high-stress episodes. Albagli et al. (2024) and Kalemli-Özcan and Varela (2021) show that uncertainty shocks amplify deviations from UIP as investors flee to “safer” currencies such as the USD. Similarly, Benigno, Benigno, and Nisticò (2012) explain that volatility shocks increase demand for low-risk assets, causing risk-sensitive currencies like the NZD to depreciate sharply. These mechanisms are consistent with the weak visual linkage between depreciation and spreads when the VIX is elevated, validating the need for the state-dependent model estimated in the next section.

4.6.2 VIX-Augmented UIP Regression (Preferred Model)

To account for the previous section that states dependent limits-to-arbitrage, the UIP specification is extended by interacting the lagged interest-rate differential with global risk conditions, proxied by the VIX index shown in Table 4.10. This follows that arbitrage efficiency varies over time, particularly during periods of heightened uncertainty. The preferred methodology allows the responsiveness of NZD depreciation to interest-rate spreads to vary in response to global risk sentiment.

The estimated specification is

$$\Delta s_t = \alpha + \beta_1(i_{t-1} - i_{t-1}^*) + \beta_2[(i_{t-1} - i_{t-1}^*) \times VIX_{t-1}] + \varepsilon_t \qquad (30)$$

Where β_2 represents the interaction term

Hypotheses:

Null Hypothesis ($\boldsymbol{H_0}$: $\boldsymbol{\beta_2 = 0}$): The relationship between interest spreads and exchange rates is constant (not state-dependent). Global risk does not alter the UIP mechanism.

Alternative Hypothesis ($\boldsymbol{H_1}$: $\boldsymbol{\beta_2 \neq 0}$): The relationship is state-dependent. The impact of interest spreads on exchange rates changes significantly when global risk (VIX) is high.

Table 4.11. VIX-augmented UIP regression results for AUD/NZD and USD/NZD

Dependent variable: Δs_t(quarterly log depreciation)

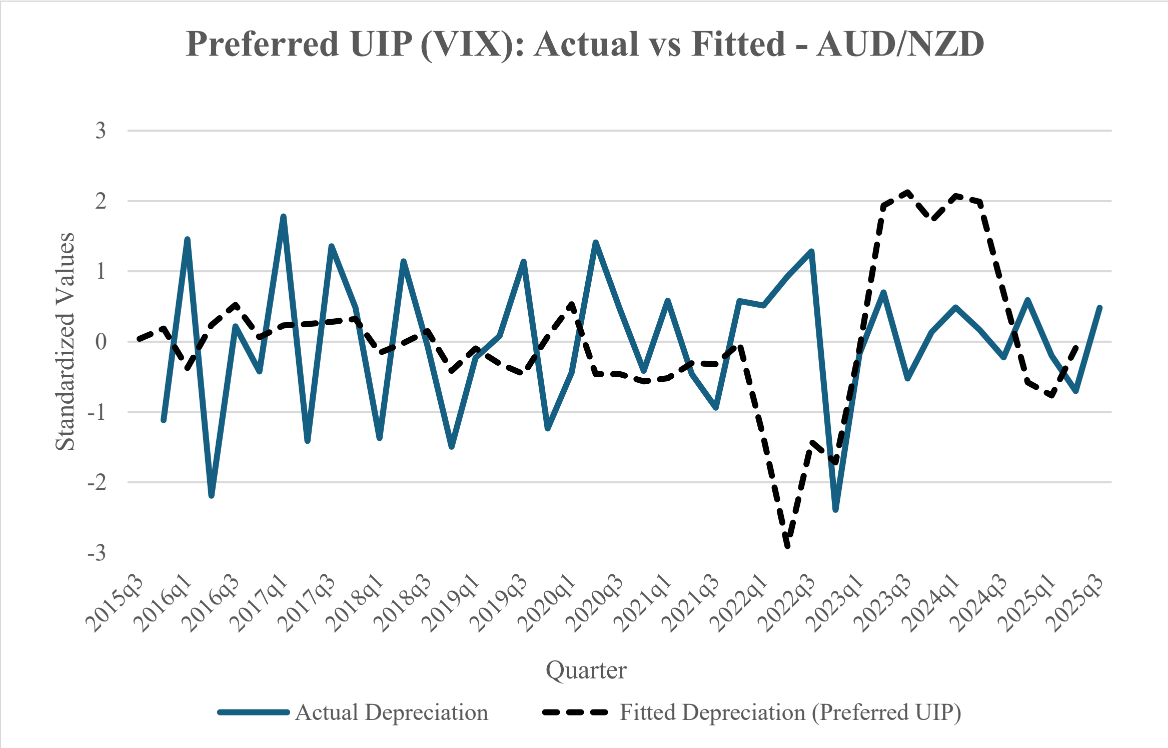
Variables	*AUD/NZD*	*USD/NZD*
Lagged interest-rate differential $L.spread_t$	0.00058 (0.00348)	-0.00534 (0.0103)
Interaction term $(L.spread_t \times L.VIX_t)$	-0.00099 (0.00466)	0.00811 (0.0209)
Constant	-0.00038 (0.00329)	0.00439 (0.00619)
Observations	40	40
F-statistic (NW)	0.06	0.64
Prob > F	0.944	0.535
SEs	Newey-West (lag = 3)	Newey-West (lag = 3)

Notes: Standard errors in parentheses. $L.spread_t$ is the lagged short-rate differential between New Zealand and the foreign country. The interaction term captures state-dependent sensitivity of exchange-rate depreciation to interest-rate differentials conditional on global risk (lagged, standardized VIX).

Source: Author's estimations using data from Refinitiv Workspace, RBNZ, RBA, FRED and Cboe Options Exchange (CBOE).

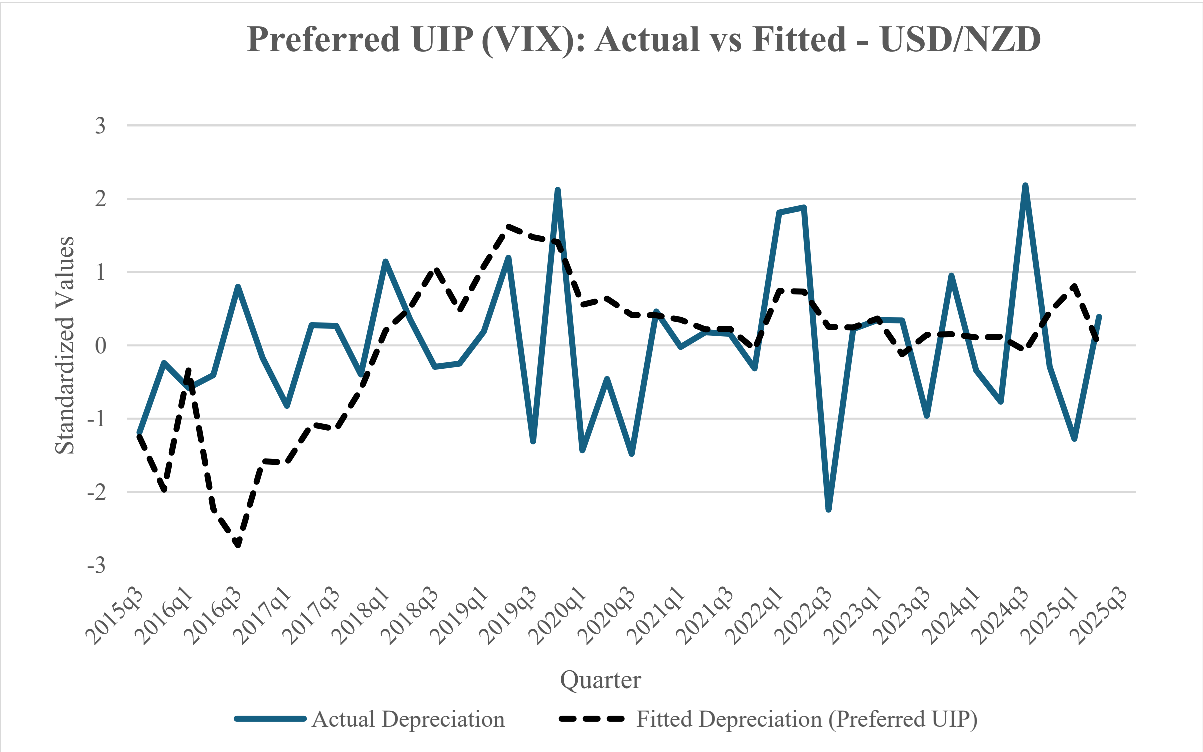
The VIX-augmented regressions in Table 4.11 continue to show small and statistically insignificant slope coefficients for both currency pairs. For AUD/NZD, the coefficient on the lagged interest-rate spread is 0.00058 (s.e = 0.00348), while the interaction term with VIX is -0.00099. For USD/NZD, the estimated coefficient for the interaction term is 0.00811, while the spread term remains statistically indistinguishable from zero (-0.00534, s.e. = 0.0103). Across both currencies, the confidence intervals include zero, and the Newey-West F-statistics remain low at 0.64 and 0.06 (p = 0.535 and 0.944 respectively), indicating no improvement in model fit over the baseline specification. Consequently, we fail to reject the null hypothesis (H_0). Empirically, within this quarterly sample, we cannot statistically confirm that the VIX level systematically alters the slope of the UIP relationship. These results suggest that incorporating global risk conditions does not materially enhance short-run UIP performance for either currency pair over the sample. Despite the varying levels of global uncertainty, interest-rate differentials do not predict quarterly NZD depreciation. This reinforces the weak short-run relationship in New Zealand's exchange rates due to various factors such as expectations formation, macro announcements, or other frictions.

Figure 4.18 Preferred UIP (VIX): Actual vs Fitted - AUD/NZD



Source: Author's estimations using data from Refinitiv Workspace, RBNZ, RBA and Cboe Options Exchange (CBOE).

Figure 4.19 Preferred UIP (VIX): Actual vs Fitted - USD/NZD



Source: Author's estimations using data from Refinitiv Workspace, RBNZ, FRED and Cboe Options Exchange (CBOE).

Figure 4.18 presents a visualization of the complementary Aziz (2024) preferred UIP model, which introduces time-varying frictions through the VIX to capture changing global risk conditions. This panel shows that the fitted depreciation series tracks the direction of the actual AUD/NZD movements, but with smoother transitions and less volatility. This suggests that the model captures the regular, state-dependent behavior of the exchange rate: UIP deviations tend to widen during “risk-off” periods when the VIX is high and to narrow when global risk is lessened. Following 2022, as market conditions stabilize, the gap between actual and fitted depreciation generally narrows, although short-term deviations remain noticeable during episodes of heightened uncertainty.

Figure 4.19 presents a visualization of the Aziz (2024) preferred UIP model for USD/NZD. In this panel, the predicted depreciation follows the broad direction of the actual series from 2018 onwards, but with smoother variation. After 2022, the VIX interactions help capture some of the cyclical behaviour of the USD/NZD during periods of changing risk sentiment and tighter global financial conditions. When global risk is elevated, the fitted values tend to lag behind the most extreme movements in the actual depreciation series, suggesting that real-time uncertainty shocks can occur more rapidly than policy or interest rate adjustments can be implemented. This lag reflects the time-varying friction captured in Aziz’s (2024) framework, where higher global risk sentiments reduce the effectiveness of arbitrage and weaken the UIP.

In comparison with forward and backward UIP models, which offer little to no predictive content, and the expectations-based UIP, which is constrained by information rigidities and limited survey coverage, the VIX specification provides a more realistic depiction of how UIP operates under uncertainty. It helps to show that interest-rate differentials alone cannot account for exchange-rate movements without considering the risk environment created by external shocks, such as the COVID-19 pandemic, supply-chain disruptions, and high energy and commodity prices following Russia’s invasion of Ukraine. However, as reported in Chapter 4, the additional explanatory power from the VIX interaction term is modest, and the coefficients are often statistically insignificant at conventional levels. The preferred model, therefore, offers a more straightforward qualitative state-dependent narrative for UIP deviations in small open economies, such as New Zealand and Australia, even though its quantitative fit remains only an incremental improvement over simpler UIP specifications.

In terms of USD/NZD, the three models show weak or unstable linkages between spreads and depreciation, the VIX-augmented preferred model of Aziz (2024) provides a more explicit qualitative depiction of how exchange rates respond to shifting global conditions and external shocks. Aziz (2024) emphasizes that UIP deviations are state-dependent rather than constant, with VIX spikes associated with larger gaps between interest rate differentials and exchange rate changes. In this USD/NZD application, the inclusion of VIX yields only modest quantitative improvements in the model, despite the interaction terms not being statistically significant at conventional levels, but it still offers a more realistic, state-dependent narrative for examining UIP in small open economies like New Zealand, especially when benchmarked against major currencies such as the USD.

4.7 Summary of Empirical Findings

This chapter presents empirical tests of Uncovered Interest Parity (UIP) conditions for two New Zealand-relevant currency pairs, AUD/NZD and USD/NZD, spanning the 10 years from 2015Q3 to 2025Q2. Unit-root tests confirm that both exchange rates behave as I(1) processes, which justifies the use of cointegration techniques and short-run specifications in first differences. While Engle-Granger tests revealed no initial evidence of cointegration, the more robust ARDL Bounds test detected a valid long-run level relationship for the AUD/NZD pair, driven by a highly significant error-correction term. In contrast, USD/NZD showed no stable long-run UIP relationship under any specification, suggesting that the two pairs exhibit distinct long-run dynamics over this sample. The short-run forward-looking UIP regressions indicate that current interest-rate differentials have very limited predictive power for the next-quarter NZD depreciation. For both AUD/NZD and USD/NZD, the coefficients are small and statistically insignificant, indicating weak short-run predictability.

This implies that higher New Zealand short-term rates do not systematically forecast either an appreciation or a depreciation of the NZD, essentially rejecting the strict UIP hypothesis ($H_0: \beta = 1$).

The backward-looking model suggests no systematic policy feedback from past exchange rate movements to current interest spreads. The coefficients on lagged depreciation are statistically insignificant for both pairs, implying that the Reserve Banks do not systematically adjust interest-rate differentials in response to prior currency fluctuations. The expectations-based estimates for USD/NZD provide weak but important evidence of a non-zero risk or information-rigidity premium. Although the slope coefficient is insignificant-suggesting expectations do not adjust one-for-one with interest differentials-the intercept is positive and statistically significant. This indicates that survey respondents, on average, expect some NZD depreciation even when the policy-rate differential is close to zero, confirming that survey-based expectations contain a persistent risk premium not captured by standard fundamentals.

Finally, the VIX-augmented “state-dependent” UIP regression is motivated by Aziz’s (2024) time-varying risk premium framework, incorporating lagged interest rate spreads and global risk conditions as proxied by the VIX. Because the data are at a quarterly frequency, both the spread and interaction terms remain small and insignificant, and the model fit does not improve relative to the baseline UIP regressions. While graphical evidence suggests that high-VIX uncertainty correlates with larger UIP deviations (particularly during the COVID-19 shock), the results do not provide strong statistical support for the state-dependent UIP in New Zealand within this specific sample.

Both the empirical results and graphical visualization confirm that lagged monetary variables alone cannot explain the short-term dynamics of USD/NZD or AUD/NZD once global uncertainty is taken into account. Graphically, high-VIX episodes coincide with larger deviations. However, the regression coefficients are imprecise and not statistically significant, so we cannot make strong causal claims about the magnitude of the relationship between high-yield currencies and rising uncertainty.

A critical comparison between the time-series diagnostics with the specific UIP regression frameworks gave slight differences and similarities. For the AUD/NZD pair, the ARDL bounds test detected evidence of a long-run level relationship (cointegration) within an ARDL error-correction framework. However, the short-run UIP frameworks (forward, backward, and VIX-augmented) still failed to achieve statistically predictable power, which is consistent with the state-dependent UIP augments that parity mechanisms can be weak in the short-run by risk premia and limits-to-arbitrage (Fama, 1984; Aziz, 2024). This implies that AUD/NZD may display longer-horizon mean-reverting adjustments in the ARDL error-correction term, the estimated long-run spread is estimated and short-term quarterly movements appear more dominated by uncertainty shocks and external risk conditions that can weak arbitrage and distort UIP small open economies as stated in Bloom (2009) and Albagli et al. (2024).

In contrast, the results for the USD/NZD pair are consistent across both methodologies. The absence of cointegration in the time-series test aligns with the insignificant coefficients in the regression frameworks and consistent with the Engle-Granger interpretation that equilibrium errors remain non-stationary when no stable long-run relationship exists (Engle & Granger, 1987). Alongside with the UIP regressions, the results in correlation with the timeseries approach suggest that that NZ-US interest-rate differentials do not systematically map into subsequent USD/NZD depreciation, in which Fama (1984) that these outcomes align with the forward premium puzzle. Hence, the USD/NZD dynamics over 2015-2025 appear more consistent with time-varying risk premia and expectations errors with a stable parity channel purely on short-rate spreads (Engel, 1996).

These findings align with recent literature, such as Gole, Perego, and Turcu (2024), who show that financial-uncertainty shocks tend to widen UIP deviations in emerging and developing economies, and that time-varying risk premia are often driven by factors beyond simple short-rate differentials (Benigno, Benigno, and Nisticò, 2012). The results confirm that classical UIP does not hold consistently for either AUD/NZD or USD/NZD, and while standard VIX-based state dependence is statistically weak in quarterly data, the persistent intercepts and visual decoupling justify the presence of a significant time-varying risk premium.

The next chapter interprets these empirical results in light of the UIP literature and small open economy policy frameworks, and discusses their implications for monetary policy, investors, and other stakeholders.

Chapter 5: Policy Implications for Investors and Central Banks

Chapter 5 bridges the empirical findings to practical insights relevant for New Zealand and its key stakeholders, including investors, corporates, and government policymakers in Australia and the United States. As the NZD serves as the base currency, the discussion focuses on how monetary and exchange-rate interactions with these larger economies shape policy and investment decisions within a small open economy context. The results show that interest-rate differentials alone were insufficient to compensate for exchange-rate movements. Time-varying risk premia associated with global uncertainty (proxied by the VIX) were incorporated through state-dependent UIP specifications; however, the interaction effects are weak, especially at a quarterly frequency.

Survey-based expectations are only available for the USD/NZD pair, allowing for the estimation of expectations-based UIP for this pair. Given that Australia and New Zealand are both small, open, inflation-targeting economies, it is plausible that the AUD/NZD is likely less sensitive to global survey expectations than USD/NZD. While the strict short-run UIP hypothesis was statistically rejected across all specifications ($H_0: \beta = 1$), a crucial distinction emerged during the ARDL bounds tests which detected a valid long-run level relationship for the AUD/NZD pair, contrasting with the complete absence of cointegration for USD/NZD. Estimated coefficients are small in magnitude and statistically insignificant, with occasional sign reversals that emphasize the instability of short-run relationships.

5.1 Primary Investors: Direct Link to UIP

Primary investors, including portfolio managers, hedge funds, asset managers, foreign-exchange traders, and treasuries, are the groups that respond most directly to movements in interest-rate differentials and exchange-rate expectations, all of whom allocate capital internationally in search of a favourable yield. Their portfolio decisions are heavily tied to theoretical and empirical deviations from Uncovered Interest Parity (UIP), as interest-rate spreads predict the expected return on holding New Zealand assets. When the New Zealand policy rate exceeds that of Australia or the United States, these primary investors will reallocate funds towards NZD assets, whether through currency forwards, sovereign bonds, or short-term deposits, due to passive interest income and potential currency appreciation.

This behaviour reflects the carry-trade mechanism, where investors exploit persistent UIP deviations noted in Aziz (2024) and Burnside, Eichenbaum, and Rebelo (2007). Beyond institutional investors, the category of primary investors also includes high-net-worth individuals with overseas income and foreign property investors who channel capital inflows into tangible assets, such as residential or commercial property. The higher NZD returns, portfolio diversification, and periods of higher domestic interest rates or anticipated NZD appreciation often make New Zealand property and domestic financial assets more attractive to such investors. This behaviour is consistent with capital-flow interpretations of UIP, where cross-border investors respond to yield differentials and expectations of currency stability (Gole, Perego, and Turcu, 2024). The “Golden visa”, such as New Zealand’s Business Investor Work Visa or the Active Investor Plus Visa programmes, administered under the Residence by Investment categories (Immigration New Zealand, n.d.), were designed to attract foreign capital and investment. Conversely, restrictions on foreign property purchases functioned as measures to manage speculative capital movements and mitigate their impact on external stability (Overseas Investment Amendment Act, 2018). The broader emphasis on investment in small-open economies, as seen in the literature (Aziz, 2024; Gole et al., 2024), highlights the importance of regulating volatile capital inflows.

Empirical evidence from this dissertation confirms that interest-rate spreads have minimal and statistically weak predictive power for quarterly exchange-rate movements, reinforcing the presence of persistent deviations from UIP. Specifically, the expectations-based regression for USD/NZD yielded a highly significant positive intercept ($\alpha \approx 0.38$), quantifying a persistent risk premium that investors demand regardless of the interest differential. However, these deviations appear to be state-dependent. In this sample, low-VIX periods are loosely associated with stronger interest rates and greater inflows into NZD assets, although the estimated interaction terms are statistically weak. Consequently, under high-VIX conditions, global uncertainty widens the risk premium. It heightens NZD volatility relative to both USD and AUD, which weakens the forward-rate predictability and reduces expected returns (Beckmann & Reitz, 2020).

Overall, the results suggest that risk-adjusted returns on NZD are correlated with global risk factors, including external shocks. The behaviour of financial markets in small open economies reinforces the link between interest rate differentials and exchange rate movements, attracting capital inflows across both financial and real asset markets. By comparison, when global uncertainty increases due to external shocks, this behaviour weakens the transmission of interest-rate differentials, reducing investor interaction and indicating that UIP deviations in New Zealand vary across different market conditions.

5.2 Secondary Investors: Indirect Link to UIP and hedging

Secondary investors, including corporate treasurers, exporters, importers, and multinational firms, are classified as secondary group exposures to foreign-currency receivables, payables, or funding obligations. Unlike financial investors, participants do not trade on interest-rate spreads; instead, they are indirectly affected by deviations from Uncovered Interest Parity (UIP) through changes in exchange-rate volatility, forward premiums, and hedging costs. During periods of global uncertainty, external shocks such as the COVID-19 pandemic (2020Q1–2021Q4) exhibited strong co-movement between exchange-rate volatility and global risk sentiment. Elevated uncertainty, amplified by UIP deviations, yields higher forward premiums and greater volatility in USD/NZD compared to AUD/NZD, as indicated by the VIX (Beckmann & Reitz, 2020). For firms with USD/NZD exposures, the evidence suggests that global risks raise forward-hedging costs and increase exchange-rate unpredictability. The USD/NZD pair is more sensitive to global risk sentiment, as New Zealand is more volatile compared to the United States. As the VIX rises, the risk premium tends to increase, indicating that firms with USD-denominated trade or debt obligations face heightened currency uncertainty.

This results as investors who demand a higher premium for USD/NZD exposure will need to adjust hedging strategies dynamically as uncertainty is associated with NZD depreciation risk against a safe-haven currency like the USD. In contrast, AUD/NZD exposure tends to be more stable due to New Zealand’s regional integration and commodity-linked trade flows than USD/NZD, primarily due to both countries sharing similar economic structures and traits, such as New Zealand’s close ties to Australia’s free trade agreements and commodity exports. Fundamentally, regional integration helps cushion short-term volatility, as commodity prices and trade cycles often correlate within small open economies, thereby reducing discrepancies in exchange rate movements. This is empirically supported by the ARDL bounds test in Chapter

4, which confirmed the existence of stable long-run cointegrating relationship for the AUD/NZD pair shown to be absent in the USD/NZD results. Based on the findings, the behavioural mechanisms are less vulnerable to sharp swings, suggesting that AUD/NZD hedging strategies can be more diverse and passive in response to global risk fluctuations and uncertainty.

5.3 Timing and macro events (Structural Breaks/External Shocks)

The results reveal that structural breaks occurred around the 2020-2021 period, capturing the COVID-19 pandemic and shifts in the monetary policy regime. These structural breaks indicate that the relationship between interest-rate differentials and exchange-rate movements is volatile over time, due to sudden changes in major domestic or global events. Chunga and Yu (2024) demonstrate that external shocks (COVID-19, Russia-Ukraine War) create global volatility and can have a statistically significant impact on structural breaks in foreign-exchange returns and risk premia, especially in small open economies like Australia and New Zealand.

The empirical results highlight the during these shock periods, the slope coefficients on interest differentials became statistically indistinguishable from zero, effectively serving the link between domestic policy rates and short-term exchange rate returns. These shifts can reflect certain behaviours as the economy and central banks quickly adapt to uncertain policy changes, supply-chain disruptions, and rapid changes in global liquidity conditions. From a practical perspective, investors should be particularly cautious when managing currency exposure and rebalancing their portfolios during periods of external shocks. Firms and investors who are alert to macroeconomic event cycles, such as central bank announcements, inflation (CPI) releases, or employment data, can better respond to short-term spikes in volatility when risk premia widen. Within this context, during high-VIX periods or quarters marked by RBNZ, RBA or Federal Reserve meetings, adjustments to hedge positions, exposure limits, or stoplosses may help mitigate short-term effects driven by unexpected policy news or announcements.

A quarterly schedule helps track key monetary-policy meetings, inflation releases, and labour-market data for investors or central banks looking for a particular *framework* to identify periods of UIP deviations that are likely to widen. A timing and macro-events-based approach helps ensure that currency and interest-rate risk are managed to reduce exposure to sudden structural breaks caused by external shocks.

5.4 Implications for central banks (RBNZ, RBA; small open economy lens)

For central banks, the results highlight that the exchange-rate transmission of monetary policy in small open economies, such as New Zealand and Australia, is state-dependent, varying with global financial conditions (Rey, 2015). The VIX interaction term offers an additional means to assess whether the effectiveness of interest-rate differentials in influencing exchange-rate movements is state-dependent (Gole, Perego, & Turcu, 2024). When global uncertainty increases, risk-sensitive currencies often face depreciation pressure (Bloom, 2009; Rey, 2015). In this sample, however, the estimated interaction effects are generally small and statistically insignificant. The conventional UIP mechanism exhibits a greater propensity to hold during periods when the VIX is low, as high domestic interest rates attract capital inflows and lead to NZD or AUD appreciation (Beckmann & Reitz, 2020), making the risk-premium channel dominant. This means that investors demand greater compensation for holding riskier currencies, causing New Zealand or Australia to offer higher nominal yields (Habib & Stracca, 2012). This implies that policy-rate increases may not always result in the expected appreciation of the domestic currency due to depreciation pressure associated with global uncertainty as shown in the VIX-augmented model during the 2020 and 2022 volatility spikes.

If similar patterns and behaviours emerge, central banks should incorporate global risk conditions into their exchange-rate projections when developing new monetary policies. During periods of high global volatility and uncertainty, small changes in the Official Cash Rate (OCR) are unlikely to generate predictable or proportionate exchange-rate adjustments; therefore, policymakers should refrain from overstating the transmission strength of interest-rate differentials in their communications. The Reserve Bank of New Zealand and the Reserve Bank of Australia need to consider the importance of the state-dependent nature of exchange-rate dynamics to help better manage public expectations, calibrate forward guidance, and design policy responses that reflect the materiality of risk exposure in small open economies (RBNZ, 2024; RBA, 2023).

Based on these attributes, the U.S. Federal Reserve is pivotal because its policy stance directly correlates with the U.S.-NZ interest-rate differential in the USD/NZD pair, as forward guidance can amplify the exchange rate response to small OCR changes in New Zealand. A second channel is the Fed's influence over global U.S.–dollar funding conditions: when dollar funding tightens, the cross-currency basis typically widens, forward premia rise and hedging costs for New Zealand entities increase. This weakens the pass-through of interest-rate differentials captured in the UIP models (Bruno & Shin, 2015). In contrast, when the Fed provides liquidity support through swap lines, funding pressures ease, the basis narrows, and the exchange-rate transmission channel tends to improve (Bahaj & Reis, 2020).

Chapter 6: Conclusion

6.1 Summary of Key Findings

Overall, this dissertation examined the validity of Uncovered Interest Parity (UIP) for New Zealand's two key bilateral exchange rates, AUD/NZD and USD/NZD, from 2015Q3 to 2025Q2. The empirical strategy employed forward-looking, backward-looking, and expectations-based models, along with an augmented specification based on the Aziz (2024) framework.

The evidence suggests that UIP behaviour in New Zealand is state-dependent and pair-specific. In the short run, interest-rate differentials provide little reliable predictive power for next-quarter exchange-rate movements for either currency pair; specifically, the strict UIP restriction $(\beta = 1, \alpha = 0)$ is not supported by the estimates. In contrast, long-run dynamics differ across pairs. The analysis indicates that AUD/NZD exhibits a stable long-run equilibrium (cointegration), whereas USD/NZD is more strongly associated with time-varying risk premia and global sentiment rather than interest-rate fundamentals.

For the New Zealand economy, these findings imply that interest-rate differentials alone are insufficient tools for managing the currency exchange rate. Policymakers must operate with the understanding that the NZD is not merely a reflection of domestic monetary policy, but a risk-sensitive asset that requires a structural premium to remain attractive in global portfolios, particularly during periods of heightened external uncertainty.

6.2 Limitations

The results align with recent literature that emphasises UIP deviations are not inconsistencies but reflections of risk compensation and time-varying expectations in financial markets and OECD countries. However, in the specific context of New Zealand (2015–2025), the empirical results highlight a distinct divergence between the two currency pairs that offers critical insights for policymakers.

Despite multiple alterations to the preferred UIP model and robust standard error corrections, limitations remain. First, the study is constrained by the use of quarterly data, which may smooth over high-frequency dynamics visible in daily or weekly data, such as immediate reactions to RBNZ announcements. Second, the VIX variable measures broad global uncertainty but may not capture specific U.S. dollar funding stresses or commodity shocks relevant to the NZD. Third, survey-based expectation data were only available for the USD/NZD pair, preventing a direct expectations-based comparison with the AUD/NZD cross-rate. Finally, parameter instability during the COVID-19 shock suggests that model coefficients shift across regimes, limiting the predictive power of a single linear specification.

Future monitoring and research should replicate this framework using high-frequency (daily) data and alternative risk proxies like the U.S. MOVE index or cross-currency basis swaps. For policymakers, the priority is monitoring the divergence between the stable AUD/NZD cointegration channel and the volatile USD/NZD risk channel, ensuring that monetary policy settings account for these differing transmission mechanisms.

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