Currency Hedging Strategy: An Empirical Study of Emerging Markets

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ABSTRACT:

Large Canadian pension funds have doubled their investment in emerging markets over the last decade. The foreign exchange risk exposure arising from emerging market investments can substantially affect the underlying assets' overall risk-return profile once redenominated in the investors' home currency. Yet there is a lack of financial literature on currency hedging strategies for emerging markets. This paper studies the correlations of foreign exchange rates with stock and bond returns in both developed and emerging markets over the period 1975 to 2021, from a Canadian investor's perspective. The emerging markets in our analysis include Brazil, China, and India, while selected developed markets are the USA, Germany, the UK, Japan, and Australia. We use mean-variance analysis to find the foreign currency positions that minimize the risk of the total portfolio. Within the period we studied, we find that Canadian equity investors should maintain close to an unhedged position[1] in US Dollars, hold a net long position in Chinese Yuan while holding a net short position in Brazilian real. For Canadian fixed income investors, the FX exposures of international bond portfolios should be at least fully hedged, if not overhedged, except for the Australian Dollar which should be partially hedged.

Keywords: currency hedging, foreign exchange risk hedging, FX risk hedging, diversification, pension funds, risk-minimizing, emerging markets, diversification, mean-variance optimization

JEL Classification: F31, G11, G15

Contributors: The views expressed here are those of the authors alone and not of Global Risk Institute. Sally Shen, *Research Associate, Global Risk Institute*; Jeremy Graham, *Research Intern, University of Toronto*; Michalis Hapides, *Research Intern, University of Toronto*; and Jin Zhang, *Research Intern, University of Toronto* thank Luis Viceira, John Hull, Mark Staley, Leo Dong, Leo Xu, Moustafa El-Gabaly, Bruce Choy, Victoria Guo and Han Vo for their helpful input.

1 An unhedged position means it does not use a derivative contract to mitigate foreign exchange fluctuations.

Section 1: Introduction

Foreign exchange (FX) risk in asset management arises from price movements of the asset's denominated currencies and/or from the currency positions placed by portfolio managers based on their investment strategy. Exchange rates tend to fluctuate over time and can move significantly even within a very short period. FX hedging, or currency hedging, helps reduce or offset the impact of changes in the exchange rate. Over the past decade, pension funds and other institutional investors across Canada have increasingly looked beyond Canada to the international markets, thus are exposed to exchange rate fluctuations.

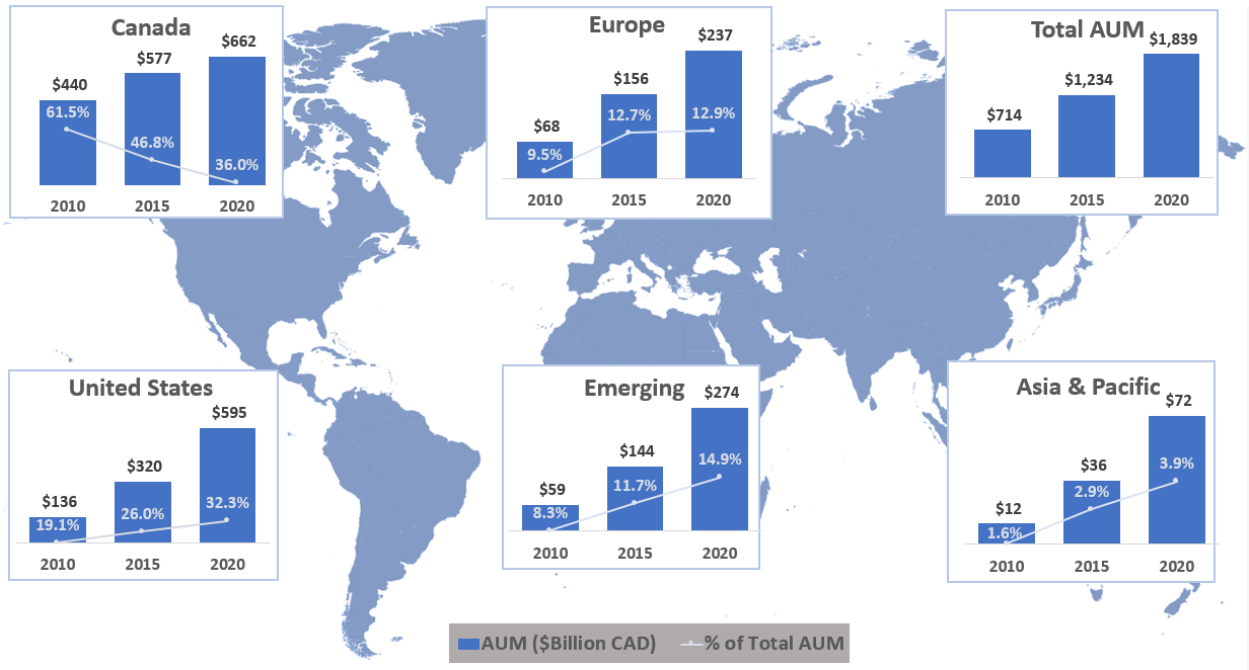


Figure 1: Summary of Asset Allocation for Top 10 Canadian Pension funds

Sources: Author's calculations, Canadian pension fund annual reports (see endnotes for specificity)

Figure 1 shows how the top 10 largest Canadian pension funds have allocated their capital from 2010 to the present. Canadian funds have recognized the growth potential of emerging markets and have been rapidly increasing exposures to international markets in the most recent decade. Canadian investments in the Asia & Pacific market have more than doubled since 2010 as a percentage of total assets under management (AUM).

In terms of hedging against foreign currency exposure, the top 10 Canadian pensions have different currency hedging strategies in place, as shown in Table 1. Some funds believe that currency risk has a neutral impact on their asset value over longer horizons. Other funds hedge their FX exposure through forward contracts. Different currency hedging strategies may be driven by investors' risk preferences, investment time horizon and the underlying asset mix.

Table 1: Summary of Top Ten Canadian Pensions' Views on Currency Risk and FX Hedging

Hedge		Not Hedged	
PSP[1]	Mitigates foreign currency risk through forward contracts or cross currency swaps	**CDPQ**[6]	CDPQ believes that the currencies tend to have neutral impact over the long term, hedges partially
OPB[2]	Hedges a portion of its foreign currency exposure through forward contracts	**CPPIB**[7]	Extensive hedging for the fund is not deemed appropriate
OP Trust[3]	Utilizes foreign exchange forward contracts to modify exposure	**AIMCo**[8]	Corporation has limited exposure to foreign exchange risk
HOOPP[4]	Risks on foreign currency are measured daily, the plan is generally hedged	**OTPP**[9]	Manages currency risk from a total-fund perspective but would hedge only in certain circumstances
OMERS[5]	Firm has traditionally hedged a significant proportion of its exposure to foreign currency	**BCIMC**[10]	Majority of holdings in Canadian Dollars. The fund is believed not exposed to significant currency risk

Source: 2020-2021 Annual Reports, see endnotes for specificity

Investors may wish to hold a globally diversified equity portfolio for speculative reasons. If the foreign-currency excess return on foreign equities negatively correlated with the return on the foreign currency, then an investor holding foreign equities can reduce portfolio risk by holding a long positive in foreign currency.

An unhedged position in international equity corresponds to a long position in foreign currency the same as the equity holding, while a fully hedged position corresponds to a net zero position in foreign currency. Also, an overhedged position refers to a net long position in domestic currency. When currencies and equities are uncorrelated, risk management demands for foreign currencies are zero, implying full hedging is optimal (Solnik 1974).

The currency exposure arising from foreign investments can substantially affect the underlying assets' overall risk-return profile once redenominated in the investors' home currency. Yet currency risk or FX hedging for emerging markets is understudied. In this paper, we aim to fill the gap by building on the seminal work (Campbell, Serfaty-De Medeiros and Viceira 2010), using the standard mean-variance optimization approach (Glen and Jorion 1993) for managing for FX exposure – a process to determine optimal currency hedging positions. This study compliments the framework of (Campbell, Serfaty-De Medeiros and Viceira 2010) in three aspects:

(1) We include emerging markets exposure in both equity and bond portfolio. Emerging market currencies present a set of unique challenges that differ from those of developed markets;

(2) We extend the time horizon in the empirical analysis till the end of 2021 to study the correlations of FX rates with equity returns during the low yield era following the aftermath of the 2008 global financial crisis (GFC);

(3) We analyze our results from Canadian investors' perspective and find the Canadian and US hedging strategies are remarkably different in equity markets.

The developed markets (currencies) in our analysis include the USA (USD), Germany (EUR), UK (GBP), Japan (YEN), and Australia (AUD). The emerging markets (currencies) are China (CNY), Brazil (BRL), and India (INR).

We discovered some unique features of the three emerging markets selected. India and Brazil have much higher nominal interest rates and inflation rates than developed markets. A higher nominal rate in the foreign market will lead to a higher forward premium if covered interest rate parity (CIP) holds. The nominal interest rate and inflation rate in China are comparable or even lower than most developed markets.

Regarding the risk-return tradeoffs of investing in emerging markets, Brazil has very low returns and high volatility in both equity and debt markets. In all selected emerging markets, hedged

equity and bond returns are higher than unhedged equity and bond returns with an exception of Chinese bond returns. In developed markets, unhedged returns are higher than the hedged returns while the differences are statistically insignificant.

As mentioned before, the objective of currency hedging is to reduce the effects of FX rate fluctuations. We adopt a standard global currency hedging framework that minimizes the variance of foreign investment portfolio return with respect to the foreign currency exposure. The optimal currency position is obtained through running a regression of portfolio excess returns on a constant and a vector of currency excess returns.

We derive optimal hedging strategies for global equity and bond investors. According to (Campbell, Serfaty-De Medeiros and Viceira 2010), for global equity investors, it is advantageous to hold foreign currencies that are negatively correlated with their equities and short-sell currencies that have positive correlations with their equities. Our first novel empirical results identify that risk-minimizing Canadian equity investors should hold a long position in the Chinese Yuan while a net short position in Brazilian Real in the single-foreign-currency case. Our results are consistent with the theoretical framework and in line with the common practice of institutional investors. We also find that Canadian bond investors should hold a long position in the Canadian Dollar against emerging market currencies. The recommended overhedged positions against emerging-market currencies are mainly driven by the positive correlations with their bond returns.

We compared the empirical results with the optimal hedging policies from a US perspective. Canadian and US investor's hedging strategies are remarkably different in equity markets: It is optimal for US investors to take overhedged positions in all markets except in Germany and the UK, where they should enter fully hedged positions. Hedging strategies for Canadian and US bond investors, however, are much more similar: In almost all single-country currency cases, both Canadian and US investors should long their domestic currencies in their bond portfolios.

As for multi-country portfolios, US investors should net long the US dollar while investing in foreign markets while bond investors' strategy should remain the same as its single-country counterpart. For Canadian equity investors, the strategy would be the same as US single-country portfolio investor except for the Chinese market.

The organization of the paper is as follows. Section 2 lays out the analytical framework we use for the empirical analysis. Section 3 introduces a toy model to analyze the relationship between the currency hedging policy and returns from investment in foreign currencies. Section 4 presents the data for our empirical analysis. Section 5 shows the optimal currency hedging strategies for equity and bond portfolios. Section 6 concludes.

Section 2: Methodology

In this section, we lay out the general framework for the global currency hedging model. Assuming CIP holds, hedging through borrowing/lending and using forwards contracts should yield equivalent results. Otherwise, arbitrageurs could make a riskless profit.

Investors who seek to minimize risk from foreign exchange rate fluctuations are assumed to adopt the following currency hedging framework displayed in Box 1. We define FX risk as the volatility of excess hedged portfolio returns. First, we consider an investor who seeks to minimize the variance of excess hedged portfolio returns. We convert the gross hedged portfolio return (see Appendix A) to log-normal returns.

Box 1: Currency Hedging Framework

1. Investors adopt the objective function that minimizes the variance of excess hedged portfolio return

$$\min_{\Psi_t} \text{Var}\,(r_{h,t+1} - r^1_{nom,t})$$

- $r_{h,t+1}$= hedged portfolio returns at period $t+1$.
- $r^1_{nom,t}$= log nominal interest rate of domestic country.

2. The optimal vector of currency demand is given by

$$\boldsymbol{\Psi}^*_t = -Var\left(\Delta \boldsymbol{s}_{t+1} + \boldsymbol{r}_{nom,t} - r^1_{nom,t}\right)^{-1} cov\left(\mathbf{1}'\boldsymbol{\omega}_t(\boldsymbol{r}_{t+1} - \boldsymbol{r}_{nom,t}), \Delta \boldsymbol{s}_{t+1} + \boldsymbol{r}_{nom,t} - r^1_{nom,t}\right)$$

- $\left(\mathbf{1}'\boldsymbol{\omega}_t(\boldsymbol{r}_{t+1} - \boldsymbol{r}_{nom,t}\right)$ = excess return on a fully hedged portfolio which has no exposure to currency risk
- $(\Delta \boldsymbol{s}_{t+1} + \boldsymbol{r}_{nom,t} - r^1_{nom,t})$= excess returns on currencies

3. Empirical method on obtained optimal currency exposure:

Regress the portfolio excess return onto a constant and the vector of currency excess returns while switching sign of the slopes.

$$\mathbf{1}'\boldsymbol{\omega}_t(\boldsymbol{r}_{s,t} - \boldsymbol{r}_{nom,t}) = \alpha + \boldsymbol{\beta}'\left(\Delta \boldsymbol{s}_{t+1} + \boldsymbol{r}_{nom,t} - r^1_{nom,t}\right) + \epsilon_t$$

The excess hedged portfolio returns are the difference between log hedged return and domestic log nominal interest rate.

$$r_{h,t+1} - r^1_{nom,t} \approx \mathbf{1}'\boldsymbol{\omega}_t(\boldsymbol{r}_{t+1} - \boldsymbol{r}_{nom,t}) + \boldsymbol{\Psi}'_t\left(\Delta \boldsymbol{s}_{t+1} + \boldsymbol{r}_{nom,t} - r^1_{nom,t}\right) + Jensen\ term$$

i. $\boldsymbol{\omega}_t$ is the diagonal matrix of portfolio weights;

ii. $\boldsymbol{r}_{t+1}$ is the vector of log nominal asset returns in local currencies;

iii. $\boldsymbol{r}_{nom,t}$ is a vector of log nominal interest rate. We consider n markets in our portfolio and index the domestic country by $c = 1$ and then the $n - 1$ foreign countries by $c = 2, \cdots, n$.

iv. $\Delta \boldsymbol{s}_{t+1}$ is the vector of the changes in log spot exchange rates.

v. $\boldsymbol{\Psi}_t = (\psi_t^1, \cdots \psi_t^n)'$ is a vector of currency exposures with $\boldsymbol{\Psi}_t' \mathbf{1} = \mathbf{0}$, as the domestic currency exposure ψ_t^1 is automatically determined once we determine the vector of foreign currency demand.

The first term of excess hedged returns represents the excess return on a fully hedged portfolio with no exposure to currency risk. In this paper, we consider an equally weighted portfolio. The second term represents pure currency exposure, controlled by $\boldsymbol{\Psi}_t$. The third term is a Jensen's Inequality correlation.

The second step of currency hedging framework (Box 1) is to derive the optimal foreign currency demands. The optimal foreign currency exposure $\boldsymbol{\Psi}_{\mathbf{t}}^* = (\psi_t^{2*}, \cdots \psi_t^{n*})'$ can be considered as the negative of a vector of multiple regression coefficients of portfolio stock returns on currency returns.

Investors could table the following positions of ψ_t^c:

- Positions where $\psi_t^c = 0$ correspond to a fully hedged portfolio.
- Positions where $\psi_t^c = \omega_t^c$ correspond to a completely unhedged portfolio position, with ω_t^c the weight of the risky asset allocated to country c.
- Positions where $0 < \psi_t^c < \omega_t^c$ indicate investors want to hold some exposure of currency c, and only hedge a portion of the foreign currency risk.
- Positions where $\psi_t^c > \omega_t^c$ are associated with short currency position, i.e., commitment to sell those currencies forward.
- Positions where $\psi_t^c < 0$ correspond to an overhedged exposure to foreign currency c.

In the last step, we obtain the optimal currency exposure via a multi-factor regression model. The regression coefficients $\boldsymbol{\beta} = (\beta^2 \cdots \beta^n)'$ measure how exchange rate and stock returns are correlated with $\boldsymbol{\Psi}_t^* = -\boldsymbol{\beta}$. The coefficient variable β^c plays a crucial role on currency hedging policy as it measures how currencies and equity/bond returns are correlated. If they are negatively correlated with $\beta^c < 0$, investors should long currency c and vice versa.

Section 3: A Toy Model – Impact of Currency Risk

Currency returns are an important factor impacting any investor when purchasing a non-domestic asset. Since the underlying investments of these assets are purchased in a foreign currency, the appreciation or depreciation of the foreign currency against the domestic currency can either increase or decrease the total portfolio returns.

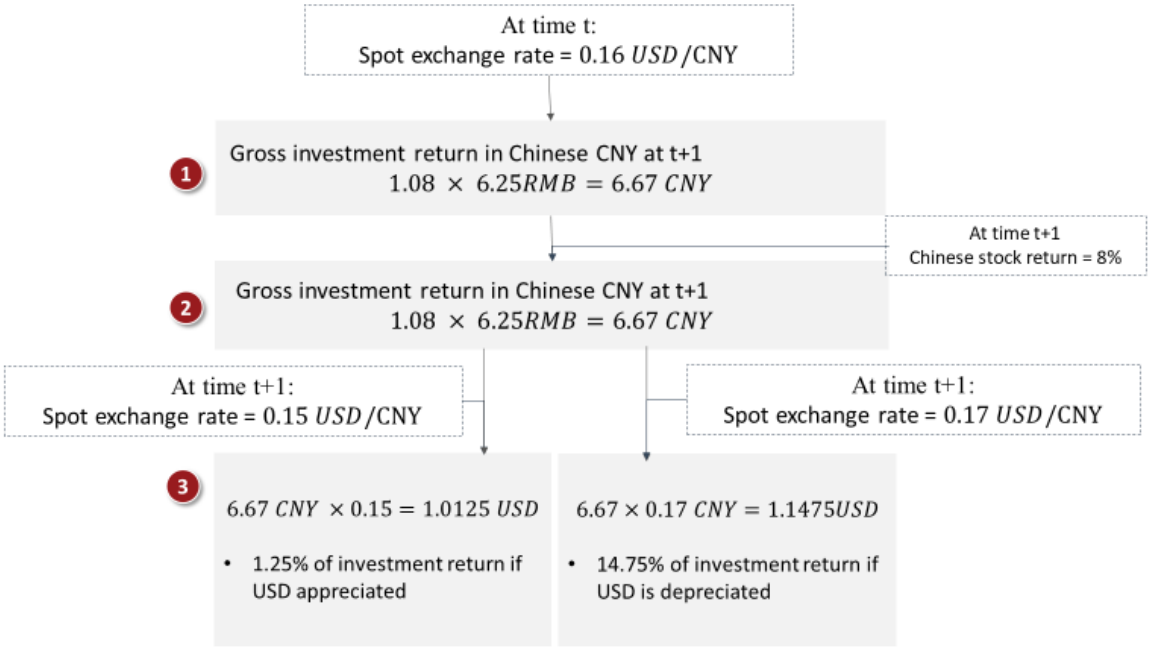
To understand the impact of currency risk on foreign investment returns, we introduce a toy model to explain the relationship between the currency hedging ratio and returns for international investors.

Unhedged Return Calculation

Currency risk can be substantial without hedging. In Box 2, we show if domestic currency is more likely to appreciate relative to the foreign currency, domestic investors would have more incentives to hedge currency risk.

Box 2: Unhedged Portfolio Return Example

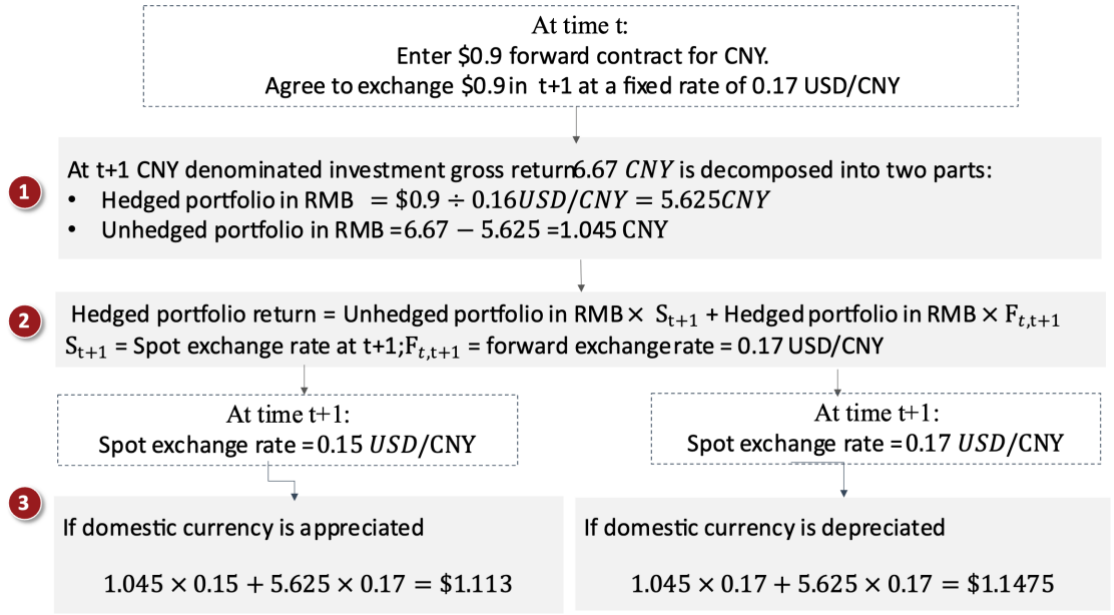
Assuming at time t, an US based investor allocates one dollar in Chinese equity market (i.e. MSCI China index). This example calculates the unhedged equity return at $t+1$ for US investor.



Hedged Return Calculation

Currency hedging can reduce the volatility of portfolio return substantially. Box 3 extends the example discussed in Box 2 to demonstrates the impact of currency hedging. With a hedging ratio at $\theta_t = 0.9$, meaning that at time t, 90% of the US dollar investment in the Chinese market is hedged against currency fluctuation using forward contracts.

Box 3: Hedged Portfolio Return Example



This toy's model can be extended. Figure 2 and Figure 3 show outcomes from various hedging strategies for future spot exchange rates, S_{t+1}, of 0.14 and 0.18 respectively. In both figures, the forward exchange rate is assumed at $\mathrm{F}_{\mathrm{t,t+1}} = 0.158\ USD/CNY$. The diagrams plot the hedged single-country stock return over a range of hedge ratios from the unhedged scenario with $\theta_t = 0$, to the fully hedged scenario with $\theta_t = 1$.

Figure 2: Hedged Returns as a Function of hedge ratio when $S_{t+1} = 0.14\ USD/CNY$

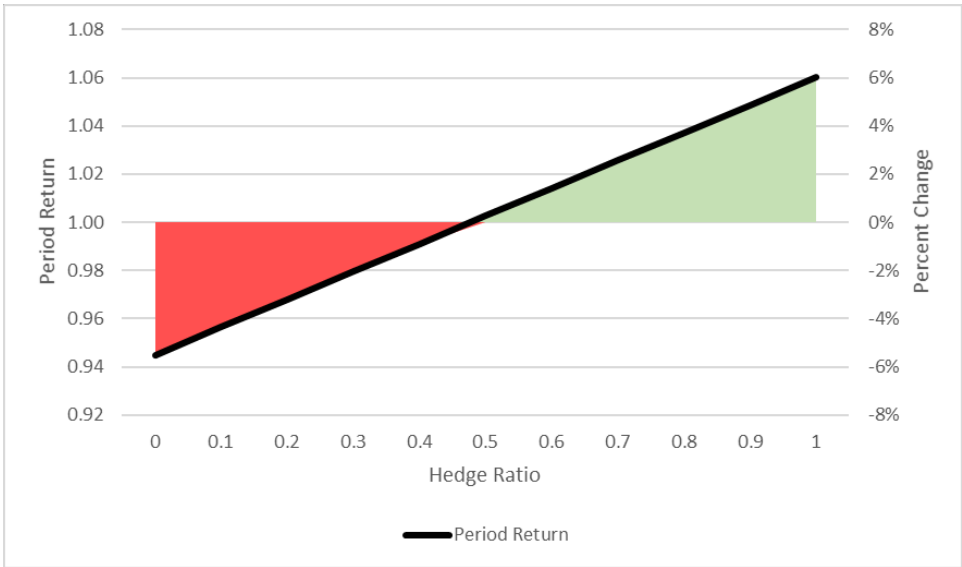


Figure 3: Hedged Returns as a Function of Hedge Ratio with $S_{t+1} = 0.18\ USD/CNY$

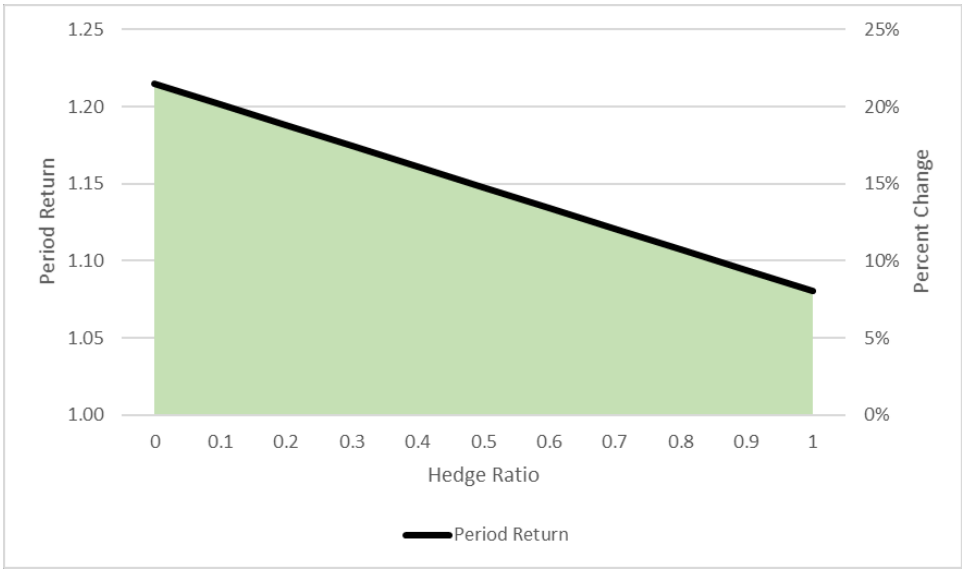


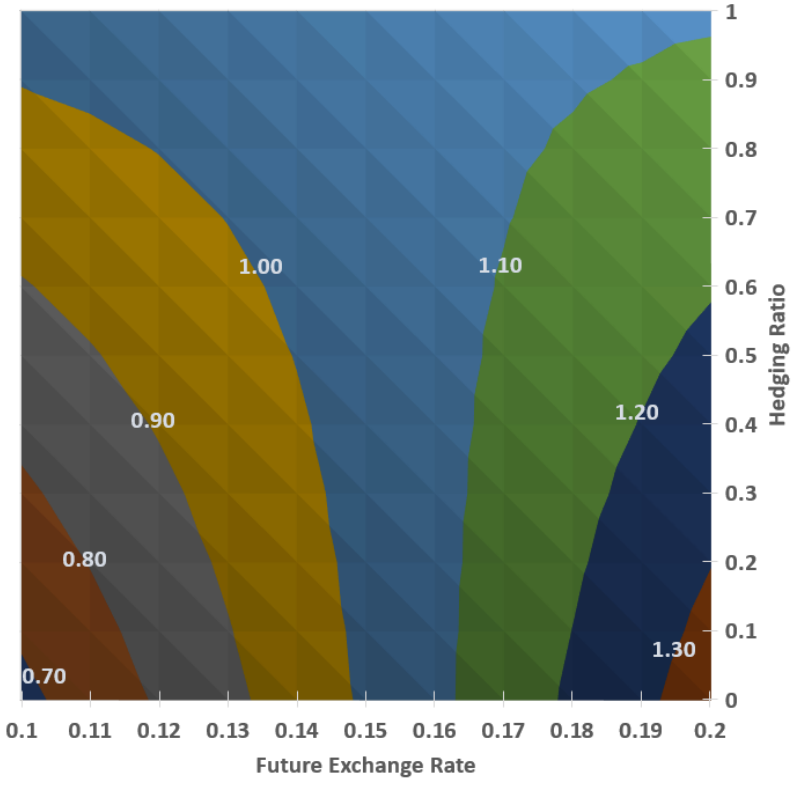
Figure 2 shows that when forward exchange rate agreed upon is greater than the spot rate realized in the future, S_{t+1}, it is advantageous to hedge. The greatest return, 6%, is realized with a fully hedged position while an unhedged position resulted in a 6% loss. However, when the future spot rate is realized to be greater than the forward rate, a different pattern arises. All returns are positive, regardless of the hedging strategy. Nonetheless, the strategy that generates

the highest returns is the unhedged strategy with 21.5%. The lowest returns are observed to be 8.0% with the fully hedged position.

In summary, the investor's decision on whether to hedge their currency risk depends on the expectations of how the domestic currency changes in value relative to foreign currencies. In Figure 2, the domestic currency is appreciated, which motivates the investor to hedge against potential losses. Whereas in Figure 3, the domestic currency depreciates; hence hedging will limit the upside potential. Therefore, if the home currency is more likely to depreciate, domestic investors have less incentives to hedge the currency risk.

Figure 4 plots the hedged portfolio returns as a function of both future exchange rate and hedging ratio. The future spot exchange rates are shown on the x-axis, the hedging ratios are shown on the y-axis and the corresponding returns are shown in colored bands in the graph. The plot is also based on the current future exchange rate of 0.158.

Figure 4: Hedged Portfolio Returns as a Function of Hedging Ratio and Future Exchange Rate



As seen on the left side of the figure, when the future spot exchange rate ends up being below the forward exchange rate (indicating an appreciated domestic currency), hedging commands a higher return compared to no hedging. This trend becomes more apparent as the future spot rate decreases as seen with the future spot rate of 0.10, the return from an unhedged position is less than 0.70 compared to a return greater than 1.00 in a fully hedged position. Naturally, the opposite trend is observed as the future spot exchange rate becomes greater than the current forward rate – that as the domestic currency depreciated, the unhedged position is preferred. Thus, Figure 4 displays a clear incentive to hedge for investors when domestic currency appreciates more than expected.

Section 4: Data Analysis

We consider nine countries – six developed economies: US, Canada, Germany, UK, Japan, and Australia; and three emerging markets: Brazil, China, and India. For most developed economies, the sample period starts in 1975:M1; all series end in 2021:M10. All data series are at a monthly frequency. The data collection was one of the major difficulties as emerging markets usually do not have a long history of documenting their capital markets data. Some of the raw data we were able to obtain does not span longer timeframes compared to developed markets. For example, the data for China and Brazil has a later starting date.

Table 2 displays the starting period of unbalanced series for all nine countries. Data on the 90-days T-bill, the 10-year Treasury constant maturity yield and exchange rates relative to USD are mostly from the FRED website[2] with initial data source from the IMF's International Financial Statistics (IFS). Country stock index returns are provided by Morgan Stanley Capital International (MSCI) via Bloomberg. The emerging market sample series is much shorter compared with developed market sample series due to data limitations.

[2] https://fred.stlouisfed.org/

Table 2: Summary of Sample Data Series (Full Sample: 1975:M1 – 2021:M10)

Country	Exchange Rate	CPI	90-days T-bill	10-year yield	MSCI
US	NA	Full Sample	Full Sample	Full Sample	Full Sample
Canada	Full Sample	Full Sample	Full Sample	Full Sample	Full Sample
Germany	Full Sample[1]	Full Sample	Full Sample	Full Sample	Start: 1995M1
UK	Full Sample	Full Sample	Full Sample[2]	Full Sample	Full Sample
Japan	Full Sample	Full Sample	Full Sample[3]	Start:1987M11	Full Sample
Australia	Full Sample	Full Sample[4,5]	Full Sample	Full Sample	Full Sample
China	Start: 1976M1	Start: 1993M1	Start:1997M6[6]	Start: 2002M7	Start:1992M12
Brazil	Start: 1994M7	Start: 1979M12	Start: 1995M1	Start: 2007M1	Start: 1992M1
India	Full Sample	Full Sample	Full Sample	Start:1998M12	Start:1992M12

[1] Currency changed to Euro after Maastricht Treaty in 1999
[2] IFS until 1985M12, OECD from 1986M1 onward
[3] FRED until 2002M3, OECD from 2002M4 onward
[4] Australian data provided quarterly
[5] Australian data acquired from OECD
[6] FRED until 2015M5, Russell from 2015M6 onward

Table 3 summarizes the statistics on rate of return, inflation level, returns and excess returns of bond portfolios, as well as returns and excess returns of stock investments. These returns are measured in log normal and based on data dated back to January 1975 for most countries, with the exceptions of Germany starting in February 1995, Japan starting in January 1989, India starting in February 2011, China starting in August 2002, and Brazil starting in August 2006.

Brazil has the highest nominal interest rate of 9.61% on average over the period from 2006-2021. This is followed by Australia at 7.44% and India at 6.62%. As for inflation rate, which is measured by the CPI indices, is led by Japan with the lowest level at 0.43% and followed by Germany with 1.43%. India and Brazil have much higher inflation rates, of 5.79% and 5.55%, respectively. Real return, calculated by the difference between nominal and inflation rate, shows us that both Brazil

and Australia are still leading with 4.05% and 3.06%, respectively, whereas Germany and Japan are taking the bottom on the rank with 0.43% and 0.41%. Following suit, the bond returns are collected based on the 10-year bond yield data. In this regard, both Brazil and India are leading with an impressive return of 13.55% and 10.71%, respectively. The excess return is the difference between the bond return and the nominal returns calculated in the first part. Results show that Brazil and India are still leading with 4.22% and 5.65%, though switching places.

Excess stock (bond) returns are the returns on foreign stocks (bonds) to a fully hedged investor, i.e. local currency returns, in excess of the log nominal interest rate. Stock returns are collected from the MSCI country indices, of which the highest are from China and India at 12.79% and 11.99%, respectively. Using the same data source, the excess return gives China a leading position at 8.87%, with Germany a runner-up at 5.81%.

Table 4 reports the annualized mean and standard deviation of changes in log exchange rates, the excess log currency returns, the log unhedged stock and bond returns with respect to USD (upper panel) and CAD (lower panel). The mean log returns (geometric averages) are adjusted by one-half their variance so that they reflect mean gross returns (arithmetic averages).

Average changes in exchange rates with respect to both USD and CAD over the given sample period are negative for the AUD, GBP, INR and BRL reflecting a depreciation of these currencies with respect to both USD and CAD. Positive average changes in log exchange rates for the EUR, YEN, and CNY with respect to both USD and CAD reflect an appreciation of these currencies with respect to USD and CAD. Exchange rate volatility relative to USD falls in a wide range between 4% to 17%. CNY moves closest with USD, given the bilateral exchange rate volatility of only 4.15%. Excess returns to currencies are small on average and their annual volatilities are similar to that of exchange rates, for the stability of short-term interest rates.

Nominal unhedged log stock (bond) returns are the sum of hedged log stock (bond) returns (Table 3) and log changes in exchange rates with respect to the domestic country. The unhedged and

hedged stock (bond) returns of the Brazilian market are significantly different for with respect to both USD and CAD. Different from other emerging markets, the unhedged Chinese stock returns are less volatile than the hedged stock returns with respect to CAD. For developed markets, unhedged returns are higher than the hedged returns with respect to CAD, while the differences are statistically insignificant.

Table 5 reports full-sample quarterly correlations of foreign currency excess returns from US and Canadian investors' perspectives, in Panel A and B respectively. Panel C and D show the excess returns for fully hedged bonds and stocks portfolios in that order.

Panel A shows that all the currencies are positively correlated with USD apart from the Japan/Brazil pair, which has a correlation of -7%. Of all the currency pairs, 75% have a correlation of less than 50%, half of the correlations are less than 30%, and only three pairs are above 60%. The currency pairs with the strongest correlations are as follows, CAD/AUD at 78%, AUD/GBP at 63% and AUD/INR at 63%.

From the Canadian dollar perspective in Panel B, most currency pairs do not have strong correlations, with only one pair having a correlation greater than 60%, USD/CNY at 90%. There are four pairs with a correlation of 50% or more, YEN/CNY (52%), USD/YEN (55%), INR/CNY (57%), and USD/INR (60%). Notably the Brazilian real was negatively correlated with all currencies except with Australia dollar and Euro.

There are many strong correlations in bond returns as shown in Panel C. The US, UK, Canadian, Australian, and German market pairs all have correlations greater than 70%, the strongest being the Canadian and American (91%), the strongest being the US and UK (85%). Brazil, India, and China all have 50% or lower correlations with the other bond markets. Brazil has the weakest correlations with all other markets with a median correlation of 28%.

The intercountry correlation amongst stock market returns appears to be stronger on average when compared to the bond markets with the lowest correlation at 41% between Germany and China. Like the bond market, the US, UK, Canadian, Australian, and German market pairs all have correlations greater than 70%. China's stock market returns has the weakest correlations with other countries (a median of 43% compared with the sample median of 63%).

Section 5: Optimal hedging results

The optimal hedge ratios for both US and Canadian investors in foreign equity and bond markets for single-country portfolios are calculated in Table 6 below. The correlations of FX rates with stock and bond returns in both developed and emerging markets for Canadian investors are all statistically significant. A comprehensive summary of the estimated results is presented in Appendix B.

Results in Table 6 are obtained by regressing the hedged excess return of the country stock market on the excess return of the domestic country currency. We run monthly regressions on overlapping quarterly returns[3]. Standard errors are corrected for auto-correlation due to overlapping intervals using the Newey-West procedure. The estimated coefficients are the opposite value of the optimal currency exposure. The hedge ratios are obtained by subtracting the opposite of the estimated coefficients in Table 6 from one. For example, for a US equity investor investing in Japanese stock market, the positive coefficient is associated with a short position in YEN of 27% or is associated with a hedging ratio of 1.27. Therefore, the US investor looking to invest in the Japanese stock market would hold a net long 27% exposure to USD.

For risk-minimizing US equity investors (see Table B.1), the implication is that the currency exposures of foreign equity portfolios should be at least fully hedged, and probably overhedged. This is especially true for the CAD and the INR as they should be heavily overhedged. The result is consistent with (Campbell, Serfaty-De Medeiros and Viceira 2010). In Table B.2, we show the

[3] By computing the 3-month moving sums of the log-returns of monthly index data, one can obtain approximate overlapping quarterly returns ending on each calendar quarter.

optimal hedging strategy for US bond investors is to hedge to a less degree compared to equity markets but still hold long positions of USD against all other currencies.

The most notable hedging ratio is one in the US stock market for Canadian investors, 0.02. This indicates that Canadian investors should maintain close to an unhedged position (see Table B.3). Canadian equity investors should not hedge but hold long positions in Chinese Yuan reflecting the significant negative correlation between Chinese stock excess returns and currency excess returns.

There are three reasons why a net short CAD position occurs when investing in China. First, the expected return on CNY exposure is positive from a Canadian perspective. Second, there is a negative correlation between CNY and the stock market return. Third, unhedged Chinese stock returns are less volatile than hedged equity returns.

These unique features indicate CNY's tango with USD. CNY moves closely with USD to prevent it from depreciating when the Chinese equity market falls. Therefore, the currency tango artificially creates this negative correlation between the CNY and the stock market, which leads the investor to short CAD when investing in China.

For currency pairs, the Canadian and US hedging strategies are remarkably different in equity markets. The US investor should take overhedged positions in all markets except for Germany and the UK, in which they should enter fully hedged positions. Switching over to emerging markets, the US investor should maintain a net long position in USD against the Brazilian, Chinese, and Indian markets. In contrast, the Canadian investor should only be net long the CAD when investing in the Brazilian market. When investing in the Chinese market, Canadian investors should short the CAD by 100% and long the CNY by 93%. Finally, when it comes to the Indian market, Canadian investors should hedge 93% of their exposure to INR.

In summary, the hedging strategies for equity markets from US investors consist of fully hedged and overhedged positions with net long USD. For Canadian investors, there are many different strategies including unhedged against USD, partially hedged against the EUR, YEN, GBP and INR, short the CAD and long the CNY and net long the CAD against the AUD and BRL.

Hedging strategies in bond markets from Canadian and US perspectives are much more similar. In almost all cases for both Canadian and US investors, they should hold long positions in their domestic currencies. US investors should also fully hedge against EUR and GBP, long domestic and partially hedged against the CAD, AUD, INR and CNY, and overhedge for the YEN and BRL. The major difference between the US and Canadian perspectives is that the Canadian investor should be overhedged in more markets. Canadians should fully hedge against the EUR, partially hedged and long the CAD against the AUD and overhedge for the remaining markets.

Table 7 below shows the optimal currency exposures considering multiple currencies simultaneously. Compared with Table 6, the hedge ratios and corresponding statistical significance tend to be much lower for the multi-currency portfolios for both bond and equity markets.

For US equity investors, the multi-currency portfolio follows the trends seen in Table 6. US investors should hold net long positions in their domestic currency when investing in the foreign markets. However, the magnitude of the long positions in the US dollar are lower for the multi-country portfolio by 46% on average. US bond investors encounter the same trend seen with the single country portfolio – US investors should hold net long positions in USD against foreign bond markets.

From the perspective of a Canadian equity investor, all the same trends with the US single and multi-currency positions hold except for the Chinese market. This is most likely due to the relationship between the stock markets of other countries providing a natural hedge against the Canadian dollar.

Section 6: Conclusion

In this paper, we extend the financial literature on currency hedging in emerging markets. We study the optimal currency risk hedging strategy of foreign stock and bond market investment from the perspective of Canadian and US investors over the period of 1975 to 2021.

We first introduce a toy model with only two countries to study the relationship between hedged portfolio returns and the hedging ratios. We find the incentives to hedge foreign currency should depend on the expectations of exchange rate movements. If the home currency appreciates more frequently, domestic investors would be better off hedging to prevent potential losses. Whereas if the home currency is more likely to depreciate, an unhedged position could be optimal.

Canadian equity investors should maintain close to an unhedged position in the US stock market, due to the strong negative correlation between their currency exchange rate with the US stock market returns. Our analysis also suggests Canadian equity investors should hold long positions in Chinese Yuan reflecting the significant negative correlation between Chinese stock excess returns and currency excess returns. However, in contrast, US equity investors are suggested to overhedge against the Chinese Yuan.

This study can be extended in several ways. First, our optimal hedging results are subjective to parameter uncertainty given the limitations in the historical data. A robustness check on subsample periods and stress testing on correlation variables could be an ideal extension of our work. Second, rather than adopting an asset-by-asset or currency-by-currency approach, we look for an extension of the hedged portfolio return model with all currency exposures relative to the strategic benchmark asset allocation (Coiai, et al. 2021), and then determine the optimal hedge ratio across all asset classes. Lastly, for institutional investors, the cost of hedging is an important factor to consider and could be included into our future analysis. Implementing a currency hedge for equity portfolios in developed markets is relatively straightforward. This isn't the case for emerging markets. Trading volumes for many emerging market currencies are

fairly small compared to those for developed markets' currencies, resulting in higher hedging costs.

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Endnotes

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Table 3: Summary Statistics

	Country	US	Canada	Germany	Australia	Japan	UK	India	China	Brazil
Variable	Start	1975M1	1975M1	1995M2	1975M1	1989M1	1975M1	2011M2	2002M8	2006M8
Log nominal rate (r^c_{nom})	Average	4.90%	5.80%	1.86%	7.44%	0.83%	6.36%	6.62%	3.36%	9.61%
	Std. Dev.	3.81%	4.36%	1.74%	4.62%	1.39%	4.47%	1.67%	1.04%	3.14%
Inflation rate (π^c)	Average	3.51%	3.37%	1.43%	4.38%	0.43%	4.29%	5.79%	2.52%	5.55%
	Std. Dev.	2.60%	2.97%	0.79%	3.34%	1.20%	4.06%	2.31%	1.85%	1.95%
Real rate (r^c_{tb})	Average	1.39%	2.42%	0.43%	3.06%	0.41%	2.07%	0.83%	0.90%	4.05%
	Std. Dev.	2.72%	2.74%	1.80%	3.08%	1.16%	3.42%	2.18%	1.95%	2.94%
Nominal log bond returns (r^c_b)	Adj. Average	7.76%	8.33%	5.52%	9.61%	3.54%	9.44%	12.25%	3.81%	13.84%
	Std. Dev.	8.74%	8.36%	5.60%	8.59%	5.43%	8.38%	10.71%	6.25%	13.55%
Excess log bond returns (x^c_b)	Adj. Average	2.85%	2.52%	3.65%	2.15%	2.67%	3.02%	5.65%	0.41%	4.22%
	Std. Dev.	8.71%	8.15%	5.27%	8.27%	5.10%	7.65%	10.89%	6.33%	13.44%
Nominal log stock returns (r^c_s)	Adj. Average	9.50%	8.21%	7.58%	8.74%	1.52%	7.92%	11.99%	12.79%	4.89%
	Std. Dev.	15.46%	17.49%	23.04%	17.56%	21.80%	15.19%	14.69%	27.55%	20.46%
Excess log stock returns (x^c_s)	Adj. Average	4.69%	2.52%	5.81%	1.32%	0.65%	1.48%	5.43%	8.87%	-4.48%
	Std. Dev.	15.99%	18.12%	23.40%	17.67%	22.45%	14.62%	15.15%	27.60%	21.61%

Note: The average log returns are adjusted by one-half their variance so that they reflect mean gross returns

Table 4. Annual Returns to International Investment

	Country	US	Canada	Germany	Australia	Japan	UK	India	China	Brazil
Variable	Start	1975M1	1975M1	1995M2	1975M1	1989M1	1975M1	2011M2	2002M8	2006M8
US Perspective										
Change in log exchange (Δs^c)	Adj. Average		-0.27%	3.55%	-0.60%	1.31%	-0.50%	-3.63%	1.35%	-6.88%
	Std. Dev.		6.68%	17.00%	11.16%	10.25%	10.79%	5.26%	4.15%	17.00%
Excess log currency returns (e^c)	Adj. Average		0.64%	3.01%	2.01%	-0.95%	1.03%	2.24%	3.19%	2.05%
	Std. Dev.		6.79%	17.56%	11.59%	10.81%	11.31%	5.08%	4.37%	17.75%
Nominal unhedged bond return r_b^{uc}	Adj. Average		8.08%	9.04%	8.80%	4.83%	8.88%	9.11%	5.08%	8.70%
	Std. Dev.		9.92%	17.13%	11.77%	11.99%	12.49%	13.08%	6.98%	25.97%
Nominal unhedged stock return (r_s^{uc})	Adj. Average		8.25%	9.74%	8.33%	1.90%	7.40%	7.38%	14.62%	0.20%
	Std. Dev.		20.87%	24.00%	22.14%	21.09%	18.98%	16.95%	27.86%	34.27%
Canada Perspective										
Change in log exchange (Δs^c)	Adj. Average	0.72%		3.19%	-0.43%	1.73%	-0.03%	-0.82%	0.71%	-5.85%
	Std. Dev.	6.68%		16.56%	7.71%	11.56%	10.53%	6.06%	8.74%	12.17%
Excess log currency returns (e^c)	Adj. Average	-0.18%		2.52%	1.24%	-1.12%	0.58%	4.82%	2.32%	2.60%
	Std. Dev.	6.79%		16.87%	7.95%	11.81%	10.97%	6.87%	9.51%	12.17%
Nominal unhedged bond return r_b^{uc}	Adj. Average	8.64%		8.78%	9.09%	5.40%	9.48%	12.00%	4.72%	9.29%
	Std. Dev.	11.69%		17.32%	9.91%	13.77%	13.34%	13.99%	12.79%	21.11%
Nominal unhedged stock return (r_s^{uc})	Adj. Average	9.73%		8.79%	8.16%	1.90%	7.69%	9.83%	12.38%	-0.07%
	Std. Dev.	14.56%		21.11%	18.93%	19.72%	17.87%	14.94%	22.68%	27.80%

Table 5 Cross-country return correlations

	US	Canada	Germany	Australia	Japan	UK	India	China	Brazil
Panel A: Excess log currency returns e^c US Perspective									
US									
Canada		1							
Germany		0.2678	1						
Australia		0.7761	0.4091	1					
Japan		0.1067	0.0039	0.2101	1				
UK		0.5351	0.4018	0.634	0.0481	1			
India		0.51	0.2076	0.6293	0.1001	0.3973	1		
China		0.1459	0.1286	0.2089	0.0891	0.3014	0.1493	1	
Brazil		0.5455	0.327	0.537	-0.0655	0.3091	0.4268	0.1182	1
Panel B: Excess log currency returns e^c Canada Perspective									
US									
Canada	1								
Germany	0.2132		1						
Australia	-0.2295		0.266	1					
Japan	0.5479		0.0977	0.0399	1				
UK	0.3715		0.3673	0.2858	0.1951	1			
India	0.5971		0.1944	0.1991	0.3631	0.3493	1		
China	0.8993		0.2317	-0.1413	0.5198	0.4413	0.5671	1	
Brazil	-0.1515		0.184	0.2416	-0.2047	-0.034	0.073	-0.1167	1
Panel C: Excess log bond return in local currency x_b^c									
US	1								
Canada	0.9088	1							
Germany	0.7362	0.7221	1						
Australia	0.8291	0.8057	0.8471	1					
Japan	0.4328	0.4255	0.5727	0.4644	1				
UK	0.8435	0.8272	0.8137	0.8635	0.4611	1			
India	0.4598	0.4396	0.3158	0.3944	0.0163	0.4643	1		
China	0.4927	0.5011	0.4338	0.4653	0.2448	0.5131	0.4388	1	
Brazil	0.2708	0.1621	0.2921	0.3201	0.275	0.3344	0.3013	-0.0131	1

Panel D: Excess log stock return in local currency x_S^c									
US	1								
Canada	0.8148	1							
Germany	0.8274	0.7759	1						
Australia	0.7909	0.7367	0.75	1					
Japan	0.668	0.6336	0.6912	0.6561	1				
UK	0.8479	0.7671	0.8188	0.8304	0.6434	1			
India	0.6017	0.6709	0.6194	0.6144	0.5769	0.5639	1		
China	0.4941	0.5285	0.4073	0.5106	0.49	0.4511	0.5802	1	
Brazil	0.5965	0.6931	0.5721	0.6261	0.5304	0.5899	0.6725	0.6136	1

Table 6 Estimated Minimum Variance Hedge Ratios for Single-Country Portfolios

	Stock		Bond	
	Currency Exposure	Std. Err	Currency Exposure	Std. Err
US perspective				
Canada	1.07***	0.17	-0.07*	0.06
Germany	-0.01	0.10	0.00*	0.03
Australia	0.40***	0.10	-0.13***	0.04
Japan	0.27***	0.11	0.08*	0.05
UK	0.02*	0.12	0.02*	0.05
India	2.02***	0.25	-0.17*	0.26
China	0.57*	0.51	-0.23***	0.09
Brazil	0.54***	0.15	0.34***	0.08
Canada Perspective				
US	-0.98***	0.16	0.08*	0.07
Germany	-0.24*	0.17	0.03*	0.03
Australia	0.23**	0.13	-0.10**	0.06
Japan	-0.43***	0.11	0.08***	0.04
UK	-0.20***	0.10	0.09**	0.05
India	-0.07*	0.24	0.44***	0.18
China	-1.93***	0.31	0.24***	0.08
Brazil	0.27*	0.18	0.29***	0.11

Table 7: Estimated Minimum Variance Hedge Ratios for Multi-Country Portfolios

	US perspective				Canada perspective			
	Stock		Bond		Stock		Bond	
	Currency Exposure	Std. Err	Currency Exposure	Std. Err	Currency Exposure	Std. Err	Currency Exposure	Std. Err
US	-	-	-	-	-1.04***	0.26	0.04*	0.11
Canada	0.62***	0.19	-0.02*	0.08				
German	-0.17**	0.10	-0.12**	0.07	-0.17**	0.09	-0.11*	0.08
Australia	0.36***	0.14	-0.02*	0.07	0.36***	0.14	-0.04*	0.07
Japan	-0.35***	0.10	0.23***	0.05	-0.36***	0.10	0.25***	0.05
UK	0.08*	0.15	-0.16***	0.06	0.10*	0.15	-0.17***	0.07
India	0.58***	0.18	0.12*	0.08	0.58***	0.18	0.12*	0.09
China	-0.23*	0.26	-0.09*	0.09	-0.21*	0.26	-0.10*	0.10
Brazil	0.14**	0.08	0.00*	0.04	0.12*	0.08	0.00	0.04

Appendix A

Unhedged Gross Returns

We denote R_{t+1}^{c} the gross return of risky assets specified in local currency c from holding country c from the beginning to the end of period $t+1$. We index the domestic country by $c=1$ and then the $n-1$ foreign countries by $c=2,\cdots,n$. Define S_{t+1}^{c} spot exchange rate with domestic exchange rate constant $\mathrm{S}_{t+1}^{1}=1$ for all time t.

At time t, the Canadian investor exchanges a Canadian dollar for $1/S_{t+1}^{c}$ units of currency c and then invests in country c's risky assets. After one period, the Canadian investor can exchange for S_{t+1}^{c} Canadian dollars, to earn an unhedged return of:

$$R_{u,t+1}^{c}=\mathrm{R}_{t+1}^{\mathrm{c}}(S_{t+1}^{c}\div S_{t}^{c})$$

Given a vector of portfolio weight $\boldsymbol{\omega}$, the gross return of a non-hedged portfolio given by

$$R_{u,t+1}=\mathrm{R}'_{t+1}\ \boldsymbol{\omega}_{t}(\boldsymbol{S}_{t+1}\div\boldsymbol{S}_{t})$$

where $\boldsymbol{\omega}_{t}=\begin{pmatrix}\omega_{t}^{1} & \cdots & 0\\ \vdots & \ddots & \vdots\\ 0 & \cdots & \omega_{t}^{n}\end{pmatrix}$ is the $(n\times n)$ diagonal matrix of weights on domestic and foreign risky assets at time t, with $\sum_{c=1}^{n}\omega_{t}^{c}=1$. $\boldsymbol{R}_{t+1}=\begin{pmatrix}\mathrm{R}_{t+1}^{1}\\ \vdots\\ \mathrm{R}_{t+1}^{\mathrm{n}}\end{pmatrix}$ is the $(n\times 1)$ vector of gross domestic and foreign asset returns in local currencies. $\boldsymbol{S}_{t+1}=\begin{pmatrix}\mathrm{S}_{t+1}^{1}\\ \vdots\\ \mathrm{S}_{t+1}^{\mathrm{n}}\end{pmatrix}$ is the $(n\times 1)$ vector of spot exchange rate with domestic exchange rate constant $\mathrm{S}_{t+1}^{1}=1$ for all time t, and $\div$ indicates the element-by-element ratio operator.

Hedged Gross Returns

Let $F_{t,t+1}^{c}$ be the one-period forward exchange rate in CAD per foreign currency c, and denote θ_{t}^{c} as the value in CAD of the amount of forward exchange rate contracts for foreign currency c. At the end of period $t+1$, the investor gets to exchange θ_{t}^{c}/S_{t}^{c} units of the foreign-currency based

return $\mathrm{R}^{\mathrm{c}}_{t+1}\omega^{c}_{t}/S^{c}_{t}$ back into CAD at an exchange rate $F^{c}_{t,t+1}$. The rest amount $\frac{\mathrm{R}^{\mathrm{c}}_{t+1}\omega^{c}_{t}}{S^{c}_{t}} - \frac{\theta^{c}_{t}}{S^{c}_{t}}$ is exchanged back at the spot exchange rate $\mathrm{S}^{\mathrm{c}}_{t+1}$. Collectively, the return of the hedge portfolio is given by

$$R_{h,t+1} = \boldsymbol{R}_{t+1}\ \boldsymbol{\omega}_{t}(\boldsymbol{S}_{t+1} \div \boldsymbol{S}_{t}) - \boldsymbol{\Theta}^{'}_{\mathrm{t}}\ (\boldsymbol{S}_{t+1} \div \boldsymbol{S}_{t}) + \boldsymbol{\Theta}^{'}_{\mathrm{t}}\ (\boldsymbol{F}_{t+1} \div \boldsymbol{S}_{t})$$

where $\boldsymbol{\Theta}_{\mathrm{t}} = \begin{pmatrix} \theta^{1}_{t} \\ \vdots \\ \theta^{\mathrm{n}}_{t} \end{pmatrix}$ is the $(n \times 1)$ vector of the hedge ratio with all hedged ratios adding up to 1

and $\mathbf{F}_{\mathrm{t+1}} = \begin{pmatrix} \mathrm{F}^{1}_{t,t+1} \\ \vdots \\ \mathrm{F}^{\mathrm{n}}_{t,t+1} \end{pmatrix}$ is the $(n \times 1)$ vector of forward exchange rate.

Log Asset Returns

We consider two risky asset classes, equity stocks and the long-term bonds. Logarithmic returns on the equity market in local currency of country c are defined by

$$r^{c}_{s,t} = \ lnP^{c}_{t} - lnP^{c}_{t-1}$$

with P^{c}_{t} the stock market price at time t of local currency in country c.

We construct the log nominal bond return series from 10-year constant maturity yield using the approach describe by (Campbell and Viceira 2002):

$$r^{c}_{b,t+1} = D^{c}_{n,t}y^{c}_{n,t} - (D^{c}_{n,t} - 1)y^{c}_{n-1,t+1}$$

where $r^{c}_{b,t+1}$ denotes the log nominal return on 10-year constant maturity yields for country c at time t, and $D^{c}_{n,t}$ is its duration, which we approximate as

$$D^{c}_{n,t} = \frac{1 - \left(1 + Y^{c}_{n,t}\right)^{-n}}{1 - \left(1 + Y^{c}_{n,t}\right)^{-1}}$$

$\boldsymbol{\Delta s}_{t} = \begin{pmatrix} \Delta \mathrm{s}^{1}_{t} \\ \vdots \\ \Delta \mathrm{s}^{\mathrm{n}}_{t} \end{pmatrix}$ is the $(n \times 1)$ vector of log spot exchange rate return, with the change in log exchange rate for domestic investors given by

$$\Delta s^{c}_{t+1} = lnS^{c}_{t+1} - lnS^{c}_{t}$$

$\boldsymbol{r}_{nom,t} = \begin{pmatrix} \mathrm{r}^{1}_{nom,t} \\ \vdots \\ \mathrm{r}^{\mathrm{n}}_{nom,t} \end{pmatrix}$ is the log short-term nominal interest rate for country c with $r^{c}_{nom,t}$ given by

$$r^{c}_{nom,t} = \log(1 + I^{c}_{t})$$

Appendix B

Table B.1 Optimal Currency Exposure for Single-Country Stock Portfolio US perspective

Country	-ψ	Currency Exposure, ψ	Hedging Ratio, Θ	Unhedged	Partial: Long Domestic, Hedge Foreign	Fully Hedged	Overhedged	Comment
Canada	1.07	-1.07	2.07				x	Net long USD 107%
Germany	-0.01	0.01	0.99			x		Fully Hedged
Australia	0.40	-0.40	1.40				x	Net long USD 40%
Japan	0.27	-0.27	1.27				x	Net long USD 27%
UK	0.02	-0.02	1.02			x		Fully Hedged
India	2.02	-2.02	3.02				x	Net long USD 202%
China	0.57	-0.57	1.57				x	Net long USD 57%
Brazil	0.54	-0.54	1.54				x	Net long USD 54%

Table B.2 Optimal Currency Exposure for Single-Country Stock Portfolio Canadian Perspective

Country	-ψ	Currency Exposure, ψ	Hedging Ratio, Θ	Short Domestic	Unhedged	Partial: Long Domestic, Hedge Foreign	Overhedged	Comment
US	-0.98	0.98	0.02		x			Unhedged
Germany	-0.24	0.24	0.76			x		Hedge 76% of EUR
Australia	0.23	-0.23	1.23				x	Net long CAD 23%
Japan	-0.43	0.43	0.57			x		Hedge 57% of YEN
UK	-0.20	0.20	0.80			x		Hedge 80% of GBP
India	-0.07	0.07	0.93			x		Hedge 93% of INR
China	-1.93	1.93	-0.93	x				Long CNY 93%
Brazil	0.27	-0.27	1.27				x	Net long CAD 27%

Table B.3 Optimal Currency Exposure for Single-Country Bond Portfolio US perspective

Country	-ψ	Currency Exposure, ψ	Hedging Ratio, Θ	Partial: Long Domestic, Hedge Foreign	Fully Hedged	Overhedged	Comment
Canada	-0.07	0.07	0.93	x			Hedge 93% of CAD
Germany	0.00	0.00	1.00		x		Fully Hedged
Australia	-0.13	0.13	0.87	x			Hedge 87% of AUD
Japan	0.08	-0.08	1.08			x	Net long USD 8%
UK	0.02	-0.02	1.02		x		Fully Hedged
India	-0.17	0.17	0.83	x			Hedge 83% of INR
China	-0.23	0.23	0.77	x			Hedge 77% of CNY
Brazil	0.34	-0.34	1.34			x	Net long USD 34%

Table B.4 Optimal Currency Exposure for Single-Country Bond Portfolio Canadian Perspective

Country	-ψ	Currency Exposure, ψ	Hedging Ratio, Θ	Partial: Long Domestic, Hedge Foreign	Fully Hedged	Overhedged	Comment
US	0.08	-0.08	1.08			x	Net long CAD 8%
Germany	0.03	-0.03	1.03		x		Fully Hedged
Australia	-0.10	0.10	0.90	x			Hedge 90% of AUD
Japan	0.08	-0.08	1.08			x	Net long CAD 8%
UK	0.09	-0.09	1.09			x	Net long CAD 9%
India	0.44	-0.44	1.44			x	Net long CAD 44%
China	0.24	-0.24	1.24			x	Net long CAD 24%
Brazil	0.29	-0.29	1.29			x	Net long CAD 29%