Reordering the Global Monetary Hierarchy in the Aftermath of the Russia-Ukraine War: A Frankel-Wei Regression Approach of the Chinese Yuan and Two Selected Asian Currencies

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إعادة ترتيب التدرج النقدي العالمي في أعقاب الحرب الروسية الأوكرانية: مقاربة انحدار فرانكل-وي لليوان الصيني وعملتين آسيويتين مختارتين

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Summary: This paper develops an analytical framework to examine recent shifts in the global monetary hierarchy. It focuses on how the Russia–Ukraine war (2022) has influenced the relative importance of core currencies in shaping the exchange rates of peripheral currencies. Using the Frankel–Wei regression method, the study evaluates the war's impact on the de facto exchange-rate arrangements of the Chinese yuan as an emerging regional currency, and of the Malaysian ringgit and the Singapore dollar as peripheral Asian currencies. The analysis relies on EViews 12 to estimate the implicit weights of major anchor currencies before and after the war. The empirical evidence indicates a decline in the implicit weight of the us dollar in the Yuan's de facto exchange rate arrangement in the post-war period, even though it remains the dominant anchor currency, accompanied by a higher weight for the Japanese Yen. The regressions for the two Asian currencies further indicate that the Yuan has strengthened its role as a regional anchor for the Malaysian ringgit, with a more limited anchoring effect on the Singapore dollar. At the same time, the Japanese yen has gained importance, whereas the euro has lost relevance for both currencies. These findings suggest a gradual reshaping of the monetary hierarchy in Asia following the war.

Keywords: Global Monetary Hierarchy; Frankel–Wei Regression; Chinese Yuan; Ukraine war.
JEL Classification Codes : F31, F33, E52, O53

ملخص تطور هذه الورقة البحثية إطارا تحليليا لدراسة التحولات الأخيرة في التدرج النقدي العالمي. وتركز على كيفية تأثير الحرب بين روسيا وأوكرانيا (2022) على الأهمية النسبية للعملات الأساسية في تشكيل أسعار صرف العملات الطرفية. وباستخدام أسلوب انحدار فرانكل-وي، تحاول الدراسة تقييم تأثير الحرب على ترتيبات سعر الصرف الفعلية لليوان الصيني كعملة إقليمية ناشئة، وللرينجيت الماليزي والدولار السنغافوري كعملات آسيوية محيطية. ويعتمد التحليل على برنامج إيفيوز -12 لتقدير الأوزان الضمنية للعملات الرئيسية المُرساة قبل الحرب وبعدها. تشير الأدلة التجريبية إلى انخفاض في الوزن الضمني للدولار الأمريكي في ترتيب سعر الصرف الفعلي لليوان في فترة ما بعد الحرب، على الرغم من أنه لا يزال العملة الأساسية المهيمنة، مصحوبا بوزن أعلى للين الياباني. كما تشير انحدارات العملتين الآسيويتين إلى أن اليوان قد عزز دوره كمرساة إقليمية للرينجيت الماليزي، مع تأثير ترسيخ أقل على الدولار السنغافوري. في الوقت نفسه، اكتسب الين الياباني أهمية، بينما فقد اليورو أهميته لكلا العملتين. تشير هذه النتائج إلى إعادة تشكيل تدريجية للتدرج النقدي في آسيا بعد الحرب.

الكلمات المفتاحية: التدرج النقدي العالمي؛ انحدار فرانكل-وي؛ اليوان الصيني؛ الحرب الروسية-الأوكرانية.
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I- Introduction :

The international monetary system is inherently hierarchical, reflecting differences in the global importance of currencies. Some major currencies exert significant influence over the exchange-rate dynamics of less prominent currencies. These are referred to as core currencies, whereas the less influential ones are called peripheral currencies. Between these categories lie "semi-core" currencies, whose exchange-rate arrangements are linked to core currencies and, consequently, shape the arrangements of peripheral currencies.

In recent years, the Chinese yuan has increasingly attracted attention. Although it remains partially influenced by major currencies, it is gradually gaining regional significance as a reference currency for peripheral currencies, particularly in Asia. Indeed, while the US dollar has long maintained a dominant position at the top of the global monetary hierarchy, the yuan is steadily emerging as a currency with growing international use. This partial internationalization, combined with China's deepening trade and financial ties across the region, has consequently enhanced the yuan's role in certain international transactions .Such developments suggest that the traditional structure of the Asian monetary hierarchy is gradually evolving. As the yuan strengthens its regional anchoring function, it may increasingly influence the exchange-rate dynamics of some Asian peripheral currencies, thereby contributing to a reordering of monetary influence within the region.

Furthermore, these dynamics become even more important during periods of geopolitical and economic shock. The Russia–Ukraine war, which began in February 2022, triggered a major reorganization of global financial flows and accelerated ongoing efforts to reduce dependence on the US dollar as the dominant currency in the international system. This shift has been supported by the development of new payment channels and the emergence of strategic monetary alliances that differ from traditional financial and monetary arrangements. Such changes may, in turn, influence the de facto exchange-rate arrangements of Asian economies, encouraging a stronger inclusion of the Chinese yuan in their currency baskets.

In this context, the present study examines whether the structure of the international monetary hierarchy has shifted in the aftermath of the Ukraine war. Three main hypotheses are proposed; the first one assumes that the yuan functions as a semi-core currency, partly dependent on core currencies while simultaneously serving as an anchor for peripheral ones. The second hypothesis suggests that the war may have reduced the importance of the US dollar, as the leading core currency, in the exchange-rate baskets of the yuan as a semi-core currency, and of the Malaysian ringgit and the Singapore dollar as peripheral currencies. The third posits that the weight of the yuan in the exchange-rate baskets of the two Asian currencies has changed between the pre-war and post-war periods of the Russia–Ukraine conflict.

Using the Frankel–Wei (1994) regression framework, this study estimates the position of three major currencies -the US dollar (USD), the euro (EUR), and the Japanese yen (JPY)- within the exchange-rate arrangements of the Chinese yuan and selected Asian currencies. It also evaluates the extent to which the Chinese yuan (CNY) functions as an influential regional anchor for Asian peripheral currencies, with particular focus on the Malaysian ringgit (MYR) and the Singapore

dollar (SGD). The analysis compares two periods, before and after the Ukraine war, in order to assess whether the yuan has expanded its regional monetary influence as a "semi-core" currency

II-Literature Review

The Frankel–Wei regression framework has been widely used to examine the structure and dynamics of exchange-rate arrangements. (Frankel & Wei, Is There a Currency Bloc in the Pacific?, 1993) initially introduced this approach to test for monetary clustering in the Asia-Pacific region, estimating how exchange rates move in relation to major currencies and inferring their implicit weights. They later refined the methodology (Frankel & Wei, 1994) by applying a regression framework to estimate the weights of key international currencies, including the US dollar, Japanese yen, and German mark, in East Asian exchange-rate movements. In their model, the dependent variable captures changes in each country's exchange rate (often measured against Special Drawing Rights or a synthetic currency), while the independent variables are the corresponding movements of major currencies. This approach forms the foundation for subsequent studies, including the present analysis.

Building on this framework, several researchers have extended and enhanced its application. (Bracke & Bunda, 2011), for example, applied the Frankel–Wei methodology to 149 emerging and developing economies over the period 1980–2010. They constructed a composite measure of exchange-rate stability and identified the reference currencies that each economy tends to follow. More recently, (Chekouri, Chibi, & Benbouziane, 2022) implemented rolling-window versions of the Frankel–Wei regression to estimate the implicit weights of the Algerian dinar's currency basket, comparing legal classifications (de jure) with actual behavior (de facto). The framework has been adapted by (Kunkler, 2022) to measure co-movements among currencies through the development of "implicit beta" variables derived from option-implied volatilities. These enhancements reflect important methodological improvements to the original regression approach, particularly in identifying anchor currencies and assessing their influence in regional and global monetary systems .

In addition, many other researches focused on how the war enhanced the internationalization of the Chinese yuan, such as (Kluge, 2024, p. 26), in which the author argues that since the Russia-Ukraine War, economic ties with China have shifted from complementary cooperation toward a strategic dependence, creating a strong reliance of Russia's economy on China. In a working note (Von Beschwitz, 2024) argues that western sanctions on Russia likely spurred greater use of the yuan in international transactions and analyzes how de-dollarization is part of china s strategic effort to expand the international role of the yuan.

These studies either focus on samples that end before 2022, apply the Frankel–Wei regression approach to specific countries, or introduce methodological refinements to the framework. However, none of them systematically employ the Frankel–Wei model to examine whether the 2022 Russia–Ukraine shock produced a measurable reordering of the de facto monetary hierarchy in Asia, whether the war altered the implicit weight of the yuan in its own exchange-rate arrangement, or in the currency baskets of Asian economies linked to it. The contribution of this research therefore lies in its attempt to integrate (a) the estimation of anchor weights using the

Frankel–Wei regression, (b) the post-Ukraine War period as a structural break, and (c) a comparative regional perspective involving the Chinese yuan and two additional Asian currencies.

1. Hierarchy of Currencies in the International Monetary System

The currency hierarchy denotes the extent to which a national currency fulfills key monetary functions at the international level, serving as a unit of account, a medium of exchange, and a store of value in cross-border transactions for both private actors and governments. The international monetary system comprises a broad array of domestic currencies, yet their global influence is highly uneven, with only a select few functioning as true international currencies (Ferreira Lima & Morris, 2022). The contemporary system is characterized by asymmetry, with a small number of currencies exerting dominant influence globally. Core currencies establish distinct geographic spheres of influence, developing monetary linkages between dominant currencies and the peripheral currencies anchored to them.

1-1. Core Currency: The US Dollar

Despite the international significance of several currencies, the US dollar remains the central pillar of the contemporary monetary system. It exerts dominance over other currencies in fulfilling key international monetary functions, both public and private. This central role has granted the United States a pivotal position in the global economic and financial system, while also serving as a "valuable privilege" and a tool of American monetary policy and influence (Arner, Buckley, Zetzsche, & Didenko, 2023). Although the British pound continued to compete with the dollar until the 1960s, its prominence subsequently declined. Similarly, the increased role of the German mark and the Japanese yen during the 1980s suggested a potential shift toward a tripolar system. However, the international use of both currencies stabilized at modest levels from the 1990s onward. Many also believed that the euro would steer the world toward a bipolar system in the early 2000s, yet subsequent experience revealed the euro's limited role as an international currency (Marie-Henri , 2012, p. 49).

The dollar's dominance has been underpinned by the United States' economic, military, and political power. This dominance can be divided into two major phases. The first corresponds to the Bretton Woods era (1946–1971), while the second aligns with the neoliberal period beginning in the early 1980s. Both phases share the characteristic of American power, although each operated under a different economic system (Palley, Caldentey, & Vernengo, 2024, p. 3). As the leading global currency, the US dollar performs three primary functions: an international unit of account, a medium of exchange, and a store of value. These functions apply across both public and private sectors (Rakic & Antonini , 2025). Dollar dominance is evident throughout the global financial system: approximately 60% of central bank foreign exchange reserves are held in dollar-denominated assets, nearly all commodity contracts—including oil—are priced in dollars, and the currency is widely used for the valuation and settlement of international financial transactions (Prasad, 2022, p. 12).

Despite its central role, the dollar hegemony has become increasingly contested due to geopolitical and geostrategic shifts. The United States' share of global exports and production has declined over

the past three decades, while China share has grown significantly. Moreover, the dollar's share in central bank foreign exchange reserves has decreased over the past twenty years, and reliance on the dollar in bond markets has diminished, as evidenced by a reduction in foreign holdings of US Treasury securities over the past fifteen years (Kaneva, 2025).

1-2. International Currencies of the Second Order

Alongside the US dollar, several other currencies play a significant international role, including the euro, the British pound, and the Japanese yen. Some currencies, although less dominant, also possess international relevance, such as the Swiss franc, the Canadian dollar, and the Australian dollar. While the dollar continues to dominate official reserves, international trade and financial transactions, and serves as a reference currency for many other national currencies, the contribution of these secondary currencies to performing certain international functions has been steadily increasing.

Notably, some of these currencies (such as the euro, the British pound, and the yen) have effectively achieved the status of a "core currency," although primarily at the regional level. Similarly, certain emerging-market currencies, including the Chinese yuan, as well as the Mexican peso, Brazilian real, and South African rand, have experienced a marked rise in international use (Orsi, Kaltenbrunner, & Dymski, 2025, p. 1). According to (Von Beschwitz, 2024), the aggregate Index of International Currency Usage[1] for the yuan accounts only about 2.5% of global usage. This is far below the US dollar, which holds a 66% share, and also lags behind the euro, pound, and yen.

Such "semi-core" currencies are forming the core of regional monetary spheres that are often shaped by geographic or historical factors, such as ties to former colonial regions. They are linked both to their respective regions and, ultimately, to the US dollar as the central anchor of the system.

1-3. Peripheral Currencies

At the lower rung of the international monetary hierarchy lie currencies whose global relevance is limited. While some of these currencies may exhibit a modest degree of international use, such use remains largely marginal (De Conti & Prates, 2016, p. 27). They do not perform any of the international monetary functions, whether public or private. While they may be fully liquid within their domestic economies, they carry little weight internationally, are essentially illiquid in global markets, and do not serve as a means of payment for either private agents or governments.

Peripheral currencies are generally anchored to core currencies, which serve as reference points for determining their exchange rates. This anchoring constitutes one of the key international monetary functions performed by the dominant currencies, which operates as "anchor currencies" within the global system.

[1] The index is calculated as a weighted average of each currency's share across several dimensions: foreign exchange reserves (25%), foreign exchange transaction volume (25%), foreign currency debt issuance (25%), and the claims (12.5%) and liabilities (12.5%) of international banks.

Although several criteria can be used to assess the dominance of core currencies, such as their role in official reserves, their prominence in foreign Exchange Markets, their use as a tool for central bank intervention, or in the settlement of cross border trade and financial importance in settling trade and financial transactions—the present study focuses specifically on the anchor function. Core currencies serve as the reference for setting both nominal and real exchange rates of peripheral currencies, thereby creating regional spheres of influence for semi-core currencies alongside the global dominance of the US dollar.

According to this logic, core currencies play a central role in determining the value of peripheral currencies. Many countries adopt exchange-rate pegs to stronger or more advanced economies, as pegging can promote exchange-rate stability and enhance long-term predictability. The US dollar, the euro, and, historically, gold constitute the most prominent anchors for exchange-rate regimes worldwide (Tudicor, 2025). Today, more than **66 countries** peg their currencies to the US dollar due to its global strength and stability, which can help maintain competitive export prices (Ganti, 2025). Exchange-rate arrangements thus serve as an important lens for understanding a country's position within the international currency hierarchy.

In terms of exchange-rate classifications, the IMF's current methodology, effective since 2 February 2009, sets out a taxonomy of member countries' exchange-rate arrangements, capturing *de jure* arrangements (as officially declared by governments) and *de facto* arrangements (based on observed practices). The system categorizes regimes into ten sub-types, grouped into four broad categories: hard pegs, soft pegs, floating regimes, and a residual group comprising other managed arrangements (IMF, 2023, p. 13). Hard pegs maintain a fixed exchange rate, whereas soft pegs allow limited fluctuations within a specified band. Pegging to the US dollar, in particular, offers stability and predictability in trade, investment, and macroeconomic policy, though it also constrains a country's monetary autonomy (Mitchell, 2025).

2. The Impact of the War on the Rising Importance of the Chinese Yuan

Although the U.S. dollar continues to dominate the full range of functions performed by a core international currency, the Russia–Ukraine war has nonetheless reshaped parts of the global monetary hierarchy. The conflict—especially the sanctions imposed on Russia—created strong incentives for many countries to reduce their dependence on U.S.–centric financial infrastructure, including the dollar-based settlement system and the SWIFT network. The war triggered several notable shifts:

2-1. Growing Reliance on the Yuan in China–Russia Trade

Since 2022, trade between Russia and China has increasingly shifted toward settlement in yuan. China now conducts nearly all of its purchases of Russian oil, coal, and several metals in the Chinese currency rather than in U.S. dollars. The war in Ukraine has therefore accelerated the yuan's role in financing a significant share of bilateral commodity trade—valued at roughly USD 88 billion. Over the course of 2022, the yuan's share in Russia's import settlements rose sharply, from 4% to 23% (Aizhu, 2023). This trajectory continued in 2023: by July, 53% of Russia's

external transactions were settled in yuan, compared with 40% during the same period in 2021 (Thibault, 2024).

2-2. Reconfiguration of Russia's Reserves and Domestic Financial System

Until 2022, the Chinese yuan played no role in Russia–China trade. This changed abruptly once Russia faced a set of Western financial sanctions following the outbreak of the war. These sanctions made the use of the U.S. dollar, the euro, or the yen increasingly complicated, costly, and in some cases effectively impossible. Major Russian banks were largely unable to open accounts or conduct transactions in these principal currencies within the international monetary system, and the Central Bank of Russia lost access to its foreign-exchange reserves held in the United States and Europe.

In this context, the yuan gained prominence as an alternative -although not a fully equivalent substitute- to the major reserve currencies (Kluge, 2024, p. 26).

2-3. Advancing Yuan-Based International Payment Infrastructure

China has made considerable efforts to develop tools and infrastructure for international yuan payments. In 2015, it launched the Cross-Border Interbank Payments System (CIPS) to facilitate cross-border transactions in yuan. China has also promoted wider international use of the currency by encouraging companies to accept it, extending trading hours, and supporting yuan-settled futures contracts. In 2018, it launched the world's first yuan-denominated crude oil futures contracts (Chuluun, 2023).

2-4. Digital Currencies Linked to the Yuan

The global digitalization trend has spurred the development of China's central bank digital currency (e-CNY), which, while unrelated to the Russia–Ukraine war, has boosted the yuan's international importance. Launched in 2019, with early adoption by companies like McDonald's, e-CNY is promoted while decentralized cryptocurrencies such as Bitcoin are restricted.

The currency has been tested domestically, with transactions reaching 7.3 trillion yuan in participating regions by July 2024. China is also encouraging its use in Africa to expand trade and financial engagement across the continent (Kurtenbach , 2025).

As a result of these efforts, the yuan is now the fifth most traded currency globally, up from 35th in 2001, and the fifth most used in global payments as of April 2023, compared with 30th in 2011. Nevertheless, the yuan remains far from challenging the U.S. dollar internationally or even regionally. Its trading volume in global FX markets is less than one-tenth of the dollar's, and it accounts for only 2.3% of global payments, compared with 42.7% for the dollar and 31.7% for the euro. By the end of 2022, the yuan represented under 3% of global FX reserves, versus 58% for the dollar and 20% for the euro (Chuluun, 2023).

II– Methods and Materials:

Using Eviews-12, the work relies on a Frankel–Wei (1994) regression framework, to estimates multiple regression models, using peripheral currencies as dependent variables and core currencies

as independent variables, to determine their actual alignment within the spheres of influence of dominant currencies.

The study compares two periods: the "pre-war" period (January 2019–February 2022) and the "post-war" period (March 2022–September 2025). By integrating time-series analysis, regression, and cointegration testing, this methodology offers a robust framework for assessing the semi-core status of the yuan and evaluating any measurable shifts in the regional and global monetary hierarchy following the Ukraine war.

1. Frankel–Wei Regression Approach

The Frankel–Wei regression approach (1994) is used to estimate the weights of reference currencies within the basket that anchors peripheral currencies. This method links the logarithmic change of a currency's exchange rate to the logarithmic changes of the reference currencies (the U.S. dollar, yen, and euro). Using logarithms of exchange rates is based on the definition of the real effective exchange rate (TC), given by the following relationship (DIA, 2023, p. 123):

$$\mathrm{TC_t} = [TC(i/sdr) * TC(sdr/usd)]^{\alpha_1} * [TC(i/sdr) * TC(sdr/eur)]^{\alpha_2} * [TC(i/sdr) * TC(sdr/gbp)]^{\alpha_3} * [TC(i/sdr) * TC(sdr/jpy)]^{\alpha_4}$$

Where $TC(i/sdr)$ is the exchange rate of currency i in Special Drawing Rights SDR units, $TC(sdr/usd)$ is the SDR-U.S. dollar exchange rate, $TC(sdr/eur)$ is the SDR-euro exchange rate, $TC(sdr/gbp)$ is the SDR-British pound exchange rate, and $TC(sdr/jpy)$ is the SDR-yen exchange rate. The previous equation can therefore be expressed as follows:

$$TC_t = [TC(i/sdr)^{\alpha_1+\alpha_2+\alpha_3+\alpha_4}] * TC(sdr/usd)^{\alpha_1} * TC(sdr/eur)^{\alpha_2} * TC(sdr/gbp)^{\alpha_3} * (sdr/jpy)^{\alpha_4}$$

By applying the logarithm, the equation can be written as follows:

$$\mathrm{LogTc} = (\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4) * logTC(i/sdr) + \alpha_1 logTC(sdr/usd) + \alpha_2 logTC(sdr/eur) + \alpha_3 logTC(sdr/gbp) + \alpha_4 logTC(sdr/jpy)$$

By setting: $\alpha_0 = (\alpha_1 + \alpha_2 + \alpha_3 + \alpha_4) * logTC(i/sdr)$

The equation can be written as follows

$$\mathrm{Log}TC_t = \alpha_0 + \sum_{k=1}^{n} \alpha_k \ logTC_{k,t} + \varepsilon_t$$

It is common to use an intermediate currency as the unit of measurement instead of Special Drawing Rights (SDR); this is often one of the major reference currencies. Additionally, the logarithmic change of the exchange rate is considered rather than the exchange rate itself, so that the equation becomes:

$$\Delta \text{Log} TC_{i,t} = \alpha_0 + \sum_{k=1}^{n} \alpha_k \ \Delta log TC_{k,t} + \varepsilon_t$$

Where $TC_{i,t}$ is the exchange rate of the local currency i at time t, and $TC_{k,t}$ represents the exchange rate of the central currency k at time t, and α_0 determines the direction of the exchange rate appreciation or depreciation relative to the central parity (Frankel, Hou , & Xie, 2023, p. 6). Where α_k (k›0) is the weight of currency k in the pegging basket, if none of the estimated coefficients is significant, the currency i can be considered freely floating. If one parameter is close to 1 and the rest are close to 0, currency i is pegged to currency j. In all other cases, the currency can be said to be pegged to a basket of currencies (Benassy-Quéré, Coeure , & Mignon, 2006, p. 114).

Studying the relationships between exchange rate changes requires selecting a numéraire to which all currencies are expressed. Some economists have expressed currency values in terms of the Swiss franc, the British pound, or the Australian dollar. The choice of a specific currency as a numéraire depends on the assumption that it is independent of the other currencies under study. Based on this logic, Frankel and Wei (1993) chose the Swiss franc to examine the exchange rate policies of Asian countries that pegged to the U.S. dollar or yen. An alternative, proposed by Frankel and Wei (1994), is to use Special Drawing Rights (SDR) as the numérair. They also suggested expressing exchange rate changes in terms of a basket of goods and services, i.e., purchasing power. In this paper, the Swiss franc will be used as the numéraire to define all currencies included in the models.

2. Regression Analysis Before and After the Russia–Ukraine War

The study examines the regression relationships between peripheral currencies and core currencies using a multiple linear regression model, which measures the relationship between a dependent and one or more independent variables. In this analysis, the change in the value of a peripheral currency is treated as the dependent variable, while the changes in core currency values serve as independent variables. Based on this approach, three multiple regression models are constructed:

-Model 1: Regresses the Chinese yuan (dependent variable) on the U.S. dollar, euro, and Japanese yen as core currencies (independent variables).

$$\Delta \text{Log}(cny/chf) = C + \ \alpha_1 \Delta log(usd/chf) + \alpha_2 \Delta log(eur/chf) + \alpha_3 \Delta log(jpy/chf) + \varepsilon_t$$

-Model 2: Regresses the Malaysian ringgit (dependent variable) on the Chinese yuan, U.S. dollar, euro, and Japanese yen (independent variables).

$$\Delta \text{Log}\left(\frac{myr}{chf}\right) = C + \ \alpha_1 \Delta log(cny/chf) + \alpha_2 \Delta log(usd/chf) + \alpha_3 \Delta log(eur/chf) + \alpha_4 \Delta log(jpy/chf) + \varepsilon_t$$

-Model 3: Regresses the Singapore dollar (dependent variable) on the Chinese yuan, U.S. dollar, euro, and Japanese yen (independent variables).

$$\Delta \text{Log}\left(\frac{sgd}{chf}\right) = C + \ \alpha_1 \Delta log(cny/chf) + \alpha_2 \Delta log(usd/chf) + \alpha_3 \Delta log(eur/chf) + \alpha_4 \Delta log(jpy/chf) + \varepsilon_t$$

III- Results and discussion :

Data on the exchange rates of the Chinese yuan, Asian currencies, U.S. dollar, euro, and Japanese yen against the Swiss franc as the numéraire were used for the period January 2019 to September 2025. The logarithms of the exchange rates were calculated on a monthly basis for each series (Appendix 1). The study period was divided into pre-war and post-war phases to enable a comparison of the relative importance of core (reference) currencies within the peripheral currency baskets across the two periods.

2-1. Regression Models for the Pre-War Period

The pre-war period spans January 2019 to February 2022 (Appendix 1-A). The analysis begins with examining the stationarity of the time series—specifically, the logarithmic changes in the exchange rates of the Chinese yuan, U.S. dollar, euro, Japanese yen, Malaysian ringgit, and Singapore dollar. Next, multiple regression relationships between core and peripheral currencies are estimated, followed by testing for cointegration between the dependent and independent variables within each model.

Stationarity was tested using the Dickey–Fuller unit root test on the series of logarithmic exchange rate changes in EViews 12. Since the regression models focus on the changes in exchange rates (ΔER) rather than the absolute levels of exchange rates (ER), the first differences of the series were used directly. The test statistics and were compared for each series, as shown in Appendix 2. All series were found to be stationary at first difference, indicating that they are integrated of order one (I (1)).

Using EViews 12, the regression equations were estimated for the semi-core currency (Chinese yuan) and the peripheral currencies (Malaysian ringgit and Singapore dollar), yielding the following regression models:

2-1-1. Chinese Yuan

The model variables are defined as follows: dlcny represents the change in the logarithm of the Chinese yuan's exchange rate against the Swiss franc (dependent variable), while dlusd, dleur, and dlyen denote the logarithmic changes in the U.S. dollar, euro, and Japanese yen, respectively (independent variables). Using EViews 12 to process the series of exchange-rate changes, the following initial estimation was obtained (Appendix 3-B):

$$dlcny_t = 0.000794 + 0.955613\ dlusd_t + 0.260301\ dleur_t - 0.443571\ dlyen + u_t$$

(6.706066) (1.457390) (-2.634011)

However, the P-values for the constant (C) and for dleur are 0.5986 and 0.1545, respectively, both exceeding the 5% significance level. Therefore, these variables lack statistical significance and were removed from the model. Re-estimating the equation using only dlusd and dlyen yields the new regression (Appendix 3-C):

$$dlcny_t = 1.025808\ dlusd_t - 0.482095\ dlyen_t + u_t$$

(7.621685) (-3.006292)

This relationship indicates that changes in the U.S. dollar have a positive effect on changes in the Chinese yuan (about 102%), whereas changes in the Japanese yen have a negative effect (about 48.2%). By contrast, the euro -largely a regional currency for Europe and North Africa- does not exert a significant influence on the yuan in this model. The estimated equation is economically acceptable: the yuan moves in the same direction as the U.S. dollar and oppositely to the Japanese yen, both of which function as key reference currencies. Additional statistical tests confirm the validity of the model:

-**Student's t-test:** the p-values for dlusd and dlyen are approximately 0.00000, indicating strong statistical significance.

-Coefficient of determination (R^2): the model achieves 0.635887, meaning that roughly 63% of the variation in the yuan's exchange rate is explained by the included variables.

2-1-2. The Malaysian Ringgit

In this model, dlmyr represents the logarithmic change in the Malaysian ringgit's exchange rate against the Swiss franc (the dependent variable). The independent variables are: dlcny (change in the Chinese yuan), dlusd (change in the U.S. dollar), dleur (change in the euro), and dlyen (logarithmic change in the Japanese yen) relative to the same numéraire. Processing the data on exchange-rate changes in EViews 12 yields the following initial regression estimate (Appendix 4-B):

$$dlmyr_t = 0.00175 + 0.56399\ dlcny_t + 0.30234\ dlusd_t + 0.33026\ dleur_t - 0.19668\ dlyen + u_t$$

(3.401836) (1.449308) (1.457390) (-2.634011)

The P-values indicate that the constant term (C) with p = 0.2276, dlusd with p = 0.1570, and dlyen with p = 0.2733 all exceed the 5% significance threshold. These variables therefore lack statistical significance and are removed from the model. Re-estimating the regression using only dlcny and dleur produces the following equation (Appendix 4-C):

$$dlmyr_t = 0.728827\ dlcny_t + 0.391210\ dleur_t + u_t$$

(6.829378) (2.291961)

This result suggests that changes in the Chinese yuan explain approximately 72.88% of the variation in the Malaysian ringgit, while changes in the euro explain 39.12%. In contrast, the U.S. dollar and Japanese yen exert no statistically significant influence on the Malaysian currency. The model is economically reasonable, as it captures a positive relationship between the ringgit and both the yuan and the euro, indicating that these two currencies serve as meaningful reference anchors for determining the ringgit's effective value. Regarding statistical significance:

Student's t-test: The p-values for dlcny and dleur are 0.0000 and 0.0280, respectively, confirming strong statistical significance.

The coefficient of determination R^2 equals 0.677844, meaning that 67.78% of the variation in the Malaysian ringgit's exchange rate is explained by changes in the Chinese yuan and the euro.

2-1-3. Singapore Dollar

The model variables are defined as follows: dlsgd is the change in the logarithm of the Singapore dollar's exchange rate against the Swiss franc (the dependent variable); dlcny is the change in the Chinese yuan; dlusd is the change in the U.S. dollar; dleur is the change in the euro; and dlyen is the change in the logarithm of the Japanese yen against the same numéraire (the independent variables). By processing the data on exchange rate changes for all currencies using EViews 12, the following initial regression estimate was obtained (Appendix 5-B):

$$dlsgd_t = 0.00052 + 0.40183\ dlcny_t + 0.36441\ dlusd_t + 0.47271\ dleur_t - 0.14668\ dlyen + u_t$$

(3.194626) (2.302436) (3.550348) (-1.095766)

Since the P-value of the constant term C equals 0.6334, and the p-value of dlyen equals 0.2814, both exceed the 0.05 significance level. Therefore, they are statistically insignificant and must be removed from the model. The relationship was re-estimated using dlcny, dleur, and dlusd as regressors. The revised regression equation is presented in Appendix 5-C:

$$dlsgd_t = 0.45369\ dlcny_t + 0.25634\ dlusd + 0.48032\ dleur_t + u_t$$

(4.111508) (2.212876) (3.769622)

According to this relationship, changes in the Singapore dollar are influenced by changes in the Chinese yuan by 45.37%, in the U.S. dollar by 25.63%, and in the euro by 48.03%, whereas the Japanese yen has no significant effect. This model appears economically accepted, as it reflects a positive relationship between movements in the Singapore dollar and movements in the yuan, the U.S. dollar, and the euro. These currencies can therefore be considered the reference currencies for the Singapore dollar.

The statistical significance of the model is demonstrated through the following tests:

Student's t-test: The p-values associated with the coefficients of dlcny, dlusd, and dleur are 0.0002, 0.0337, and 0.0006, respectively, indicating strong statistical significance.

Coefficient of determination (R^2): The model's R^2 is 0.784877, meaning that 78.48% of the variation in the Singapore dollar's exchange rate is explained by the changes in the Chinese yuan, the U.S. dollar, and the euro.

It is necessary to conduct cointegration tests on the previous models to determine whether a common long-term equilibrium exists between changes in peripheral currencies and changes in core currencies. Since the series are integrated of order one, the cointegration analysis is performed using the Johansen test for the variables within each model. The test indicates that the first model (Chinese yuan) exhibits three cointegrating relationships (Appendix 6-A), the second model (Malaysian ringgit) also shows three cointegrating relationships (Appendix 6-B), and the third model (Singapore dollar), which includes four variables, reveals four cointegrating relationships (Appendix 6-C).

2-2. Post-War Regression Equations

This period covers March 2022 to September 2025 (Appendix 1-B). Following the same methodology as the pre-war analysis -testing time series stationarity, estimating multiple

regressions using the Frankel–Wei approach, and conducting cointegration tests-we examine whether the war led to shifts in the relative importance of the U.S. dollar and the Chinese yuan by comparing their weights in the currency baskets across the two periods.

Stationarity tests indicate that all series are integrated of order one (Appendix 7). Subsequently, regression equations for the semi-core currency (Chinese yuan) and peripheral currencies (Malaysian ringgit and Singapore dollar) were estimated, yielding the following results:

2-2-1. Chinese Yuan

Using data on exchange rate changes for the period March 2022–September 2025 and processing them in EViews 12, the following regression estimates were obtained (Appendix 8-B):

$$dlcny_t = 0.002205 + 0.58659\ dlusd_t + 0.10086\ dleur_t - 0.207983\ dlyen + u_t$$

(7.021208) (0.679757) (2.608572)

However, the P-values for the constant C and the variable dleur both exceed the 0.05 significance level. Consequently, these terms were removed, and the regression was re-estimated using only dlusd and dlyen, resulting in the following model (Appendix 8-C):

$$dlcny_t = 0.62816\ dlusd_t + 0.26435\ dlyen_t + u_t$$

(8.609628) (3.786138)

The results indicate that the effect of changes in the U.S. dollar on the Chinese yuan declined from 102% to 62.81%, while the relationship with the Japanese yen shifted from a negative effect of 48.2% to a positive effect of 26.43%. This reflects a shift in the relative influence of the two core currencies on the yuan as a semi-core currency. Economically, the model appears sound.

Student's t-test: The p-values for dlusd and dlyen are both effectively 0.0000, indicating strong statistical significance.

The coefficient of determination R^2 is 0.6585, meaning that 65.8% of the variation in the yuan's exchange rate is explained by the model.

2-2-2. Malaysian Ringgit

Using EViews 12, the initial regression estimates were obtained as follows (Appendix 9-B):

$$dlmyr_t = 0.00234 + 0.69494\ dlcny_t - 0.11898\ dlusd_t + 0.11151\ dleur_t + 0.20321\ dlyen + u_t$$

(3.527221) (-0.773622) (0.615050) (1.932645)

However, the p-values for C, dlusd and dleur exceed the 0.05 significance level, indicating they are not statistically significant. These variables were therefore removed, and the regression was re-estimated using only dlcny and dlyen, yielding the following model (Appendix 9-C):

$$dlmyr_t = 0.574162\ dlcny_t + 0.206197\ dlyen_t + u_t$$

(5.123249) (2.273714)

The results show that the influence of the Chinese yuan on the Malaysian ringgit decreased from 72.88% to 57.41% between the pre- and post-war periods. The euro's effect disappeared, replaced by the Japanese yen, whose changes now affect the ringgit by 20.61%, while the U.S. dollar and euro have no significant impact. Economically, the model appears sound, reflecting a positive relationship between changes in the ringgit and both the yuan and the yen.

Student's t-test: The p-values for dlcny and dlyen are 0.0000 and 0.0284, respectively, indicating strong statistical significance.

The coefficient of determination is 0.5235, meaning that 52.35% of the variation in the Malaysian ringgit's exchange rate is explained by the changes in the yuan and yen.

2-2-3. Singapore Dollar

The regression equation was estimated for dlsgd against changes in the logarithms of dlcny, dlusd, dleur, and dlyen, yielding the following results (Appendix 10-B):

$$dlsgd_t = 0.00228 + 0.25778\ dlcny_t + 0.3318\ dlusd_t + 0.24974\ dleur_t + 0.138760\ dlyen + u_t$$

(2.914255) (4.805613) (3.068079) (2.939370)

According to this model, the influence of the Chinese yuan on the Singapore dollar declined from 45.37% in the pre-war period to 25.77% in the post-war period. Meanwhile, the impact of the U.S. dollar increased from 25.63% to 33.18%, the effect of the euro decreased from 48.03% to 24.97%, and the Japanese yen emerged as a relevant factor, affecting the Singapore dollar by 13.87%. Economically, the model is reasonable, showing a positive relationship between the Singapore dollar and the four reference currencies (yuan, U.S. dollar, euro, and yen) in the post-war period.

Student's t-test: The p-values for all coefficients (dlcny, dlusd, dleur, dlyen) are below the 0.05 significance level, indicating strong statistical significance. The coefficient of determination is 0.8702, meaning that 87.02% of the variation in the Singapore dollar's exchange rate is explained by changes in the four reference currencies.

Appendix 11 presents the Johansen cointegration test results for the post-war models, indicating multiple cointegrating relationships within each model. Specifically, the yuan model shows three cointegrating relationships (Appendix 11-A), the Malaysian ringgit model also shows three (Appendix 11-B), and the Singapore dollar model, which includes four variables, shows five cointegrating relationships (Appendix 11-C).

IV- Conclusion:

This study examined the shifting roles of the U.S. dollar, the Chinese yuan, and other major currencies using the Frankel–Wei approach before and after the Russia–Ukraine war. The main findings reveal the following:

-The regression results indicate that the yuan's value is significantly influenced by both the U.S. dollar and the Japanese yen, demonstrating a dual dependence on core currencies. At the same time, its impact on the Malaysian ringgit and Singapore dollar confirms its anchoring role within the region. These findings are consistent with the hypothesis; thus, the first hypothesis H1 is validated.

-Comparing pre-war and post-war periods, the weight of the U.S. dollar in these baskets decreased, while the role of alternative currencies, particularly the yuan and the yen, increased in shaping exchange-rate dynamics. This evidence supports the notion that the war reshaped monetary influence in Asia, and therefore, the second hypothesis H2 is accepted.

-Empirical analysis reveals a noticeable increase in the yuan's contribution to both currencies' exchange-rate baskets following the onset of the war, reflecting its growing regional prominence. These results are consistent with the third hypothesis H3 is validated.

1-Proposals Based on the Field Study

Based on the empirical results, the study suggests that:

-Asian central banks should continue diversifying their exchange-rate baskets to reduce exposure to geopolitical shocks;

-Policymakers could also strengthen regional monetary cooperation, enhance currency-swap arrangements, and monitor the growing role of the yuan in regional exchange-rate dynamics;

-It is important for China to stabilize the yuan, in order to emphasize its regional monetary role.

2-Theoretical and Practical Limits of the Research

The results of this study exhibit certain limits. For instant, the monthly data may not capture short-term volatility, and the period under investigation is relatively limited given the evolving geopolitical landscape. The Frankel–Wei model focuses on exchange-rate co-movements and does not incorporate geopolitical indexes or capital-flow variables that may influence currency behavior. Future research could extend the time horizon, include more Asian currencies, or integrate broader macro-financial indicators.

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- Appendices:

APPENDIX.1

A.

	USD to CHF	EUR to CHF	CNY to CHF	yen to CHF	MYR to CHF	SGD to CHF
January 31. 2019	0.989443	1.129976	0.145694	0.009076	0.240446	0.729447
February 28. 2019	1.001144	1.136371	0.148514	0.009072	0.245499	0.739424
March 31. 2019	1.00015	1.129934	0.148968	0.009	0.245178	0.738359
April 30. 2019	1.008922	1.13345	0.150225	0.009033	0.244929	0.743929
May 31. 2019	1.010422	1.130839	0.147472	0.009186	0.242416	0.737349
June 30. 2019	0.987993	1.116422	0.143228	0.009142	0.237737	0.725113
July 31. 2019	0.987947	1.108203	0.1436	0.009127	0.239652	0.725634
August 31. 2019	0.978687	1.090465	0.138625	0.00922	0.233658	0.70693
September 30. 2019	0.99025	1.091578	0.139179	0.009215	0.236702	0.717823
October 31. 2019	0.993056	1.098584	0.139949	0.009183	0.237154	0.72474
November 30. 2019	0.99325	1.097755	0.141462	0.009123	0.239003	0.729434
December 31. 2019	0.983292	1.092409	0.140247	0.009014	0.237175	0.724865
January 31. 2020	0.970074	1.076432	0.140097	0.008872	0.237844	0.718061
February 29. 2020	0.975738	1.06517	0.139474	0.008876	0.234627	0.702556
March 31. 2020	0.95889	1.059742	0.136456	0.008896	0.223235	0.676936
April 30. 2020	0.970316	1.054441	0.137237	0.00901	0.223039	0.681867
May 31. 2020	0.968781	1.059289	0.136381	0.009034	0.2233	0.683244
June 30. 2020	0.952094	1.071487	0.134438	0.008847	0.222703	0.682556
July 31. 2020	0.93418	1.070134	0.133254	0.00875	0.219034	0.673111
August 31. 2020	0.910201	1.076526	0.131336	0.008588	0.217278	0.664701
September 30. 2020	0.91523	1.0788	0.134316	0.008666	0.220548	0.669741
October 31. 2020	0.912508	1.074069	0.135718	0.008673	0.219778	0.671094
November 30. 2020	0.910093	1.07758	0.137839	0.008724	0.221332	0.675625
December 31. 2020	0.889138	1.082762	0.135945	0.008569	0.219174	0.667426
January 31. 2021	0.887539	1.079539	0.137077	0.008551	0.219745	0.669225
February 28. 2021	0.897931	1.085973	0.138879	0.008515	0.221784	0.676137
March 31. 2021	0.930421	1.107436	0.142871	0.008553	0.226454	0.692893
April 30. 2021	0.922126	1.103306	0.141384	0.008456	0.223645	0.6908
May 31. 2021	0.902632	1.096344	0.140389	0.008269	0.218758	0.679134
June 30. 2021	0.908346	1.093444	0.141352	0.00825	0.219701	0.681001
July 31. 2021	0.917506	1.08498	0.141671	0.00832	0.218393	0.677206

August 31. 2021	0.91438	1.076227	0.141141	0.008324	0.216668	0.674954
September 30. 2021	0.922428	1.085982	0.142848	0.008376	0.221363	0.684619
October 31. 2021	0.922916	1.070287	0.14373	0.008161	0.221602	0.682959
November 30. 2021	0.921819	1.05118	0.144267	0.00809	0.220563	0.678917
December 31. 2021	0.920555	1.040584	0.144511	0.008088	0.218509	0.675143
January 31. 2022	0.918452	1.039836	0.144516	0.008	0.219262	0.680113
February 28. 2022	0.923095	1.04754	0.145544	0.008006	0.220426	0.685302

Source: Investment Web Site: (https://www.ofx.com/en-au/forex-news/historical-exchange-rates/) Accessed 02/11/2025.

B.

	USD to CHF	EUR to CHF	CNY to CHF	YEN to CHF	MYR to CHF	SGD to CHF
March 31. 2022	0.929239	1.0228	0.146439	0.007833	0.221202	0.684349
April 30. 2022	0.945582	1.021806	0.147017	0.007482	0.221687	0.69217
May 31. 2022	0.980438	1.035866	0.146359	0.007608	0.223803	0.709012
June 30. 2022	0.969999	1.024957	0.144868	0.007241	0.220451	0.700512
July 31. 2022	0.968693	0.98718	0.143873	0.007101	0.218211	0.69445
August 31. 2022	0.957344	0.968275	0.140776	0.007072	0.214393	0.691575
September 30. 2022	0.97278	0.964229	0.138809	0.006806	0.214368	0.688477
October 31. 2022	0.996041	0.979404	0.138538	0.006777	0.21235	0.699409
November 30. 2022	0.963074	0.98432	0.134397	0.006787	0.208867	0.695215
December 31. 2022	0.931969	0.987048	0.133624	0.006922	0.211285	0.689327
January 31. 2023	0.924307	0.996541	0.136104	0.007096	0.213459	0.697509
February 28. 2023	0.926675	0.991848	0.135408	0.006953	0.212322	0.695134
March 31. 2023	0.925317	0.991159	0.134246	0.006927	0.20705	0.690072
April 30. 2023	0.898499	0.987519	0.130458	0.006725	0.20305	0.67447
May 31. 2023	0.898444	0.977359	0.128565	0.006548	0.199045	0.670444
June 30. 2023	0.900167	0.976217	0.125839	0.006366	0.194515	0.668883
July 31. 2023	0.874994	0.966828	0.121704	0.006191	0.195219	0.655301
August 31. 2023	0.878422	0.958594	0.121244	0.006069	0.190683	0.650294
September 30. 2023	0.898716	0.960049	0.123289	0.006079	0.192049	0.659324
October 31. 2023	0.90387	0.954924	0.124319	0.006045	0.190547	0.660219
November 30. 2023	0.89102	0.963876	0.123555	0.005947	0.189886	0.660778
December 31. 2023	0.86411	0.943456	0.121423	0.006011	0.185453	0.648892
January 31. 2024	0.858314	0.936492	0.120695	0.005873	0.183302	0.642479
February 29. 2024	0.876938	0.946491	0.122403	0.005861	0.184017	0.651879
March 31. 2024	0.888881	0.96618	0.123398	0.005933	0.188108	0.662627
April 30. 2024	0.90921	0.974905	0.125615	0.005907	0.190781	0.669857
May 31. 2024	0.909529	0.983806	0.125755	0.005839	0.192812	0.673264
June 30. 2024	0.894818	0.963047	0.123349	0.005664	0.189979	0.661541
July 31. 2024	0.893164	0.969459	0.123009	0.00566	0.190865	0.663676
August 31. 2024	0.858268	0.945827	0.120054	0.005866	0.194349	0.652269
September 30. 2024	0.847022	0.940966	0.119734	0.005923	0.198876	0.653686
October 31. 2024	0.861469	0.938581	0.121544	0.005747	0.200504	0.657205

November 30. 2024	0.880757	0.935594	0.122217	0.005734	0.198716	0.658822
December 31. 2024	0.89147	0.933983	0.122424	0.005793	0.199839	0.66006
January 31. 2025	0.909908	0.94215	0.124717	0.005812	0.203738	0.668352
February 28. 2025	0.903681	0.941199	0.124446	0.005953	0.203488	0.671251
March 31. 2025	0.884314	0.955356	0.121667	0.005931	0.199373	0.661678
April 30. 2025	0.833833	0.936234	0.114301	0.00578	0.188921	0.629919
May 31. 2025	0.829426	0.935353	0.114843	0.005731	0.194362	0.640543
June 30. 2025	0.814124	0.938546	0.113305	0.005629	0.191956	0.634428
July 31. 2025	0.798121	0.932222	0.111316	0.005428	0.188419	0.622953
August 31. 2025	0.806703	0.940206	0.112452	0.005473	0.190652	0.627908
September 30. 2025	0.795856	0.933867	0.111698	0.00538	0.188908	0.619246

Source: Investment Web Site: (https://www.ofx.com/en-au/forex-news/historical-exchange-rates/) Accessed 02/11/2025.

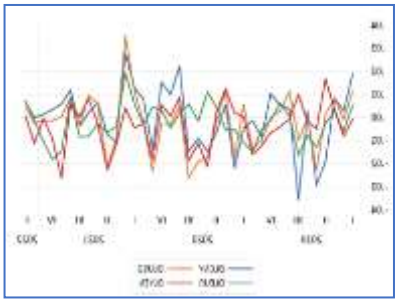
APPENDIX.2

Variables	T Values	First Difference Series			Results
		Trend & Intercept	Intercept	None	
DLCNY	t_c	-6.123649	-5.587574	-5.661120	$t_{tab} > t_c$
	t_{tab}	-3.540328	-2.945842	-1.950394	Reject H_0 and accept H_1 No unit root
DLUSD	t_c	-5.520877	-5.526258	-5.440716	$t_{tab} > t_c$
	t_{tab}	-3.540328	-2.945842	-1.950394	Reject H_0 and accept H_1 No unit root
DLEUR	t_c	-4.251995	-4.317249	-4.145687	$t_{tab} > t_c$
	t_{tab}	-3.540328	-2.945842	-1.950394	Reject H_0 and accept H_1 No unit root
DLYEN	t_c	-5.455133	-5.358881	-4.929146	$t_{tab} > t_c$
	t_{tab}	-3.540328	-2.945842	-1.950394	Reject H_0 and accept H_1 No unit root
DLMYR	t_c	-6.306452	-6.240441	-6.040272	$t_{tab} > t_c$
	t_{tab}	-3.540328	-2.945842	-1.950394	Reject H_0 and accept H_1 No unit root
DLSGD	t_c	-5.349202	-5.245558	-5.185473	$t_{tab} > t_c$
	t_{tab}	-3.540328	-2.945842	-1.950394	Reject H_0 and accept H_1 No unit root
t_c: calculated value; t_{tab}: Table value at the significance level 5%					

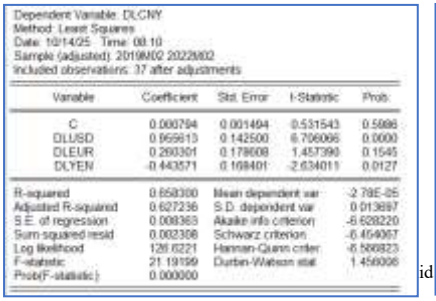
Source: Author's calculations using data from (https://www.ofx.com/en-au/forex-news/historical-exchange-rates/), with Eviews -12

APPENDIX.3

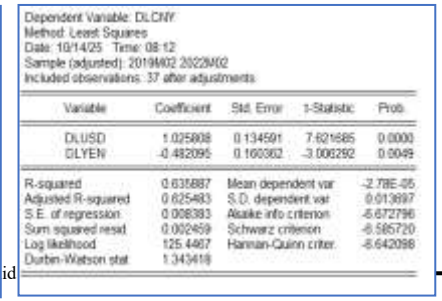
A



B

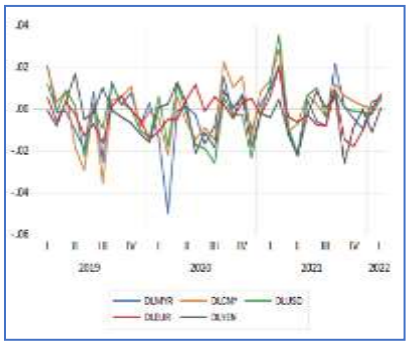


C



APPENDIX.4

A B C



Dependent Variable: DLMYR
Method: Least Squares
Date: 10/14/25 Time: 08:19
Sample (adjusted): 2019M02 2022M02
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001757	0.001429	-1.230108	0.2276
DLCNY	0.563997	0.165792	3.401836	0.0018
DLUSD	0.302347	0.208615	1.449308	0.1570
DLEUR	0.330264	0.175495	1.881896	0.0690
DLYEN	-0.196681	0.176442	-1.114705	0.2733

R-squared	0.710526	Mean dependent var	-0.002350
Adjusted R-squared	0.674342	S.D. dependent var	0.013957
S.E. of regression	0.007965	Akaike info criterion	-6.702472
Sum squared resid	0.002030	Schwarz criterion	-6.484781
Log likelihood	128.9957	Hannan-Quinn criter.	-6.625726
F-statistic	19.63631	Durbin-Watson stat	1.591294
Prob(F-statistic)	0.000000		

Dependent Variable: DLMYR
Method: Least Squares
Date: 10/11/25 Time: 18:02
Sample (adjusted): 2019M02 2022M02
Included observations: 37 after adjustments

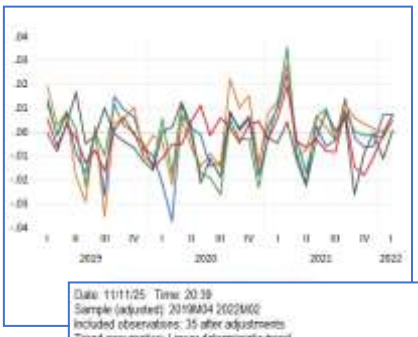
Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLCNY	0.728827	0.106719	6.829378	0.0000
DLEUR	0.391210	0.170688	2.291961	0.0280

R-squared	0.677844	Mean dependent var	-0.002350
Adjusted R-squared	0.668640	S.D. dependent var	0.013957
S.E. of regression	0.008034	Akaike info criterion	-6.757665
Sum squared resid	0.002259	Schwarz criterion	-6.670589
Log likelihood	127.0168	Hannan-Quinn criter.	-6.726967
Durbin-Watson stat	1.539115		

Source: Eviews -12 Outputs

APPENDIX.5

A B C



Dependent Variable: DLSGD
Method: Least Squares
Date: 11/06/25 Time: 22:20
Sample (adjusted): 2019M02 2022M02
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000522	0.001084	-0.481519	0.6334
DLCNY	0.401837	0.125795	3.194826	0.0031
DLUSD	0.364417	0.168275	2.302436	0.0280
DLEUR	0.472719	0.133147	3.550348	0.0012
DLYEN	-0.148895	0.133865	-1.095786	0.2814

R-squared	0.792971	Mean dependent var	-0.001687
Adjusted R-squared	0.757082	S.D. dependent var	0.012521
S.E. of regression	0.006043	Akaike info criterion	-7.254790
Sum squared resid	0.001169	Schwarz criterion	-7.037098
Log likelihood	139.2136	Hannan-Quinn criter.	-7.178043
F-statistic	30.64187	Durbin-Watson stat	1.548118
Prob(F-statistic)	0.000000		

Dependent Variable: DLSGD
Method: Least Squares
Date: 11/06/25 Time: 22:24
Sample (adjusted): 2019M02 2022M02
Included observations: 37 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLCNY	0.453691	0.110347	4.111508	0.0002
DLUSD	0.256349	0.115844	2.212876	0.0337
DLEUR	0.480323	0.127419	3.769622	0.0006

R-squared	0.784877	Mean dependent var	-0.001687
Adjusted R-squared	0.772223	S.D. dependent var	0.012521
S.E. of regression	0.005976	Akaike info criterion	-7.324551
Sum squared resid	0.001214	Schwarz criterion	-7.193936
Log likelihood	138.5042	Hannan-Quinn criter.	-7.278503
Durbin-Watson stat	1.584607		

Date: 11/11/25 Time: 20:39
Sample (adjusted): 2019M04 2022M02
Included observations: 35 after adjustments
Trend assumption: Linear deterministic trend
Series: DLCNY DLUSD DLYEN
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.486471	40.04360	29.79707	0.0024
At most 1 *	0.283218	18.05516	15.49471	0.0201
At most 2 *	0.167131	6.400758	3.841465	0.0114

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Trend assumption: Linear deterministic trend
Series: DLMYR DLUSD DLEUR
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.469230	49.81511	29.79707	0.0001
At most 1 *	0.388153	27.64521	15.49471	0.0005
At most 2 *	0.259136	10.45065	3.841465	0.0012

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Trend assumption: Linear deterministic trend
Series: DLSGD DLCNY DLUSD DLEUR
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.503436	58.54985	47.85613	0.0028
At most 1 *	0.391166	35.04836	29.79707	0.0113
At most 2 *	0.299777	17.08101	15.49471	0.0231
At most 3 *	0.138272	5.208556	3.841465	0.0225

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Eviews -12 Outputs

APPENDIX.7

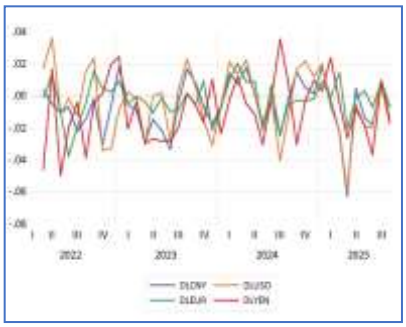
Variables	T Values	First Difference Series			Results
		Trend & Intercept	Intercept	None	
DLCNY	t_c	-6.123649	-5.587574	-5.661120	$t_{tab} > t_c$
	t_{tab}	-3.540328	-2.945842	-1.950394	Reject H_0 and accept H_1 No unit root
DLUSD	t_c	-5.520877	-5.526258	-5.440716	$t_{tab} > t_c$
	t_{tab}	-3.540328	-2.945842	-1.950394	Reject H_0 and accept H_1 No unit root
DLEUR	t_c	-4.251995	-4.317249	-4.145687	$t_{tab} > t_c$
	t_{tab}	-3.540328	-2.945842	-1.950394	

					Reject H_0 and accept H_1 No unit root
DLYEN	t_c	-5.455133	-5.358881	-4.929146	$t_{tab} > t_c$
	t_{tab}	-3.540328	-2.945842	-1.950394	Reject H_0 and accept H_1 No unit root
DLMYR	t_c	-6.306452	-6.240441	-6.040272	$t_{tab} > t_c$
	t_{tab}	-3.540328	-2.945842	-1.950394	Reject H_0 and accept H_1 No unit root
DLSGD	t_c	-5.349202	-5.245558	-5.185473	$t_{tab} > t_c$
	t_{tab}	-3.540328	-2.945842	-1.950394	Reject H_0 and accept H_1 No unit root
tc: calculated value; ttab: Table value at the significance level 5%					

Source: Author's calculations using data from (https://www.ofx.com/en-au/forex-news/historical-exchange-rates/), with Eviews -12

APPENDIX.8

A



B

Dependent Variable: DLCNY
Method: Least Squares
Date: 10/11/25 Time: 18:44
Sample (adjusted): 2022M04 2025M09
Included observations: 42 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.002205	0.001667	-1.323070	0.1937
DLUSD	0.586597	0.083546	7.021208	0.0000
DLEUR	0.100864	0.148382	0.679757	0.5008
DLYEN	0.207983	0.079730	2.608572	0.0129

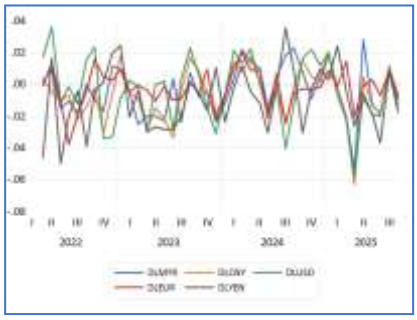
R-squared	0.677010	Mean dependent var	-0.006448
Adjusted R-squared	0.651511	S.D. dependent var	0.016457
S.E. of regression	0.009715	Akaike info criterion	-6.338628
Sum squared resid	0.003586	Schwarz criterion	-6.174436
Log likelihood	137.1385	Hannan-Quinn criter.	-6.278269
F-statistic	26.55024	Durbin-Watson stat	1.678496
Prob(F-statistic)	0.000000		

C

Dependent Variable: DLCNY
Method: Least Squares
Date: 10/11/25 Time: 18:46
Sample (adjusted): 2022M04 2025M09
Included observations: 42 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLUSD	0.628165	0.072961	8.608628	0.0000
DLYEN	0.264364	0.069822	3.786138	0.0005

R-squared	0.658507	Mean dependent var	-0.006448
Adjusted R-squared	0.649970	S.D. dependent var	0.016457
S.E. of regression	0.009736	Akaike info criterion	-6.379460
Sum squared resid	0.003792	Schwarz criterion	-6.296714
Log likelihood	135.9687	Hannan-Quinn criter.	-6.349130
Durbin-Watson stat	1.742585		



Dependent Variable: DLMYR
Method: Least Squares
Date: 10/11/25 Time: 18:55
Sample (adjusted): 2022M04 2025M09
Included observations: 42 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002344	0.002070	1.131995	0.2649
DLCNY	0.894944	0.197023	3.527222	0.0011
DLUSD	-0.118980	0.153790	-0.773622	0.4441
DLEUR	0.111513	0.181307	0.615050	0.5423
DLYEN	0.203215	0.105149	1.932645	0.0610

R-squared	0.548454	Mean dependent var	-0.003758
Adjusted R-squared	0.499638	S.D. dependent var	0.016680
S.E. of regression	0.011799	Akaike info criterion	-5.930259
Sum squared resid	0.005151	Schwarz criterion	-5.723394
Log likelihood	129.5354	Hannan-Quinn criter.	-5.854435
F-statistic	11.23518	Durbin-Watson stat	2.055167
Prob(F-statistic)	0.000005		

Dependent Variable: DLMYR
Method: Least Squares
Date: 10/11/25 Time: 18:58
Sample (adjusted): 2022M04 2025M09
Included observations: 42 after adjustments

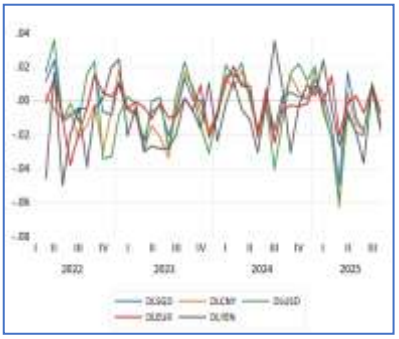
Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLCNY	0.574162	0.112070	5.123249	0.0000
DLYEN	0.206197	0.090687	2.273714	0.0294

R-squared	0.523547	Mean dependent var	-0.003758
Adjusted R-squared	0.511635	S.D. dependent var	0.016680
S.E. of regression	0.011657	Akaike info criterion	-6.019424
Sum squared resid	0.005435	Schwarz criterion	-5.936677
Log likelihood	128.4079	Hannan-Quinn criter.	-5.989094
Durbin-Watson stat	2.069324		

Source: Eviews -12 Outputs

APPENDIX.10

A



B

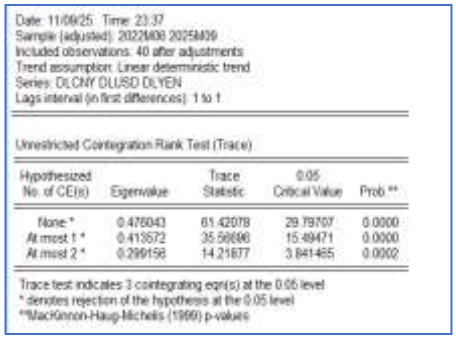
Dependent Variable: DLSGD
Method: Least Squares
Date: 10/11/25 Time: 19:01
Sample (adjusted): 2022M04 2025M09
Included observations: 42 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.002288	0.000929	2.461788	0.0186
DLCNY	0.257781	0.088455	2.914255	0.0060
DLUSD	0.331819	0.069048	4.805613	0.0000
DLEUR	0.249740	0.081389	3.068079	0.0040
DLYEN	0.138780	0.047207	2.939370	0.0056

R-squared	0.870198	Mean dependent var	-0.002380
Adjusted R-squared	0.856166	S.D. dependent var	0.013968
S.E. of regression	0.005297	Akaike info criterion	-7.531907
Sum squared resid	0.001038	Schwarz criterion	-7.329042
Log likelihood	163.1701	Hannan-Quinn criter.	-7.456083
F-statistic	62.01253	Durbin-Watson stat	1.720570
Prob(F-statistic)	0.000000		

APPENDIX.11

A



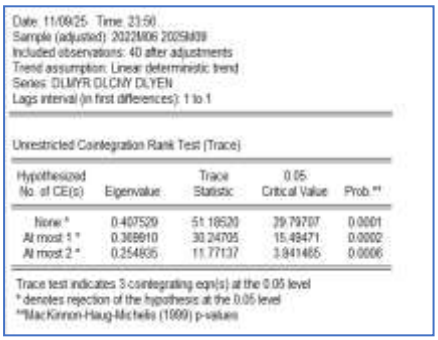
Date: 11/09/25 Time: 23:37
Sample (adjusted): 2022M08 2025M09
Included observations: 40 after adjustments
Trend assumption: Linear deterministic trend
Series: DLCNY DLUSD DLYEN
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.476043	61.42078	29.79707	0.0000
At most 1 *	0.413572	35.56698	15.49471	0.0000
At most 2 *	0.299158	14.21877	3.841465	0.0002

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

B



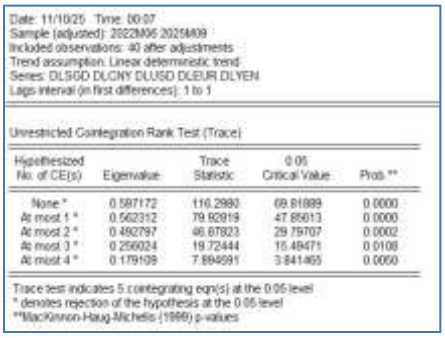
Date: 11/09/25 Time: 23:50
Sample (adjusted): 2022M08 2025M09
Included observations: 40 after adjustments
Trend assumption: Linear deterministic trend
Series: DLMYR DLCNY DLYEN
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.407529	51.18520	29.79707	0.0001
At most 1 *	0.369910	30.24705	15.49471	0.0002
At most 2 *	0.254935	11.77137	3.841465	0.0006

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

C



Date: 11/10/25 Time: 00:07
Sample (adjusted): 2022M06 2025M09
Included observations: 40 after adjustments
Trend assumption: Linear deterministic trend
Series: DLSGD DLCNY DLUSD DLEUR DLYEN
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.587172	116.2980	69.81889	0.0000
At most 1 *	0.562312	79.82919	47.85613	0.0000
At most 2 *	0.492797	46.87823	29.79707	0.0002
At most 3 *	0.256024	19.72444	15.49471	0.0108
At most 4 *	0.179109	7.894991	3.841465	0.0050

Trace test indicates 5 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Eviews -12 Outputs

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