The US Dollar's Changing Global Role and Its Volatility – an Illustrative Analysis Using an Analogy from the Stock Market*

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Over the past 25 years, the share of USD-denominated assets in the foreign exchange reserves of the world's central banks has gradually declined. On the one hand, this tendency can be partly attributed to exogenous factors, such as the US dollar's declining role in foreign trade and certain international financial transactions. On the other hand, it may also reflect changing perceptions of USD hegemony. This essay first maps the risks to the primacy of the dollar, relying on the research findings of Rogoff. Then, an empirical analysis is performed to address the following question: how is the volatility of the USD exchange rate expected to change if the risks were to materialise. The approach used exploits the analogy between a stock swap deal of two Hungarian listed companies and the changing composition of foreign reserves. Based on the results, it cannot be ruled out that further rearrangements in reserve composition may cause substantial fluctuations in the exchange rate, especially in the case where central bank decisions are driven by shifts in perceptions.

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1. Introduction

In general, the *exchange rate regime* is a comprehensive indicator of how important the US dollar and other reserve currencies are for individual countries: when a decision is made on the exchange rate regime, central banks are advised to take into account the weight of the major currencies in their external trade and

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international capital flows. For example, if two countries fix their exchange rates against a basket of currencies, then the US dollar is presumably more important to the country where it has a larger weight in the reference basket. Let us take another example, where the dollar is the only reference currency for two countries under comparison. It is reasonable to think that USD has greater importance in a country where the domestic currency is more closely tied to the dollar. Since the *de facto* exchange rate regimes can be different from the *de jure* regimes (see *Frankel – Wei 2008*; *Frankel – Xie 2010*), it is insightful to use the *composition of central banks' foreign exchange reserves*, rather than the officially declared regime, to quantify the relative importance of major currencies.[1]

In addition to foreign trade and capital flows, exchange rate volatility also plays a role in the choice of reserves (see *Gopinath – Stein 2021*). If a central bank considers that its economy is extremely sensitive to changes in the exchange rate of its domestic currency against a given major currency, such as the US dollar, it will pay attention to the stability of this exchange rate. To keep volatility low, it will form a larger reserve from the foreign currency in question. On the one hand, larger reserves enhance the central bank's ability to intervene on the forex market. On the other hand, it also makes intervention unnecessary if the market is informed about the central bank's objective and perceives the central bank as being committed to keeping its exchange rate stable.

It is a well-known fact that *the share of USD assets in the foreign exchange reserves of the world's central banks has been slowly but steadily declining over the past few decades*: according to the IMF's Currency Composition of Official Foreign Exchange Reserves (COFER),[2] at constant exchange rates, the US dollar's share of global foreign exchange reserves amounted to only around 58 per cent at the end of 2024,[3] compared to 69 per cent in 2007, just before the financial crisis, whereas it was 91 per cent in 1999, before the European Economic and Monetary Union was established.[4]

This trend can be studied using two different perspectives. First, the trend can be interpreted as the result of central banks' reaction in their reserve policy to exogenous changes in the world economy, which take into consideration the

[1] An alternative approach for determining the relative importance of the major currencies for the domestic economy is to quantify the co-movement of the central banks' policy rates. However, policy rates are subject to country-specific shocks.

[2] https://data.imf.org/en/datasets/IMF.STA:COFER

[3] It is important to note that, despite the US dollar's declining share in reserves, neither the share of euro, nor that of renminbi have increased significantly over the last eight years, while the share of some other currencies has increased slightly. For example, the share of the Australian dollar increased from 1.7 per cent to 2.1 per cent, the Canadian dollar from 1.9 per cent to 2.8 per cent, and the Japanese yen from 4 per cent to 5.8 per cent between 2016 and 2024. Meanwhile, the People's Bank of China concluded currency swap agreements with 38 countries between 2009 and 2018 with a value of 2,664 billion renminbi (see *Bahaj – Reis 2020*).

[4] See *Ito – McCauley* (*2020*).

changing foreign exchange composition of both foreign trade settlements and international loans, as well as changing exchange rate volatilities. As an example of such exogenous changes, one can think of the declining role of the United States in international trade over the last two decades.

There is also an alternative interpretation: the foreign currency composition of reserves is not only a technical decision influenced by exogenous changes, but also has a signalling feature: It reflects the expectations and perceptions of central bankers, which then have a feedback effect on the global financial system, in particular, on the evolution of the competition between reserve currencies. Central bank decisions are therefore not only the consequences of economic and geopolitical changes, they also actively shape such changes. Along these lines, shifts in the composition of foreign exchange reserves can also be interpreted as a sign of trust in the stability of the economy behind the given currency and the stability of the currency's value.

McCauley (*2011*) makes the point that the relative position of reserve currencies is shaped not only by market forces, but also by political and institutional decisions. As an example, he mentions the rise of the renminbi,[5] which is taking place in a controlled manner similarly both to China's role in international capital transactions and the evolution of the strictly regulated Chinese financial system. In this framework, the declining share of USD in central bank reserves can be seen as a sign that confidence is eroding in the stability of the global economic order that emerged in the 1920s and consolidated after World War II. However, the same tendency can also be interpreted as the gradual emergence of a multipolar reserve currency system with increasing roles for the renminbi, the euro and some other currencies.

It is important to highlight that the literature is not conclusive about the future of the US dollar. While *Rogoff* (*2025*) predicts a gradual erosion of the dollar's global role, several other authors – such as *Bertaut et al.* (*2025*) – argue that the dollar's international role may remain stable in the long run. They make the point that the high liquidity of the USD-based financial markets and the strong global demand for safe assets may continue to preserve USD dominance. *Mühleisen – Zeneli* (*2025*) reach a similar conclusion, highlighting the geopolitical significance and technological advantage of the United States as stabilising factors. According to *Alekseeva et al.* (*2024*), the dollar's dominance is supported not only by economic but also by institutional factors: the IMF, the World Bank and other multilateral organisations continue to use USD-denominated instruments, which makes the dollar structurally embedded in the global financial system.

[5] On the controlled international expansion of China, see *Hao et al.* (*2022*), and *Zhang et al.* (*2017*), who use econometric methods to analyse the trade and exchange rate effects of currency swap agreements provided by the Chinese central bank.

The arguments in favour of the stability of the US dollar's dominance are also strengthened by certain interpretations of some recent economic policy developments. Since the beginning of Donald Trump's second presidency, several measures have been explicitly aimed at maintaining the primacy of the dollar. These include several points in the US tariff negotiations, in which repositioning the US dollar globally appears as a strategic goal. A similar example is the regulation of crypto stablecoins under the "Guiding and Establishing National Innovation for US Stablecoins Act" (GENIUS Act). In addition, US-based global digital platforms – such as streaming services, Facebook, Meta and artificial intelligence systems – continue to support the technological dominance of the United States and indirectly strengthen the US economy.

To sum up, although several factors – institutional embeddedness, technological superiority, economic policy measures – support a continuation of the dominant global role of the US dollar, there are warning signs reflecting that financial market players are increasingly cautious about American assets. Central bankers' views are not independent of those of market participants, who have been willing to finance the growing sovereign debt of the US only at an elevated level of yields since mid-2023 (see *Jiang et al. 2025*). The rise in sovereign bond yields reflects that foreign investors are less willing to sacrifice yields for the liquidity and relative safety of the US dollar. Moreover, it may undermine the safety of USD assets in the long run through the decreasing seigniorage income of the United States.

In this essay, we first map the risks that may threaten the primacy of the US dollar. An empirical analysis is then conducted to address the question of how the volatility of the dollar's value is expected to change if the risks indeed materialise. In mapping the risks, it is primarily Kenneth Rogoff's 2025 book that is relied on. To perform the empirical analysis, we employ a novel approach.[6]

This approach relies on the similarity of two problems: one of the problems is studied in the international macro-finance literature, while the other one is studied in the corporate finance literature.[7] In particular, we use an analogy between the strategic alliance between two companies listed on the stock exchange and the cooperation of countries to maintain the status quo, even just out of necessity. In the analysis, using an example, we show that, in the case of two listed Hungarian companies, concluding such an alliance – as formalised by a stock swap agreement

[6] While the implications of freezing Russian USD reserves and the evolving conflicts of interest between BRICS countries and the United States merit rigorous empirical investigation, this essay does not attempt to address these issues. Likewise, we refrain from evaluating the extent to which the depreciation of the US dollar against the euro observed in 2025 reflects a market-driven adjustment or constitutes a deliberate economic policy intervention by the United States.

[7] *Naszódi* (*2002*) used the similarity of another pair of problems studied in the same fields when she developed a model describing the exchange rate in a target zone with two financial options.

– resulted in a sudden, relatively lasting increase in the correlation between the returns of the stocks involved.

Analogously, we hypothesise that the continued changes in the composition of central banks' foreign exchange reserves may accompanied by a surge in USD volatility vis-à-vis other currencies.[8] One related surprising finding is that since the increase in the correlation after the stock swap agreement was triggered by a relatively small change in the cross-ownership of the companies concerned, namely OTP and Mol, a rise in USD volatility could also be triggered even by small additional change in the composition of reserves. At the same time, other exchange rates, such as the exchange rate between the Canadian dollar and the euro, could be stabilised if the Bank of Canada increases its euro reserves and the European Central Bank (ECB) increases its Canadian dollar reserves.

As we will see, the analogy between a stock swap and the changing composition of reserves is not perfect. One obvious difference, for example, is that while the fundamentals of the stocks directly involved in the swap were changed almost overnight by the deal, the composition of reserves changes only slowly and gradually, typically in response to changes in numerous other economic and political factors (see *Eichengreen – Mathieson 2000*). Fortunately, the rapid change in the former case allows us to quantify how the stock swap agreement itself and the strategic alliance sealed by the deal affect the correlation in returns for the stocks involved. Naturally, the correlation may have changed independently of the stock swap in the days around the analysed swap deal. We control for the effects of the confounding factors by computing the change in correlations between the stocks affected by the swap and a third stock, which was not involved in the swap.

In the following, we summarise *Rogoff's* (*2025*) main points on the causes behind the US dollar's potential loss of dominance.[9] We then introduce the stock swap agreement between the Hungarian companies before discussing the potential and the limitations of the analogy between the swap deal and reserve management. Finally, we conclude the paper.

[8] In addition, one can expect the continuing weakening of the US dollar if the dollar's loss of primacy will be similar to the dethronement of the British pound in the 1920s. While one pound cost more than 4 US dollars before 1920, it cost less than 3 after 1950. It is important to emphasise, however, that the historical analogy has its limits similarly to the analogy between a stock swap and foreign exchange reserve management. The economic environment after World War I – including the increased debt of the United Kingdom due to its war-related expenditures and the associated rearrangement of international debtor-creditor relations – entailed unique factors that cannot be directly compared to the current situation in the US. The United States still functions as a global creditor, and although its sovereign debt is significant, other fiat-currency countries, such as Japan or the members of the eurozone, have similar or even higher debt-to-GDP ratios.

[9] This study provides only a dry summary of *Rogoff's* (*2025*) book. However, we recommend reading the original work, which is a particularly enjoyable book. In addition to its stylistic and rhetorical richness, it is also entertaining. Rogoff achieves this by illustrating the economic ideas discussed with some personal elements, as well as with striking quotes capturing complex ideas in a concise form.

2. What could threaten the hegemony of the US dollar according to Rogoff?

A frequently repeated claim in *Rogoff's* (*2025*) book is that the primacy of the US dollar will certainly remain unchanged in the short term. However, there are risks in the long run.[10] Let us review the three main risk factors identified by Rogoff.

Rogoff identifies three main risks. According to him, one of these stems from the fact that even the mere mention of *financial sanctions* by the US will force China to loosen the close ties between the renminbi and the US dollar. For example, Chinese investors will reduce their purchases of US government bonds and money market instruments, and the People's Bank of China will continue to trim its USD reserves.

In recent years, the State Administration of Foreign Exchange (SAFE) has released some information on the composition of China's central bank reserves. In its 2018 annual report, for example, SAFE revealed that while the share of USD in the Chinese reserve portfolio was 79 per cent in 1995, this share had fallen to 58 per cent by 2014 (see *Ferranti 2023*). *Prasad* (*2019*) interprets the SAFE statement not only as suggesting that China is simply reducing the share of the US dollar in its reserves, but also as suggesting that the USD share in Chinese reserves in 2014 was already smaller than the dollar's share in the aggregate portfolios of all other central banks.

One expected *qualitative effect* of this trend, according to Rogoff, is that the renminbi's exchange rate against the US dollar will become more volatile, which will have an impact on other Asian countries. They may also reduce their USD reserves and at the same time increase the use of renminbi in their trade with China.

Rogoff does not attempt to *quantify the expected effects*. This is not an easy task, as several factors make it difficult to empirically study the relationship between the compositional choice of foreign exchange reserves and the strength of the US dollar's relative position. One factor is that most central banks do not publish the foreign exchange composition of their reserves: This limits the possibility of conducting multi-country empirical analyses.[11] We consider it to be a more

[10] What exactly the short and long run mean is a bit unclear. Rogoff quotes *Rudiger Dornbusch*'s related insight: "In economics, things take longer to happen than you think they will, and then they happen faster than you thought they could." Relatedly, *Ilzetzki et al.* (*2022: p. 92*) state that "although the renminbi may well be the global currency in the year 2100, to date it has still made limited headways as an international currency". *Eichengreen – Flandreau* (*2009, 2010*) also give a hint about the time horizon of the changing roles of the reserve currencies: they find that it took nearly 15 years for the US dollar to overtake the prominent role of the British pound.

[11] While conducting a multi-country analysis is not impossible, it requires considerable preliminary work. For example, it involves estimating the composition of reserves of the central banks that do not publish the related data. *Ferranti* (*2023*) uses a hidden Markov model for this purpose. He estimates the composition of reserves for China and Singapore from the total value of reserves published each month by using the observed fluctuations in the exchange rates of the major reserve currencies. According to his point estimates, which are subject to high uncertainty, the Bank of Singapore has slightly increased the proportion of the renminbi in its portfolio since 2022, but it had not reached 5 per cent by 2024.

important limiting factor relative to the lack of publicly available data that the composition of reserves typically changes slowly. The slow pace makes it difficult to compute the impact of the shock which is the focus of our interest, net of some other effects. For example, it is challenging to estimate the extent to which the 11-percentage points global decline in the USD share in reserves between 2007 and 2024 contributed to the increase in economic uncertainty.

Finally, there is probably a critical threshold for USD reserves; after exceeding this threshold, the results of analyses for periods before the threshold was reached are of little relevance for future periods. Accordingly, even if we could estimate how the decline in the USD share of foreign exchange reserves between 2007 and 2024 affected exchange rate volatility in the past, there remains considerable uncertainty about the expected future volatility of the US dollar.

Another set of factors, according to Rogoff, that could potentially threaten USD hegemony is the rise of crypto-assets, central bank digital currency (CBDC) and the euro. His claim gains support from the following trend: while previously USD cash played a significant role in conducting illegal transactions (e.g. human, weapons and drug trafficking), it is now demand for cryptocurrencies that is typically strengthened by transactions in the black economy. Since the weight of the black economy is significant (nearly 30%), the effect of cryptocurrencies on weakening USD demand cannot be neglected, according to Rogoff.

He continues by noting that while there has been no drastic change in relation to the emergence of digital central bank money, CBDC could also cause disruption in the functioning of the USD-dominated financial system, both in the US and indirectly in the rest of the world. Rogoff's opinion on whether the euro can compete with the US dollar is clear, insofar as that as long as there is no common fiscal background for the European currency, the euro does not threaten the primacy of the dollar. However, he also notes that if the Russian invasion of Ukraine ultimately forces fiscal and political unity in the EU, then his view of the potential of the euro will have to be revised.

Finally, Rogoff makes the point that "although external challenges to dollar dominance and stability are serious enough, the greatest vulnerabilities come from within." He identifies the United States' large debt as a key threat with internal roots. US sovereign debt reached 120 per cent of GDP by mid-2024,[12] and is projected by the Congressional Budget Office to continue rising for the next three decades. Rogoff believes that if the rapidly rising debt is not curbed – and he sees no commitment from either Democratic or Republican politicians in this regard – the United States and the world will experience persistently elevated financial volatility,

[12] See "Gross Federal Debt as Percent of Gross Domestic Product" (series: GFDGDPA188S), FRED (Federal Reserve Bank of St. Louis) (https://fred.stlouisfed.org/series/GFDGDPA188S).

accompanied by higher average real interest rates and inflation, and more frequent debt and financial crises.

Analysing the relationship between risks from within and outside the US, Rogoff builds on an idea well-known among chess players:[13] a game can be lost not only if the opponent plays well (meaning the fundamentals of the euro, renminbi, or crypto assets are strong), but also if we make mistakes.[14] The relevance of the example with chess is also seen from the historical experience that the fall of great empires – such as the Roman Empire and the Soviet Union – was often not the result of external attacks, but of internal conflicts or weaknesses.

From a European perspective, we would like to see mistaken policies in the US – especially a fiscal policy with sharply rising sovereign debt after the outbreak of the Covid pandemic – as being primarily an internal problem. If this were not the case, then the world outside the US would run a serious moral hazard vis-à-vis the country. Unfortunately, the arguments put forward by Rogoff call into question whether the United States' problems are primarily those of the Americans. For example, we might think that just as Japan's debt-to-GDP ratio of 230 per cent – which even exceeds that of the US – is primarily a Japanese problem, so the same could be true for the US.[15] There is, however, a crucial difference between the two countries: the US is more indebted to foreign investors than Japan. All of these facts shed light on why Rogoff chose "Our dollar, your problem" as the title for his book.

3. An example for a stock swap

Let us turn to the example of the Hungarian stock swap agreement mentioned in the introduction. Its relationship to reserve composition will be explained in *Chapter 4*. Here, we introduce the deal itself. The stock swap was carried out by two listed companies, OTP and Mol. OTP is one of the largest banks in Hungary, while Mol is the country's leading oil and gas company. The swap deal was announced on 16 April 2009. According to the deal, Mol acquired an 8.57 per cent stake in OTP Bank, while OTP acquired a 4.9 per cent stake in Mol.[16]

[13] The analogy with chess occurs at several points in the book after Rogoff reveals that he himself is a chess Grandmaster and was among the top chess players until the age of 17–18.

[14] *Baldwin* (*2025*) provides a detailed analysis of the United States' failed economic and social policies. One of the central ideas of his analysis is that the decline in potential productivity in the US in the 21st century has been significantly contributed to by a series of policy measures put in force after 1980 that undermined the living standards of the middle class and weakened welfare institutions (see *Case – Deaton 2020*).

[15] While US government debt held by foreigners accounts for about 25 per cent of total government debt (see FRED statistics https://fred.stlouisfed.org/series/FDHBFIN), in Japan this ratio was below 12 per cent in June 2025 (see Bank of Japan, Flow of Funds Accounts – Preliminary Figures, June 27, 2025, https://www.boj.or.jp/en/statistics/sj/sj.htm).

[16] For more details see, the official communication of OTP entitled "Extraordinary Report" reference number BK-113/2009 (https://www.bet.hu/newkibdata/101897820/090416_csere_113.pdf), and *Vince* (*2013*).

Additional details of the swap are as follows. The stock swap agreement was due to expire in July 2012, until which date either party could initiate cash or physical settlement of the transaction. That is, according to the stock swap agreement, OTP received the right to repurchase the OTP stocks affected by the agreement, while Mol was granted the right to repurchase the Mol shares involved in the swap. Ex post, we know that neither of the options were exercised. In fact, the stock swap agreement has been extended multiple times. It is still in effect in 2025, at the time of writing this study.

Another feature of the deal is that "the transaction does not involve a change in the number of own stocks held by Mol, and OTP will also hold the same number of Mol stocks as before the transaction. The reason is that OTP already had 6,987,362 Mol shares under a previous agreement, of which 5,010,501 stocks were now lent, and the same number was now exchanged for OTP stocks."[17]

To understand who gained what with the deal, it is worth mentioning that OTP's capital adequacy ratio increased by 125 basis points due to the swap.[18] However, an even more important gain is due the strategic alliance of the two companies. It is worth noting that the cross-ownership of Mol and OTP does not fit into the typical stock swap transactions, as most such swaps are between companies operating in the same industry and can be seen as an initial step in the process of mergers and acquisitions. The purpose of the agreement between OTP and Mol was rather to mutually help each other avoid external acquisitions and unwanted stock price fluctuations.[19]

4. Comparing changes in reserves' composition and stock swaps

Let us turn to the common features of reserves' composition and stock swaps. First, central banks' foreign exchange reserves represent a guarantee for the repayment of sovereign debt denominated in foreign currency. While reserves are reported on the asset side of the state's consolidated balance sheet, sovereign debt is reported on the liability side. Thus, the reserves contribute to maintaining the stability of loans borrowed and bonds issued by the state. Similarly, the swapped Mol stocks – reported on the asset side of OTP's balance sheet – contribute to the value of the OTP stocks reported on the liability side of OTP's balance sheet. (The same applies for the swapped OTP stocks recorded on the asset side of Mol's balance sheet and the Mol stocks on the liability side.) Accordingly, from a *balance sheet perspective*, corporate cross-ownership and the central bank's foreign exchange reserves are similar.

[17] See: Index – Economy – MOL becomes major shareholder in OTP. https://index.hu/gazdasag/magyar/2009/04/17/nagytulajdonos_lett_a_mol_az_otp-ben/
[18] Hungarian regulation interprets the swap of common stocks as if the stocks were sold.
[19] The cooperation between the two companies was also strengthened by the fact that there were already overlaps in their management in 2009: for example, Sándor Csányi, the Chairman and CEO of OTP, was also the Vice Chairman of the Board of Directors of Mol.

Second, the management expected the cross-ownership between Mol and OTP to provide protection against adverse price movements on the stock market. The mechanism they might have in mind is this: stock price volatility can be mitigated by the fact that cross-ownership increases the opportunity for purchasing own shares, thus giving companies more room to prevent fluctuations in their stock prices. Similarly, the foreign exchange reserves of emerging countries provide protection against unwanted changes in exchange rates.

Third, the stock swap between Mol and OTP also represents a strategic alliance that is difficult to price. The difficulty can be explained by the fact that it was also part of the deal to prevent the buyout of Mol by OMV (OMV is a competitor of Mol, which also operates in the energy sector). Selecting the composition of foreign exchange reserves can be interpreted along similar lines, as this is not merely a technical decision and is often the result of financial and geopolitical cooperation. Take China, for example, the country with the largest USD reserves: over a long period, it opted for a gradual reduction of its USD reserves, signalling that the country would continue to accept the international economic role it had previously developed. Coming either as a forced decision or reflecting China's free will, this served to maintain the status quo, within the framework of which China had accumulated significant trade surpluses and participated financing the US sovereign debt, while continuing to maintain a high household saving ratio. The bilateral financial agreements concluded after 2009 point in a new direction: their purpose is to strengthen the global role of the renminbi. The partner countries in these agreements are aware of China's long-term strategic ambitions, and thus their decisions can be interpreted as conscious participation in the transformation of the international financial system.

Other parallels can be drawn between stock indices, such as the Hungarian BUX index, and a basket of currencies, such as the SDR; and also between requirements imposed on commercial banks' capital adequacy ratio and a rule of thumb's, such as the Greenspan–Guidotti rule.[20] Finally, a similarity can be found between OTP's call option on its own shares and some conditionalities in the agreements between central banks.

Interestingly, some of the conditional swap and credit line agreements between central banks have become as atypical over the past decade as the OTP–Mol agreement was in comparison to most corporate equity swaps. The reason for this is that currency swap and credit line agreements with China are increasingly becoming geopolitical elements of the international financial architecture. While the currency swap agreements of Western central banks – such as the US Federal

[20] Under the Greenspan-Guidotti rule, reserves must cover 100 percent of short-term external sovereign debt to eliminate the repayment risk caused by a potential sudden stop on the debt market.

Reserve or the ECB – typically serve to increase supply when demand for foreign liquidity in their own currencies rises,[21] the Chinese central bank often provides renminbi-denominated liquidity to countries where there is no explicit market liquidity shortage in renminbi. [22]

Horn et al. (*2023*) built a comprehensive database of China's international financial arrangements concluded between 2000 and 2021. They show that the global currency swaps provided by the PBoC are increasingly functioning as a financial rescue mechanism. Within this framework, more than USD 170 billion worth of revolving liquidity has been given to countries in crisis, which typically have low levels of foreign currency reserves. These arrangements have allowed the affected countries to increase their gross reserves. However, they were priced with a relatively higher interest rate and in a less transparent manner. In addition, these swap agreements were offered almost exclusively to countries participating in the Belt and Road Initiative. The swaps implicitly serve the internationalisation of the renminbi, while they expand China's financial influence. As a by-product, they also challenge the IMF's traditional role as an international lender of last resort.[23]

Having reviewed some similarities, let us turn to the *differences between reserves and stock swaps*. First, while it is relatively easy to determine the cross-ownership ratio of companies using the balance sheet approach,[24] it is far more challenging to define and compute its counterpart in the other problem. It may be tempting to determine the "cross-ownership" ratios of countries based solely on the composition of foreign exchange reserves.[25] However, there are strong arguments in favour of considering broader categories of assets and liabilities in both the denominator and the numerator of the ratio. At the same time, it is not worthwhile investing too much effort into calculating the "cross-ownership" ratios if the balance sheet approach is limitedly suitable to explain the changes in share prices. As we see in the next chapter, the balance sheet approach provides indeed only a partial explanation for the observed jump in the correlation of stock prices following the MOL–OTP stock swap. Therefore, it seems likely that the balance sheet approach is also limitedly applicable to analyse the nexus of different currencies.

[21] For example, the ECB made some swap and credit line agreements with certain European central banks in 2009 as a response to the liquidity shortage in the financial crisis (*Wiggins et al. 2023*).

[22] As highlighted by *Gerőcs* (*2017*), the PBoC started to provide significant amounts of liquidity to the world's central banks in 2009, when China announced the policy of internationalising the renminbi – in response to the global financial crisis originating in the US mortgage market.

[23] The case of Argentina is particularly insightful: in 2023, the Argentine central bank called on a renminbi-denominated loan from the PBoC, which was then partially converted into US dollars and used to repay Argentine's IMF debts (see *Arnold 2023*).

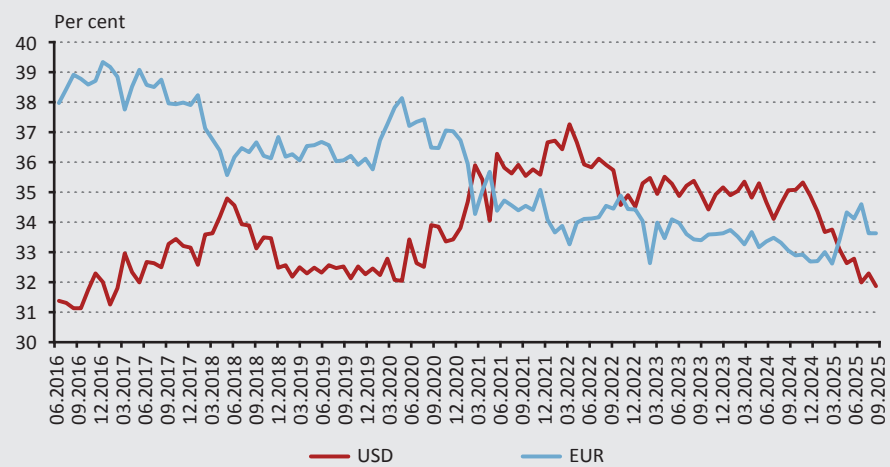
[24] For those familiar with derivative pricing and geometric series, it is not a difficult task to take into account the call options embedded in the swap, and the fact that the MOL stocks involved in the stock swap are partly backed by OTP stocks, which in turn are partly backed by MOL stocks, and so on. Similarly, the OTP stocks involved in the stock swap are partly backed by MOL stocks, which in turn are partly backed by OTP stocks, and so on (see *Footnote 29*).

[25] Before mechanically applying such an approach, it is important to note that renminbi enters the Fed's balance sheet almost exclusively through the SDR stock in its reserves.

There is also a significant difference between the stock swaps and the reserves' composition in their roles of *price protection and buyout prevention*. Specifically, the scope of public information is different: for example, while OMV's attempt to buy out MOL and its failure are publicly known, the details of currency attacks on the foreign exchange market and interventions rarely become public.[26]

Another difference is that while the Hungarian stock market has low liquidity and consists of assets with high-beta, the USD market has exceptionally high liquidity and consists of financial assets with the lowest beta.[27] Furthermore, another significant difference is that while listed companies are required to publish detailed reports and balance sheets, most central banks report only a selected set of information on their reserves. The Swiss, Croatian and Brazilian central banks are exceptions (see *Figures 1, 2 and 3*). The Swiss National Bank, for example, publishes the foreign exchange composition of its reserves on a monthly basis.

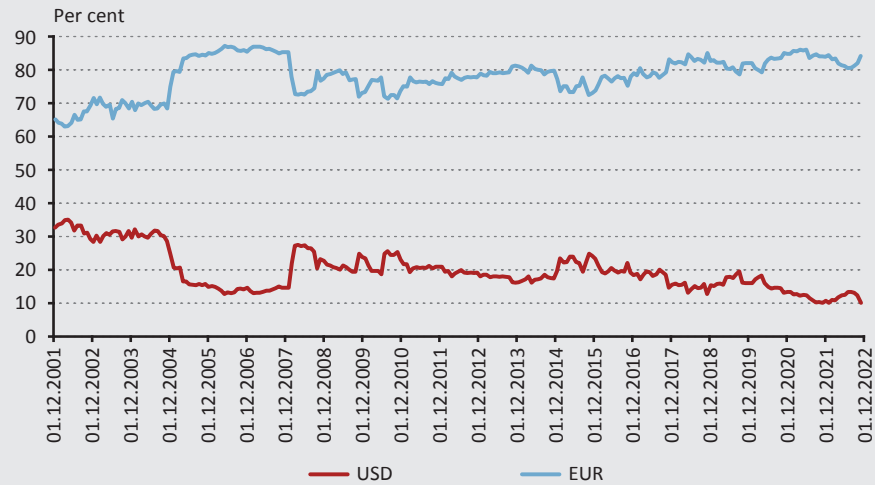
Figure 1
Share of USD and EUR in the foreign exchange reserves of the Swiss National Bank (SNB) between June 2016 and October 2025



Source: SNB, https://www.snb.ch/en/the-snb/mandates-goals/investment-assets/reserves-bonds, downloaded on 19 June 2025

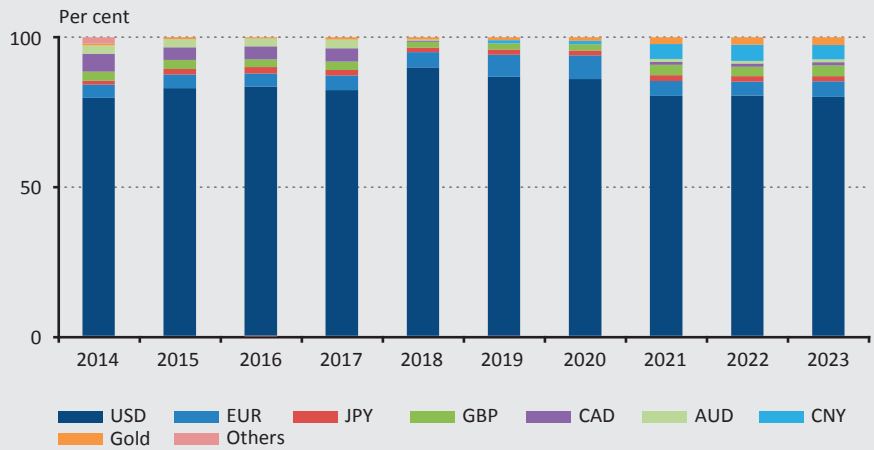
[26] A well-known exceptional case was when a group of currency speculators successfully attacked the British pound on 16 September 1992.
[27] These differences were emphasised by an anonymous reviewer of the essay.

Figure 2
Share of USD and EUR in the foreign exchange reserves of the Croatian National Bank (Hrvatska narodna banka, HNB) between December 2001 and Croatia's accession to EMU in January 2023



Source: HNB, https://www.hnb.hr/en/statistics/statistical-data/financial-sector/central-bank-cnb/international-reserves, downloaded: 19 June 2025

Figure 3
Share of the dollar and other currencies in the foreign exchange reserves of the Brazilian Central Bank (Banco Central do Brasil) between 2014 and 2023



Source: International Reserves Management Report, 2024 December, https://www.bcb.gov.br/en/publications/irmr, page 16

5. Empirical analysis

There is a well-known monotonic relationship between two variables: the higher the cross-ownership ratio, the higher the correlation between percentage changes in the stock prices of companies involved in a stock swap. This relationship has the direct consequence that as the degree of cross-ownership increases, the volatility of the price of one stock expressed in terms of the other stock becomes smaller. In the hypothetical extreme case, where the cross-ownership ratio is so high that the stocks of OTP and Mol generate the same cash flow, their stock prices (more precisely, the percentage changes in the prices) are perfectly correlated, while the ratio of the prices remain unchanged.

The cross-ownership of the two Hungarian companies was far from the extreme level discussed above. Thus, the correlation measured after the stock swap was not 1, but "just" 0.7 (see the dark blue line in *Figure 4* for the last quarter of 2009 and 2010). At the same time, the correlation of 0.7 is still surprisingly high (besides also being relatively stable), especially in light of the fact that the same correlation was close to 0.4 before the stock swap (see the dark blue line in *Figure 4* around the vertical blue line in a 2- to 3-month range).

We can decompose the increase of 0.3 in the measured correlation – denoted by ΔCorr – as follows:

$$\Delta\text{Corr} = \text{IE} + \text{ME} + \text{SE}, \tag{1}$$

where IE, ME and SE denote, respectively, the effects of factors independent of the stock swap, the mechanical effects of the stock swap agreement, and the effects of the strategic partnership sealed by the stock swap agreement.

How can we rationalise the decomposition given by *equation (1)*? First, a certain fraction of the 0.3 (= 0.7 – 0.4) increase in correlation can be attributed to factors independent of the stock swap. Since 2009 was an eventful year (see *Figure 5*), we cannot disregard the effects of some potential confounding factors simultaneously impacting the stocks involved in the swap, while also impacting some other listed Hungarian companies. We estimate IE to be roughly 0.1. Thus, the fraction of the increase in the correlation between OTP and Mol – that is not due to the stock swap agreement – is around one-third of the total increase in correlation.

Our estimates are based on how much the correlations increased between OTP and some other companies' stocks not involved in the swap and also how much the correlations increased between Mol and some other companies' stocks (also not involved in the swap). An example for such a company is Magyar Telekom.

We obtain an underestimate of the correlation between the returns of OTP and Magyar Telekom, and of Mol and Magyar Telekom, with a value of 0.4 for the period before the stock swap. It is an underestimation, because the correlations between the daily returns of OTP and Magyar Telekom, and of Mol and Magyar Telekom computed from the closing prices in 60 days before the stock swap agreement were typically somewhat higher than 0.4 (see the light blue and green lines in *Figure 4* before the vertical blue line). However, within 60 days after the stock swap – when the potential effect of the agreement could not yet be fully reflected in the three correlation indicators – the correlations reached values of around 0.4.

In the period between 28 August 2009 and 30 August 2010 – when the potential impact of the stock swap was reduced neither by the retrospective nature of the correlation indicator, nor by the potential legal challenge of the stock swap agreement by a third party – the average of the daily correlations took a value of around 0.5 for both between the OTP and Magyar Telekom, as well between Mol and Magyar Telekom. All in all, the increase in correlation of 0.1 (= 0.5 – 0.4) is an overestimate of the effects independent of the stock swap.

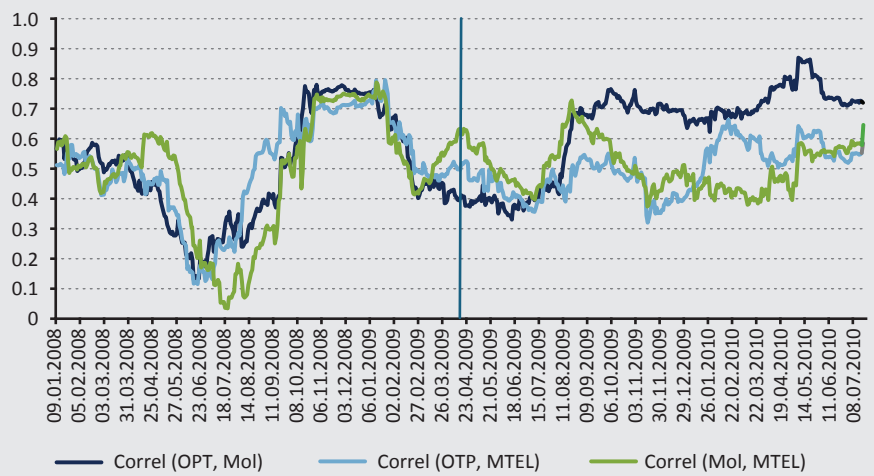
It is important to note that the light blue and green lines in *Figure 4* – which show the evolution of the correlation between OTP and Magyar Telekom and Mol and Magyar Telekom – do not show a cascading pattern following the stock swap agreement. By contrast, the dark blue line depicting the correlation between OTP and Mol is clearly cascading. We interpret this finding as a sign of a regime switch triggered by the stock swap. Our interpretation is confirmed by the fact that, according to *Figure 4*, all three time series of the correlations moved closely together in 2008. This shows that Magyar Telekom's returns also closely followed those of OTP and Mol when country-specific risk increased in the run-up to the autumn of 2008. However, the correlation increase after the share swap only occurred between OTP and Mol, while the correlations related to Magyar Telekom did not change similarly. This suggests that the jump in the correlation between OTP and Mol was not the result of a general, country-specific shock, but rather specifically the effect of the share swap.

Let us turn to the discussion of the so-called mechanical effect (ME). We can quantify this by calculating how much correlation would have increased between two portfolios if the initial portfolios had only contained OTP and only Mol shares, respectively, while the final portfolios had also included OTP and Mol shares according to their shares involved in the stock swap. Thus, the initial weights are (100%; 0%) and (0%; 100%). The final portfolios also include both OTP and Mol shares, in accordance with the cross-ownership ratios according to the swap transaction. Therefore, the final weights are close to the values (100% – 8.57%;

4.9%) and (8.57%; 100% – 4.9%).[28] Such a change in the composition of the two portfolios makes the correlation increase by no more than 0.13.

An increase of 0.13 is clearly an overestimation of the mechanically quantifiable effect of the stock swap, as it does not account for three specificities of the deal: 1) It ignores the fact that the Mol stocks involved in the swap had already been transferred to OTP before the swap; 2) and it also ignores the fact that the swap had a predetermined maturity date rather than being perpetual; 3) and that a pair of buyback options were also part of the agreement. Intuitively, each of the three ignored specificities would justify a correlation increase of less than 0.13.

Figure 4
Correlation between daily returns of OTP, Mol and Magyar Telecom

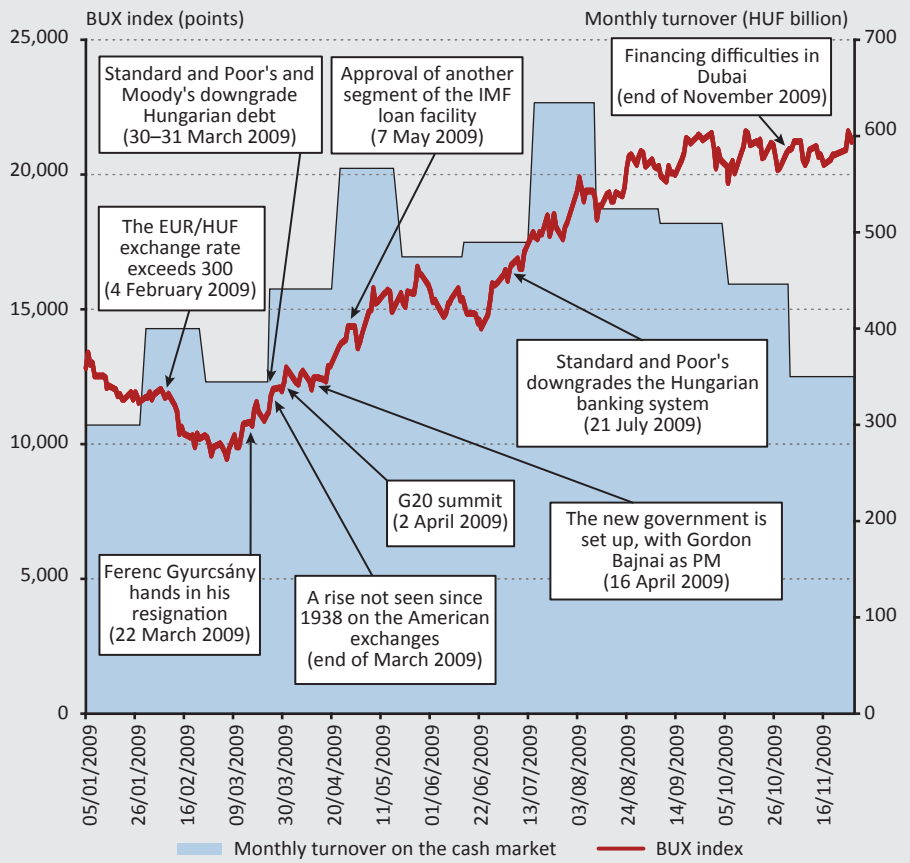


Note: The vertical line marks 16 April 2009 on which the Mol–OTP stock swap agreement was made. The correlations are calculated from the daily returns of the previous 60 days, which is why the correlation only jumped with a seemingly delayed effect compared to the announcement of the stock swap.

Source: Author's calculations based on closing prices published on the website of the Budapest Stock Exchange (BSE), (https://www.bse.hu/pages/data-download)

[28] A somewhat more precise approximation of the corresponding weights in the first portfolio are (100% – 8.57% + 4.9%*8.57% – 4.9%*8.57%^{2} + 4.9%^{2}*8.57%^{2} – 4.9%^{2}*8.57%^{3} + …; 4.9% – 4.9%*8.57% + 4.9%^{2}*8.57% – 4.9%^{2}*8.57%^{2} + 4.9%^{3}*8.57%^{2} –…) ≈ (91.8%; 4.5%).

Figure 5
Evolution of the BUX index and cash market turnover, as a reflection of events in 2009



Source: BSE, Press release entitled "Summary of 2009 at the BSE", (https://bse.hu/site/newkib/en/2010.01./BSE_Release_103407866, Chart 1)

Finally, let us examine the third effect. We can express it by rearranging *equation (1)*:

$$SE = \Delta Corr - IE - ME, \qquad (2)$$

We can think of SE as that fraction in the increase in the correlation that is explained neither by the independent, nor by the mechanical effects.

The question arises as to what could have caused the unexplained part of the increase in correlation? Our answer is that it was the "strategic partnership" factor, the content of which is difficult to define. In relation to this, we could quantify its effect on the correlation only as a residual term. We found the residual term to account for at least 1/3 of the observed increase in the correlation (see *Table 1*).

Table 1
Correlations between daily returns calculated from the closing prices of OTP, MOL, and Magyar Telekom

	MOL–OTP	MOL–MTelekom	OTP–MTelekom
Correlations			
Minimum correlation before the 2008 financial crisis	0.13	0.12	0.04
Maximum correlation between end of 2008 and beginning of 2009, reflecting the impact of the financial crisis	0.78	0.79	0.79
Estimation with potential downward bias – before the full impact was realised of the OTP-MOL stock swap	0.4	0.4	0.4
Average after the OTP–MOL share swap*	0.71	0.51	0.49
Changes in correlation			
Estimation with potential downward bias of the correlation increment (ΔCorr) around the date of the stock swap	0.31		
Estimation with potential upward bias of the effect of factors independent of the stock swap (IE)	0.10		
Estimation with potential upward bias of the mechanical effect of cross-ownership (ME)	0.13		
Estimation with potential downward bias of the residual term, also called the strategic partnership effect (SE)	0.08		

*Note: * Average correlations between daily returns calculated from closing prices of 60 days between 28 August 2009 and 30 August 2010.*

What is the relevance of our findings to the composition of foreign exchange reserves and exchange rate volatility? First, we can conclude that the total effect of moving to a new regime of reserve policies can be twice as large, or even larger than what one can estimate by using either the balance sheet approach or data from the past two decades. Second, the example of the MOL–OTP stock swap also shows that even a relatively small shift in cross-ownership of, for example, 5–8 percentage points can induce significant changes in the correlation of returns. Analogously, a small additional decrease in the weight of the US dollar in global foreign exchange reserves could trigger a significant increase in the volatility of the US dollar's value.

6. Conclusion

In this essay, we first reviewed the risks described by *Rogoff* (*2025*) in his recently published book that could potentially threaten the primacy of the US dollar in the long term. We then explained what aspects of the problem make it difficult to

predict the future volatility of the dollar. Finally, we performed a qualitative analysis of the relationship between the volatility and the composition of foreign reserves using the analogy between the problem at hand and the empirical relationship between a stock swap agreement and the correlation of the stocks involved in the swap.

We concluded that the impact of a regime switch reflected in further changes in reserves on volatility may be substantially larger than the mechanically quantifiable effects. Furthermore, a surge in volatility could occur even with a small further decline in the USD share in reserves. One key aspect of our argument is that the composition of foreign exchange reserves indicates the intention and ability of central banks to stabilise the value of their domestic currencies, while the changing composition of reserves signals the shifting intentions and abilities.

This essay leaves some additional questions to future research. For example, the question of whether the faster changes in the financial architecture in the 21st century relative to that in the 20th century can accelerate the potential reordering of the significance of the major reserve currencies. It is also worth analysing how individual central banks adapt their foreign exchange reserve policies to changing geopolitical conditions.

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