University of Oran 2
Faculty of Economics, Business and Management sciences

THESIS

Prepared in candidacy for the Degree of DOCTORATE IN SCIENCE
in ECONOMICS

International Reserve Accumulation and Exchange Rate Regimes

Presented and publicly defended by:

M. ABDELOUAHAB Mohammed Zine El Abidine

Jury members:

Mr. BOUKLIA-HASSANE Rafik	**Professor**	**University of Oran 2**	**Chairman**
Mr. KENNICHE Mohamed	**MCA**	**University of Oran 2**	**Supervisor**
Mr. BOULENOUAR Bachir	**Professor**	**University of Oran 2**	**Examiner**
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Mr. SENOUCI Benabou	**Professor**	**HSE of Oran**	**Examiner**

October 2022

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To my parents.

In memory of Belkheir Maamar and Amar Affani.

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SUMMARY

Chapter III. RESERVE ACCUMULATION AND ERRs: LITERATURE REVIEW AND EMPIRICAL EVIDENCE

LIST OF ACRONYMS AND ABBREVIATIONS

AEs	Advanced economies
Bln	Billion
BPM6	Balance of Payments and International Investment Position Manual –6th ed.
BW	Bretton Woods
CBDC	Central Bank Digital Currency
COFER	Currency Composition of Official Foreign Exchange Reserves
ECB	European Central Bank
EMEs	Emerging market economies
EMDEs	Emerging market and developing economies
ERR	Exchange Rate Regime
EWN	External Wealth of Nations Database (by Lane and Milesi-Ferretti)
excl. gold	excluding gold
FDI	Foreign Direct investment
Fed	Federal Reserve (US –)
FinTech	Financial and Payment Technologies
Forex	Foreign exchange market
FRR	Fond de régulation des recettes (Acronym in French)
GDP	Gross Domestic Product
GFC	Global Financial Crisis of 2008-9
GSC	Global Stablecoin
IFS	International Financial Statistics Database (IMF)
IIP (N–)	International Investment Position (Net –)
IMF	International Monetary Fund
IM(F)S	International Monetary (and Financial) System
IRR	Ilzetski, Reinhart and Rogoff (Classification)
PDC	Private Digital Currency
RoW	Rest of World
RR	Reinhart and Rogoff (Classification)
SDR	Special Drawing Right
SWF	Sovereign Wealth Fund
US	United States (of America)
USD	United States Dollar
WDI	World Development Indicators Database (World Bank)
WEO	World Economic Outlook Database (IMF)

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General Introduction

Since the end of the major episodes of financial and currency crises, which have particularly hit emerging market economies (EMEs hereafter) during the second half of the 1990s, and with the "boom" of commodity prices between 2003 and 2008, many EMEs and commodity-exporter countries have accumulated important levels of international reserves, most often denominated in United States Dollar (USD). According to International Monetary Fund (IMF) data, world reserves (excluding gold) increased from just over USD 2,000 bln in 2000 to more than USD 9,650 bln in 2010. After a reversal between 2014 and 2016 due mainly to a drop in oil prices and a slowdown in the Chinese economy, world reserves resumed their rise to reach USD 13,127 bln in 2020, of which 3,238 bln by China. In terms of world GDP share, reserves increased from 6% in 2000 to 15.4% by the end of 2020[1] (IMF, 2022a).

That said, it is useful to begin by giving a brief presentation of the concept of "international reserves"[2], also called "official reserves" or "reserve assets". They are defined by the IMF as "*... those external assets that are readily available to and controlled by monetary authorities for meeting balance of payments financing needs, for intervention in exchange markets to affect the currency exchange rate, and for other related purposes...*" (IMF, 2009a). Components of reserve assets are grouped into four broad categories: monetary gold, special drawing rights (SDRs), reserve position at the IMF, and other reserve assets, also called (foreign) exchange reserves or reserves in convertible currencies.

[1] We have chosen 2020 for these data in order to be consistent with the period covered in the study of accumulation trends we will analyze in the first chapter, which ends with this year. That said, IFS data (IMF, 2022a) gives statistics up to 2021. In the example we cited: world reserves in 2021 exceeded USD 13,950 bln, of which more than 3,300 bln by China, and the global GDP share of reserves was 14.7% in 2021.

[2] A more detailed discussion about the concept of international reserves as well as other related concepts is given in Chapter 1 - Section 1.

The definition of international reserves brings out their functional aspect[3]. The "oldest" function is to enable countries to directly finance temporary imbalances (deficits) of (current and / or financial) payments, particularly in the case of countries suffering from domestic or external cyclical volatility, or indirectly address these imbalances through interventions in the foreign exchange market (Forex hereafter). In addition, in an increasingly globalized world and with financial accounts openness to hot money (short capital movements), the use of reserves for interventions has become an objective *per se* to support national currencies and defend them against speculative attacks, especially under peg regimes. In addition to these (regulation) objectives, reserves also make it possible to provide confidence to financial markets in the economy in general, and in the capacity of the country to honor its external commitments. Reserves serve also as a basis (or collateral) for external borrowing, satisfying the government needs for foreign currencies, and providing funds in case of national emergencies or disasters (IMF, 2013b).

On the academic side, the question of reserves accumulation has been, in one way or another, associated with major economic policy debates that have marked the economic literature since the beginning of the century. One can find this through, at least, three topics which are, in fact, interrelated, and which are briefly pointed out here. First, we cite the debate about the origins of US current account deficit and its consequences on the value and status of the dominant international currency (the dollar). A first group of economists supports the assumption of unsustainability of the US current account deficit and links it to internal origins, including the weakness of the private saving relative to the domestic investment and the continuous deterioration of the net public saving, *i.e.* fiscal deficit (Roubini and Setser, 2004; Summers, 2004; Blanchard et al., 2005; Frankel, 2009); or the false expectations made by investors about the viability of the US economy (Krugman, 2007). Others, such as Bernanke (2005) and Clarida (2005) adopt the "Global Saving Glut" hypothesis, which argues that the US current account deficit (and therefore that of saving) is due to foreign saving surpluses, especially in China -surpluses which lead to an increase

[3] At this stage of the study, we discuss the objectives of holding reserves (which are often given in definitions by different guides such as those of the IMF or in the economic literature in general) separately from the so-called "accumulation motives". The "objectives" highlight functional and technical aspects, whereas accumulation motives are rather related to economic policy choices (precaution, monetary mercantilism) or to structural characteristics of the economy. The issue of motives is discussed later in this introduction and in further developments in our study.

of the level of reserves held by these countries and which are subsequently intended to finance the US public deficit.

Secondly, the issue of reserve accumulation reappears with the so-called "Bretton-Woods II" debate. This hypothesis formulated by Dooley et al. (2003) is based on the idea that (emerging) Asia is currently playing the role assumed by European countries and Japan in the 1960s as "periphery" countries, by buying dollars in order to fight against the appreciation of their currencies, usually pegged to the US currency. Such policies led Europe, and now Asia, to have a large accumulation of dollar reserves.

Thirdly, the issue of reserve accumulation was also involved in the debate on the Chinese currency (the renminbi) undervaluation. For a long time, strong criticism has been made by US officials as well as by the IMF against the Chinese authorities (Frankel, 2009). The currency undervaluation is an important factor of price competitiveness in export-led growth strategies pursued since long time by South-East Asian countries, led by China. The currency undervaluation favors trade surpluses and, thus, reserves accumulation.

With the Global financial crisis of 2008-9 (GFC), the issue of reserve accumulation has become more topical. There are two points that deserve to be highlighted in this regard. Firstly, foreign exchange reserves enabled major holders (Asian EMEs and oil-exporters) to cope with financial contagion and speculative attacks against their currencies (despite the fact that the situation of EMEs at that time was no longer comparable with that of the second half of the 1990s). In addition, the high levels of reserves allowed many of these countries to maintain sufficiently high levels of public spending (comparable to those before the crisis), despite the fall in export earnings, which helped to reduce the intensity of the shock to domestic and global demand (IMF, 2009c).

Secondly, heavy losses have been recorded on reserve investments done by government agencies of reserve holding countries (central banks and sovereign wealth funds). Investments in the US were the most affected because of falling stock prices and debt securities (such as Treasury bills), but also because of the dollar depreciation. Losses on net assets invested abroad pushed the major holders, especially China, to declare their willingness to diversify their reserve currency portfolio, or even to substitute the dollar by the euro or SDRs, which gave a renewed interest to the very old idea of an international

monetary and financial system (IMFS) with several reserve currencies. In this regard, Chinn and Frankel (2007, 2008) predicted that the dollar could possibly be surpassed by the euro as the dominant international currency over the next decade – something that has proven to be incorrect, at least up until now.

Giving more interest to the relevance of reserve accumulation policies, other studies focus on costs and benefits of these policies as well as on the optimal level of reserves to be held. According to some economists (Aizenman and Marion, 2003; Jeanne and Rancière, 2006; Rodrik, 2006; Summers, 2006; etc.), reserves have reached exaggerated levels, and emerging and developing economies have often accumulated reserves in the form of low-yield investments (public debt securities). For Rodrik (2006) for example, this represents an opportunity cost supported by these countries (yields on US Treasury bonds are often below the cost of local indebtedness or in dollars) and represents an annual loss of about 1% of GDP. Aizenman and Marion (2003) also highlight the problem of opportunity cost and further stress that the return on reserve investments is significantly lower than the potential returns that would be generated by reserves if they are transformed into real investments in these economies.

The supporters of accumulation policies rely on self-protection argument or "precautionary motive" which means that reserves are useful for dealing with speculative attacks and avoiding strong and expensive depreciations. In that sense, Feldstein (1999) indicates that the way to reduce the cost of crises, or even to reduce their likelihood, is to increase the level of held international (net) liquidity, through: the reduction of short-term debt, the creation of collateral on credits, and reserve accumulation. But generally, it is this third way that is followed. In fact, with the rise of financial globalization and the accession of many developing economies (especially EMEs) to this movement through financial liberalization policies, the precautionary motive no longer means self-protection against current account shocks, but also those caused by the volatility of capital flows, particularly the short-term ones. Numerous studies attest the existence of the precautionary motive, such as Flood and Marion (2001), Wijnholds and Kapteyn (2001), Aizenman and Marion (2003), Jeanne and Rancière (2006), Aizenman and Lee (2007), Bastourre et al. (2009), and Obstfeld et al. (2010).

Other personalities representing the official position of highly influential monetary and financial institutions (like the Fed and the IMF) also supported these policies: A. Greenspan (1999) and S. Fischer (2001b) explicitly encouraged EMEs to hold sufficiently high levels of reserves allowing them, at least, to cover the short-term debt. In addition to this self-protection argument, reserve accumulation also increase confidence of international capital markets about the ability of (public or private) borrowers in EMEs to repay their external debt. This "insurance" thus enables borrowers to access these markets. The subprime crisis and its international spread, then transformation into a global recession (the Great Recession), played in favor of the self-protection argument. Many studies have highlighted this (Aizenman, 2009; Frankel, 2009; Obstfeld et al., 2009; etc.). However, other studies have pointed out that reserve accumulation has certainly helped to protect against financial contagion, but not against the economic cycle transmission (Blanchard et al., 2009; IMF 2009b, c).

On the other hand, some authors consider that the precautionary motive does not (completely) explain the high levels of accumulated reserves. Dooley et al. (2003) speak about a "monetary mercantilism motive" that corresponds to the monetary and exchange rate policies followed by some countries in the logic of export-led growth models[4]. These policies are based on undervalued currencies to enhance international competitiveness. With undervaluation objective the central bank counters upward pressures on the value of its currency through sustained interventions on the Forex by purchasing foreign currencies, which leads, quite naturally, to an increase in reserve stock. China was "accused" during the 2000s of having pursued such a policy, which aggravated, moreover, the current imbalances of (with) the US, as already indicated when we talked about global imbalances. Several studies have empirically distinguished the effect of the mercantilist motive from the precautionary one (Aizenman and Marion 2003; Bar-Ilan and Marion 2009; Dordu, Mendoza and Terrones 2009; Delatte and Fauquau 2012; etc.).

In reality, questions relating to reserves, including those focusing on the causes and consequences of accumulation, have never ceased to arouse the interest of economists; and it would be wrong to consider that the debate(s) on this theme was limited only to the

[4] The monetary mercantilism motive is also called "neo-mercantilism". This term alludes to the mercantilist doctrine (from the 16th century to the middle of the 18th century).

period of accelerating global accumulation in the 2000s. Such a thought might be due to the fact that for some countries, achieving a relatively high level of reserves is almost exclusively dependent on particular circumstances, such as an upward phase of the oil cycle. However, the downward phases of such cycles are also long, which does not prevent the global trend of increasing accumulation to continue, as we have seen from data given at the beginning of this introduction.

Indeed, the academic interest in issues related directly or indirectly to international reserves has not ceased and is still relevant, as for example the debate on the sustainability of US external financial position, which is a perpetual renewing debate (since the 1960s with the Triffin dilemma) and which is closely related to the debate on the dollar status durability as a hegemonic international and reserve currency. The downward trend of the dollar share in world reserves since the GFC, and the emergence of "non-traditional" currencies, have raised questions about the ability of the US economy (and its currency) to safeguard its "exorbitant privilege." As with all major issues, opinions are divided between "pessimists" who think that the US external position, and therefore the dominant status of the dollar, are no longer sustainable (Roach, 2020; Atkeson et al., 2022; etc.), and others "more optimistic" who believe that the world hierarchy of international currencies, especially for reserves, is not likely to be significantly altered in the foreseeable future (Eichengreen et al., 2016; Iancu et al., 2020; Milesi-Ferretti, 2021; Gopinath and Itskhoki, 2021; Ilzetzki et al., 2021; etc.).

There are also new factors which mean that interest in the status of reserve currencies, notably the dominant one, as well as the reserves themselves, is not likely to weaken in the near future. Financial and payment technologies (FinTech) are experiencing a deeper and faster development since several years. This is seen in particular through the rise of digital assets such as private crypto-assets and central bank digital currencies (currently under development). The world is also experiencing a continuous rise in tensions linked to the strategic interests of countries and new global geopolitical issues such as: trade and political tensions between the US and China since the mid-2010s, or the war in Ukraine in 2022 and the economic sanctions it involved on Russia, including the freeze of important part of its reserves. These and other elements, which we will review in sufficient detail later in this work, illustrate the implication of the issue of reserves (and reserve currencies) in the functioning of the IMFS, as well as its future challenges.

In fact, one cannot speak of the latter without mentioning one of its pillars, namely the (international) exchange rate system, and whose components, the exchange rate regimes (ERRs), particularly involve the variable of international reserves. Indeed, one of the most controversial topics over the debate on international reserves since the post-war period is the issue of the relation between holding / accumulating reserves and the nature of ERRs. Most textbooks in open macroeconomics distinguish (only) between two configurations of regimes: fixed and floating regimes, and stipulate that it is the first category that is (the most) favorable to holding / accumulating international reserves.

Our research work takes part in this debate and aims to provide theoretical and empirical answers to the research problem based on the relation between ERRs and the accumulation of international reserves. Our research problem is formulated through the following developments.

A priori, one might think that it goes without saying that the adoption of floating means a "systematic" absence of any utility of holding (important) reserves. Theoretically, ERRs are not the same in this regard. Changes in reserves under floating regimes are supposed to be nil. This is explained by the fact that one of the major differences between the two configurations of ERRs is explained by the mode of adjustment of external payments and its relation to (influence on) the internal equilibrium, as well as the consequences in terms of international reserve holdings. The (traditional) theory states that adjustment in floating rates removes the external constraint and thus the need to hold reserves, which is not the case with fixed rates. Indeed, under fixity, the monetary authorities intervene on the Forex and must therefore hold reserves to defend the parity (or the accepted fluctuation band) when there is downward pressure on the national currency. In the opposite case of upward pressure, reserves increase as a result of purchases by monetary authorities.

However, reserve holding is, in fact, done for several reasons, as we already indicated. Stylized facts also show that accumulating countries are not only those who follow fixed or intermediate regimes. For example, Japan, which is the second largest reserve holder with more than USD 1,350 bln at the end of 2020, is a free floater since 1978, and until 2005, Japan was the country with the largest stock of reserves in the world, and the first country who has surpassed the USD 100 bln level (in 1994). Other advanced

economies (AEs) and emerging and developing economies (EMDEs), whose reserves have exceeded this threshold, are also floater countries (UK, US, Brazil, Mexico, etc.).

Also, there is a methodological problem: ERRs' practices do not necessarily correspond to the official statements by the monetary authorities. The economic literature gave great interest to the distinction between "*de jure*" and "*de facto*" regimes (Ghosh et al., 1997; Bubula and Otker-Robe, 2002; Calvo and Reinhart, 2000; Bailliu et al. 2003; Reinhart and Rogoff, 2002; Levy-Yeyati and Sturzenegger, 2005; Ilzetzki, Reinhart and Rogoff, 2017b ; etc.). The use of a "*de jure*" classification of ERRs could be responsible for a "falsification" of facts by associating accumulation with "*de facto*" pegs, untruthfully declared as floating. Thus, studying the effect of exchange rate regimes on reserve accumulation requires the relevance of used classification of regimes.

The question which could be asked to summarize our research problem is the following: *Would the accumulation of international reserves be influenced by the adoption of specific exchange rate regimes*? *Would it be favored only by fixed exchange rates, as mentioned in open macroeconomics textbooks?*

Two other (secondary) questions arise from this central question: a) *Why do countries accumulate reserves under fixed regimes? and b) Is there really no need to accumulate reserves when following floating regimes? and if so, why?*

A priori, we assume that there is not really a systematic relation between the adoption of a particular category of ERRs and the behavior of holding and accumulating stocks of international reserves. There may be accumulation under fixed regimes (and intermediate regimes) for the well-known reasons in traditional theory, such as for the needs for external imbalances' adjustment and interventions on Forex. There can also be accumulation even under floating regimes, because the role of reserves is not limited to the functions of regulating external variables. The precautionary and monetary mercantilism motives may also have a meaning under floating conditions, as well as for other structural characteristics such as limited absorptive capacity or under-developed financial system. Stylized facts, such as those already mentioned about large accumulator and floating

countries (ex: Japan) corroborate this "intuition". We will test these assumptions (or hypotheses) through a study of the literature dealing directly or indirectly with the relation between reserves and ERRs, and then through an empirical study.

To answer the questions asked and test the relevance and validity of the hypotheses put forward, we propose a research plan with three chapters written and organized in such a way as to allow both: to deal with three specific themes concerning international reserves; and to respect the "common thread" in our work, which revolves around the idea that reserves are at the heart of the international financial and monetary architecture, even if they could sometimes be considered, wrongly, as a simple residual variable.

Thus, in a first chapter entitled "*International Reserves: Concepts and Accumulation Trends*", we present the concept of international reserves as well as other related concepts, and then we analyze their evolution over a period of two to four decades, and according to different parameters, as well as the evolution of reserve components, notably the foreign exchange reserves. This last point highlights a hierarchy of currencies used for reserve asset holdings and makes it possible to introduce the notion of "the dominant currency".

This notion is at the center of a second chapter entitled "*Dominant Reserve Currency and International Monetary and Financial System"*, and through which we set out the very controversial and constantly renewed issue of the hegemonic status of the dollar as an international and reserve currency. Starting from the idea that the status of the dominant currency is related to the issue of US external position sustainability, we study the evolution of that debate from the 1960s until the very recent developments integrating economic and extra-economic factors that feed this debate and raise new questions about the future of the IMFS.

In a third chapter, we relate the phenomenon of reserve accumulation with one of the most important elements of the IMFS, namely the typology of ERRs to answer the questions defining our research problem. In this chapter, entitled "*Reserve Accumulation and Exchange Rate Regimes: Literature Review and Empirical Evidence*", we begin by explaining the rationale for holding reserves under fixed regimes (and pegged regimes in general), then we try to deduce, through a literature review, whether floating regimes are also favorable to reserve accumulation, contrary to what is stipulated by traditional theory.

Finally, the third chapter attempts to provide empirical evidence by testing the hypothesis that ERRs do not (significantly) affect reserve accumulation. The technique used is One-factor variance analysis (One-way ANOVA) which makes it possible to verify the existence of a relation between a continuous explained variable (the accumulation of reserves) and a categorical explanatory variable (the exchange rate regime), based on data of 117 AEs and EMDEs for a period of 40 years (1977-2016).

Chapter I.

International Reserves:
Concepts and Accumulation Trends

Introduction

This first chapter focuses on the study of our work's central concept, namely the "international reserve accumulation". The first section begins with technical definitions of international reserves and their components, published in the 6th edition of the IMF's *Balance of Payments and International Investment Position Manual*. In parallel, other concepts closely related to that of international reserves, and frequently used in the field of open monetary and financial macroeconomics, are also presented.

These are: international liquidity and (net) international investment position. The precise definition of the three concepts and the explanation of the relation between them allow us to avoid analytical and empirical confusion in what follows in this work. The section ends with some examples of external financial position (and its relation to reserves) of particular countries, which will be used in further developments.

The following two sections are dedicated to the study of international reserve accumulation trends at the global level and by development level (AEs and EMDEs). The study covers two to four decades, depending on the case, and analyzes accumulation trends according to several parameters (absolute value, GDP share, annual changes, international trade, global and local economic conditions, etc.).

Accumulation trends are also analyzed by component of international reserves (SDRs, position at the IMF, monetary gold and foreign exchange reserves). This last category of assets, being the largest in terms of use and share in global reserves, is treated with particular attention. Indeed, the analysis focuses on the composition of currencies used as reserve assets (their hierarchy and evolution over time), and allows us to have a clear idea on the evolution of the dominant currency, the other traditional currencies as well as the new emerging reserve currencies. This will be of a great help to us in the next chapter.

Section 1. International Reserves and Related Concepts

The central concept in our study – international reserves – is linked to other concepts frequently used in technical papers and literature in the field of open monetary and financial macroeconomics, namely, international liquidity and international investment position. Therefore, it seems important to give precise definitions for these concepts and clarify the relations between them in order to avoid confusion which could undermine the relevance of the analytical and empirical developments that will follow.

1.1. International reserves

1.1.1. Definition and criteria

The "international reserves" also called "official reserves" or "(official) reserve assets" are often defined by their objectives, their composition and the conditional characteristics of their components. According to the "Balance of Payments and International Investment Position Manual – 6th Edition" (BPM6), published by the IMF, "*Reserve assets are those external assets that are readily available to and controlled by monetary authorities for meeting balance of payments financing needs, for intervention in exchange markets to affect the currency exchange rate, and for other related purposes …*" (IMF, 2009a).

International reserves are presented in balance sheet logic (gross assets which do not include external liabilities even if they constitute reserves for other countries) and they represent external claims (in convertible currencies) on nonresidents, except monetary gold in its physical form. Two other basic conditions are: the immediate availability for use by the monetary authorities, in that they can liquidate the assets (exchange into cash currency) at the least cost and time; and the direct control by monetary authorities through direct possession or through conditional delegation for asset management.

1.1.2. Composition of international reserves

The BPM6 also gives the composition of reserve assets and groups them into four main categories: monetary gold, special drawing rights, reserve position at the IMF, and other reserve assets.

A. Monetary gold

According to the BPM6, "*Monetary gold is gold to which the monetary authorities (or others who are subject to the effective control of the monetary authorities) have title and is held as reserve assets.*" (IMF, 2009a). Monetary gold is held in the form of physical gold (coins, bullions, bars and gold held in allocated gold accounts) and unallocated gold accounts held with nonresident institutions and which give title to claim the delivery of gold. The necessary condition to consider allocated or unallocated gold accounts as reserve assets is that they must be readily available and on demand by monetary authorities.

B. Special drawing rights

Special drawing rights (SDRs) "*are international reserve assets created by the IMF and allocated to members to supplement existing official reserves. SDR holdings represent unconditional rights to obtain foreign exchange or other reserve assets from other IMF members*" (IMF, 2009a). When it was introduced in 1969, while the Bretton Woods (BW hereafter) system prevailed, one SDR was equivalent to one dollar (0.888671 grams of fine gold), but since the collapse of the system and the adoption of floating exchange rates by the main currencies, the value of the SDR is determined with respect to a weighted basket, currently containing five currencies: US dollar, euro, Japanese yen, pound sterling and the Chinese renminbi.[5]

However, despite the collapse of BW and the adoption of floating regimes have reduced the importance of SDR position as a reserve asset, SDR allocations are still used to provide liquidity to member countries, alongside other reserve assets, during financial and balance of payment crises.

C. Reserve position at the IMF

The reserve position at the IMF (or unconditional drawing rights) is the "*sum of the reserve tranche … and any indebtedness of the IMF (under a loan agreement) that is readily available to the member country*". The reserve tranche corresponds to the amounts in foreign currency and SDRs that the country can draw on the IMF at a short notice

[5] The official name of the Chinese currency is "Renminbi", which means "the people's currency", but it is also called "Yuan", which is, more precisely, the unit of account of the Chinese currency, and whose standard code according to the ISO-4217 is "CNY". Economists often use both terms interchangeably. We will do the same in our work.

without conditions, and which result from its quota subscriptions and the IMF's sale of the country's currency (if it is a country with a strong external position) to meet the demand of other countries for balance of payment needs (IMF, 2009a).

D. Other reserve assets

Other reserve assets, also known as "foreign exchange reserves" or "convertible currency reserves", now account for the largest share of official reserve assets in most countries, and include different types of assets:

- currency and deposits held in foreign central banks, the Bank for International Settlements (BIS), other nonresident deposit-taking corporations, etc.;
- securities, which includes liquid and marketable equities and short- and long-term debt securities issued by nonresidents such as treasury bonds or other governmental securities;
- financial derivatives used for the management of reserve assets; and
- other claims (loans to nonresident corporations other than deposit-taking corporations and other financial instruments).

1.1.3. The issue of whether other foreign currency assets belong to reserve assets

An important question about the content of international reserves is whether assets held under stabilization funds, sovereign wealth funds, regional pools, and swap agreements between central banks are part of them. In other words, do international reserve statistics include these assets' amounts?

To answer this question, it is necessary to know whether these assets meet the criteria (or characteristics) used in the BPM6 (or earlier editions) definition of international reserves, which we have already mentioned, so: *Are these assets liquid or marketable assets representing claims on nonresidents, immediately available and under the control of the monetary authorities to meet balance of payment needs, intervene on the foreign exchange market (Forex hereafter) or other related needs?* (Galicia-Escotto, 2005)

A. Stabilization Funds

A priori, (internal macroeconomic) stabilization funds are to be excluded from reserve statistics, despite the fact that they often come from the same source (trade surpluses), because they do not represent claims on nonresidents, but are rather related to earmarked accounts (special assignment accounts) managed by the treasury, as in the case of the Algerian Revenue Regulation Fund (or FRR, according to its acronym in French). The FRR was created in 2000 with the aim of enabling the Algerian economy to cope with the volatility of hydrocarbon prices and therefore to cope with budgetary effects of a drop in external revenues (Chibi, Chekouri, and Benbouziane, 2019).

The fundamental operating principle of the Algerian FRR was initially established so that it is financed by hydrocarbon export receipts beyond a reference price of USD (37) a barrel, and used as a countercyclical policy tool. A few years after its creation, changes have been made to its status so that it also could be used for the payment of public debt, instead of its original conception as a strict budgetary regulation mechanism, as reported by Talahite and Beji (2013)[6].

Apart from its official mission, the Algerian FRR was also able to serve as an instrument to sterilize a part of petrodollar inflows or an anti-inflationary tool (Bouklia-Hassane, 2014), in the lack of other (monetary and foreign exchange) market-based techniques for a real (partial or total) sterilization of foreign reserves, such as those used by central banks of economies beyond a certain level of financial development.

B. Sovereign wealth funds

Unlike stabilization funds, sovereign wealth funds (SWFs) often have their own legal personality. But, this affects the criterion of immediate availability for monetary authorities of the assets they held. Furthermore, SWFs, whose funds come from external and internal sources (current and/or financial account surpluses, official foreign exchange transactions, privatization operations, budget surpluses, etc.), are managed separately from official reserves, and often pursue financial investment strategies particularly based on high yield and/or strategic value (Galicia-Escotto, 2005).

[6] The FRR ran out in early 2017, less than three years after the 2014 oil counter-shock. With the dramatic rise in oil prices from 2021, the Algerian government has declared (through the 2022 Finance Act) its intention to reactivate it.

But if, on the other hand, the SWF is only mandated by the central bank as an external manager of a part of its reserve assets, and that these latter remain on the central bank's balance sheet, then the assets will be considered as reserves. This is the case of the Korea Investment Corporation – KIC, on which the Bank of Korea retains the right to recover the delegated assets for urgent liquidity needs (Lagerblom and Levy-Rueff, 2006).

The "Stabilization Fund –SF" created by Russia in 2004 is a sovereign investment fund of a portion of Russian reserves, despite the confusion that the term "stabilization" could induce. In 2008, the Russian SF has been split into two separate funds: "Reserve Fund" and "National Wealth Fund". The Reserve Fund has kept the same objectives of the former SF, namely protecting the economy from the effects of the decline in raw material revenues, including hydrocarbons. In this respect, it keeps the same objectives of an internal stabilization fund, but differs in terms of resource management: investments are made only in sovereign debt securities (considered to be more liquid and safer). In this respect, this fund may be confused with the reserve assets managed by the central bank.

The National Wealth Fund was mainly used for financing pension funds (and later contributed to fund infrastructures and bank bailouts). The Fund is now more oriented towards investing in riskier financial market assets, and therefore potentially earns higher yields than government bonds held by the Reserve Fund or as reserve assets directly held by the central bank (Chevrier, 2009; Kazakevitch and Trishkna, 2010)[7].

C. Regional reserve pools

A regional reserve pool is a collective investment device on which participating countries hold claims to ensure cooperative reserve management. Claims on the asset pool are considered as reserves if they comply with the definition criteria of immediate availability, control by the country's monetary authorities, and liquidity of foreign-denominated claims on nonresidents. The Latin American Reserve Fund (FLAR) is an example of a regional reserve pool whose assets are currently held by eight countries in the Latin American region. The Fund represents a common investment vehicle in assets and declares that it is pursuing a *Strategic Asset Management Framework* (*SAMF)* in

[7] The last two references are taken from two collective work: Revue d'économie financière (ed.), 2009, and Das U., Mazarei A., and van der Hoorn H., (eds.), 2010, respectively; which could be very useful for a more detailed study of state-owned funds, particularly sovereign wealth funds (macroeconomic role, institutional frameworks, investment strategies, utility during the 2008-9 crisis, etc.).

international markets in particular debt securities. Table (1.1.) shows the investment mix approved by the FLAR Board of Directors in April 2015[8].

Table (1.1.): FLAR investment benchmark in 2015

Assets	Share
0 to 1-year Notes from the Treasury of the United States of America	40
3 months LIBOR rate (USD)	40
1 to 3-year Notes from the Treasury of the United States of America	9
1 to 10-year inflation-indexed bonds from the U.S. Treasury (TIPS)	5
1 to 3-year Corporate bonds A- or higher credit rating	3
U.S. Agency Mortgage-Backed Securities (MBS)	3

Source: Data from FLAR website <https://flar.com/en/about-flar/investment-parameters>

D. Swaps between central banks

The last particular point concerns swaps between central banks. Despite the traditional criteria that allow or not to consider foreign currency assets as reserve assets (immediate availability, direct control by monetary authorities and liquidity of foreign-denominated claims on nonresidents), the realization of an "effective" exchange of deposits between central banks is an additional condition in the case of swap lines. Thus, the resources that can be obtained under swap agreements are "potential" resources and do not constitute existing claims, and are therefore not included in reserve holdings.

For example, during the 2008 crisis, the US Federal Reserve (Fed) played the role of an "international lender of last resort" by granting US dollar emergency swap lines (loan facilities by lending dollars in exchange for foreign currency) for an amount of USD 30 bln with the central banks of Brazil, China, Mexico and South Korea (Eichengreen et al., 2018).

Later, with the uncertainty created by the spread of the Covid-19 pandemic and distortions in dollar liquidity markets, the Fed continued to play the role of international provider of liquidity by reactivating (or strengthening) the leverage of temporary (or

[8] The Fund was established in 1978 as the "Andean Reserve Fund – FAR" to enable the five founding countries to address the problems of external imbalances (Bolivia, Colombia, Ecuador, Peru and Venezuela). In 1989, it became the "Latin American Reserve Fund – FLAR". Three other countries joined the Fund in the 2000s (Costa Rica, Uruguay and Paraguay).

standard) swap lines with other central banks from March 2020. In the early days of the pandemic, many central banks sold dollar reserve assets for obtaining liquidity and fighting against important volatility (depreciation) of their currencies due to capital outflows. Goldberg and Ravazzolo (2022) show that swap lines with the Fed have had a positive effect on liquidity availability and reserve safeguarding. Overall, these actions have allowed concerned central banks to increase, or at least not lose too much of, their reserve asset stocks, compared with other central banks. In these two crisis examples (2008 and 2020), swap lines resulted in effective exchanges of liquidity, which makes it possible to consider these resources as part of the reserve assets of the concerned countries.

1.2. International liquidity

1.2.1. Difference between global and domestic meanings

The concept of "international liquidity" is sometimes confused with or used as a synonym for international reserves (Williamson, 1973). It can be used in a global sense, as global liquidity, and means the central bank-money (monetary base) created by central banks around the world. The two main sources of this monetary creation are monetary policies, particularly those of advanced countries' central banks and reserve accumulation, principally by EMEs and oil (and natural resources) exporters (Artus and Virard, 2010).

On a domestic level, the concept of international liquidity has a double (qualitative and quantitative) significance. Indeed, international liquidity means a country's access to international means of payment. In this sense, Arndt (1948) uses the term "liquidity position" that it defines as a country's ability to cope with temporary balance of payments' deficits without the need for structural adjustment measures that involve a reduction of imports and an increase in the unemployment level, as also mentioned in Allegret (1997).

1.2.2. The concept of international liquidity through the IMS evolution

The deep meaning of the concept of international liquidity has not changed although the IMS has considerably evolved over time; but the nature and composition of means of payment have well progressed. Thus, under the gold standard system, international liquidity meant access to gold that can be used to buy the national currency held by foreign partners. Under BW system, international liquidity meant access to US dollars through held reserves or credit lines, as well as access to SDRs.

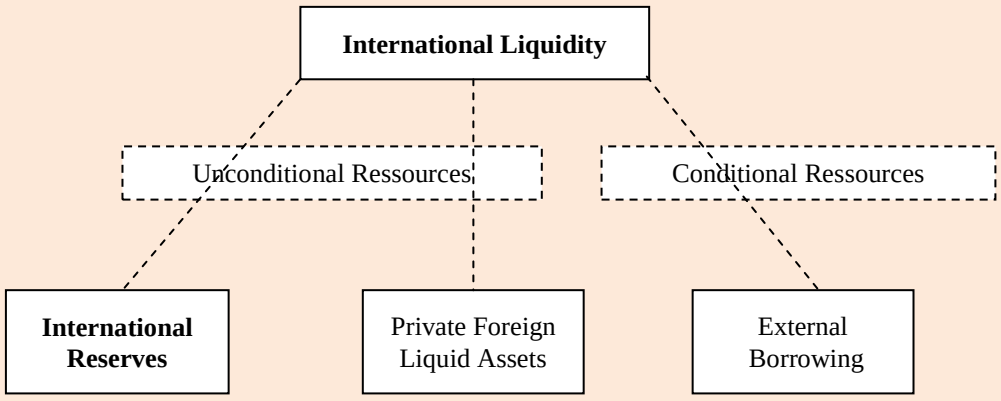
After the collapse of BW system, and with the rise of international capital markets, the definition of international liquidity is given in the sense that it includes all means of payment available to public authorities and country residents. The ultimate objective of international liquidity is the financing of payment deficits through a net reduction of reserves and/or a net increase in external debt of country residents (Cohen, 2006).

1.2.3. The relation between international liquidity and international reserves

Below, we give two presentations of the relation between the concepts of international reserves and international liquidity that can be found in the economic literature and in IMF Guidelines. The first one is older and based on gross values (Figure 1.1. –Chart A.). The second one, given by 2001 and 2013 IMF Guidelines (IMF, 2001, 2013a), is more recent and based on net values (Figure 1.1. –Chart B.). The private sector position is explicitly expressed in the first presentation, but not in the second. [9]

Figure (1.1.): The relationship between "International reserves" and "International liquidity" concepts

A. Old scheme



Source: Adapted by the author from Xu (1992)

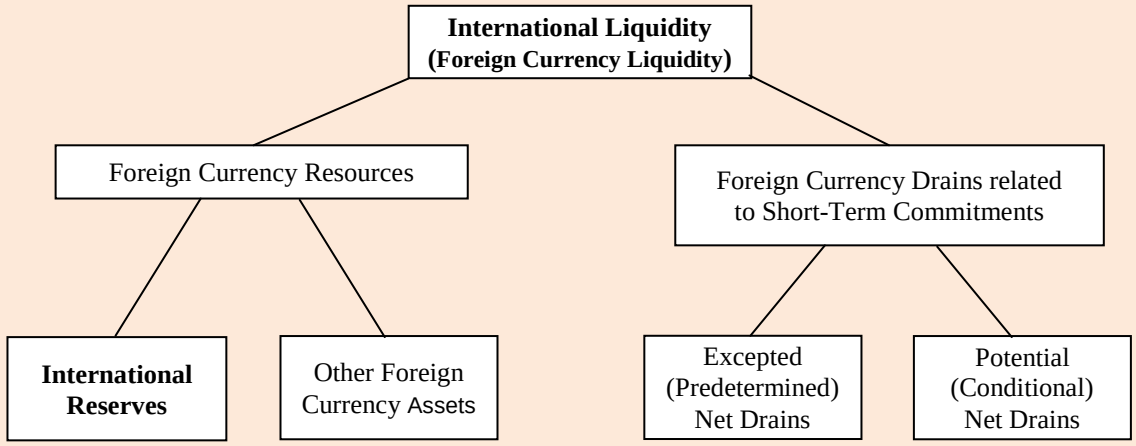
The international liquidity position of a country includes, on the one hand, unconditional foreign currency resources which are existing resources and which combine official reserve assets (international reserves) as well as external liquid assets held by private sector (private holdings of foreign currencies and short-term commercial claims on

[9] The term "private sector" refers to all corporations doing an economic activity, even if they are fully or partially controlled by the government. The term "public sector" refers to governmental administrations.

nonresidents) and, on the other hand, conditional resources which are non-existing but potential resources (IMF conditional loan facilities, potential indebtedness on international capital markets or *vis-à-vis* banks, including swaps between central banks). Net liquidity is measured by deducting (short-term) liability positions from assets (Xu, 1992).

Figure (1.1.): continued

B. IMF Guidelines' scheme



Source: IMF (2001, 2013a)

According to 2001 and 2013 IMF Guidelines (IMF, 2001, 2013a), a country's international liquidity position is assessed by comparing the amount of foreign currency resources immediately available for use by the monetary authorities with the amount of expected and potential net drains (outflows) related to short-term liabilities on such resources. Foreign currency resources include official reserve assets and "other foreign currency assets" (assets of authorities representing claims that are not official assets and can emanate from positions with other residents).[10]

Thus, we conclude that the field covered by the concept of international liquidity (or liquidity position) is broader than that of international reserves despite the fact that their objective is the same: balance of payments financing needs. The difference concerns the nature of the entities and the extent of assets' composition. Ultimately, international reserves are part of international liquidity.

[10] Authorities include both monetary authorities and central administration. Foreign currency claims are claims on nonresidents and residents.

1.3. International Investment Position

1.3.1. Definition

Another concept related to international reserves, allowing to assess the country's financial position *vis-à-vis* the rest of the world (RoW), in the same way of international liquidity (position), is that of the "International Investment Position – IIP" proposed by the IMF as a complement to balance of payments data. The BPM6 defines it as "*a statistical statement that shows at a point in time the value of: financial assets of residents of an economy that are claims on nonresidents or are gold bullion held as reserve assets; and the liabilities of residents of an economy to nonresidents*" (IMF, 2009a). Financial assets held by residents on nonresidents include:

- foreign direct investment (controlling interests in subsidiaries abroad, *i.e.* owning capital share that gives 10% or more of the voting power);
- portfolio investments (holdings by residents of equities or bonds issued by nonresidents);
- other investments (including loans or deposits with nonresidents, trade loans, etc.);
- financial derivatives; and
- reserve assets.

In parallel, external financial liabilities are defined and classified in the same way (except for foreign exchange reserves which are excluded); but conversely to assets, liabilities are claims of nonresidents on country's residents. Also, the balance of payments is a flow concept. Its data measure capital flows (both inward and outward) during the period considered. The IIP is a stock concept. Its data measure stocks of external assets and liabilities at the end of period (Lane and Milesi-Ferretti, 2007).

1.3.2. Net International Investment Position

The country's financial position *vis-à-vis* the RoW (net lending/borrowing) can be calculated in net terms (Net IIP or NIIP). It is the difference between the country's external financial assets and liabilities, and has therefore a positive or negative value. That allows classifying the country as "net creditor (lender)" or "net debtor (borrower)", and have important implications for external debt sustainability (Lane and Milesi-Ferretti, 2018).

The NIIP is given by the formula:

NIIP = [Financial assets of residents that are claims on nonresidents + Physical gold held as reserve assets] – [Liabilities of residents to nonresidents] **(1)**

On the global scale, IIP and NIIP data are used to assess trends of international financial integration as well as the evolution of global imbalances' phenomenon (Lane and Milesi-Ferretti, 2018).

1.3.3. Net foreign assets

Economic literature, as well as statistical statements, also uses the concept of "Net Foreign Assets" (NFAs) to assess a country's financial position *vis-à-vis* the RoW, but proceeds through a calculation based on the financial account items:

$$NFA = [\ IR + FDIA + EQA + DEBTA\ ] - [\ FDIL + EQL + DEBTL\ ] \quad \textbf{(2)},$$

with:

IR: international reserve assets,

FDI: stock of foreign direct investments,

EQ: stock of portfolio investments,

DEBT: debt stock (or claims),

A: assets,

L: liabilities,

and in terms of flows:

$$\Delta NFA = \Delta IR + [\Delta FDIA - \Delta FDIL] + [\Delta EQA - \Delta EQL] + [\Delta DEBTA - \Delta DEBTL] \quad \textbf{(3)}$$

$$= \Delta IR + KA \quad \textbf{(4)}$$

with:

Δ IR: changes in reserves, and

KA: net capital flows (or financial account balance, excluding reserves).

Thus, residents' claims on nonresidents are given by the sum of: SDRs, the position at the IMF, foreign exchange reserves and FDI, portfolio investment and debt assets[11]. It

[11] Gold holdings are excluded when calculating NFAs because they do not constitute a claim on nonresidents. Similarly, if gold is excluded from NIIP calculation – as usually done in many databases (and empirical studies) focusing on external financial position – both concepts will have the same meaning.

can also be deduced from Equation (2) that the stock of reserves does not imply *per se* the external financial position of a country, and that it is not because a country accumulates large stocks of reserves that it is necessarily a net creditor.

1.3.4. International Comparisons

A. Net Creditors (lenders) and net debtors (borrowers)

In what follows we will give some examples of countries with different external financial positions. Table (1.2.) provides an overview of the largest net creditors (lenders) and debtors (borrowers) at the end of 2020 in terms of value and GDP share.

Table (1.2.): Largest net debtors and creditors - End of 2020*

Largest net debtors		Largest net creditors	
(Billions of USD)			
United States	- 14,505	Japan	3,397
Spain	- 1,194	Germany	2,344
France	- 1,002	Hong Kong	2,153
India	- 823	China	2,026
Ireland	- 798	Taiwan	1,366
(% of GDP)**			
Ireland	- 208 %	Hong Kong	616 %
Greece	- 191 %	U.A.E.	321 %
Portugal	- 123 %	Norway	317 %
Spain	- 93 %	Singapore	308 %
United States	- 69 %	Taiwan	204 %

* The table considers countries with GDP above USD 150 bln in 2020.
** GDP measured in USD and not in local currency as presented in data source.

Source: By the author; based on EWN database by Lane and Milesi-Ferretti (Dec. 2021 update)

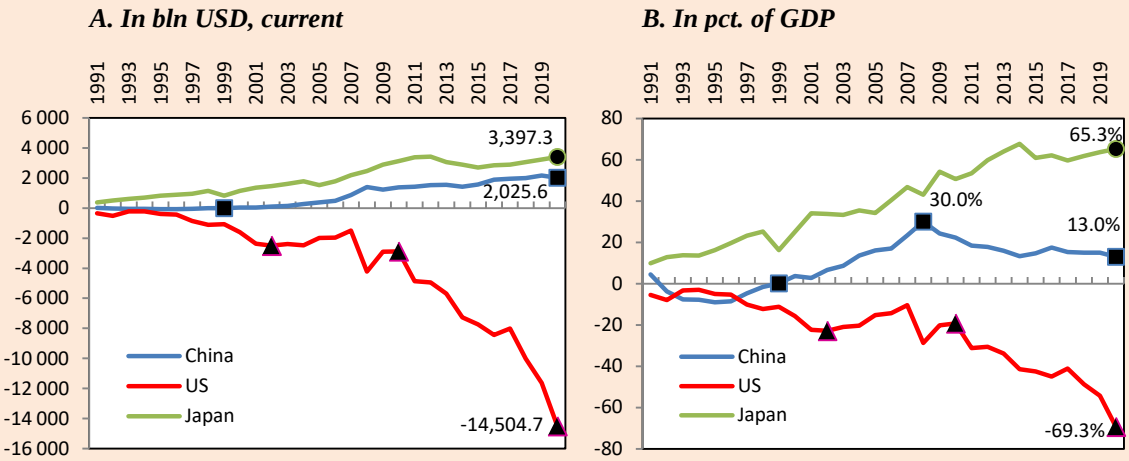
On net borrowers' side, the US is the most indebted economy in the world. In terms of absolute value or GDP share, economies with negative NIIP, in addition to the US, can be grouped regionally as follows: European AEs (Spain, France, Ireland, Portugal, and Greece), Asian EME (India) and other European and Latin American EMEs (if the list was extended to more than five ranks). In parallel, the largest net creditors are mainly Asian AEs (Japan, Hong Kong, and Singapore) and European AEs (Germany and Norway), Asian EMEs (China and Taiwan) and oil-exporters (United Arab Emirates, Norway, and Saudi Arabia). This configuration outlines the mapping of global imbalances that

characterized the world economy since the 1990s, and which we will focus on in the Chapter 2 with more details.

The comparison in terms of GDP share shows that the US economy is surpassed by only four countries (Ireland, Greece, Portugal, and Spain), all of which have experienced significant financial turmoil following the GFC, and more particularly during the European debt crisis from 2010. This observation acquires particular importance in relation to the issue of the US external financial position sustainability, which will also be largely discussed in the Chapter 2.

Figure (1.2.) shows the financial situation *vis-à-vis* the RoW of the three largest economies in the world, namely the US, China, and Japan.

Figure (1.2.): Net International Investment Position (excl. gold) of US, China, and Japan, 1991-2020



Source: By the author; based on EWN database by Lane and Milesi-Ferretti (Dec. 2021 update)

A.1. United States

The US position has been structurally negative since the 1990s. It's a net debtor. Nevertheless, three different phases can be emphasized, according to Atkeson et al. (2022). In the first phase, covering the period from 1990 to 2002, US experienced a growing current account deficit, This phase was characterized by a deterioration of its NIIP from USD (-338.9) bln to (-2,501) bln, or, in terms of GDP share, from (-5.5%) to (-22.9%)[12].

[12] Data are obtained from *External Wealth of Nations* (EWN) database by Lane and Milesi-Ferretti (2001,2007) - December 2021 update, and are slightly, but not significantly different from those used by

The second phase, from 2002 to 2010, showed a certain stability with an average of nearly USD (-2,500) bln, notwithstanding further widening of the current account deficit. This phase is described as a period of "special privilege" for the US economy where the financing of the deepening deficit was facilitated by the attractiveness of high returns on foreign assets, in particular investments in EMEs which have experienced strong growth during this period (Atkeson et al., 2022).

In a third phase, which begins after the Great Recession (2010), the US external position as net debtor deteriorates more strongly and goes from over USD (-4,850) bln to over USD (-14,500) bln at the end of 2020, or almost (-70%) of GDP. This marks "the end of the special privilege", according to Atkeson et al. (2022), and could be explained by the fact that when the US economy was experiencing a strong pace of growth (and therefore growing financial returns for nonresidents investing in US assets), many creditor countries, like EMEs, experienced a period of weaker growth of economic activity and asset returns including those held by US residents (Atkeson et al, 2022).

A.2. China

The case of China is very relevant. China moved from a net debtor to a net creditor position in 1999. This turning point corresponds to the period following the Asian crisis, when many EMEs, more particularly in South-East Asia, but also others, and whose growth is led by exports, have begun to adopt international reserve accumulation policies, mainly with a motive of self-precaution against external shocks and financial crises, but also, for some of them, like China, with a mercantilist motive which means accumulating reserves in order to safeguard the currency competitiveness, and consequently, exports.

The boom of commodity prices from 2003 and the magnitude of global growth (except the Great Recession in 2009-10) have strengthened the growth of reserve assets holdings by the EMDEs, including China, and therefore their overall financial assets. Chart (A) in Figure (1.2.) shows that the positive trend in China's financial position was sustained until reaching an all-time high in 2019 with nearly USD 2,170 bln. In terms of

Atkeson et al. (2022) obtained from the *US Bureau of Economic Analysis* (BEA) database. The EWN database, which is regularly updated, is the richest and most reliable source on IIP data, unlike the IMF database, which is based on member countries' statements and does not cover a long period for all countries. For example, Algeria started reporting its IIP data to IMF just in 2011.

GDP share, China's financial surplus *vis-à-vis* the RoW has decreased since 2008 from 30% into an average of 15% in the 2010s.

That is most likely due, as cited in the description of the third phase relating to the US, to the relative decline in emerging yields relative to those of US residents, and more particularly, due to the slowdown in Chinese growth seemingly caused by its gradual shift from an export-led growth strategy towards a growth model based on internal demand.

A.3. Japan

In contrast to the US, Japan's external position is experiencing a positive structural trend since several decades. Indeed, Japan's NIIP trend is marked by a quasi continuous linear growth and reached nearly USD 3,400 bln at the end of 2020. Thus, Japan is the world largest net creditor. This trend can be explained by several factors that impact, directly or indirectly, the structure and the composition of Japan's external assets and liabilities. The chronic deflation that Japan has experienced since the 1990s (in the aftermath of the real-estate and financial crises) has fostered significant domestic net savings, with growth in its corporate component. International reserves, which are also a form of savings, have had a continuous positive growth: Japan is the second largest reserve accumulator, and was the first until 2005, before being surpassed by China.

Another explanation can be deduced from the observation of the income balance. Colacelli et al. (2021) found a positive return differential between investments abroad and investments received, especially the FDIs. This is reflected in a positive growing income balance trend since the mid-1990s. The same applies to the returns on portfolio investments, whose liabilities (on investments received) are often lower than those on assets (investments abroad) because of Japan's highly accommodative monetary policy (zero or negative real interest rate policy, quantitative and qualitative easing), as well as low credit-risk, explain Colacelli et al. (2021).

B. External financial position and the level of reserves

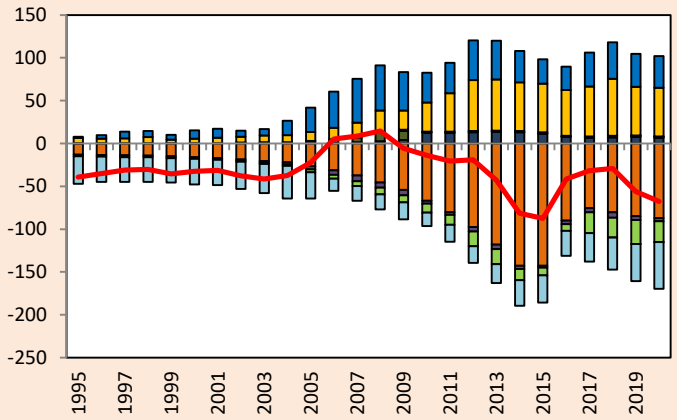
In comments on Equation (2) used to calculate NFAs (or NIIP excl. gold), we have noted that a country's external position as a net creditor or debtor is not determined only by the greater or lesser stock of reserves it holds. It is not because a country has large stocks

(in value or GDP share) that it has necessarily a net creditor position, and conversely, holding a relatively limited level of reserves is not synonymous with a net debtor position.

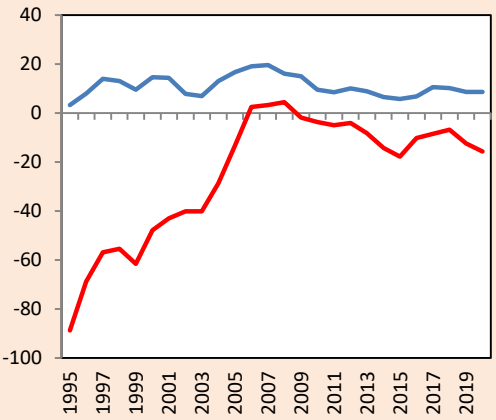
Figure (1.3.) gives comparisons between external financial positions of four selected countries (at different levels of development) and their reserve holding levels: two developing economies (Nigeria and Algeria), one emerging economy (India) and one advanced economy (Belgium). Nigeria and India are both net debtors over the entire period between 1995 and 2020 (with the exception of a modest positive position for Nigeria between 2006 and 2008). Both countries are accumulators of international reserves. In parallel, Belgium and Algeria are both net creditors (over most of the period under study). In terms of GDP share, Belgium has always had low levels of reserves, while Algeria is (was) considered to be an important accumulator (over much of the period under study).

Figure (1.3.): External financial position and reserve level, 1995-2020

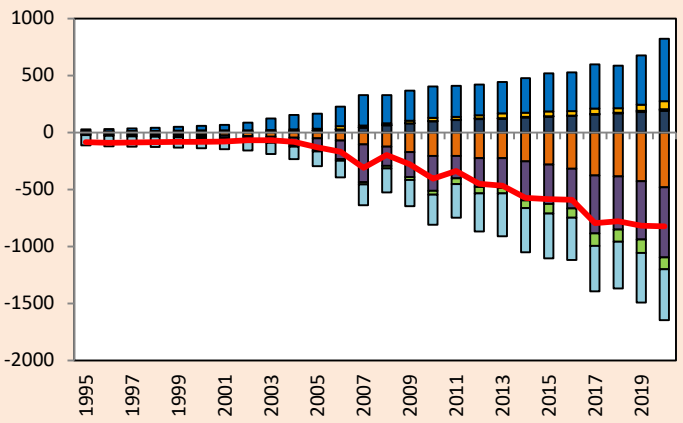
A1. Nigeria. Decomposition of NIIP *(Bln. USD)*



A2. Nigeria. NIIP and Reserves *(pct. GDP)*



B1. India. Decomposition of NIIP *(Bln. USD)*



B2. India. NIIP and Reserves *(pct. GDP)*

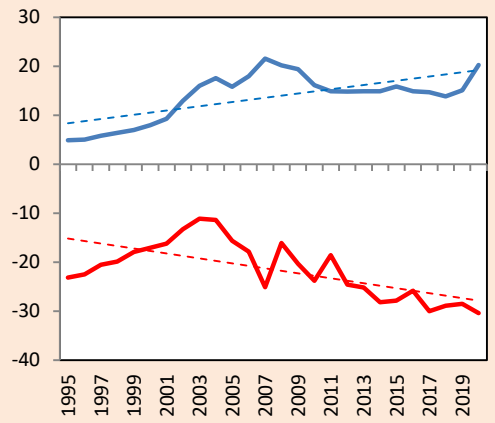
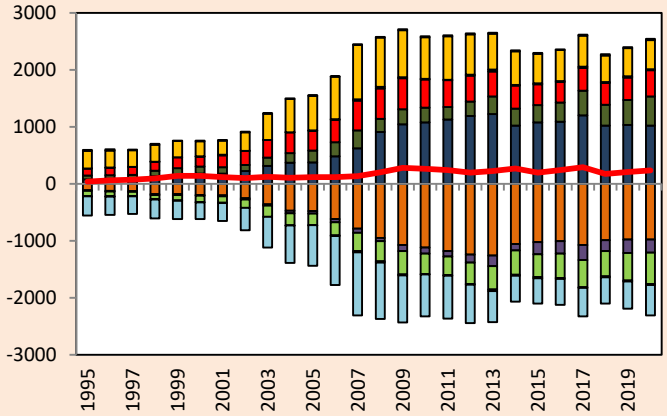
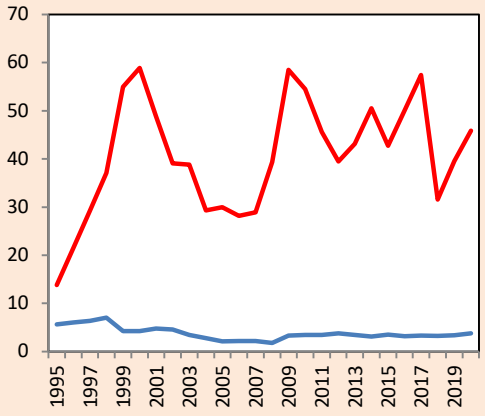


Figure (1.3.): continued

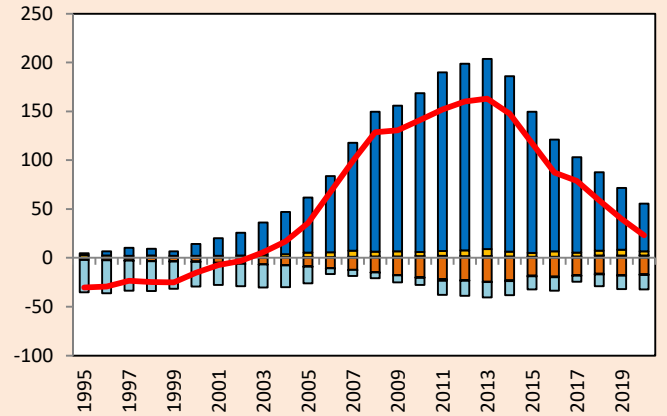
C1. Belgium. Decomposition of NIIP *(Bln. USD)*



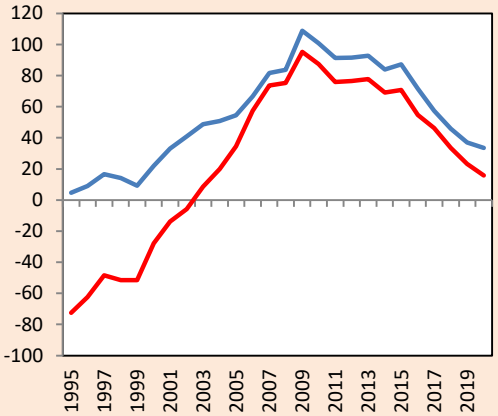
C2. Belgium. NIIP and Reserves *(pct. GDP)*

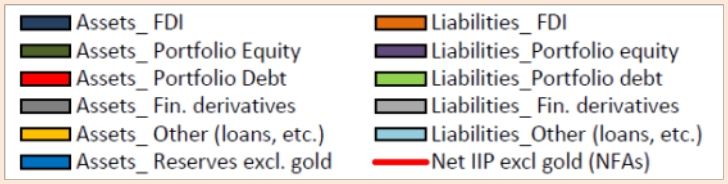


D1. Algeria. Decomposition of NIIP *(Bln. USD)*



D2. Algeria. NIIP and Reserves *(pct. GDP)*





Source: By the author; based on EWN database by Lane and Milesi-Ferretti (Dec. 2021 update)

B.1. Nigeria

Nigeria, like other oil-exporters, have benefited from hydrocarbons' price boom since 2003 to 2008. Its reserve stock[13] increased from less than USD 8 bln on average over the period 1995-2004 to more than USD 40 bln on average over the period 2005-14, and subsequently dropped with the fall in oil prices since 2014, with USD 35.5 bn on average

[13] Data on international reserves in future developments do not include the gold component, unless otherwise noted. The abbreviation (excl. gold) meaning (excluding gold) will be used in this sense.

over the period 2015-20. Reserve level improvement has not led to a change in Nigeria's position as a net debtor, as shown in Charts (A.1.) and (A.2.). In terms of GDP share, a first phase was characterized by a significant improvement of NIIP until becoming positive between 2006 and 2008. In a second phase, beginning in 2009, the NIIP returned into the negative area. It is, however, interesting to note that during this second phase, the evolution of the NIIP and the stock of reserves (both in terms of GDP share) became more synchronized. The decomposition of the NIIP shows that the stock of reserves (among other external assets) does not entirely cover liabilities *vis-à-vis* the RoW (including those related to FDI received and which represent a significant share of total liabilities). That explains a negative NIIP and a (quasi-) structural net debtor position.

B.2. India

India has been one of the most dynamic EMEs in the last decade and is actually one of the largest international reserve accumulators, with holdings rising from almost USD 38 bln in 2000 to over 275 bln in 2010, and almost 550 bln in 2020: 10^{th}, 8^{th} and 4^{th} ranks, respectively. Thus, the stock of reserves has doubled over the last decade, and shows an upward trend in terms of GDP share over the period covered (1995-2020), as shown in Chart (B.2.). However, despite the substantial and continuous accumulation of reserves, the external financial position is structurally negative and characterized by a continuous deterioration (Charts B.1. and B.2.). As in the case of Nigeria, accumulated reserves, although larger, do not cover (even with other foreign assets such as FDI assets) all liabilities, in which the FDIs received, portfolio investments and external debt account for the majority. So this is an example where even a large reserve accumulator can be a net debtor *vis-à-vis* the RoW.

B.3. Belgium

The example of Belgium represents the case of a net creditor country despite a relatively low level of reserves. Chart (C.2.) shows that the NIIP is largely positive over the period with an average of over 40% of GDP, and a record of 58.5% in 2009, while reserve levels in value and GDP share are relatively stable and low: almost USD 14.5 bln and 3.8% on average, respectively. This is the case of an advanced economy with very high levels of international financial integration and financial market development. The positive external financial position is explained by a total of (diversified) assets that are

permanently higher than a total of (diversified) liabilities, as shown in Chart (C.1.). In fact, one of the characteristics of AEs (whether they are net creditors or net debtors) is the broad (qualitative and quantitative) composition of assets and liabilities items in the financial account. In other words, the (quasi-) perfect financial openness, as well as the low country-risk of AEs, among other factors, explain the fact that these economies do not have structural needs for holding large levels of reserves, unlike EMDEs, more fragile.

B.4. Algeria

The last point, above, is very clear in the case of Algeria where, since 2003, the move from a net debtor to a net creditor status is almost exclusively explained by the evolution of accumulated reserve stock and impacted by hydrocarbon revenues during the period between the beginning of the commodity boom and oil counter-shock since 2014. Chart (D.2.) shows a near-juxtaposition of NIIP and reserve plots, particularly from 2006 onwards, due to the external debt refund, which constituted the bulk of external liabilities, with the low level of FDI. On the asset side, and with the exception of a very small share of the item “Other investment assets” (which are mainly: loans, commercial credits or deposits on nonresident entities), reserves represent almost all external assets. This is the case of a developing economy dependent on oil and gas export earnings and with one of the lowest levels of international financial integration in the world.

Section 2. General Trends in Reserve Accumulation

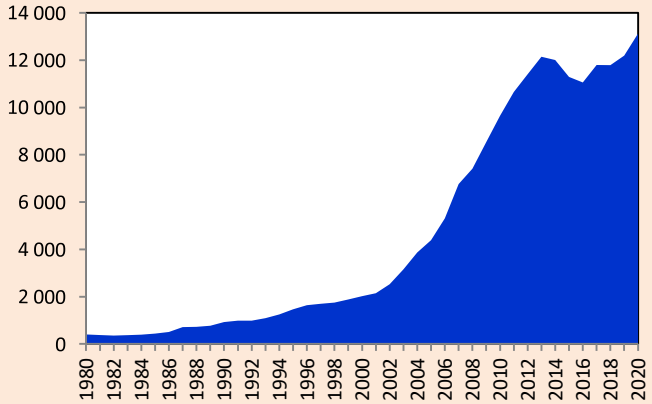
After having given in the previous section a presentation of the concept of international reserves and its relation to other concepts, notably those of international liquidity and international investment position, with some specific examples of countries for the latter, we address the concept empirically in this section through the trend of international reserve accumulation (excl. gold) on a global scale and according to the level of development of countries.

2.1. Trends of reserves in absolute values

2.1.1. The global trend of accumulation

Figure (1.4.) shows a stable growth of global reserve accumulation until the early 2000s, followed by acceleration from 2002, with an increase from USD 2,532.5 bln to USD 13,127.9 bln in 2020 – an increase by a factor of 5.18. Then, a decrease of USD (-362.4) bln is noted between 2014 and 2016, before a recovery until 2020.

Figure (1.4.) : World reserves (excl. gold), 1980-2020
(in bln. of USD)



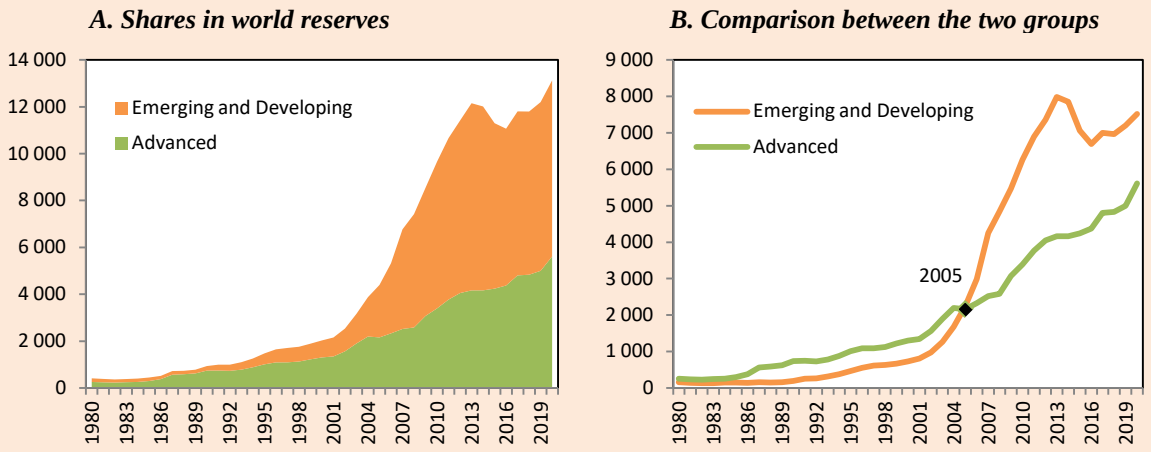
Source: By the author; based on IFS database (IMF, 2022a)

2.1.2. Trends in AEs and EMDEs

The decomposition of world reserves between the two country groups (AEs and EMDEs), as in Figure (1.5.), clearly indicates that the global acceleration is influenced by

the trend in EMDEs. The AEs curve seems to be relatively stable over the whole period 1980-2020, while a break is observed since 2003 for EMDEs, where the USD 1,000 bln level is crossed for the first time. In 2005, the level of reserves accumulated by EMDEs, which was previously lower than that of AEs, exceeded this latter and continued its strong growth until reaching all time high record of USD 7,848,2 bln in 2013 – a year of a reversal until 2016, before resuming its growing trend. This year, 2005, is also the year when China surpassed Japan as the largest accumulator of international reserves in the world.

Figure (1.5.): Reserves (excl. gold) by country group, 1980-2020
(in bln. of USD)



Source: By the author; based on IFS database (IMF, 2022a)

2.1.3. The largest reserve accumulators

Table (1.3.) ranks the 20 largest reserve accumulators for 2000, 2010 and 2020. China rose from 8.3% to 24.7% of world reserves from 2000 to 2020, respectively. It can also be noted that in (or until) the early 2000s, AEs occupied more than half the number of countries on the list. This share fell to 30% at the end of the next two decades: five AEs came out of the ranking (Germany, France, Canada, Spain, and Norway). At the same time, the number of EMEs continued to increase (45, 50, and then 55%), while that of oil-exporters rose in the 2000s from 0 to 20%, and subsequently fell to 15% by the end of the next decade (Figure 1.6. – based on data in Table 1.3.).

Table (1.3.): Top 20 largest reserve holders (excl. gold)*
(in bln. of USD)

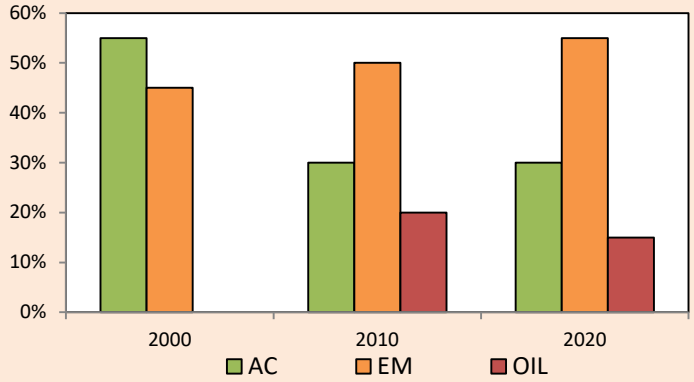
Rank in 2000	Country	Reserves in 2000	Rank in 2010	Country	Reserves in 2010	Rank in 2020	Country	Reserves in 2020
1	Japan	354.90	1	China	2,866.08	1	China	3,238.78
2	China	168.28	2	Japan	1,069.99	2	Japan	1,344.28
3	Hong Kong	107.54	3	Saudi A.	444.72	3	Switzerland	1,020.17
4	Korea, Rep.	96.13	4	Russia	443.59	4	India	549.09
5	Singapore	79.96	5	Korea. Rep.	291.49	5	Hong Kong	491.65
6	Germany	56.89	6	Brazil	287.06	6	Russia	457.02
7	US	56.60	7	India	275.28	7	Saudi A.	453.21
8	UK	46.64	8	Hong Kong	268.65	8	Korea. Rep.	437.11
9	India	37.90	9	Singapore	225.50	9	Singapore	362.09
10	France	37.04	10	Switzerland	223.48	10	Brazil	351.52
11	Mexico	35.51	11	Thailand	167.53	11	Thailand	248.74
12	Brazil	32.43	12	Algeria	162.61	12	Mexico	191.77
13	Switzerland	32.27	13	US	121.39	13	Israel	173.29
14	Canada	32.10	14	Mexico	120.26	14	Czech Rep.	165.54
15	Thailand	32.02	15	Malaysia	104.88	15	UK	161.19
16	Spain	30.99	16	Libya	99.65	16	Poland	140.32
17	Indonesia	28.50	17	Indonesia	92.91	17	US	133.85
18	Malaysia	28.33	18	Poland	88.82	18	Indonesia	131.14
19	Norway	27.60	19	UK	84.01	19	Malaysia	105.28
20	Poland	26.56	20	Turkey	80.71	20	U.A.E.	103.20

* In this table, AEs are: Canada, France, Germany, Hong Kong, Japan, Norway, UK, US, Singapore, Switzerland, and Spain; EMEs are Brazil, China, India, Indonesia, Israel, Rep. Korea, Malaysia, Mexico, Poland, Czech Rep. Thailand, and Turkey ; and Oil-exporters are: Algeria, Libya, Russia, Saudi Arabia, and United Arab Emirates.

Source: By the author; based on IFS database (IMF, 2022a)

It is also useful to note that euro area data (the Eurosystem comprising the ECB and the national central banks of the euro area) are not taken into account in Table (1.3.) to avoid double registration, in particular for 2000, where several euro area countries are included in the list. Including the euro area in the ranking would show the following results: 2000 (USD 242.33 bln – 2nd); 2010 (USD 300.24 bln – 5th); 2020 (USD 422.90 bln – 9th). Also, Taiwan's data are not reported because it is not an IMF member country, and therefore its data are not included in IFS dataset. However, Taiwan's data can be obtained from the official website of the *Central bank of the Republic of China (Taiwan)*. Including this data in the ranking (neglecting the euro area) would show the following results: 2000 (USD 106.74 bln – 4th); 2010 (USD 382.01 bln – 5th); 2020 (USD 529.91 bln – 5th).

Figure (1.6.): Shares of Advanced, Emerging and Oil-exporters' countries among the largest reserve holders, in 2000, 2010, and 2020



Source: IFS database (IMF, 2022a) and author's calculation

2.1.4. Explanations of differences in accumulation behavior

A. Lower needs for AEs

According to Chiţu et al. (2019), the explanation for the lower level of reserve holdings by AEs is that many of them have adopted floating regimes since long time, or that the exchange rate in these countries do not constitute a monetary policy target, and even in the case if central banks want to intervene on the Forex, they have other tools that allow less use of reserves, such as the use of interest rates and reserve swaps.[14]

B. Self-protection accumulation (the precautionary motive)

In addition, the accelerating reserve accumulation, beginning in the early 2000s by the EMDEs, is explained by several factors that are well documented in the literature. Firstly, EMEs, which were heavily hit by the financial and currency crises of the late 1990s and early 2000s, wanted to build up reserve shields in order to protect themselves against financial shocks (speculative attacks, insolvency, sudden stop, etc.) and real shocks (smoothing negative impacts on income and domestic demand). These accumulation

[14] This explanation is based on the omnipresent assumption in basic textbooks of international economics that reserve accumulation (and changes) is not necessary under float, and that reserve usefulness is limited to the unique purpose of interventions for manipulating exchange rates. However, in reality, reserves are not held only for that purpose, and there are several reasons to do it under float, and some floaters are large accumulators. The relationship between reserve accumulation and ERRs is at the heart of our research problem, and will be discussed in the Chapter 3.

policies are based on a "precautionary motive", studied in a wide literature[15]. This motive was comforted by the resilience of these economies and other developing countries including-oil exporters, during the 2008 GFC and the ensuing Great Recession[16], even if these performances were not unanimous[17].

C. Accumulation and exchange rate manipulation (neo-mercantilist motive)

The literature which explains the increase in the level of reserves, especially in the Asian EMEs, also mentions the role of export-led growth strategies, often based on an undervaluation of national currencies to increase international price-competitiveness. That was the case of China in particular, which experienced, among other East-Asian EMEs, large trade surpluses and an impressive increase in reserve stocks. The undervaluation of the renminbi has been criticized by the US (officials and academicians) as being one of the most important causes of the huge and continuously growing US trade deficit, especially *vis-à-vis* China, *i.e.* global imbalances phenomenon on which we will focus with more details in Chapter 2. Thus, beyond the precautionary motive, literature adds a "(neo) mercantilist motive" as a complementary explanation to reserve accumulation by the EMEs, including China, as many studies conclude.[18]

D. Accumulation due to low absorptive capacity (of favorable shocks)

The significant boom of commodity prices (including oil) since 2003-4 is another factor that has benefited many developing economies and positively impacted their current balances and reserve stocks. For example, for the Middle East and Central Asia (MECA) region, which includes a significant number of large hydrocarbon exporters, the level of reserve holdings rose from USD 191.9 bln in 2003 to USD 1,437.81 bln in 2014 – the year from which a downward price situation began and lasted until 2021. The stock of accumulated reserves during this period (2003-14) was thus multiplied by a factor of 7.5.

[15] Such as: Flood and Marion (2001), Wijnholds and Kapteyn (2001), Aizenman and Marion (2003), Mendoza (2004), Jeanne and Rancière (2006), Aizenman and Lee (2007), Bastourre et al. (2009), etc.

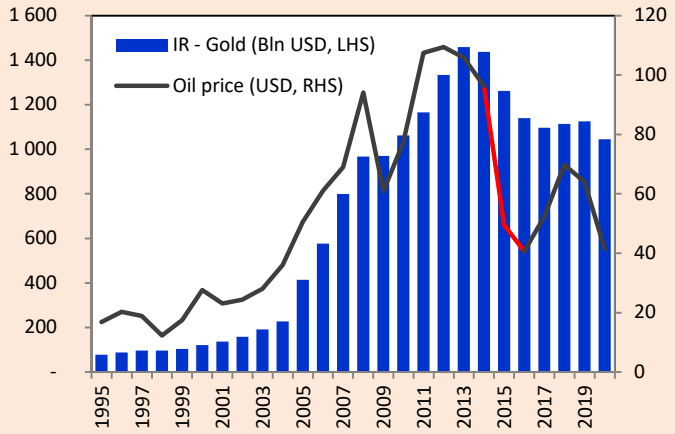
[16] Such as: Aizenman (2009), Obstfeld et al. (2009), Llaudes et al. (2010), Frankel and Saravelos (2012), Bussière et al. (2014), etc.

[17] Blanchard et al. (2009) and IMF (2009b, c) agree that these economies have succeeded to cope with financial shocks caused by the subprime crisis, but not as much *vis-à-vis* the transmission of the real cycle.

[18] Such as: Aizenman and Marion (2003), Aizenman and Lee (2007), Bar-Ilan and Marion (2009), Dordu et al. (2009), Delatte and Fouquau (2012), etc.

Figure (1.7.) shows a strong synchronization between the trend of accumulated reserves by the MECA group and that of the annual average oil price.[19]

Figure (1.7.): Reserves (excl. gold) held by MECA OE countries and OPEC average annual oil price, 1995-2020



Source: By the author; based on IFS (IMF, 2022a) and Statista databases

It is not normal that such reserve levels was held by energy-exporter developing countries (such as Algeria) while having significant investment and infrastructure needs (Artus, 2007; Talahite and Beji, 2013). This accumulation cannot be explained by precautionary motive against capital outflows or neo-mercantilist motive, but rather by weak "absorptive capacity" of large external incomes due to under-developed financial systems (Talahite and Beji, 2013), or lack of industrial policies (Hadj Nacer, 2009).

In addition, other factors contribute to explain the trend of reserves in EMEs, notably the growth of industrial competitiveness in Latin America and Asia as well as large financial account surpluses exceeding current account deficits in other EMEs such as Brazil, India, and Eastern European countries (Elhiraika and Ndikumana, 2007).

2.2. Trends of reserves in GDP share

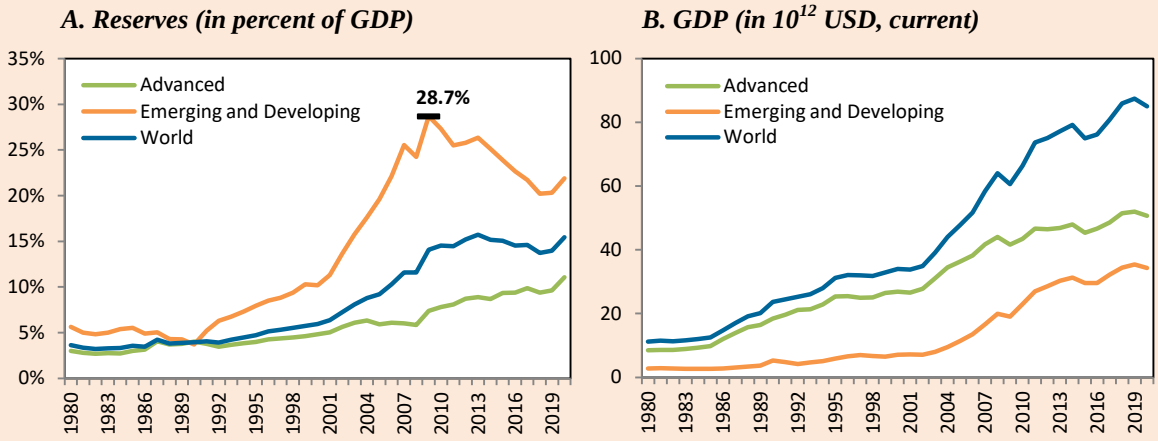
2.2.1. Increasingly growing "foreign exchange savings" in EMDEs' GDP

The analysis of the trends of worldwide held reserves and by the two groups of countries in terms of GDP share, as shown by Figure (1.8.), reveals several observations.

[19] According to the IMF classification, the group of oil exporting countries in this region, called "ME&CA OE", includes: Algeria, Azerbaijan, Bahrain, Iran, Iraq, Kazakhstan, Kuwait, Libya, Oman, Qatar, Saudi Arabia, Turkmenistan, and the United Arab Emirates.

Growth of reserves in terms of GDP share has been slower in AEs, but remained steady (except a relative stability at 6% between 2004 and 2008, probably explained as a phase of adjustment face to the commodity price boom). At the same time, the share of reserves in EMDEs' GDP was often higher than in AEs as well as globally. The gap between the two groups of countries grew continuously from 2000 until the Great Recession of 2009 – the year it reached an all-time high of 28.7% for EMDEs, against 7.4% and 14.1% for AEs and at World level, respectively, for the same year.

Figure (1.8.): Reserves (excl. gold) and GDP by country group, 1980-2020



Source: By the author; based on IFS database (IMF, 2022a)

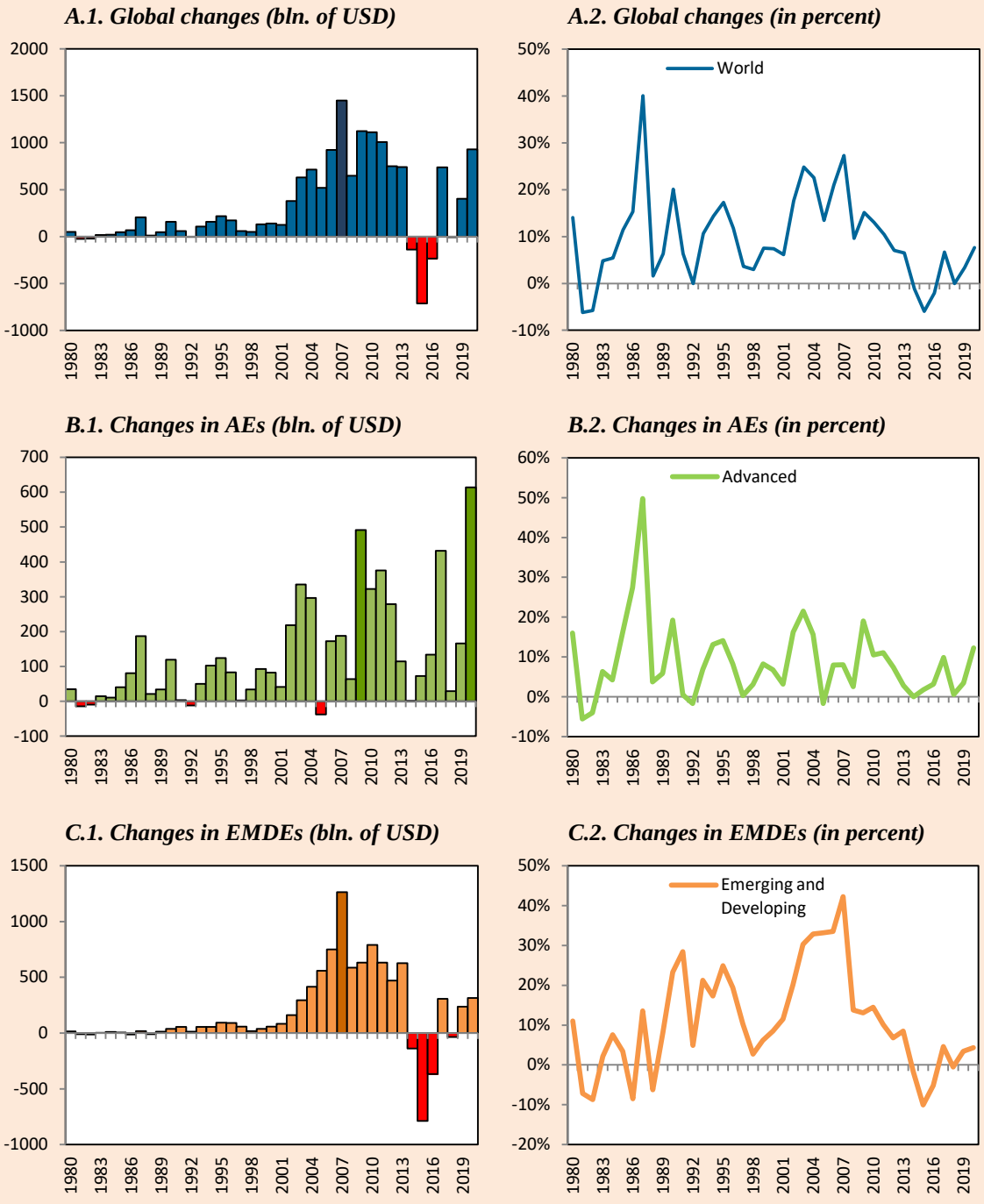
2.2.2. Sources and uses of reserves differ between the two groups

The trend in EMDEs is reversed from 2009 onwards and the gap is decreasing. The "de-accumulation" in EMDEs, in terms of GDP share (not absolute value), or in other words, the fact that there were fewer changes in 2009 and 2008 in comparison with 2007 and 2006 (as we will see in Figure 1.9. -Chart C.1.), supports the idea that large reserves have allowed these countries to be more resilient to real and financial shocks during the crisis (precautionary motive). Chart (B) in Figure (1.8.), showing GDP trends, indicates that there was less activity losses in EMDEs than in AEs. It can also be seen that following the 2008 crisis the share of reserves in GDP continued on a downward trend for EMDEs' group while it rebounded for AEs' group. This confirms, as discussed above, the use of reserves to cope with crises by the former and the decline of imports (or trade deficits) for the latter.

2.3. Annual changes in reserve holdings

Figure (1.9.) shows disparities in the evolution of reserve stocks over time and between the two groups of economies.

Figure (1.9.): Annual changes in reserves by country group, 1980-2020



Source: By the author; based on IFS database (IMF, 2022a)

2.3.1. The great influence of changes in EMDEs since the 2000s

A first striking feature is that prior to the 2000s, the global trend was influenced by the AEs' trend; while afterwards, it was the pace and the volatility level of EMDEs' accumulation that have shaped the global pattern. Thus, the world record in terms of annual changes was in 2007, with USD 1,450.6 bln more than the year before, of which 1,262.6 bln went to EMDEs.

Also, the reversal of the global accumulation trend between 2014 and 2016 was strongly influenced by the downward trend in EMDEs during this period, as shown in Figures (1.5.) and (1.7.). Indeed, the cumulative world losses during these three years were USD (-1,087.1) bln, *i.e.* a cumulative rate of (-9.2%), and USD (-1,295.0) bln, *i.e.* a cumulative rate of (-17.0%) for EMDEs. For AEs, the corresponding levels have weakened but remained positive. The decline is mainly due to the Chinese economy slowdown, which had a double effect on the level of world reserves.[20] On the one hand, China's declining trade surpluses had a significant impact on its reserve holdings. On the other hand, because of its weight in the global economy, the decline in Chinese demand due to activity slowdown led to a decline in world demand for raw materials, particularly oil in 2014, as shown in Figure (1.6.), given that the build-up of reserves for many EMDEs during the period 2003-13, including OPEC countries and other exporters such as Russia, was fuelled by commodity export earnings.[21]

2.3.2. Increasingly symmetrical trends of changes

Also, it seems that during certain particular circumstances, the trends of changes in the two groups of countries were quasi-symmetrical (opposite). For example, the two

[20] The decline in the pace of Chinese activity is the result of a planned structural mutation from an export-led growth regime into a domestic demand-based regime where services and the private sector play a greater role. Double-digit growth in the 1990s and 2000s (10.0% and 10.4% on average, respectively) gave way to an average rate of 7.7% for the decade 2010-2019.

[21] In addition to the slowdown in China's demand and its weight in global demand, other factors explain the imbalance (between supply and demand) in the global oil market that drove down prices between 2014 and 2016, in particular the return of Iran to the market and the rivalry for market control between Saudi Arabia and the US, whose production surpass, from 2012 onwards, those of traditional leader countries (Saudi Arabia and Russia), and this thanks to the growth of unconventional hydrocarbons production (shale oil and gas), whose profitability benefited from high prices during the favorable economic conditions' period. OPEC's strategy to increase production and lower prices has led to the eviction of unconventional producers; and the agreements with Russia (OPEC+) from 2016 for supply regulation led to a slow recovery of prices until 2020. Disagreements between Saudi Arabia and Russia in 2020 triggered a historic collapse of markets where contracts were traded at negative prices. The "Great Lockdown" crisis of 2020 related to the Covid-19 pandemic confirmed the low oil conjuncture.

largest (positive) changes in value for AEs (500 and USD 600 bln) correspond to two major crises (2009 and 2020, respectively), while the corresponding changes for EMDEs remained relatively moderate if compared with previous performances (631 and USD 314.5 bln), respectively.

That can be explained by the fact that for AEs, a global crisis is synonymous with a reduction in external payments (imports) and trade deficits due to price- and quantity-effects, and also the use of fiscal and monetary tools (not foreign exchange reserves) to counter the crisis effects, contrary to EMDEs for which the holding of reserves is partially, or even fundamentally, motivated by their precautionary usefulness, as we have already noted. In addition, there is also the dramatic decline in global demand and exported goods' prices, which are often the main source of their reserves.

2.4. Reserve trends relative to world trade

2.4.1. Synchronized trends (in appearance)

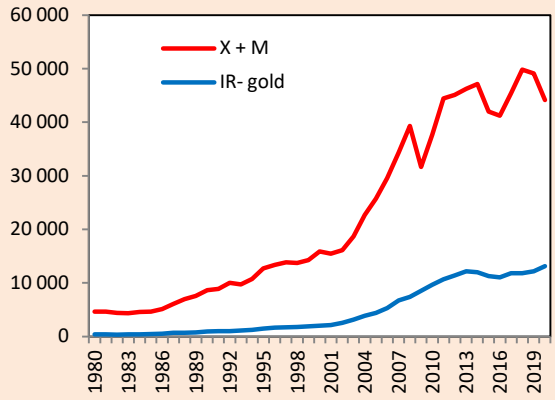
International trade –the ancestral locomotive of economic globalization, experienced, in general, a positive growth trend since the second half of the 1980s, but its acceleration began clearly in the early 2000s. Of course, international crises' episodes or abrupt cyclical reversals (such as oil counter-shocks) are temporary brakes. Chart (A) in Figure (1.10) shows that the value of world trade (measured as the sum of exports and imports) far exceeds the world stock of reserves.

2.4.2. An increasingly clear disconnection (in reality)

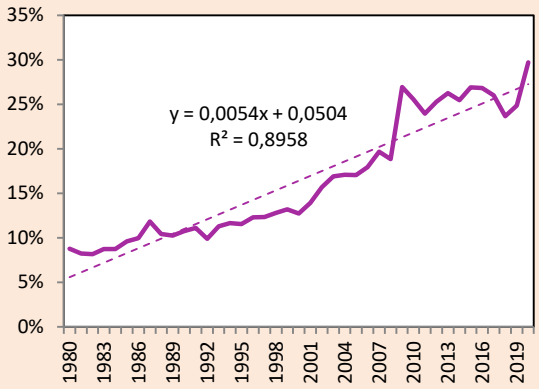
If one takes into account the share of reserves in world trade, he can clearly see that it is constantly increasing. The value of trade-related reserves was less than 10.0% in the early 1990s and reached almost 30.0% in 2020 (Chart B). The growth rate of reserve accumulation relative to trade growth intensifies from 2001. In 2020, the growth rate of reserves was 3.8 times that of trade (Chart C). This may be interpreted, upstream, by the fact that reserves are less and less considered according to their basic functional utility, namely ensuring payment needs, in particular commercial transactions; and downstream, by the fact that an increasing disconnection between trade and reserves would mean that, generally, the current account loses its weight as a major source of reserve accumulation in favor of the financial account.

Figure (1.10.): World reserves (excl. gold) and trade, 1980-2020

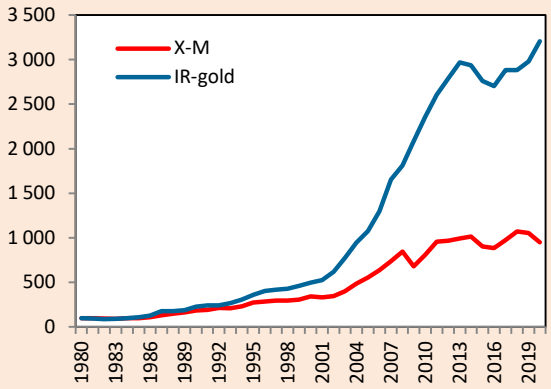
A. In bln USD, current



B. Reserves / World trade (in pct.)



C. Compared growths (1980=100)



Source: IFS (IMF, 2022a) and WDI (WB, 2022) databases, and author's calculation

Section 3. Trends of International Reserves by Component

In the previous section, we studied the evolution of global reserves (excl. gold) according to several parameters and, if any, in comparison between AEs and EMDEs. We focus here on the evolution of international reserves' components, namely SDRs, reserve position at the IMF, monetary gold, as well as other reserve assets, or what is commonly known as foreign (exchange) reserves. For this fourth type of assets, we analyze the world composition of reserve currencies (hierarchy and evolution over time). This last point represents a transition to Chapter 2 devoted to the issue of the hegemonic status of the US dollar as a reserve currency and its sustainability.

3.1. SDRs and Reserve position at the IMF

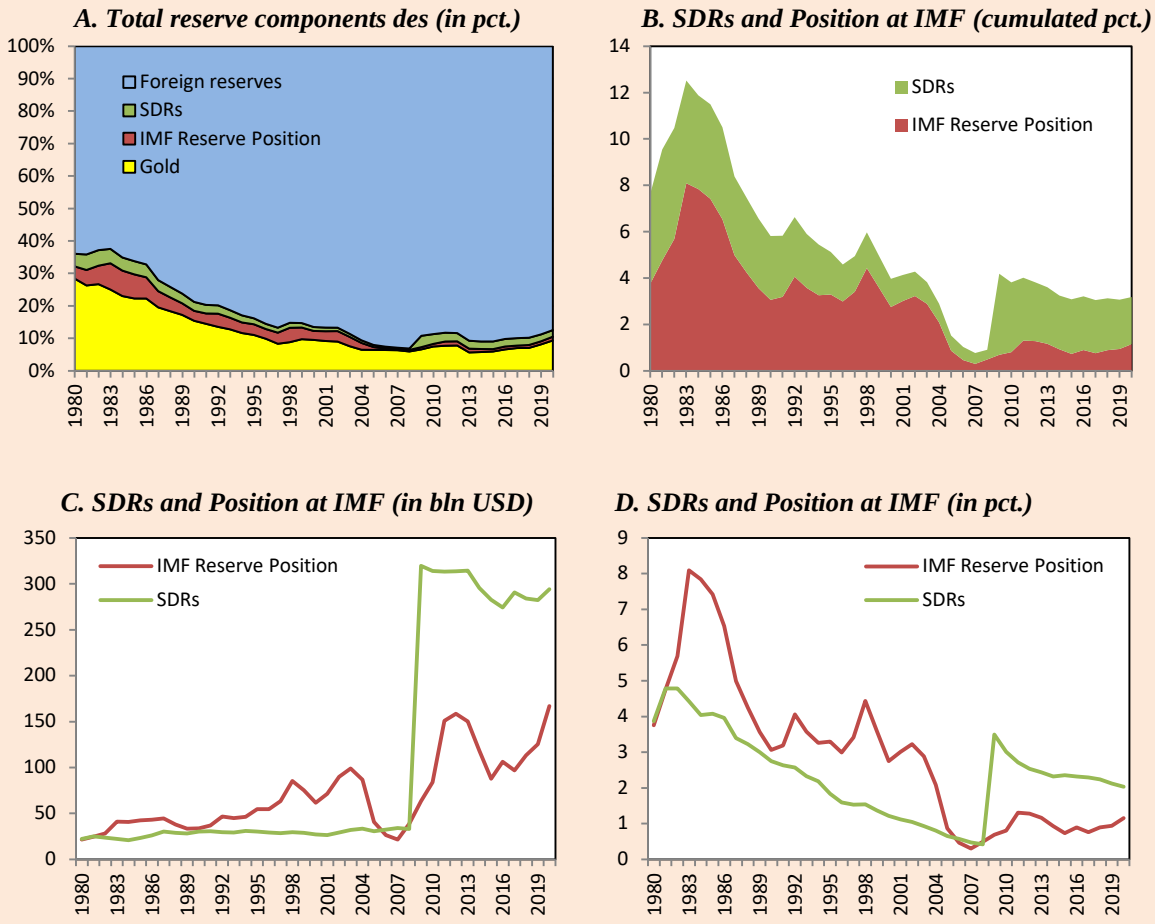
In comparison with gold, and even more with foreign reserves, the shares of SDRs and the reserve position at the IMF represented a small minority in international reserve composition on a global scale during the period 1980-2020, and even before (Figure 1.11. - Chart A). The cumulative share of the two asset classes shows a downward trend since the mid-1980s (with peak of over 12%), followed by an accelerating decline in the early 2000s, until the pre 2008 crisis period (less than 1%), as shown in Chart (B). This decline is explained by the large increase in the stock of foreign exchange reserves during the 2000s, on the one hand, and the relative stability (in value) of the two components' total (SDR and reserve position at the IMF assets), on the other hand.

In 2009, the IMF increased SDR allocations of its member countries by the equivalent of USD 286.7 bln. Moreover, only since this date that SDR total asset value exceeds the position at the IMF total asset value (Charts C. and D.). Despite this increase, the combined share of the two components in total world reserves has remained below 4% over the last decade.

It is therefore clear that SDR holdings and the position at the IMF represent a decreasing small share in global reserves. Despite that, they are often included in reserve data used in empirical studies, due to their immediate availability to monetary authorities (*c.f.* the definition of international reserves) –an availability in the event of crises or to deal with external payment problems, for example, but which is "less immediate" in

comparison with foreign exchange reserves, particularly for frequent interventions on the Forex. That said, if compared with monetary gold (which is studied in the next point), these three asset classes (SDRs, the position at the IMF and foreign exchange reserves) are more liquid; and also represent assets held on nonresidents, unlike gold.

Figure (1.11.): Shares of SDR holdings and Position at the IMF assets in world reserves, 1980-2020



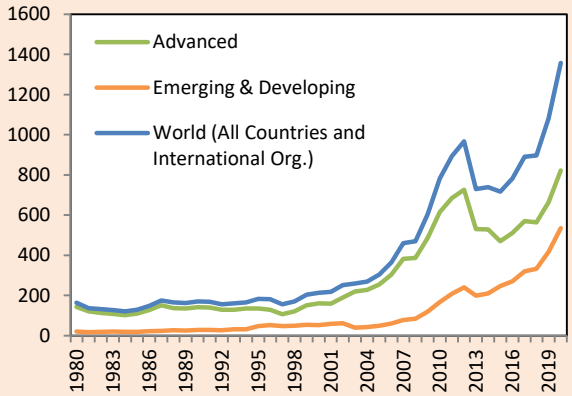
Source: By the author; based on IFS database (IMF, 2022a)

3.2. The gold share in international reserves

3.2.1. Trends of gold reserves in absolute values

World monetary gold reserves' value rose until 2012, decreased sharply until 2015, then recovered to historical levels in 2020 USD 1,357.1 bln. This trend is strongly influenced by the evolution of gold reserves held by AEs, whose overall value has always been higher than that of EMDEs (Figure 1.12.).

Figure (1.12.): Gold reserves by country group, 1980-2020
(in bln. USD, current)



Source: By the author; based on IFS database (IMF, 2022a)

However, it is very useful to take into account two factors in order to understand the trend of gold reserve assets' value.

A. Gold prices instability

The valuation of gold reserves is based on gold prices. However, the latter is more or less volatile, and we can therefore have different valuations for the same quantity of gold in different dates. In other words, an increase in the value of gold stock does not necessarily mean an increase in the quantity held, and *vice versa*. For example, the decline in the value of gold reserves between 2012 and 2015 corresponds to a period of a sharp gold price decline (almost 40% between the end of 2012 and the end of 2015). A decomposition of changes in the total value into price-effect and quantity-effect would allow detecting the real evolution of physical gold stocks. That said, the general trend of gold holding quantities has nevertheless evolved positively over time.

B. Gold as a "safe-haven" asset

In addition to its status as a reserve asset for central banks, gold also plays a role of "safe-haven" *par excellence* during financial turmoil or uncertainty periods. There was an accelerated rise in the value of gold reserves between 2008 and 2012, particularly in AEs. This period was marked by the Great Recession of 2008-9, the European debt crisis between 2010-2, and the fears about the "US Fiscal Cliff" at the end of 2012. The increase in the demand for gold as a safe haven by financial players, but also by the central banks,

more particularly in AEs, had an effect on prices and quantities during this period. These factors, together, explain the rapid development observed over this period, as it can be seen in Figure (1.12.).

3.2.2. Trends of gold reserves as a share of international reserves

A. Decline of gold importance through the evolution of the IMS

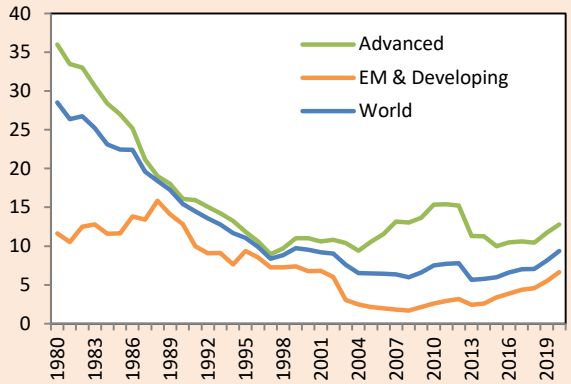
After having been considered as the main asset of international reserves (or liquidities), especially during the gold-standard system and also after, the importance of the status of gold decreased relatively under BW system because of the new international role of the US dollar, the return to convertibility of major western currencies in the late 1950s, the introduction of the SDR in the late 1960s, and the rise of euromarkets since the 1970s. The collapse of BW system in 1971 and the official demonetization of gold as a means of international settlements in 1976 (Jamaica Accords) have accentuated the eviction of gold as a dominant reserve asset. The resulting sharp volatility in gold prices has made its use in Forex interventions less evident, compared to foreign exchange assets, or even SDRs – which represents an important criterion in the definition of reserve assets, as Williamson (1984) points out. It should also be noted that gold price fluctuations make it undesirable to "go back and forth" between gold and currencies because of the fear of selling before the rise or buying before the fall. Gold has become a "reserve for reserves" for large holding countries (Scammel, 1987). For these two reasons (declining share of gold in international reserves and price volatility), empirical studies are usually using data on reserves (excl. gold), report Cheng (2014) and Steiner (2009), and as we have already noted.

B. Decline then stability of gold in reserve composition

Figure (1.13.) shows that, generally, the position of gold as a component of world's official reserves has declined significantly in last decades. More specifically, the decline was quite pronounced until the end of the 1990s, from almost 30% in 1980 to less than 9% in 1997. Over the past two decades, the share of gold in world reserves fluctuated between 5 and 10%. This trend was mainly driven by the trajectory of the AEs' curve. In addition to the fact that this group holds the most of gold as reserve assets, as indicated in previous developments, AEs also are in a higher position in terms of the ratio (Gold/Total reserves). For the EMDEs' group, the declining trend began from the end of the 1980s (15%) until

2008 (1.7%). This share remained below 5% until 2018 – a year after which renewed interest in gold increased its share in total reserves of both groups of countries, although the effect of the rise in gold prices should not be excluded to explain this recent rise.

Figure (1.13.): Gold share in total reserves by country group, 1980-2020
(in percent)



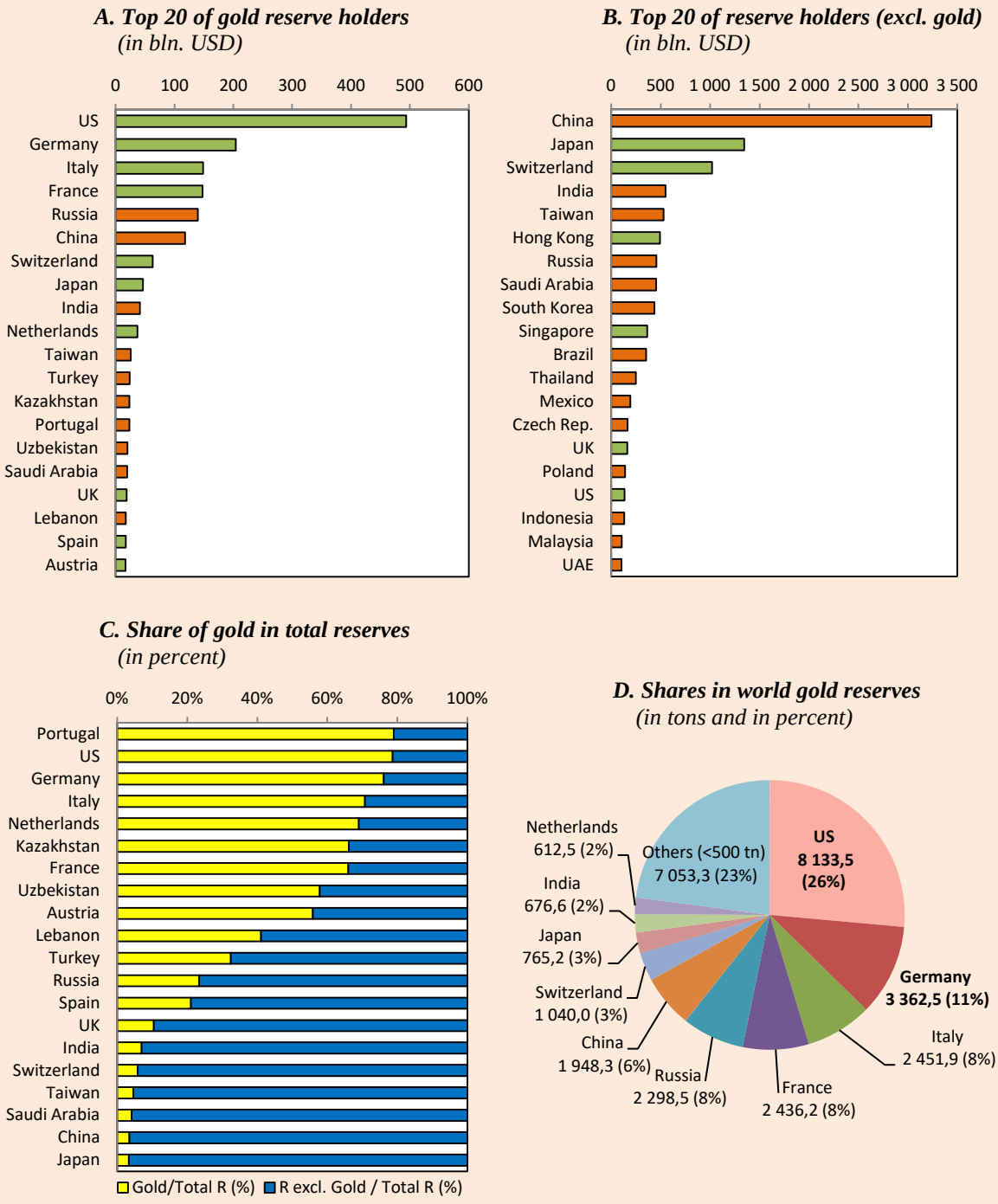
Source: IFS (IMF, 2022a) and World Gold Council (2022) databases, and author's calculation

3.2.3. Largest gold reserve holders

AEs have always outperformed EMDEs in gold holdings, either in terms of value or share in total reserves. Charts (A and B) in Figure (1.14.) show, through a comparison between the largest gold holders and the largest reserves (excl. gold) holders, that in 2020 the first category is relatively dominated by AEs, while the second contains more EMDEs.

Chart (C) shows that many of AEs among the 20 largest gold holders have a greater preference for this reserve component than other asset classes, including foreign exchange reserves. For example, Portugal, the US, and Germany held more than 75% of their international reserves in 2020 as gold assets. At the same time, for a majority of EMDEs in the top 20 list, the trend is going on the opposite direction: less gold than other reserve assets in the composition of total reserves. Moreover, for the three largest reserve accumulators in the world (China, Japan and Switzerland), the share of gold in total reserve assets is between 3.3 and 5.8%. This could probably be explained by national preferences for reserve composition and management strategies where a threshold effect (in value and/or as a share) for gold is one of the key parameters.

Figure (1.14.): Largest gold reserve holders, 2020



Source: IFS (IMF, 2022a) and World Gold Council (2022) databases, and author's calculation

Finally, the ranking of countries about gold reserve holdings can also be expressed as shares of worldwide held quantities. In 2020, the US held more than a quarter of the world's gold reserves, followed by Germany with nearly 11%. The top ten gold holders, alone, had more than three-quarters of the world's stock. Seven among these ten countries are AEs (Chart D).

3.3. Other reserve assets (foreign exchange reserves)

3.3.1. The reserve currency: an international currency

Central banks hold most of their foreign exchange reserves in the form of assets denominated in a small number of international currencies. An international currency, like the currency of a country (or of a monetary area), fulfils the three traditional monetary functions, namely: unit of account, means of exchange, and store of value; but also enjoys an advantage of extraterritoriality in terms of credibility and therefore uses; or in other words, a credibility beyond the borders of the issuing country (or the issuing area).

Thus, for the unit of account function, the prices of many products traded on international markets, such as oil and other commodities, are denominated in international currencies, mainly in US dollars. For the medium of exchange function, international currencies are used as a means of payment for different international transactions (trade, foreign exchange, deposits, investments, debt, etc.). For the store of value function, the stability over time of the purchasing power, and the use as accepted (liquid) and low-risk (safe) asset on an international scale, give some currencies the status of reserve currencies. The sterling had this status for much of the 19th century and several decades in the 20th. Gold, until its official demonetization in 1976, played this role (directly during the gold-standard system and indirectly during BW system). Since then, only a few currencies have had this status, at different levels of notoriety.

Table (1.4.) summarizes the various functions of an international currency. These functions facilitate international transactions of private actors (vehicle-currency for transactions, bank deposits and loans, invoicing, etc.) and official actors (exchange rate anchor, Forex interventions, and reserve holdings). Complementary links and network effects (or network externalities) exist between these functions, and the role of an international currency –the dominant currency in particular, is to ensure sufficient liquidity to “lubricate gears” between these transactions within (and between) international markets of goods, services and capitals (Gourinchas et al., 2019). We will return, later in this work, to the importance of network effects when studying the issue of the US dollar sustainability as a dominant currency.

Table (1.4.): International currency functions

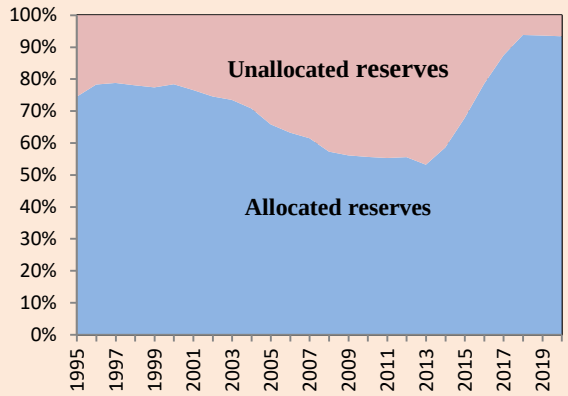
	Means of exchange	Store of value	Account unit
Private actors	Vehicle-currency for trade transactions and asset markets	Securities issuance Banking deposits and loans	Trade invoicing Denomination of securities
Official actors	Vehicle-currency for Forex interventions Lender of last resort	Foreign exchange reserves	Anchor for exchange rate

Source: Gourinchas et al. (2019); adapted from Kenen, P., (1983), The Role of the Dollar as an International Currency, *Occasional Paper* 13, Group of Thirty, New York.

3.3.2. Allocated and unallocated reserves

The IMF provides quarterly and annual data on the composition of foreign reserves in different currencies in a statistical statement called "Currency Composition of Official Foreign Exchange Reserves" – COFER). Member countries are encouraged to periodically report the composition of their reserves through official reports: these are the "allocated reserves". The sum of the remaining foreign currency reserves (for which the currency composition is not reported) is the "unallocated reserves"[22].

Figure (1.15.): Shares of world allocated and unallocated reserves, 1995-2020 (in percent)



Source: By the author; based on COFER database (IMF, 2022b)

Figure (1.15.) shows that the share of allocated reserves progressed from just over 74% in 1995 (when COFER was set up) to almost 94% in 2020. That means a greater

[22] COFER dataset does not give the currency composition of the reserves by country, because strictly confidential, according to the IMF. Data are published by country block (World, AEs and EMDEs). Also, at the time of writing these lines, only the data for World are fully up to date. AE and EMDE data stop at 2014 for annual data and Q1 2015 for quarterly data.

transparency in the composition of foreign reserves. However, the trend is not linear over the entire period. A decrease in the share of allocated reserves (from 78.4% to 53.2%) is observed between 2000 and 2013, This can be explained by the fact that this period coincides with the increase of reserve accumulation phenomenon mainly led by EMEs and hydrocarbon exporters – countries that are generally less accustomed to financial data reporting, unlike advanced countries. Later, acceleration in the share of allocated reserves is observed from 2013 to 2018. This period corresponds to the accession of more countries to the reporting protocols (and therefore more transparency), notably China which is the worldwide largest reserve holder, and which began collaboration for the COFER in 2015.

3.3.3. Shares of different currencies in the composition of (allocated) reserves

A. Dominance of the US dollar, followed by the euro by far

Data on the composition of allocated reserves clearly show the dominance of the US dollar over other reserve currencies (Figure 1.16. – Chart A). In 2020, its share is 59% against a little more than 21% for the euro in the second place. However, the share of both currencies is on a downward trend over the last two decades. The dollar represented 71% in 2001 and the euro 19.2%. The dollar, then, began a downward trend, unlike the euro; but, together, the two currencies represented 90% until the 2008-9 crisis – a date from which the share of dollar-euro couple began to give way to other currencies and represented in 2020 "only" 80.2% of the world allocated reserves. The rebound in the proportion of the dollar in the 2014-6 phase is due to the (first) Quantitative Easing Tapering Program initiated by the Fed in early 2014[23]. The positive effect of the Tapering on the dollar's share in reserves can be explained by the fact that, as a tool of monetary tightening policy, Tapering reinforces exchange rate of the dollar, and consequently the value of dollar-denominated reserve assets.

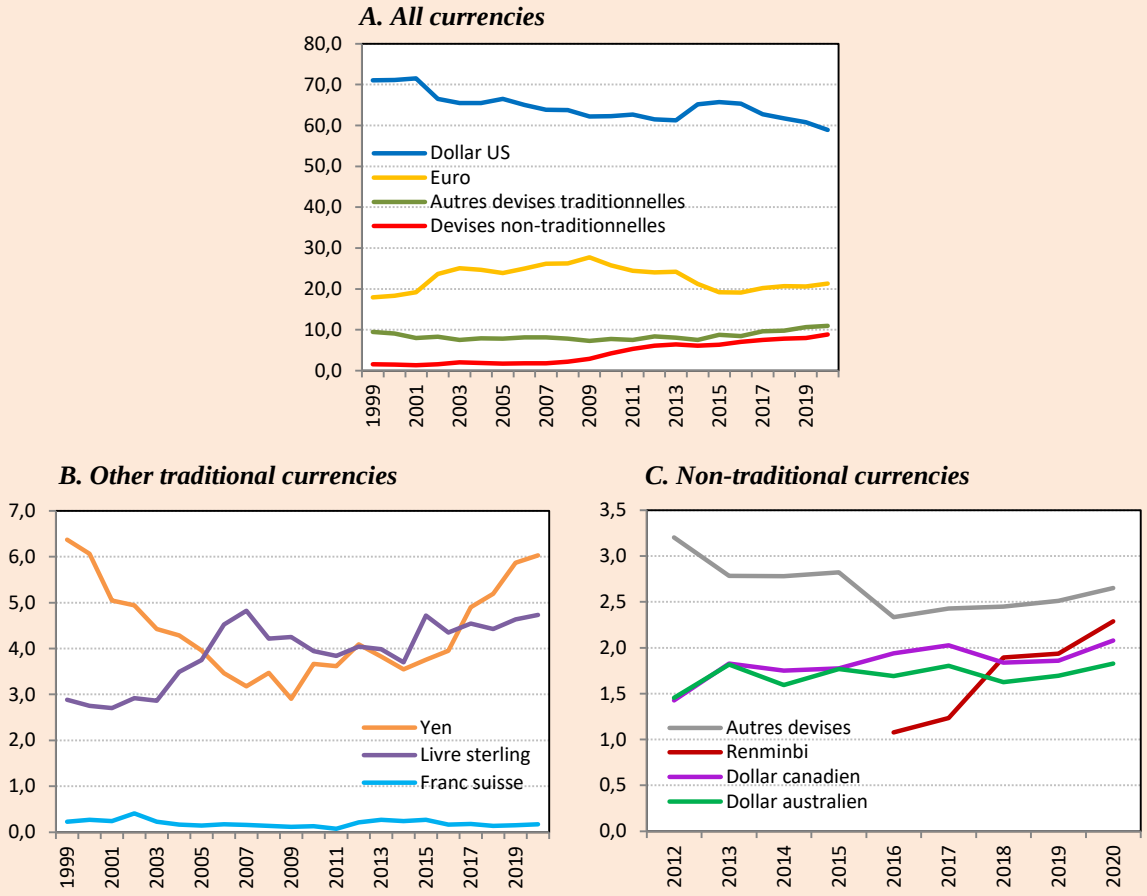
B. Stagnation of traditional currencies and emergence of non-traditional currencies

On the one hand, the three "other traditional currencies" of reserves (yen, sterling, and Swiss franc) have remained, together, on quasi-stable share around an average of 8.5%

[23] Quantitative easing is an accommodative monetary policy that increases the size of the central bank's balance sheet by buying debt bonds to inject liquidity into the markets. The Fed has adopted this policy in response to the 2008 crisis to avoid a deep deflation. Tapering means the reduction of bond-buying program as a first step for a return to a conventional (rate-based) policy.

over the last two decades (with a slight excess of 10% from 2019), as shown in Figure (B). On the other hand, the so-called "non-traditional" currencies, with essentially the Canadian dollar, the Australian dollar and the Chinese renminbi[24], increased in terms of cumulative share in the post-GFC period (2008-9). The most remarkable increase, as shown in Chart (C), was that of the renminbi, which doubled between 2016 and 2020[25].

Figure (1.16.): Currency composition of world allocated reserves, 1999-2020 (in percent)



Source: By the author; based on COFER database (IMF, 2022b)

Generally, over the last two decades, and more clearly since the Great Recession, the US dollar has lost about ten percentage points in world reserves in favor of (secondary plan) AEs and dynamic EMEs currencies, including China. Aizenman et al. (2020) study

[24] As well as other currencies such as the South Korean won, Swedish krona, Singapore dollar, South African rand, Indian rupee, etc.

[25] It should be noted that in the COFER data the group known as «Other currencies» included all currencies without distinction, except the traditional five (US dollar, euro, yen, sterling, and Swiss franc). Data for Canadian dollar and Australian dollar begin to be presented separately from the Q4 2012, and from the Q4 2016 for Chinese renminbi.

the determinants of the composition of (aggregated) reserves of 58 countries between 2000 and 2017 and note, among other things, a decline in demand for the "big four" currencies taken together (USD, euro, yen, and sterling) after the GFC, then an increase with the Fed's Tapering in 2014, and that beyond a certain threshold of the ratio (Reserves/GDP), reserve accumulators tend to increase the share of currencies other than the "big four".

Arslanalp, Eichengreen and Simpson-Bell (2022) give three reasons to explain the decline in the dollar's share in favor of non-traditional currencies. Firstly, their financial and Forex markets have become increasingly deep and liquid, which allow a qualitatively and quantitatively more attractive supply of assets, and a transition between these currencies and others at lower costs and without the need to go through a third currency (vehicle-currency), which traditionally has been the dollar or the euro. Secondly, central banks have become more active in seeking returns for their investments (reserve assets). Thirdly, and not far from the previous point, the weakness of yields, particularly of debt securities in traditional currency issuers' markets, including the dollar, has made it more attractive to invest in more profitable non-traditional assets, but also more volatile.

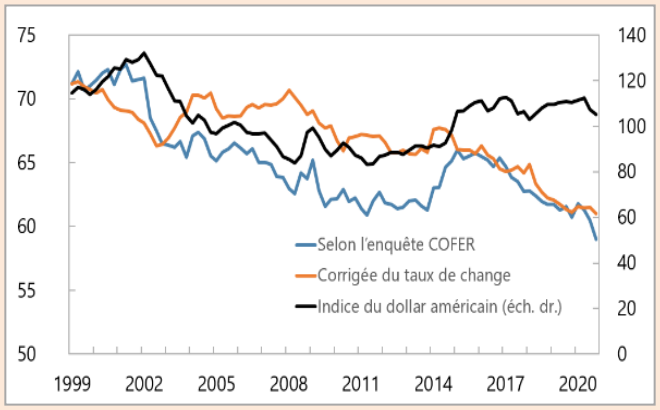
C. Exchange rate fluctuations and currency composition of reserves

Apart from what we have seen, it should nevertheless be noted that it is useful to take into account reserve currencies' exchange rate fluctuations in order to assess more exactly the evolution of their shares in the world reserve composition. Since this latter is expressed in US dollar, when the value of the latter is on a downward trend (relative to one or more among other reserve currencies), its relative share in the overall composition decreases, and when it strengthens, its share increases, *ceteris paribus* (Arslanalp and Simpson-Bell, 2021)[26]. That said, we have not noticed any significant differences in the general trend between our study and others that have corrected the value of reserves from exchange rate fluctuations (*e.g.*, Chiţu et al., 2019; Arslanalp and Simpson-Bell, 2021). Figure (1.17.) compares the evolution of the COFER share of the US dollar with the adjusted (effective) exchange rate share.

[26] (Real) Interest rate differentials can also influence the composition, but in a global context of strong financial integration, where rates often follow similar trends or are even influenced by the US monetary policy, their effects are generally less than that of exchange rates. For an empirical analysis of the effect of interest rate differential between US and other reserve issuers on the dollar's share in world reserves, see Arslanalp, Eichengreen and Simpson-Bell (2022) – a paper that expands the scope of Arslanalp and Simpson-Bell (2021).

Figure (1.17.): Share of the US dollar in world allocated reserves and exchange rate, 1999-2020

Share of USD in pct. Dollar Index*



* The dollar index, calculated by the Fed, represents the effective exchange rate of the dollar against other advanced countries' currencies (January 2006 = 100).

Source: Arslanalp and Simpson-Bell (2021)

Conclusion

In this chapter**,** we have discussed the concepts of international reserves and their components, as well as those of international liquidity and international investment position. We also looked at the phenomenon of reserve accumulation from a statistical and historical perspective, through the analysis of global trends and according to the level of economic development (AEs and EMDEs), and according to various parameters (values, GDP share, annual changes, international trade, economic conjuncture, etc.).

Several stylized facts and highlights have been detected, such as: the development of the accumulation phenomenon from the beginning of the 2000s, especially in the EMEs and hydrocarbon exporters; the emergence of China as the largest reserve accumulator since 2005; a better resilience of accumulator countries during the Great Recession of 2008-10; the slowdown/reversal of accumulation trend towards the middle of the 2010s due to factors as the Chinese slowdown in and the oil counter-shock.

The study of the composition of global reserves and its evolution over time, has allowed us to discover other facts, such as: the weakening of SDRs and position at the IMF shares over time; a more preference for gold as reserve assets by AEs, compared with EMDEs; etc. Also, the analysis of the currency composition of the world's exchange reserves has allowed us to deduce: a quasi-stagnation of traditional currencies such as the euro, the yen and the sterling; the emergence of non-traditional reserve currencies issued by smaller AEs (Canadian and Australian dollars) or dynamic EMEs (Chinese renminbi); and above all, the somewhat declining dominance of the US dollar in the global reserves' portfolio.

The latter observation, *i.e.* the historically dominant status of the dollar, and its close relation to the US structural net debtor position, as we have seen, will be studied extensively in the following chapter to understand the "eternal" debate on the sustainability of the dollar as a hegemonic international and reserve currency.

Chapter II.

The Dominant Reserve Currency and the International Monetary and Financial System

Introduction

The downward trend of the US dollar share in the world's exchange reserve composition has led to a re-emergence of the debate on the durability of its hegemonic status as the leading reserve currency, and more generally, as the dominant international currency for different types of economic transactions. The issue of the dollar's dominant status durability is related to the debate on the US external deficit sustainability – a very old and constantly renewed debate since the 1960s.

The central idea on which this chapter is based on is as follows: The dominant reserve currency's issuer (the US), has a structural and long-run negative external position (net debtor). In the event that the hypothetical unsustainability of this position results in a loss of RoW creditors' confidence, this will lead to a sudden stop in capital flows financing US deficits, the economy and the dollar will suffer a collapse, and the latter will lose (much of) its hegemonic status as an international currency (for transactions, pricing, and reserve uses).

The US external position sustainability, that conditions the dollar status durability as a hegemonic international and reserve currency, has been the subject of debate for more than 60 years. We propose, through this chapter, a lecture of the issue in a (quasi-) historical perspective: starting from the "Triffin dilemma" and the rise of the "exorbitant privilege" in BW system era, then going through a literature review on the origins of "global imbalances" phenomenon and "Triffin II" in the 2000s, until the re-emergence of a more recent debate between supporters and opponents to the hypothesis of an imminent "end of the privilege" in the light of recent economic and geopolitical developments. Finally, we analyze the feasibility of alternatives that have been proposed in the past or are currently discussed to replace (or at least compete) the dominant currency. The future potential role of the developing digital currencies is also discussed as a final point in this chapter.

Section 1. US External Position Sustainability and Dollar Hegemony

The issue of US external financial position sustainability is closely linked to that of the dollar durability as a hegemonic (dominant) international and reserve currency. This was the subject of an old debate, periodically renewed since the 1960s. We focus in this section on the genesis of the debate in BW era (with the Triffin dilemma) when the focus was on the budget deficits and the ability of the US to bear them (exorbitant privilege), then the re-emergence of the controversy in the 2000s which were characterized by twin deficits (debate on global imbalances phenomenon of and the new Triffin dilemma).

1.1. An old debate: the Triffin dilemma and the exorbitant privilege of the US

1.1.1. The Triffin Dilemma

Triffin (1960) criticizes the BW system based on the fixity of exchange rates with a single international currency that acts as the pivot for gold pegging. The system worked so that the US must import from the "periphery countries" of that period (mainly Western Europe and Japan), or even be in a trade deficit, in order to provide dollars that permit them to export to US. Exchanges led to growing dollar reserves for these countries, and created an increase in the US external liabilities to nonresidents (countries holding dollar reserves). According to BW system principles, these liabilities are synonymous with a guarantee of the gold supply to the creditors at a fixed price (fixed parities between nonresident currencies and the dollar and between this latter and gold).

For Triffin (1960), this situation is paradoxical and *in fine* unsustainable. On the one hand, the growing demand for dollar reserves by the periphery can only be met by US monetary creation, regardless of their limited gold stocks, so as not to create a shortage of global liquidity and a deflationary spiral. But on the other hand, an unlimited creation of dollar assets undermines the confidence of nonresidents in the ability of the issuing country to guarantee the conversion of their dollarized assets into gold, and consequently confidence in the dollar itself –a situation which would jeopardize the entire system. In other words, the hegemony of a currency for the international reserve holding forces the issuing country to be constantly in deficit, which, in the long-run, would betray confidence in it and accelerate the loss of its status.

Indeed, signs of a weakening BW system appeared in the late 1960s because of the particular American position, which led to its collapse in the early 1970s. But there has been no loss of the dollar hegemony. However, this does not mean that the basic idea of the Triffin dilemma is not still relevant despite of several changes in the international monetary and financial system (IMFS), as we shall see in subsequent developments.

1.1.2. The exorbitant privilege

In reality, the Triffin dilemma is based on the idea that the US has the peculiarity of being the "*core*" or the "center country" of the IMFS thanks to its economic, political and military hegemony: the center country issues the dominant currency (Gourinchas et al., 2019). The "special privilege" that the US obtains from its international currency is more commonly referred to in the literature as the "exorbitant privilege".[27] In general terms, it is defined as *"…(the) benefits enjoyed by countries in the form of either external borrowing costs or net returns on their international investment position"*. Its *modus operandi* can be schematized as follows: RoW central banks' demand for liquid and safe assets in an international currency is made with the objective to hold them as reserves. This lowers the financing costs of the issuing country of the reserve currency (ECB, 2019).

The center country does not have to "worry" about financing its growing deficits, at least in the short and medium-run, and to resort to costly external adjustment, fiscal restrictions, or other deflationary policies, because it enjoys the privilege of trust by the periphery (especially EMEs) in its economic potential and the vehicle-currency of this financing (Gourinchas et al, 2019). This allows the center country to live beyond its means (Eichengreen, 2004). On the other hand, the periphery pursues export-led growth strategies where undervaluation plays an important role; and thus, benefits from surpluses that are a source of "safe" reserves since they are mainly denominated in the center's currency.

However, this relation is not a zero-sum game; such an IMS is not symmetrical (Obstfeld, 2013). Asymmetry is the main character defining the exorbitant privilege: there is a net surplus of US-held asset returns on nonresidents (short, less liquid and riskier assets) relative to returns on their liabilities held by nonresidents (long, liquid and safer assets). Thus, the US has an international function of "intermediation and recycling" due to

[27] Before being used in literature, the term of "exorbitant privilege" was first publicly stated in 1964 by French Finance Minister Valéry Giscard d'Estaing (later elected President of the French Republic in 1974).

the asymmetry between risky assets it buys and safe liquid liabilities it sells[28]. This is similar to a "world banker" or even a "world venture capitalist" status (Gourinchas and Rey, 2007). For Farhi and Maggiori (2018), the exorbitant privilege is a "monopoly rent" situation resulting from being the unique issuer of the dominant international currency.

Historically, the US was not the first country to have benefited from an exorbitant privilege allowing it to guarantee the financing of its deficits. For long time, the UK was controlling a great empire and clearly played the role of the center country until World War I. Chen et al. (2022) show in an empirical study that the UK's public debt was not always fully covered by future budget surpluses. Its economic potential (and thus its ability to refund debt based on macro fundamentals' forecasts) did not cover more than three-quarters of the public debt (owned by nonresidents). Moreover, until 1914, the sterling was undoubtedly the dominant currency in worldwide foreign reserve composition, as we shall see later in this work. In inter-war period, and more clearly after World War II, the UK's debt became fully covered by its anticipated surpluses (on the basis of fundamentals). This period corresponds to the emergence of an increasingly competitive dollar in the world currency composition (between the two wars), and then dominant (since the 1940s).

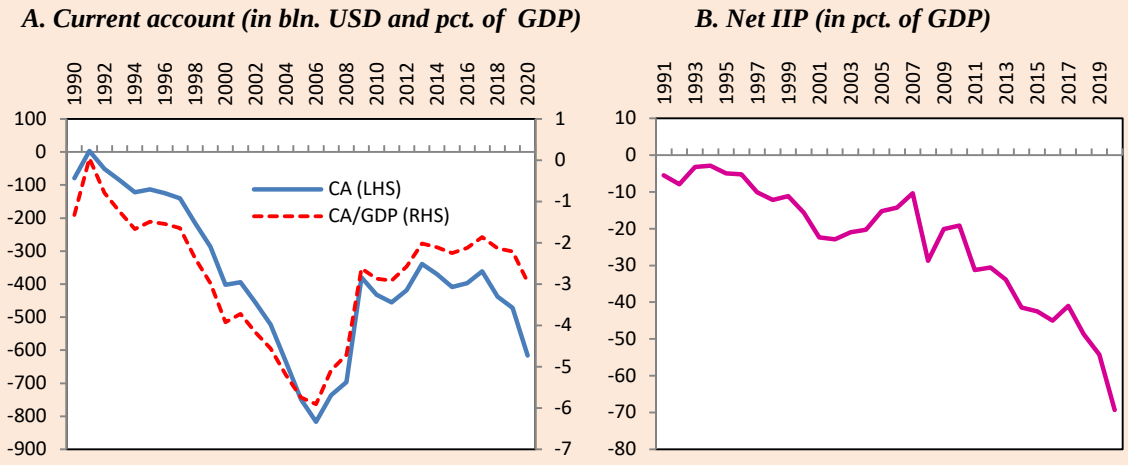
1.2. Persistent deficits: the global imbalances phenomenon

1.2.1. The phenomenon and the risks

The widening of the US current account deficit, particularly since the 1990s, occupied the 2000s' literature on the so-called "*Global Imbalances*" phenomenon. In fact, global imbalances mean the considerable current account deficit of the US, on the one hand, and the surpluses of other economies such as the Asian EMEs, led by China, some oil-exporting countries, and some AEs such as Japan and Germany, on the other hand. Global imbalances can be summarized by: a strong growth in the US (before the GFC) combined with large current account deficits and capital inflows; modest growth in Europe and balanced current payments; a spectacular economic expansion in Asian EMEs combined with massive current account surpluses; and a growing international reserve accumulation by these countries as well as oil-exporters (except for 2014-6).

[28] Net surplus of asset returns is used to quantify the exorbitant privilege. For empirical literature review on this issue, see, for example, Habib (2010), Curcuru et al. (2013), Gourinchas and Rey (2007), ECB (2019), Gourinchas et al. (2019), among others.

Figure (2.1.): US external position, 1990-2020



Source: By the author; based on WEO (IMF, 2021) and EWN (Dec. 2021 update) databases

Figure (2.1.) shows the persistent current account deficit, with a record in 2006 USD (-816.6) bln, or (-5.9%) as GDP share. This deficit, combined with a growing fiscal deficit (*i.e.* twin deficits) since the early 2000s, gave rise to an increasing IIP deficit. Global imbalances revived the debate on US external position sustainability and, among other things, its relation with the spectacular rise of world reserves, especially denominated in US dollars.

Global imbalances are combined with cross-border capital movements financing US deficits which cannot be indefinitely sustained. One could ask about the consequences associated with a possible fall of capital flows to the US (sudden stop phenomenon). In such a case, the dollar could depreciate rapidly, foreign exchange and capital markets could become highly volatile, and interest rates could rise dramatically. This would seriously compromise the stability of the IMFS. This would also be particularly worrying for countries like Algeria, whose economy is directly or indirectly linked to that of the US, or heavily dependent on the dollar exchange rates against other major currencies, notably the euro. For Algeria, a drop in dollar revenues (due to its depreciation and/or a drop in oil prices**)** would certainly have important macroeconomic effects[29].

[29] According to the dataset used in Boz et al. (2022), which gives the shares of several currencies in international trade invoicing, the dollar is used for 99% in Algeria's exports. For imports, the dollar and the euro represent on average 46% each (with changes depending on the year between 43 and 50%).

1.2.2. The debate on the origin and the implications of global imbalances

An overview of the most important studies on the origins of global imbalances will show us that there is no consensus on the sustainability of US deficits[30] and, by extension, the durability of the dollar status as the hegemonic international and reserve currency.

A. Deficits are not sustainable

A.1. Public and private saving deficits

Several studies focus on the domestic (private and/or public) saving deficit[31] (Roubini and Setser, 2004; Summers, 2004; Blanchard et al., 2005; and Frankel, 2009). In the 1990s, there was a weakness in private saving compared to a high level investment, but no large public deficits. Thus, investment financing needs were imported (giving rise to net capital inflows). From 2001 onwards, investment weakens and the public deficit widens further and further, which implies a growing debt *vis-à-vis* the RoW for its financing. According to this explanation, the dollar could initially appreciate and then depreciate.

A.2. Investors' false expectations (*the Wile E. Coyote Moment*)

Krugman (2007) also supports the assumption of a long run unsustainability of the US external position and asks the question about the timing of the resulting dollar collapse. For him, investors buying American bonds, even at higher rates than elsewhere, do so on the basis of a false theory (false expectations) about the viability of the American economy. When the time comes, they will discover their mistake and liquidate their positions. This will produce a sudden outflow of capitals and a sudden correction (collapse) in the dollar value - this is what he calls: the *Wile E. Coyote Moment*[32].

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[30] Eichengreen (2006) makes a brief remark about the lack of consensus on the sustainability of US deficits: "*...the longer the deficit persisted and the further it expanded without obvious adverse consequences, the larger swelled the ranks of the doubters...*" (p. 645)

[31] The (simplified) equation of macroeconomic balances under a floating ERR provides a general framework for these explanations: (X-M) = [(S-I) + (T-G)] = (XK-MK), *i.e.* the equivalence between current account balance, national (private and public) saving balance and net capital inflows (outflows).

[32] Paul Krugman, Nobel Prize winner in 2008, uses a metaphor based on the character of a famous cartoon to describe his hypothesis: *Wile E. Coyote*. He notes "*For those not familiar with the classics: there were often scenes in Road Runner cartoons in which the ever-frustrated Wile E. Coyote would run off a cliff, take several steps on thin air, then look down – and only after realizing that there was nothing under him, would he plunge.*" (Krugman, 2007, p. 440)

B. Deficits are sustainable

B.1. Productivity shock

Among studies which evoke internal factors for the US deficits but assume their sustainability, Engel and Rogers (2006) focus on the effect of an anticipated productivity shock (growth and returns on US financial assets potential). This is accompanied by a decline in private saving in favor of consumption and household indebtedness (inter-temporal substitution), and a demand for US assets by nonresidents and thus an inflow of private capital strengthening the dollar (Engel and Rogers, 2006; Engel, 2005).

B.2. Global Saving Glut

Also among studies which consider that US deficits are sustainable but assume external factors, Bernanke (2005), Clarida (2005), and others, propose the hypothesis of a "*Global Saving Glut*", according to which the US current account deficits, and therefore that of saving also, are due to outside factors such as keeping of high saving rates in Europe and Japan, strong increase in saving rates in some EMEs for self-protection[33], under-consumption in the EMEs in particular, lack of investment opportunities in Asia and increase in commodity prices.

Thus, foreign saving surpluses, especially those of China, and the resulting increase of reserves in these countries, are intended to finance the US government deficit. Capital inflows raise the dollar value and lower US interest rates. Low rates lead to inter-temporal smoothing of consumption (further decline in private saving, increase in consumption and debt). As a result, imports increase due to the rise of consumption and the dollar strength, while exports fall. Global saving glut hypothesis concludes that the dollar will only depreciate in the long-run but deficits remain sustainable.

B.3. Safe asset shortages

Caballero et al. (2008, 2017) join those who highlight external factors for global imbalances. The authors note that increasing US current account deficits coexist with a decline in long real interest rates and a continuous increase in the proportion (and value) of

[33] At a microeconomic level: to compensate for the lack of effective social protection systems, as in China; and at a macroeconomic level: to cope with financial and currency crises through reserve accumulation.

US assets in the portfolio held by the RoW, notably the EMEs. According to them, this seems to be an anomaly from conventional models' perspective, because, "normally", the fall in US long-term real interest rates, in addition to the depreciating effect of current account deficit, should make US assets (Treasury bonds for example) less attractive. However, the increase of these assets' proportion in the global portfolio suggests the opposite. For Caballero et al. (2008, 2017), this phenomenon –which is, in fact, an expression of the issue of global imbalances and sustainability (financing durability) of US deficits by the RoW– can be explained by a "shortage of safe assets" comparable with those offered by US markets. For example, in the years following the 2008-9 crisis, several AEs treasury bills also became highly risky (Italy, Spain, etc.). Thus, this guarantees the US external position sustainability, and appreciates the dollar, then puts it on a stable path in the long-run.

Cooper (2004) agrees with this idea of a comparative advantage of US assets in terms of quality, and points out that the deficit is not only sustainable, but also logical. US assets offer better returns than developed markets in Europe and Japan, and are more reliable and safe than those of EMEs which are less developed and more restrictive on capital inflows, such as China and India (Cooper, 2005).

B.4. The "missing dark matter"

Hausmann and Sturzenegger (2006) are also among the supporters of the assumption that US external position is sustainable, but give a different analysis from the standard one. According to them, US current account deficits are largely overvalued, while assets abroad are largely undervalued in official statistics. Their argument is that if the deficits were really so large, the US would have to pay significant interest on its debts. However, the income balance (for 2004) was indeed positive, which would be a contradiction. They deduce that there is a "*missing dark matter in the Wealth of Nations*" that comes from an under-accounting of assets abroad: US multinational firms export, in addition to ordinary goods and services, intangible assets associated with their FDIs (reputation, brand, know-how, etc.), but which do not appear in official trade statistics. Thus, the US deficit should be smaller if properly valued, and therefore there is no real problem or threat about the external position (and dollar) sustainability.

B.5. Bretton Woods II

The hypothesis of a "renewal" of BW system (BW II), formulated by Dooley et al. (2003, 2004, 2007), also evokes external factors for global imbalances, namely EMEs' exchange rate policies, and also supports the assumption of sustainability of the US external position based on the idea that the international financial architecture of the 1990s and especially the 2000s is, in some respects, comparable to that of the BW era. Indeed, during the latter, Europe and Japan represented the "periphery" and amassed dollar reserves for not to let their currencies appreciate and therefore remain competitive. Now, it is mainly the Asian EMEs, including China, that play this role by undervaluing their currencies, accumulating large reserves and financing the deficits of the center: the US.

In the BW II configuration, the dollar is not under the pressure of convertibility to gold as in the 1960s and 1970s, and therefore its demand can be met through the issuance of securities to finance US deficits. The value of the dollar would remain relatively stable as depreciation pressures due to the current account deficit and money creation are offset by appreciation pressures due to private capital inflows attracted by growth and high returns on US assets and public capital inflows (foreign exchange reserves) attracted by issuer stability and notoriety (*e.g.* US Treasury bills)[34]. A decade after their original contribution on BW II, Dooley et al. (2014) argue that this configuration of IMFS did not collapse during the 2008 crisis and that it will continue to prevail, although the evolution of the Chinese economy shows that it is moving more and more towards the "center".

Indeed, we believe that the observations confirm gradual and politically planned changes in the Chinese economy since the 2010s, from an export-led growth model to a model more based on domestic demand, and detectable through: a decline in activity growth pace, a slowdown in reserve accumulation growth, a decline in trade surpluses, a rise in net capital inflows, more development in domestic financial markets, first bubble collapses (in stock and real-estate markets), etc.

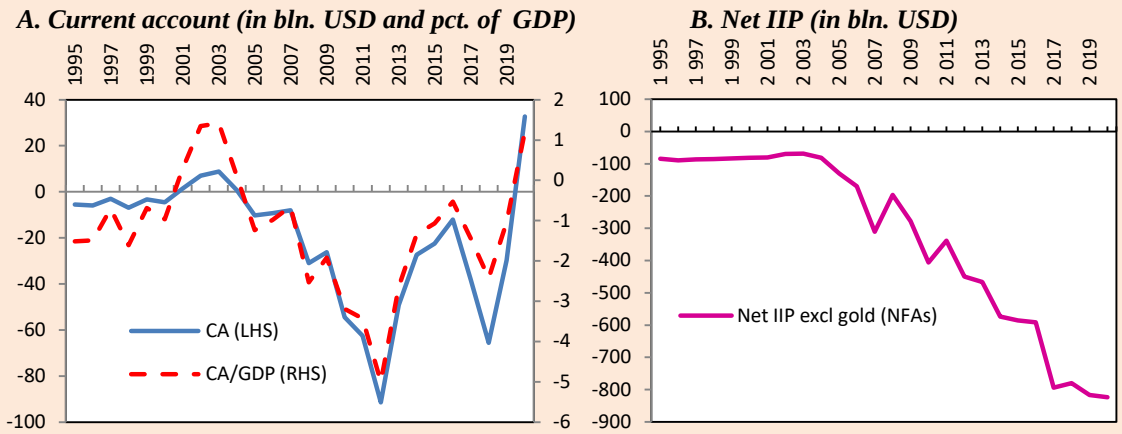
For Dooley et al. (2014), Chinese mutations, or what they cautiously call "the end of the Chinese phase", do not pose a threat to the sustainability of BW II, as India will replace China as the main country of "the periphery". For this latter prediction, the authors

[34] The BW II hypothesis has been criticized in many papers, including: Eichengreen (2004), Roubini and Setser (2005), Goldstein and Lardy (2005), Frankel (2009), etc.

rely on certain similarities between the two economies, such as labor market competitiveness and currency undervaluation which makes it possible to pursue an aggressive trade policy.

That said, by analyzing the evolution of India's external position until 2020, given here by Figure (2.2.), and Figure (1.3.) in the Chapter 1, we can express doubts on its ability to replace China as the main locomotive of the periphery, at least in the foreseeable future. Indeed, India is a net debtor and has an increasingly widening negative NIIP (after Dooley et al.'s paper in 2014). Otherwise, the current account balance deficit was reduced since its low in 2012 (except for 2017-8) and becomes a surplus in 2020. Becoming a net creditor requires India to achieve large current account surpluses on a stable basis.

Figure (2.2.): India's external position, 1995-2020
(in bln. of USD and in percent of GDP)



Source: By the author; based on WEO (IMF, 2021) and EWN (Dec. 2021 update) databases

1.3. New Triffin dilemma

Many studies in the 2000s suggest that the Triffin dilemma is still relevant (Triffin II), for example: Gourinchas and Rey (2007), Farhi et al. (2011), Bini Smaghi (2011), Obstfled (2013), Farhi and Maggiori (2018), Gourinchas et al, (2019), Ilzetzki, Reinhart and Rogoff (2017a, 2021). In fact, a Triffin dilemma framework becomes real whenever the increase in demand for assets denominated in a reserve currency makes it difficult for the issuer of that currency to guarantee supply in sufficient quantities as well as to guarantee its stability (Obstfeld, 2013).

Of course, there are notable differences between the current IMS and that of Robert Triffin's era: 1) less restrictive adjustment rules thanks to more floating exchange rates; 2) existence of another international currency with a relatively important weight, the euro; 3) the lack of a global liquidity problem inherent in the functioning of the current system, as in the past. But on the other hand, there are similarities between the two eras: 1) in addition to the private demand of non-residents on US assets, central banks in surplus countries demand assets (as liquid and safe investments for their reserves), leading to a fall in US real interest rates, favoring more debt, and ultimately increasing US financial system fragility and global systemic risk (ex: 2008-9 crisis); 2) as in the Triffin era, the current system lacks a credible global anchorage: this pushes the borrowing country (reserve currency issuer) and lender countries (reserve accumulators) to pursue policies that are independent of each other and that result in negative externalities affecting each other (Bini Smaghi, 2011; Farhi et al, 2011).

For example, EMEs' undervaluation policies lead to the expansion of their reserves and thus the purchase of US securities, which lowers real interest rates and increases systemic fragility, as noted above. On the other hand, the issuer exports inflation generated by its monetary creation to its currency holding countries because, as Farhi and Maggiori (2018) explain, the issuer of hegemonic currency can be tempted to increase its borrowing because convinced that the consequences (in case of crisis) would be more a high inflation that it would transmit to the RoW than a default on its debt: reserve holders suffer the risk of importing inflation generated by the global liquidity expansion[35]. Also, the issuer can cause great difficulties for countries whose debt is denominated in its currency if it raises interest rates to fight inflation (US interest rates dictate the direction of rates in financial markets and around the world)[36].

Ilzetzki, Reinhart, and Rogoff (2017a, 2021) point out that despite the declining US share in global GDP, reserves continue to rise, and that about half of safe assets (such as treasury bills which constitute a large portion in reserve assets)[37] has, as a source of

[35] To cope with this, central banks of reserve holders sterilize foreign exchange inflows by selling domestic securities they hold to counter the swelling of their liabilities following the monetization (purchase) of foreign exchange currencies.

[36] Example: The debt crisis of developing countries in 1982 after the high increase of Fed's rates in order to fight against the great inflation of the late 1970s and early 1980s.

[37] In addition to US Treasury bills, government debt securities from other major advanced countries, such as Japan, Germany, and the United Kingdom, are also considered as safe reserve assets.

guarantee, the fiscal capacity of the US. However, the demand for these assets (as reserves) has grown strongly while the US tax base (which is supposed to guarantee them) has decreased. This is similar to the difficulty, and then, the incapacity, the US faced to hold gold-dollar parity in front of the demand for dollar reserves in BW era, as stipulated previously by the Triffin dilemma. Actually, fiscal resources replace gold-dollar parity as a source of guarantee for reserves (Ilzetzki, Reinhart, and Rogoff, 2021). The collapse of the dollar and the US external position could be caused by a change in sentiment about the safety of assets in which holding countries invest their reserves. Their efforts to stabilize their currencies (pegged to the dollar) in the short-run would lead to a long-run destabilization of the anchor currency (Ilzetzki, Reinhart, and Rogoff, 2017a).

Gourinchas and Rey (2007) and Gourinchas et al (2019) also attest to the existence of a Triffin II. The stability of the current IMFS is undermined by a risk of confidence loss in the dollar, as was the case for BW collapse. On the one hand, the mismatch between the declining share of the US in the world economy and the growth of the global stock of dollar liquidity could lead to a confidence loss in the value of (US) debt in dollars and its replacement by a demand for assets in other reserve currencies. But on the other hand, a shrinking supply of US dollar liquidity would lead to dangerous dysfunctions in international financial markets (a systemic liquidity crisis).

Section 2. A Continuously Renewed Controversy

In this section, we show that the debate on the sustainability of the US external position and the durability of the dollar as a hegemonic currency still remains relevant. Very recent and even ongoing global developments of various kinds (economic, geostrategic, etc.) are reviving it.

2.1. The end of the privilege?

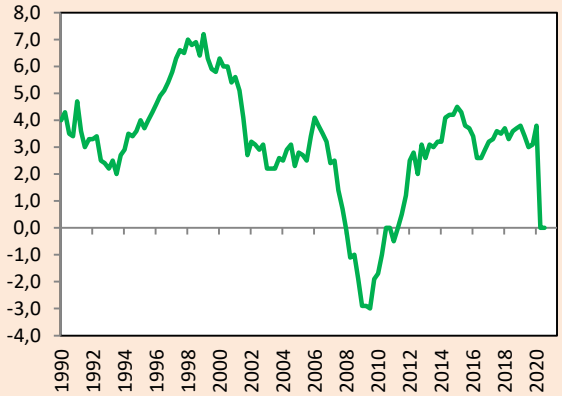
2.1.1. The fall in net savings as a triggering factor

Some recent contributions are pessimistic about the US external position sustainability and evoke the "end of privilege", which means that there is a potential for significant changes in the status and the value of the dollar. Roach (2020) focuses on two factors (which interact with each other), namely the drop in the US savings balance to zero in 2020, because of the public deficit explosion due to the pandemic context (Figure 2.3.), and the widening of the current account deficit (Figure 2.1. –Chart. A), According to him, the combination of the two factors will lead "imminently" to a great dollar collapse. In lack of necessary savings, growth needs drive to more demand for RoW savings, which further aggravates the current account deficit, and the debt[38].

In front of that, the Fed should, according to Roach (2020), either increase interest rates to attract foreign capitals (RoW savings) –but this measure is countercyclical in a pandemic recession context– or "let" the dollar (which is already overvalued relative to other major currencies) depreciate very sharply in order to reduce the current account deficit, stimulate inflation and lighten the debt burden (since this latter is dollar-denominated). The end of the exorbitant privilege for Roach (2020) is certain because the current situation differs from those during which the US benefited from it. In the 1970s, 1980 and 2000, the domestic saving was positive and relatively high and the current account deficits were lower. Thus, the dollar collapse should not be long to occur.

[38] Data from the BEA (*U.S. Bureau of Economic Analysis*), not reported here, show that the fall of US net savings in 2020 is mainly due to the explosion in the budget deficit. The other two components of national net saving, namely that of corporations and households, have, for the former, fallen slightly but not to zero, and for the latter, increased sharply, without offsetting the sharp fall in public saving.

Figure (2.3.): US net saving, 1990-2020
(in percent of GNI)



Source: By the author; based on Bureau of Economic Analysis – BEA Database

A posteriori, we can make some comments about Roach (2020) conjecture. The dollar did not collapse before the end of 2021, as he predicted. In reality, the dollar has remained on an upward trend since the end of the first half of 2021 against the three major reserve currencies (euro, yen and sterling). Moreover, US net national saving rebounded as of Q4 2020, averaging 3.5% of GNP for the following quarters (data not reproduced in Figure 2.3.). In addition, 2021 was marked by a global rebound in growth following the Great Lockdown crisis of 2020. With the recovery and the rise of inflationary pressures, the Fed decided in Q4 2021 to accelerate the *Quantitative Easing Tapering*[39] so that it ends in March 2022, and alluded to a return to rising interest rates. Indeed, in the Q1 2022, and with the confirmation that observed inflation is not transitory (due to the strength of the economic recovery) and also because of the Ukraine war effects on prices, the Fed declares starting a series of rate hikes. Naturally, the rise in rates strengthens the dollar.

2.1.2. The reversal of returns and investment flows

In (Chapter 1 – Section 1), we gave the example of the US as a net debtor through the analysis of Atkeson et al. (2022) of the NIIP evolution over three decades (1990-2020). The study explicitly considers the period after the 2008-9 crisis as the end of the special (or exorbitant) privilege of the US because of a differential in returns on assets in favor of US residents compared to those of the ROW, especially in EMEs. By contrast, the period

[39] Tapering end was initially scheduled for mid-2022, but confirmation of the structural nature of inflation shortened the calendar to March 2022 by accelerating (increasing) the buyback movement from 15 to USD 30 bln/month.

between 2002 and 2010 represented the phase of a special privilege *par excellence*, as the returns on investments in the EMEs were significantly higher than those on assets invested in the US. The idea is that investment by US residents in EMEs (especially as FDIs) attracted by high returns and significant growth potential, leads to massive inflows of capital into these countries. EMEs' central banks transform these inflows into reserves to avoid overvaluation of their currencies –harmful to export-led growth strategies they pursue. Reserves are then recycled into purchases of US debt securities, which are not very profitable but meet the requirements of liquidity and safety.

2.2. The optimistic view about the durability of the dollar dominance

By contrast to the pessimistic view evoking a Triffin II and the end of the exorbitant privilege, other recent contributions are rather optimistic about the sustainability of the US external position and the future of the hegemonic status of dollar.

2.2.1. Negative NIIP but still sustainable

Milesi-Ferretti (2021) defends the US external financial position sustainability and, as a result, a dollar dominance durability. The author considers that the US negative NIIP does not represent a great risk of unsustainability, despite its worsening (over the last decade). He gives several reasons. First, since the 2008-9 crisis, the good pace of growth in the US (compared to its lenders, including the EMEs) and the enormous liquidity created by quantitative easing have had a positive impact on US stock markets, including equities held by nonresidents (in addition to US residents). These stocks are part of external liabilities, the increase of which further widens the US external position deficit[40]. Thus, if the trend is reversed (a slowdown in US economic performances compared to RoW), the downward impact in stock markets and in dollar exchange rate would reduce external liabilities and the current account deficit, he adds.

Secondly, there is also a valuation effect of FDIs which artificially increases net liabilities and thus the NIIP deficit. The valuation method of net FDI assets (FDI assets held on nonresidents minus FDI liabilities held by nonresidents), being based on market value, therefore tends to undervalue FDI abroad. In fact, the market value fully integrates the stock market index where the FDI affiliate's stock is quoted, and since after the GFC

[40] Clearly, this analysis contrasts with that by Atkeson et al. (2022) on the evolution of the US NIIP.

the US markets were performing better (more growth) than markets abroad, the value of US affiliates abroad is undervalued compared to foreign affiliates in the US. If these assets, on both sides, are measured at the current cost (today's price) of the affiliate's stock, the value of net FDI assets will be greater, and as a result, the NIIP will always be negative but less deteriorated.[41]

2.2.2. Dominant Currency Paradigm in International Trade

Some work focus on the study of dominant currencies in international trade. Gopinath and Itskhoki (2021) assess, among other things, the effect of dominant invoicing (pricing) currencies in commercial transactions (in which the issuing country is a party or not) on the transmission of monetary policy shocks from the issuer, on the ERPT, and other effects[42]. They point out that, differently from the "Producer Currency Pricing" (PCP) paradigm, the transmission of monetary shocks under the "Dominant Currency Pricing" (DCP) paradigm is more important, and the effect is amplified more with the dollar compared to other invoicing currencies such as the euro, for example [43]. Boz et al. (2022) elaborate the largest and most up-to-date database of pricing currencies used in international trade. The data confirm stability in the shares of invoicing currencies, and the dollar remains the dominant currency.

2.2.3. Historical supremacy of the dollar as an anchor currency

Even if (Ilzetzki,) Reinhart and Rogoff adhere to the opinion that attests a new Triffin dilemma, as already noted, they confirm the dollar persistent hegemony in their series of (essential) studies on the evolution of *de facto* ERRs and anchor currencies. They note that the central banks' demand for the issuing country's reserve assets is not only for their safety but also to stabilize their exchange rate, since it is generally the anchor currency. Actually, the number of *de facto* anchored currencies to the dollar, as rigid

[41] Note that this criticism about the relevance of the valuation method of external assets and liabilities, somewhat echoes, as we have already seen, the hypothesis of the "Missing Dark Matter" proposed by Hausmann and Sturzenegger (2006) to explain Global Imbalances, and also the debate on the measure of the exorbitant privilege (Curcuru et al., 2013; Gourinchas and Rey, 2007; etc.).

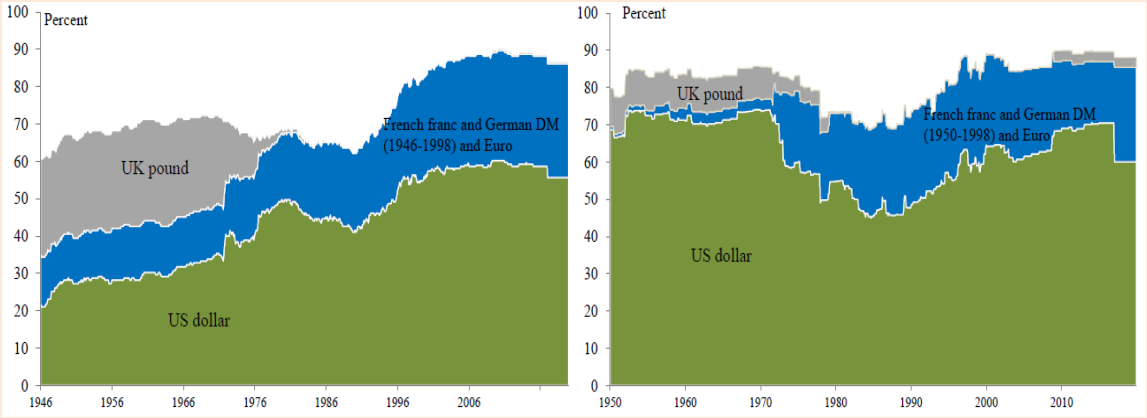
[42] ERPT (Exchange rate pass-through): transmission of the exchange rate to the domestic prices of the importing country.

[43] Under the "producer currency pricing" paradigm, exporter invoices the transaction in its own currency. Under the "local currency pricing" paradigm, the price is set in importer currency. Under the "dominant currency pricing" paradigm, the exporter and the importer use a dominant currency that is not necessarily the currency of either.

anchors (fixed ERRs) or flexible anchors (intermediate regimes and managed floats) is as important as during BW era. In fact, the relation is circular between the reasons for using the dollar as anchor and its implications: its choice results from its widespread use in trade and finance, which in turn reinforces its widespread adoption (Ilzetzki et al., 2021).

Figure (2.4.): Shares of anchor currencies, 1946(50)-2019

A. In percent of countries, 1946-2019 ***B. Nb. of countries weighted by their share in world GDP, 1950-2019***



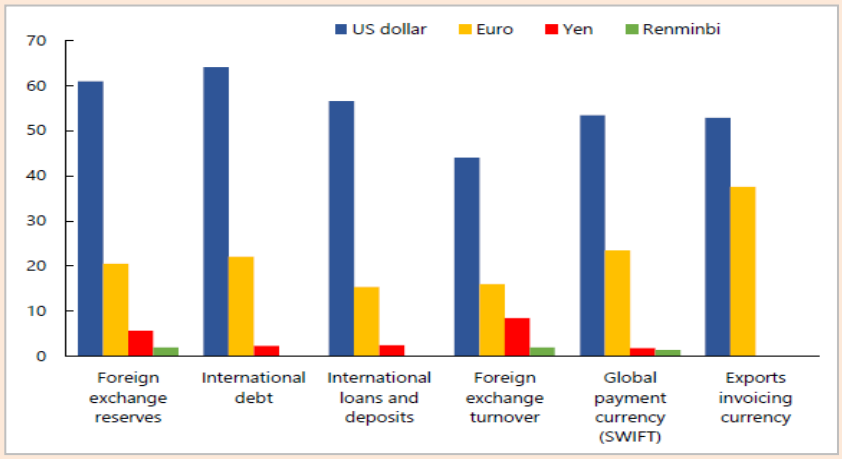
Source: Ilzetzki, Reinhart, and Rogoff (2021)

2.2.4. Network effects and inertia effect

In a book studying the exorbitant privilege issue from a very enriching historical perspective, Eichengreen (2011), and although he supports that a world with multiple reserve issuers is beneficial because increasing reserve asset supply, however, considers that in lack of realistic alternatives, the dollar dominance will always remain relevant. Indeed, for him, if we take into account only the declining share of the US in world GDP and trade relative to the past and to other countries, mainly the EMEs, the dollar should lose its hegemony and give ground to other currencies. But in reality, the dollar benefits from being a "historical incumbent" currency in all types of international transactions.

Figure (2.5.) shows the dominance of the dollar in all types of international financial and commercial transactions: reserves and foreign exchange transactions, international debt, cross-border bank loans and payments, and trade invoicing. These transactions are interconnected through complementarities and network externalities, which would make it difficult for private and public actors to replace the dollar fully or partially (Gopinath and Itskhoki, 2021).

Figure (2.5.): Weights of the US dollar and other currencies in the international monetary and financial system, 2019



Source: Gopinath and Itskhoki (2021)

For example, exporters invoice their sales in the dominant currency in order to avoid confusion for their customers due to exchange rate fluctuations. Trade requires Forex transactions (conversion, hedging, etc.). The latter is also a "place" of interactions between private and public bond markets, cross-border bank loans and transfers, and other capital markets; and also through which the central bank manages its reserve and foreign exchange policy. Using a dominant currency is, to a certain extent, doing like others and as in the past (Eichengreen, 2011). A significant change in currencies would undermine the imperatives of: exchange rate stability (for trade and Forex), returns and safety (for financial markets), liquidity and safety (for central bank operations, anchor and reserves).

Eichengreen et al. (2016) study the determinants of currency composition of reserves in (58) countries (in aggregate data) between 1947 and 2013 and seek to detect whether there has been a structural change with the collapse of BW. They conclude that inertia effects strengthened after BW era, which was beneficial to the resilience of the dollar's dominant status. Inertia results from habits or lack of low-cost alternatives to replace the dominant currency. At the same time, the weight of network effects, as a determinant in the currency composition of reserves (which are in favor of the dollar) has declined after BW era. According to Eichengreen et al. (2016), this would mean that nothing is permanently won for the dollar. The weakening of network effects over time, without altering the dominance of the dollar, can be explained by the fact that moving

between currencies becomes less costly (and more discreet) thanks to the continuous development of FinTech[44].

Figure (2.6.) also shows the quasi-stable dominance of the dollar over global financial links in: global Forex, cross-border bank claims, and international private and public bond markets.

Figure (2.6.): International currency composition in Forex and international debt markets' transactions

Source: Iancu et al. (2020), based on data from BIS, WB and IMF.

For Iancu et al. (2020), the key element for the longevity of the dollar as a hegemonic reserve currency (and the euro to a lesser extent), is its dominant use in the global economy. The authors study the determinants of currency composition of reserves based on global and individual (by country) data[45]. They conclude the importance of network effects, especially for financial links between reserve demanders (especially EMDEs' holders) and the issuing country, as a determinant in the currency composition of

[44] Empirically, inertia effect is captured by lagged reserve currency share, and network effect by reserve issuer's share in global GDP.

[45] Iancu et al. (2020) use an original database because of its temporal extent (1947-2018 for aggregate data) and also because it contains individual data of 52 AEs and EMDEs. Note that individual data are obtained from the central banks of concerned countries agreeing to make them public – which is not the case for the majority of countries.

reserves – which seems partially opposed to results by Eichengreen et al. (2016). They also find an increase of inertia effect of these links since the Great Recession. For Iancu et al. (2020), network effects amplify the inertia effect. Thus, as long as the dollar dominates financial relations (real and portfolio investments, exchange rate anchoring, etc.), the need to hold it as a majority component in reserves will continue[46].

2.3. Country strategies and geopolitics: A new Controversy

2.3.1. The weight of geostrategic alliances

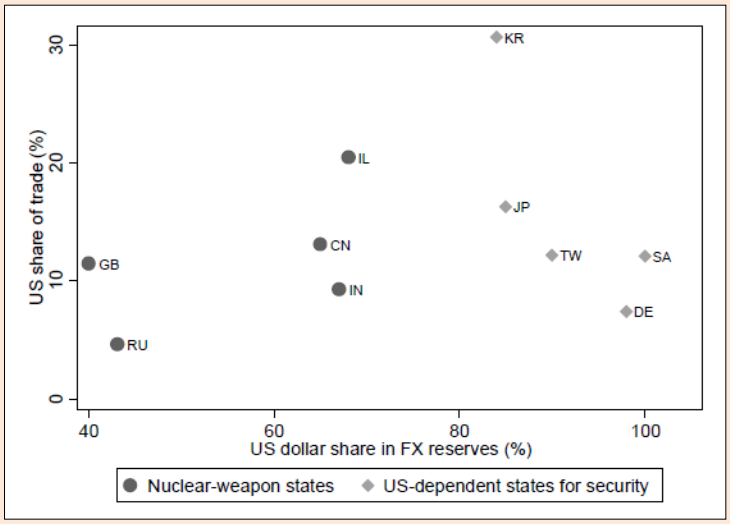
Beyond purely economic factors, national strategic interests and geopolitical challenges influence the composition of reserves at individual and global levels. To distinguish between the two categories, Eichengreen et al. (2019) refer to a "Mercury hypothesis" according to which the choice of one (or several) international and reserve currency is subject to pecuniary motives (liquidity, safety, trade and financial links, network effects, etc.), that we have pointed out, as well as a "Mars hypothesis" according to which the preference of one currency (or several) is more a matter of strategic, diplomatic and military power criteria[47]. Using data on reserve composition before the Great War, the authors show that both hypotheses hold, and that military alliances between issuers of reserve currencies and holders would strengthen the position of the currency in question by 30%.

Eichengreen et al. (2019) go further and also show, through examples from the post-World War II era (which are valid until today), that the level of military power of the partner country significantly influences its reserve composition, beyond its economic relations. Germany, Saudi Arabia, South Korea and Japan are countries that do not possess nuclear weapons and are heavily dependent on the US for their security. The dollar's share in their reserves is greater than that of China, France or Russia, which are nuclear powers. Figure (2.7.) below provides a very clear overview of this finding.

[46] About the determinants of the currency reserve composition see also: Chinn and Frankel (2007) and Aizenman et al. (2020).

[47] These expressions, which may seem anecdotal, are in fact profoundly significant. In Roman mythology, "Mercury" is the divinity of commerce, while "Mars" is the divinity of war and soil protection.

Figure (2.7.): Military power and share of the dollar in reserves



GB: Great Britain;
RU: Russia;
CN: China;
IN: India;
IL: Israel;
KR: Korea (Rep.);
JP: Japan;
TW: Taiwan;
DE: Deutschland;
SA: Saudi Arabia.

Source: Eichengreen et al. (2019)

2.3.2. Economic and geopolitical tensions and protests about the dollar status

Contemporary international monetary history gives us examples showing that geopolitics can fuel criticism and protests about the dollar status, or even tensions. We have seen, for example, how France in the 1960s criticized the exorbitant privilege of the US (Eichengreen, 2011), or how China criticized the dollar dominance because of losses in its dollar reserve assets (US government debt securities) during the GFC, or the frequent statements by Chinese officials of their desire (or proposals) for changes to the IMFS, or their intentions to achieve greater diversification of their reserve currency composition, or some calls to break the dollar dominance on oil market, as in 2009 by China, Russia, Japan and France, and more frequently by Iran and Venezuela (Economist, 2010).

More recently, we have also seen how geopolitical tensions and conflicts may have raised concerns among countries accumulating dollar assets, or even actual reallocations of reserve portfolios. In 2018, for example, in a context of trade tensions between the US and several major economies, China reduced its holdings of US Treasury debt by approximately USD 60 bln, among a total holding around USD 1,000 bln. In the same year, Russia, which is also one of the largest reserve accumulators, exchanged USD 100 bln of its dollar reserves for assets in euro, renminbi and gold, thus making the euro the leading currency in its reserve composition (Chiţu et al., 2019; ECB, 2019). This occurred in the context of a new round of sanctions after the annexation of Crimea in 2014.

2.3.3. Would sanctions against a large reserve holder threaten the dollar dominance?

The Russian invasion of Ukraine in 2022 and the large volume of sanctions by the US and several advanced countries, mainly in Europe, are likely to cause reallocations in reserve portfolios, or at least fears about the safety of dollarized held assets. Indeed, from the beginning of the conflict, a significant part of Russian reserve assets held in US and European monetary or financial institutions were "frozen" (about half among a total equivalent to USD 640 bln), to prevent Russia from defending the ruble and financing its war, among others. The scale of these sanctions is unprecedented. Also, the exclusion of Russian banks from SWIFT payment system is part of collective sanctions, whose key element is the use of the dollar hegemony and its role as the main vehicle-currency (means of exchange) and liquid and safe savings (store of reserve)[48].

With the beginning of the conflict, economists and officials in national and international monetary and financial institutions (central banks, IMF, etc.) have pay attention to the impact of sanctions on the dominant status of the dollar.[49] That said, opinions remain once again divided, like with multiple controversies characterizing the previous debates on the durability of the dollar hegemony and the sustainability of the US external position, which we have studied in previous developments in this chapter**.**

A. The skeptical view

Several observers and/or economists consider that financial sanctions and reserve freeze represent a turning point in the IMFS history and an accelerator of the decline of the dollar international role (Financial Times, 2022b; Loots, 2022)**,** and that the US exorbitant privilege will become more difficult to maintain (Kessler, 2022). Modern history has shown that the great geopolitical changes have often been associated with the end of the dominance of currencies, announcing the arrival of others (Pozsar, 2022; Kessler, 2022).

[48] US sanctions, against Russia or other countries before that, like Iraq, Iran, Venezuela, etc., or even on companies doing business with these countries, are based on the principle of the US laws' extraterritoriality that give it the right to prohibit the use of the dollar –being the property of the United States of America.

[49] A scientific approach for analyzing economic phenomena and the publication in academic journals or as working papers require a relatively long setback. Most of the analyses discussed here have been published by economists on (renowned) media such as: *Financial Times, Wall Street Journal, Reuters, IMF Blog*, etc. For us also, given the importance and the close link of the issue with this part of our work, we preferred to address the issue based on facts, the few contributions already available, and our own reflection, despite the short time elapsed between the conflict beginning and sanctions (February-March 2022) and the writing of these developments (May 2022).

A.1. The risk of confidence loss

With such sanctions, it is the confidence in the safety of dollar reserve investments that is likely to be undermined. Indeed, sanctions, including reserve freezing, have increased fears among some countries that are under sanctions (or fear they will) on guaranteeing the availability of their assets in all circumstances –which is a fundamental principle in the definition of reserve assets. Because of the fears raised by the sanctions, even some countries that are traditional allies of the US can undertake actions that could significantly affect the international role of the dollar, not just as a reserve currency, but also as a means of exchange. For example, in the energy market, historically dollarized, India has agreed to pay in ruble its purchases of Russian gas, at a lower cost; Saudi Arabia could also sell oil to China for renminbi. Such actions will certainly have a significant impact on international financial markets, including Forex (Wall Street Journal, 2022).

A.2. Fragmentation of the international monetary landscape

For Gita Gopinath, First Deputy Managing Director (and former Chief Economist) of the IMF, sanctions could be a motive for diversifying reserves to other currencies and asset classes. Even if the dollar remains the dominant currency, such sanctions could weaken its status and lead to a fragmentation in the international monetary landscape where smaller monetary blocks using other currencies could emerge. According to her, the migration of some countries to other currencies for trade invoicing would encourage these countries to reduce the dollar's share of their reserves in favor of new currencies used in trade (Financial Times, 2022a).

A.3. A stimulus for non-traditional currencies

Barry Eichengreen, who supports a multipolar world, as we have seen through many of his individual and collective contributions, argues that the Russian reserve freeze and the "weaponization" of the dollar by the US is likely to push for a greater diversification of reserve currencies, particularly towards increasingly dynamic non-traditional issuers: Canada, Australia, Sweden, South Korea, and Singapore. The renminbi is not part of this scenario despite its remarkable recent performances because China's ambiguous position *vis-à-vis* the conflict and its geopolitical tensions with the US about Taiwan dissuade other accumulators to turn to the Chinese currency (except for Russia and

other countries already under US sanctions). Such a scenario also requires that other governments do not go along with US sanctions (Eichengreen, 2022).

A.4. Loss of attractiveness of US public securities

Sanctions against Russia and rising interest rates on US Treasury securities (partially caused by sanctions) have contributed, according to Brettel (2022), to a reduction of these securities' attractiveness (that are reserve assets *par excellence*) for oil-exporters in particular, and which are major holders of this asset class. Pozsar (2022) goes so far and considers that we are at the beginning of a third episode of Bretton Woods (BW III), which will know the end of the dollar as the dominant currency and which has already begun with the abandonment of US public debt securities. The IMS in BW era was based on gold as anchor; that of BW II with an inside money (the dollar) as a dominant currency in which the reserves are held in the form of claims on great financial institutions (such as the US Treasury); and that of BW III will rely more on currencies (or assets) outside the system (outside money), where reserves will be held in the form of commodities (such as gold and oil), crypto-assets, or emerging currencies (such as the renminbi).

B. The optimistic view

In parallel, other observers (economists and/or professionals) are less skeptical or even optimistic about the impact of sanctions on the future of the dollar status as the dominant international and reserve currency.

B.1. Unprecedented sanctions but not without antecedents

For the optimists, even if the sanctions against Russia in 2022 are qualitatively and quantitatively unprecedented, this is not the first time that the US has been involved in political and/or economic tensions in which they impose sanctions, nor the first time that significant economic impacts or financial losses were incurred due to the holding of dollar assets by (public or private) non-residents. The recent trade tensions with China, or the loss of reserves during the 2008-9 crisis, have repeatedly pushed China to advocate for a multipolar IMFS and more diversified reserves, as we have just noted. Whether these "quarrels" are part of real strategies for changes in the long-run, or are only simple tactics of negotiation, the international monetary and financial architecture does not seem to have been too affected: deeds do not necessarily follow words.

B.2. The reserve managers' opinion

For example, the annual HSBC survey of central bankers (*HSBC Reserve Management Trends*) reveals, in its April 2022 edition (published just after first sanctions against Russia and its reserves' freeze), that the 82 reserve managers surveyed (controlling more than USD 7 trillion) have more interest in increasing their investments in financial assets related to commodities and energy, mainly denominated in dollars, than a reallocation in terms of currencies (HSBC, 2022). In the 2019 edition, the survey reveals that among the 80 reserve managers questioned (controlling USD 6.900 bln), 80% of them considered geopolitics as a factor affecting the currency composition of their portfolios, and almost 75% considered the trade tensions of this period among the most important factors. However, only a third said that geopolitical forces would directly impact their currency composition, and considered that the dollar remains a safe haven currency (HSBC, 2019).

B.3. The sanctions further strengthen the dollar status

Dooley, Folkerts-Landau and Garber, famous for their innovative and some controversial papers, oppose the view that sanctions against Russia and the reserve freeze will push countries, with which the US has an unfriendly relationship, to reduce their dollar assets, and as a result, will have a negative impact on this latter's value and status. In contrast, Dooley et al. (2022) emphasize the role of reserves as a "collateral value" for FDIs in these countries. The collateral provides protection for investors in host countries with authoritarian regimes and/or capital controls, as theses countries know they are under threat of potential of sanctions and/or reserve freeze if there are major commitment breaches or more serious hostilities (nationalizations, conflicts, etc.). It was the case of China in the early 2000s, which benefited from a long cycle of private capital inflows (particularly from the US) which felt protected despite the ideology of the political regime, thanks to the substantial dollar reserves. This role of collateral allows a guarantee to both parties. In this sense, the US sanctions would reinforce the dominance of the dollar. So it's a "financial deterrent weapon".

Section 3. Alternatives to the Dominant Currency and the Future of the IMFS

After exploring the issue of the US external financial position sustainability and its relation with the dominance of the dollar as an international and reserve currency, we review in this section the history, the actuality, and the future perspectives of some alternatives (or competitors) to the hegemonic currency.

3.1. Existing international reserve currencies

3.1.1. The SDR: An old and constantly renewed proposal

A. Statutory obstacles for the SDR

The SDR, introduced by the IMF in 1969, at a time when the US budget deficit weighed heavily on the dollar-gold parity, was not able to become a competing reserve asset for several reasons: the SDR has no the monetary status which is necessary to fulfill the three functions of an international currency; its supply is insufficient to absorb the world demand for reserves (*cf.* Chapter 1 – Section 3); the lack of SDR-denominated and market-tradable debt securities (especially private bonds), because, as we have already seen, the most important characteristic for a reserve asset, in addition to safety, is its liquidity. Contrary to this, the dollar has been (for a very long time) based on the most liquid capital markets in the world.

B. The unrealistic proposal to replace the dollar with the SDR

In the previous section, we discussed China's large losses on its reserves during the GFC due to the decline in stock values and debt securities (such as US Treasury bills), but also because of the depreciation of the dollar[50], and the statements by Chinese authorities of their intentions to reduce the dollar share in favor of the euro or the SDR. However, swapping dollars for SDRs would shift some of the foreign exchange risk to other IMF members; and as it was the case in the 1970s, neither the IMF members would agree on

[50] Even outside the crisis context, the Chinese currency remained on a long run trend of appreciation against the dollar since the 2005 revaluation and the adoption of a less rigid ERR –a decision partially taken under pressure and criticism from the US about the Yuan undervaluation, considered as an important aggravating cause of the global imbalances (as mentioned in Section 1).

who would bear this risk nor the US would tolerate it (Economist, 2010). Similarly, proposals made from time to time, particularly in the aftermath of the GFC, by advanced and emerging country officials to use the SDR for pricing the commodities, such as oil, have not resulted in concrete actions, at least until now, because of technical, economic, and geopolitical considerations.

C. A global currency and a global central bank

The very old proposal of creating an international currency, independent from national monetary authorities, pegged to gold, and managed by an independent world institution (Keynes' Bancor), or the proposal of an artificial reserve asset pegged to a basket of commodities (Triffin), have been firmly rejected by the first power from the outset; likewise for the proposal of using SDRs as global reserve assets, or even to transform the statutes of the SDR and the IMF into a global currency and a global central bank, respectively (Economist, 2010). More recently, and in the same vein, Aglietta et al. (2022) consider that SDRs can be used as a global common currency, which would overcome the hegemony of a single currency and its related risks (Triffin dilemma), because SDRs are not the counterpart of a single country's debt. But this would only be possible if the IMF truly became an international lender of last resort, and thus a global central bank. However, this idea runs against the evidence that there can be no global institution with a discretionary power without existence of a global power center. Eichengreen (2011) notes in this sense: "*No global government, which means no global central bank, means no global currency. Full stop.*" (Eichengreen, 2011, p. 141).

3.1.2. The ability of other currencies to compete with the US dollar

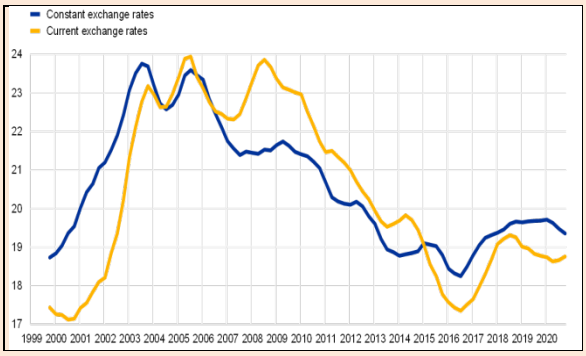
A. The euro

On the side of major fiduciary currencies, the yen and the deutschemark were predicted in the early 1990s to be able to compete with the dollar, but the difference in economic size of Japan and Germany and their financial markets compared to the US made this not possible (Frankel, 2009). Later, all eyes turned into the euro as the closest competitor to the dollar. Chinn and Frankel (2007, 2008) estimated that the euro had a real chance of surpassing the dollar in the coming decade, with two conditions: 1) the accession to the Economic and Monetary Union (EMU) of all the countries of the European Union

(EU), including the United Kingdom, for a significant economic scale effect; and 2) the pursuit by the US of macroeconomic policies undermining confidence in the value of the dollar (through inflation and depreciation). However, at present, neither the United Kingdom joined EMU, nor indeed remained in the EU (Brexit in 2020), nor the euro could exceed 27% (at its best) in world reserve composition.

As a reserve currency, the current share of the euro in world (allocated) reserves is around 20% (*cf.* Figure 1.16.). The weight of the euro declined significantly after the 2008-9 global crisis and the 2010-2 European debt crisis, and stabilized, since then, close to this value. In terms of trade and financial transactions' uses, the euro currently ranks second (*cf.* Figure 2.5.). A composite index of the international role of the euro is calculated by the ECB (for financial transactions in particular)[51]. The evolution of this index after the 2008-9 crisis indicates a deterioration during the European debt crisis episodes, then a relative stability (19-20%), as shown in Figure (2.8.).

Figure (2.8.): Composite index of the international role of the euro, 2020*
(share in percent)



***** At current exchange rate and constant exchange rate (Q4 2020); four-quarter moving averages
Source: ECB (2021)

After a turning point in 2010 marked by serious financial upheavals and a decline in the international role of the euro, the ECB and the European Commission (EC) have worked to improve the attractiveness of the euro and increase its presence in financial and trade transactions through several initiatives: the strengthening of the banking union (creation of a single supervisor, a single resolution fund, and a European deposit insurance

[51] The index is an arithmetic average of the euro shares (at current and constant exchange rates) in: stocks of international bonds, loans by banks outside the euro area to borrowers outside the euro area, deposits with banks outside the euro area from creditors outside the euro area, global foreign exchange settlements, global foreign exchange reserves, and global ERRs (as legal tender or as anchor) (ECB, 2021).

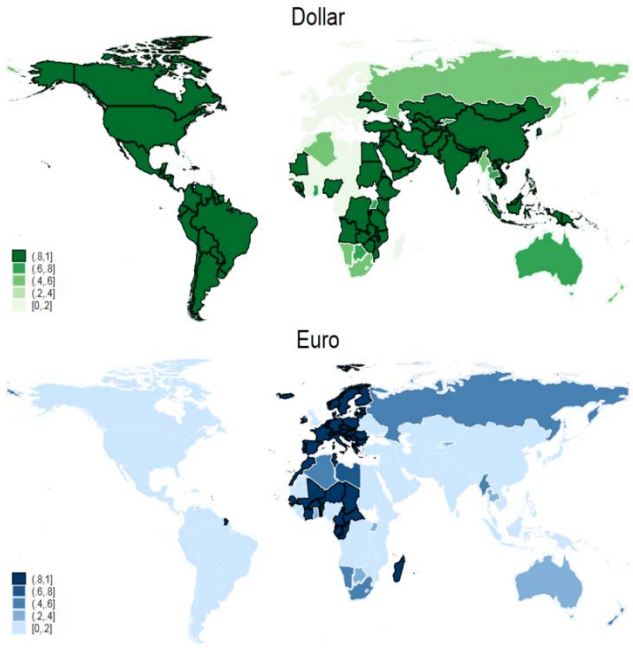
mechanism); more integration of European financial markets (for greater depth and liquidity); more credibility through sound fiscal policies; and other aspects deepening the EMU (ECB, 2019, 2021). These and other initiatives allowed in the second half of the 2010s a stability of the euro international status, and will allow the consolidation of the two fundamental elements for an international currency, namely confidence and deep and liquid financial markets (Eichengreen et al., 2018).

Also, recent studies quantifying the exorbitant privilege (net surplus of asset returns) of the dollar and the euro consider that the latter also benefits from it, even if at a lower level. This privilege effect could be enhanced through the quantitative and qualitative improvement in safe debt supply backed by sound fiscal policies of the euro area members (ECB, 2019). Debt issued in a collective framework could also play an effective role, such as the EC's exceptional program of debt issuing EUR 750 bln as bills in 2020 among other measures against the economic effects of the Covid-19 pandemic (Iancu et al., 2020).

In addition, other factors come from outside and directly affect the share of reserves, such as the use of the euro by certain central banks (in EMEs) in order to stabilize its share in their portfolios during episodes of instability (decline) of the dollar, or the substitution of part of the dollar's reserve assets by the euro following unilateral economic sanctions (ex: Russia in 2018).

Generally, despite the efforts of the European institutions or the effects of pro-cyclical factors, the international status of the euro seems to be stagnating. Indeed, as shown by the study of Iancu et al. (2020) on the determinants of currency composition of reserves, the level of trade and financial links and their impact on the anchor currency determination are very significant in explaining the relative weights of the different currencies. For example, we can see that the "euro currency area", *i.e.* the area where the euro is a legal tender or the main anchor currency, is more limited than the "dollar currency area": the euro mainly influences exchange rates of European countries (outside the euro area) and some African countries, while the dollar serves as anchor for most countries in the Western Hemisphere, Asia and the Middle East (ECB, 2019), as shown in Figure (2.9.).

Figure (2.9.): The Dollar and the euro currency areas, 2018



Source: ECB (2019)

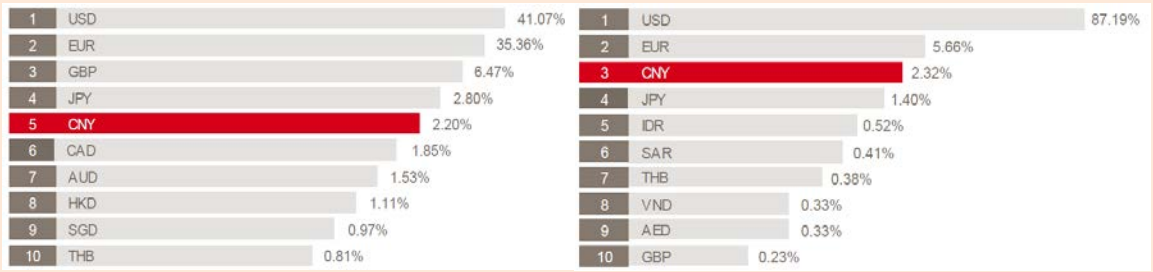
B. The renminbi

For Eichengreen et al. (2018), three scenarios can be imagined regarding the internationalization of the renminbi and a potential competition (or complementarity) with the dollar. First, a rapid rise of the Chinese currency status as was the case with the dollar "big bang" between 1914 and 1924, announcing the beginning of the end of a long sterling dominance. A second scenario is based on the experience of the yen in the 1980s-90s and the failure of Japan's efforts to give it a prominent place in the world. Japan –the second largest economy and rival of the US in the 1980s– was caught in the trap of a chronic deflation and a financial instability since the early 1990s. That has undermined the yen chances to compete seriously with the dollar. Similarly, argue Eichengreen et al. (2018), the efforts to internationalize the renminbi could be hampered by an economic slowdown (apparently more present since the Great Recession) and financial instability aggravated by the effect of policies that were originally designed to promote the renminbi attractiveness (credit bubble, financial openness, exchange rate revaluation, etc.). A third scenario, which seems to be the most plausible, is to adopt a slower but sustained approach, based on monetary and financial reforms to gain credibility *vis-à-vis* international institutions, investors and markets. We will see in what follows that it is this third scenario that the Chinese authorities are realizing.

In fact, the renminbi is one of the non-traditional reserve currencies whose shares in the composition of world reserves have increased over the past decade, although they remain far behind the two major currencies (*cf.* Figure 1.16.). According to the March 2022 edition of *SWIFT RMB Tracker*[52], the renminbi ranks fifth in global payments with a share of 2.20%, very far behind the dollar with 41.07% and the euro with 35.36%, and the third in the trade finance market with only a share of 2.32%, against 87.19% and 5.66% for the dollar and the euro, respectively (SWIFT, 2022).

Figure (2.10.): Renminbi shares in SWIFT payments, 2022

A. Share as a global payment currency ***B. Share as global currency in trade finance market***



Source: SWIFT (2022)

The renminbi benefited from its inclusion in the basket of currencies defining the SDRs value by the IMF in 2016 (with the dollar, the euro, the yen, and the pound sterling). Since that year also data on world (allocated) reserves in renminbi appear distinctly in the COFER tables. The inclusion of a currency in the SDRs basket requires the issuer country to be one of the world's leading exporters and that its currency is freely usable in Forex. China's efforts to internationalize its use in trade and finance have thus promoted its inclusion in the SDR basket, which in turn allows for greater international acceptance of the renminbi (IMF, 2016).

In this context, China launched financial reforms to develop deep and liquid markets, establish an acceptable level of financial openness, and improve credibility and transparency of institutions enabling market integrity. Initiatives in that way include: the launch of renminbi-denominated financial products for foreign investors, such as trading platforms to invest directly in the Chinese interbank bond market; the authorization of

[52] *SWIFT RMB Tracker* is a monthly report published by SWIFT (*Society for Worldwide Interbank Financial Telecommunication Business Intelligence*) which tracks the performance of the international use of the renminbi both geographically and in the financial sector (Source : https://www.swift.com/our-solutions/compliance-and-shared-services/business-intelligence/renminbi/rmb-tracker).

Chinese companies to issue renminbi bonds in some developed financial centers such as Hong Kong; the introduction of Chinese sovereign debt in benchmark indexes[53]; the development of the banking sector in terms of asset size and diversification; the launch of platforms for cross-border interbank payments[54]; etc. (ECB 2019, 2021 ; SWIFT, 2019).

Also, among the Chinese efforts to strengthen the international role of the renminbi as a unit of account and medium of exchange, we note the initiative of launching crude oil futures and options denominated in renminbi[55] with the ambition to establish it as a benchmark for transactions in the Asia-Pacific region, such as *Brent* and *WTI* Indexes (ECB, 2019); or its use for invoicing trade transactions with other countries within the framework of the gigantic strategic project(s) of the "*New Silk Road*"[56].

Not far from the strategic considerations of economic development, the move of the Chinese economy from an export-led growth model to an internal demand-based growth model (where consumption and services play a more decisive role) is reflected in an increasing weight of imports, and thus an increased preference by China to use its currency in international transactions to avoid the negative effects of exchange rate fluctuations. Also, the improvement of the middle class in Chinese society (thanks to poverty reducing policies), as well as a more open current account, are also factors increasing consumption, imports, and therefore leading to more preference for the use of renminbi (SWIFT, 2019).

But on the other hand, the process of financial reforms –an intermediate and crucial step for the renminbi internationalization– has been slowed down due to financial disruptions during the second half of the 2010s, in particular, as explained by Aglietta et al. (2022). The attempt to accelerate reforms in 2015 caused a very high instability in the Forex (two consecutive devaluations during the 2015 summer) and in the stock and real-estate markets[57]. Also, the financial problems of real-estate companies in 2017-8, and later (as for the very big Group *Evergrande*), the explosion of the debt of manufacturing

[53] Such as *Bloomberg Barclays Global Aggregate Bond Index* (in 2019).

[54] Such as *Cross-Border Inter-Bank Payments System (CIPS)* launched in 2015 by the Chinese central bank.

[55] Launched by the *Shanghai International Energy Exchange*

[56] The "*New Silk Road*", also known as the "*Belt and Road Initiative*", is an evolving intercontinental economic initiative launched in 2013 and led by China, which aims to increase trade with countries in Asia, Europe, and Africa.

[57] The 2015 Chinese financial "earthquake" had rapid and very sensitive "aftershocks" in emerging as well as developed markets during the month of August. These problems occurred in a context of an increasingly confirmed slowdown in Chinese real activity and exports.

companies, the Covid-19 crisis; all these factors have drastically increased private and public debt in China[58]. To control the rise in debt, the authorities have put a great pressure on the non-bank credit market (*shadow banking* such as hedge funds, etc.). These measures have, however, had an "over-effect" on the debt market, notably the bond market, which is considered to be a fundamental milestone in the development of financial markets, and consequently in the process of internationalization of the currency. These challenges have prompted the authorities to take a slower approach to better control financial reforms, as well as the launch of a digital central bank currency –a point we will focus on later.

Accordingly, we can say that progress in fulfilling international currency functions is expected to further stimulate demand for renminbi reserve assets by central banks. However, despite the Chinese initiatives and the improvement of the international role of the renminbi (more notable in trade transactions compared to financial markets), the Chinese currency is still in its beginnings on the international scene and its presence remains minor in comparison with the two major currencies (dollar and euro).

3.1.3. An IMFS with several (dominant) currencies

The question whether a multipolar world is better than a world with a hegemonic currency, or the contrary, is not new. It was mainly associated with debates on the US external position sustainability and the stability of the IMFS and all related issues (Triffin dilemma, exorbitant privilege, etc.). Generally, two views are opposed, according to Eichengreen et al. (2018). An old view argues that there can only be a room in the IMFS for a single hegemonic currency, marginally competed by minor (international) currencies: the pound sterling held the monopoly from the 19th century until it was replaced by the dollar at least from the second half of the 20th century; the renminbi could be the next substitute. This view is based on the importance of network effects, which always promote the international dominance of a single currency and reinforce the inertia effect.

Nurkse (1944) considers that a multipolar world is less sustainable than a hegemonic world and represents a threat to the stability of the IMS, because in the event of a loss of confidence in one or the other currency and because of the problem of coordination between issuers, the sudden reallocations of reserve currencies' portfolios which result, would lead to a greater instability, or a collapse of the entire system. Nurkse

[58] In 2022, Chinese manufacturing corporations' debt was the highest in the world (Aglietta, 2022).

relies on facts during the interwar gold-exchange era (1920s-30s), where the sterling, after a few years, has been itself rivaled and sometimes even surpassed by the dollar in the composition of foreign exchange reserves –a period often described in the literature as a period of "international monetary disorder".

In parallel, a new view supports the viability of a multipolar world characterized by the coexistence of several international (and reserve) currencies. This would help to avoid a new Triffin dilemma's situation and the exorbitant privilege of the hegemonic currency, which are both harmful and inevitable in a context marked by an excess of global dollar liquidity and a declining share of the US in world economy (Gourinchas et al, 2019). A multipolar landscape is beneficial for the global system as it increases the supply of reserve assets, argue Eichengreen (2011). The downward trend of the dollar share in world reserves over the past two decades, combined with a more active role of non-traditional currencies (discussed earlier in this work), suggests the following scenario: in the case of a fall of the dollar dominance, there will be more chances to have a multipolar system with a large group of alternative currencies than a system where will be visible only the main rivals of the dollar, as for example a tripolar configuration "dollar-euro-renminbi" (Arslanalp, Eichengreen, & Simpson-Bell, 2022).

Indeed, in a multipolar world, the sources of (safe) liquidity are more diversified, contrary to a hegemonic system which is prone to instability, because with a growth of the EMEs faster than the US, the ability of the latter to issue public debt securities (reserve assets) will not satisfy infinitely the increasing demand of the former. Similarly, the ability of the US government to raise domestic taxes for the repayment of maturing public debt held as reserves by the RoW is very limited[59]. Thus, the probability of deterioration in dollar confidence is real, and the systemic consequences would be catastrophic on domestic and global scales. It is because of such risks that the pessimists about the US external position sustainability evoke the renewal of the Triffin dilemma. On the contrary, a multi-sourced supply of international liquidity, including that of safe assets held as reserves, reduces risks and tensions as well as a better resources-uses' adequacy in the global liquidity market, at least that of the public debt (Eichengreen et al, 2018).

[59] Especially because the bipartisan positions (Republicans and Democrats) within the *Congress* are very opposed about the possibility of exceeding the "*public debt ceiling*", and sometimes cause budget freezes that can lead to temporary shutdown of public activities (*US Government shutdowns*), as was the case in 2013, 2018 and most recently at the end of 2021.

Furthermore, the importance of network and inertia effects in strengthening the dominant currency was, as has already been explained, criticized by Eichengreen et al. (2016). After estimating the determinants of the world reserve composition, they deduce a weakening of network effects after the BW era, contrary to inertia effect that has since strengthened. In another paper, Eichengreen et al. (2018) provide a methodological review of historical data on the composition of foreign exchange and gold reserves of 18 countries –representing three-quarters of the world's reserves. They conclude, *inter alia*, that the oligopolistic state before the Great War, where the pound sterling, the French franc and the German mark were the main currencies in the world reserve portfolio, gave way for a duopoly between the pound and the dollar for much of the interwar period. This shows, according to the authors, that the IMFS has not always been dominated by a single currency which, after its «retirement», gives a way to a single other dominant currency.

Going further, Farhi and Maggiori (2018) propose a model for global supply and demand for reserve assets in several currencies with different configurations in terms of the number of issuers: hegemonic currency (where only one currency is largely dominant) and multipolar world (where several currencies share most of the reserve asset supply). But in reality, most multipolar configurations are more likely to be a duopoly than an oligopoly state. In fact, the coordination problem is playing an important role. By moving from a hegemonic monopoly state to a duopoly state *à la* Cournot[60], the coordination between actors deteriorates; and if investors (public demanders for assets) substitute one currency for another, the equilibrium will become unsustainable. The resulting instability could lead to a collapse in the global asset supply (Farhi and Maggiori, 2018), probably because the issuing country of the currency towards which the movement is directed cannot satisfy the overall demand. The resulting large fluctuations of interest and exchange rates (devaluation or depreciation according to the prevailing IMS) would naturally spread beyond the money market and the Forex. Obviously, this scenario takes inspiration from Nurkse (1944).

In addition, the Farhi and Maggiori (2018) model shows that a larger number of currency issuers of reserve assets, and thus greater competition, would increase the global supply (as predicted by Eichengreen, 2011) and reduce the risk of disruptions due to lack of coordination between issuers. This would be beneficial for the IMFS stability especially

[60] The equilibrium of Cournot in a duopoly state (extensible in an oligopoly state) describes a market structure with two (or few) suppliers competing in terms of production volume without taking into account (coordinating) the quantities produced by each one.

since it would avoid a Triffin dilemma scenario linked to the hegemonic monopoly. Overall, the different configurations in terms of reserve issuers' number given by Farhi and Maggiori (2018) model are U-curve shaped: a multipolar world with a reduced number of reserve currencies is less advantageous than with a larger number, or even threatening the IMFS stability; and a hegemonic monopoly situation, even if it is not the best for global well-being (Triffin dilemma, asymmetries, etc.), is less perilous than a duopoly.

3.2. The Development of Financial and Payment Technologies

3.2.1. Digital private assets (currencies)

The 21st century is the century of increased digitalization in all fields, including finance. From the end of the 2000s, the development of Financial and Payment Technologies (FinTech) gave rise to a first generation of crypto-assets. The most famous among them are: bitcoin, ripple, ether, litecoin, nem and dash. These virtual assets are created using *Blockchain* technology and exchanged through decentralized (or *peer-to-peer*) networks. Their values (prices), which are highly volatile, are fixed only by supply and demand on digital platforms. Crypto-assets are issued by private issuers (companies or fully decentralized issuance), do not rely on a trusted third party, such as a central bank, and have no intrinsic value. For this reason, these assets are not considered as currencies in the legal sense.[61]

In reality, crypto-assets are mainly traded for speculation. However, if, by consent of the payment community, they are used for payment or store of value purposes, they will *de facto* acquire a currency status in the economic sense, hence the name "crypto-currencies" or "private digital currencies – PDCs", which is increasingly generalized (and accepted)[62]. Indeed, the perception of crypto-assets as currencies in the legal sense is changing: in September 2021, El Salvador became the first country to adopt a crypto-asset (bitcoin) as its legal tender alongside its official currency, the US dollar[63]. Bitcoin is allowed to initially serve as a medium of exchange (Alvarez et al, 2022).

[61] According to the French Financial Markets Authority (AMF) <https://www.amf-france.org/fr>

[62] In addition to private crypto-currencies, crypto-assets include other asset classes such as : Utility Tokens, Security Tokens, and the Non-Fungible Tokens (NFTs)

[63] Since 2001, El Salvador has adopted an official dollarization, replacing its former national currency, the Salvadoran colon.

To overcome the problem of excessive volatility[64], a relatively newer category of private crypto-currencies has been designed so that the value of the digital asset remains stable *vis-à-vis* other assets. These assets are called "stable private digital currencies" (or stablecoins). The "centralized or classic" stablecoins are backed by traditional currencies, such as the dollar, the euro or the yen, which constitute a guarantee collateral. The most important centralized stablecoins in terms of capitalization are: USDT (by *Tether*) and USDC (by *Coinbase* and *Circle*).

Other stablecoins, known as "decentralized or algorithmic", are backed in a complex way by other (not stable) crypto-assets and a basket of currencies, such as the Terra USD (or UST by *Terraform Labs*)[65]. In the (hypothetical but very likely) case of a large adoption in the future of one (or more) stablecoin or a launch of new assets by large existing technological companies or platforms (BigTech) such as Diem (ex-Libra) project by *Facebook*, and with the condition of authorization by the national legislations, one would then speak about Global stablecoins (GSCs). The latter could exert more monetary functions, notably as a means of payment on a global scale, or even as a store of value[66].

In parallel, serious risks for the international financial stability are to be feared: if GSCs are adopted on a significant international scale and their interoperability with traditional financial systems (international financial markets, banking systems, cross-border payment systems, etc.) is considerably developed, financial disorders in the event of a loss of confidence in one or more of these assets could take on systemic extents and even spread to the real sphere (IMF, 2020; FSB, 2022). The risk of international financial and economic crises is quite likely to occur[67].

[64] After just seven months, the global crypto-asset market moved from its historical highest value of more than USD 3 trillion in early November 2021 to USD 1.3 trillion in early May 2022, losing almost 60% of its capitalization (*Atlantic Council – GeoEconomics Center*): <https://www.atlanticcouncil.org/programs/geoeconomics-center/>

[65] That said, stablecoins, and more particularly the algorithmic stablecoins, are not as stable as that: in May 2022, the price of the UST have literally collapsed, falling in few days from its anchor value of USD/UST = 1 to 0.05. Traditional Stablecoins such as the USDT, for example, have also suffered losses in the wake of the panic created by the collapse, but less important than that of the UST.

[66] In addition to documentary sources on crypto-assets cited in this section, other sources (as websites) have been used: professional websites, issuers' websites, regulators' websites, etc.

[67] In the same vein, we believe, without claiming an economic prophecy, that the next major international crisis will have as a triggering factor disruptions related to the FinTech sector, or the international debt market (or that of a large country). The likelihood that it will be a combination of the two is also not negligible. In reality, two principles are constant in the history of major financial crises: i) each major

3.2.2. Central bank digital currencies

In order to cope with the rise of PDCs and the risks they may induce, more and more central banks are interested by creating their own digital currencies – CBDCs. A CBDC is only a digital version of the currency issued, managed, and controlled by a central bank and represents a liability for it like any currency. *A priori*, one could confuse a CBDC with other existing payment instruments such as transfers, debits, payment cards, and electronic "money". These instruments, just like the "physical" supports of payment (such as cheques), represent electronic payment instruments involving claims on private financial institutions (such as secondary banks), while the CBDC represents a direct claim on the central bank. Also, CBDCs are designed according to two configurations: "Detail" (or general use) which confers to the public the use of digital currency as a medium of exchange and a store of value, and "Wholesale" (or interbank use) which is intended for the central bank's use as reserves, accounts for major interbank settlements, and to provide (digital) central bank-money for the settlement of transactions related to assets in new digital infrastructures (BIS, 2022).

According to the survey published in BIS (2022), which includes over 80 central banks (covering more than 90% of world GDP), by the end of 2021, nine out of ten (surveyed) central banks are at a more or less advanced stage of the project to launch their CBDC, and that more than half are already in the phase of concrete experimentation. At the end of 2021, nine EMDEs have already launched a CBDC: the Bahamas, Nigeria, the seven countries of the Organization of Eastern Caribbean States; and fifteen other countries were at "pilot" phase. The latter group includes some major emerging countries, such as: Russia, South Korea, Thailand, Saudi Arabia, Ukraine and China (BIS, 2022)[68].

systemic innovation is accompanied by its major crisis – financial globalization being in this sense a major systemic innovation, as described by Aglietta (2000), and the very impressive rise of financial digitalization could also be; ii) all financial crises are liquidity crises, and debt is obviously at the heart of financial liquidity; so with the current debt levels, notably the public debt, the risk that negative externalities or endogenous dysfunctions will lead to confidence loss in the sustainability of a large country's debt (such as the US or China that currently hold debt levels never equaled) or a group of EMDEs because of the rise in global interest rates (*i.e.* US rates), is a major risk for the stability of the IMFS. In fact, there is nothing to suggest that "this time is different," as said in the expression-title of Reinhart and Rogoff (2009).

[68] At the time of writing these lines (May 2022), and according to *CBDC Tracker* edited by the *Atlantic Council – Geoeconomics Center*, the statuses (or phases) of the CBDC creation projects of 91 countries or monetary areas are classified in decreasing order of achievement as follows: Launched (09); Pilot (15); Development (16); Research (40); Inactive (07) ; Cancelled (02).

The latter country – China, has extended the "pilot" phase of its digital currency (e-yuan) to all of its provinces for retail and wholesale use during the *Beijing Olympic Winter Games* in February 2022. The project was initially launched in 2014. Beyond the objectives of a national currency digitalization, this initiative also aims to develop the international role of the renminbi. However, this latter objective, as for the rest of the financial reforms, has been rethought so that it follows a more controlled and slower process, in order to avoid serious financial and monetary deviations like those encountered in 2015 and after, as we have pointed out about the potential of the renminbi as an international (and reserve) currency in the previous sub-section. At present, the e-yuan project is the most successful project among the largest economies.

The ECB has also accelerated its process for the lunch of the e-euro. It is currently at "development" phase, and its launch is scheduled for 2024. Officially, the ECB does not state that its CBDC project primarily aims to strengthen the international role of the euro (ECB, 2021). Moreover, since the launch of the euro in 1999, the ECB has shown that it was not in its primary intentions to create a currency for competing with the hegemonic status of the dollar, and that it was preferable to let it to evolve naturally in that sense (ECB, 2019), probably because of fears of the negative effects of a strong hegemonic currency (penalizing external trade-competitiveness and/or European "phobia" of large budget deficits). Thus, for the digital version of the euro, the ECB does not seem to change its philosophy. However, it must be said that if, once launched and cross-border payments authorized, the digital euro would contribute, *ceteris paribus*, to make the European currency more attractive, particularly as a reserve currency.

The Fed –the world's largest central bank, and whose policies still have a strong influence on national policies and the global economy– is however only at the phase of "research" in the project of digital version of the dollar. In reality, the US seems rather hesitant or even reluctant about a very significant development of a CBDC or other forms of assets that could significantly change the IMFS architecture. This should not be really surprising, because digital currencies, especially CBDCs, stipulate a monetary symmetry that is opposed to the fundamental principle on which the hegemony of the dollar is based, and therefore to the American exorbitant privilege, as we have already shown. The principle of the key-currency would be fundamentally challenged in the event of the emergence and expansion of CBDCs (or even CSGs), argue Aglietta et al. (2022).

3.2.3. The effects of digital currencies on the international status of currencies

Indeed, the significant advances in FinTech, and their use stimulated by the Covid-19 pandemic, have facilitated and will continue to facilitate the use and diversification of portfolios in different currencies, since this externality (technological progress) reduces transaction costs, impediments to switching (currencies), and information's costs and asymmetry (Eichengreen et al, 2018). The decline in network effects, and to some extent in inertia effect, during recent decades as stated by Eichengreen et al. (2018) and Iancu et al. (2020), goes in this direction. Indeed, network effects in particular, convince actors in international transactions to prefer remaining, as far as possible, on the same currency, including the dominant one (inertia effect). That would reduce the costs of reallocation and others. However, these gains are becoming increasingly acquired through technological progress, which explains the weakening of the role of these two types of effects.

Theoretically, *Stablecoins* are also supposed to increase the demand and the international use of fiduciary currencies on which they are backed (linked); and even if not linked, a CSG could achieve international status if it offers the collateral and liquidity required for a reserve currency (Iancu et al, 2020). The authors also imagine a scenario where several CSGs could be included in central bank reserve stocks.

The CBDCs are more predestined than private currencies to become a catalyst for the existing major reserve currencies, but also for the currencies of smaller countries with credible policies and solid fundamentals, add Iancu et al. (2020). Three features of digital means of payment will facilitate the adoption of CBDCs on international scale in addition to their domestic use: safety, lower transaction costs through competition, and "programmability" and bundling effects that allow them to be combined with other complementary services, which will allow a greater financial inclusion[69] (IMF, 2020; ECB, 2021).

In IMF (2020), several scenarios for the evolution of CBDCs and GSCs are given, including a multipolar configuration where a small number of major CBDCs and GSCs are competing locally and globally. Thanks to technology that reduces the network and inertia

[69] In parallel with the cited advantages, the CBDCs (as well as the CSGs) may present future challenges for monetary and regulatory authorities in terms of the transmission of monetary policy, capital flows, exchange restrictions, and macroeconomic policies and regulatory mechanisms in general. For more details on these aspects, see IMF (2020) and Martinez Peria (2021), among others.

effects, the fact that a digital currency has the advantage of the "first-mover" (or historical incumbent) does not guarantee the dominance durability. The interoperability of different systems and/or networks will allow for low-cost migrations.

In that way, it seems interesting to question the viability of the different competitive configurations between currencies in this digital era. In fact, and as we have already seen, opinions do not agree about the viability of multipolar system(s) (of fiduciary currencies): competition between currencies could destabilize the whole system in the event of a problem of confidence (Nurkse, 1948) ; multipolarity would increase the global supply of safe liquidity for reserves and overcome the Triffin dilemma (Eichengreen, 2011; Eichengreen et al, 2018); competition between a large number of currencies is beneficial for the entire system; unlike a duopoly situation (Farhi and Maggiori, 2018). In reality, the field of conjecture is still broader with this respect, and several parameters must be included and add complexity to this task, in particular the conduct of and the transmission of monetary policy in the digital era, the degree of tolerance *vis-à-vis* the substitutability of digital currencies,[70] the interaction with macro-prudential rules, and the security of the digital ecosystem.[71]

On a more global level, recent contributions, clearly inspired by old ideas, even propose a "hegemonic synthetic currency" backed by a CBDC basket and whose credibility is derived from those of the participating central banks (Carney, 2019). This digital synthetic currency could even be used for global goals such as the ecological transition (Carney, 2021). Of course, such proposals mean a rethinking of the overall architecture of IMFS, or at least a multipolar system that is very different from what we have known until now. Moreover, and as we have already pointed out about the previous proposals for universal currencies, such ideas require a condition that seems almost impossible in the near future, namely a global political cohesion, as Aglietta et al. (2022) also point out.

[70] The substitutability of currencies is the situation in which a foreign currency replaces a domestic currency for domestic transactions, and differs from the internationalization of a currency, which means acceptance that a currency performs all three functions on an international scale (IMF, 2020).

[71] In that way, we believe that monetary digitalization, which will inevitably and very quickly intensify in the coming years, will contribute, alongside the extraordinary development of financial markets (and the movement of financial globalization), to "reshape" several paradigms in (open) monetary macroeconomics: inflation, its determinants and the scope of monetary policy are examples. We cannot, of course, develop this reflection here, for methodological concerns.

Ultimately, it can be said that the emergence of CBDCs, and even GSCs, will most likely have an impact on the international role and weight of existing currencies. This may be slow, but may also change the structure of the international reserves held by central banks, as well as new dominant currencies could emerge (Martinez Peria, 2021). Furthermore, CBDCs should not alter the importance of economic fundamentals that define the international role of currencies (ECB, 2021; IMF, 2020). The specific features of digitalization (greater safety, reduced costs and bundling effects) may help to facilitate and increase the international attractiveness of a currency for the three monetary functions. This is therefore a complementary but not a negligible role (ECB, 2021). The configurations (or designs) under which the CBDCs and/or PDCs will evolve, the degree of acceptance and the reactions of financial markets, as well as the influence of geopolitical forces, will determine how and to what extent monetary digitalization will influence the architecture of the IMFS and the composition of worldwide reserves.

Conclusion

In this chapter we focused on the dominant currency of world reserves, namely the US dollar, which is more generally the hegemonic international currency for all types of financial and trade transactions. We have deduced, through a literature review on the issue since the BW era, that the durability of the dollar status is intimately related to the external financial position sustainability of the center country (the US) since the end of the Second World War. The overview of the debates on this subject, constantly renewed according to the periods and circumstances, and without ever leading to a consensus, allows us to say that this controversy was, in fact, always interested in two fundamental questions: *could the US continue to attract financing for their deficits for a longtime? and could the dollar maintain its dominance indefinitely?* knowing that the different answers to these two questions, even if always debated, agree on the fact that there is a circularity of influence between the financial privilege of the US and its currency hegemony.

Beyond any economically rigorous argument, the observer will find that so many major events have impacted the global economy and geopolitics in the last 50 years, and in which the dollar has been heavily involved, but could not do much harm to its hegemonic status, nor to American economic domination: the collapse of BW system, the 9/11, the Great Financial Crisis of 2008-9, etc. The dollar has always survived and remained *primus inter pares*. In reality, the lack of realism and feasibility of other alternatives or proposals undermines the chances of dethroning the dollar, at least in the foreseeable future despite all the problems and asymmetries it presents for the IMFS.

Nevertheless, the evolution of several parameters characterizing the current global landscape could probably change the situation. As we have seen, in addition to all the factors in favor of a continuity of the dollar dominance (financial links, network and inertia effects, etc.), other factors have the potential to provoke changes in the future world structure of reserve currencies and to threaten more seriously the dollar status. These factors, as summarized by Iancu et al. (2020), are: the likely effects of the Covid-19 pandemic on trade through industrial relocations in the medium run, the demand evolution in debt markets outside of the dollar, trade links (and invoicing practices), the credibility of

the economic policies of debt issuers, and the progress of financial and payment technologies, including the emergence of public and private digital currencies.

The strategic and geopolitical considerations of reserve currency issuers and reserve accumulators are also important, we have found. All the more, it is a highly synchronous element with the writing of this part of our work (the triggering of conflict in Ukraine and the sanctions against Russia that followed), to which we devoted a special part. On the same subject, but well before the beginning of the conflict, Ilzetzki, Reinhart and Rogoff (2021) point out that changes in dominant anchor currencies are rare and occur at critical moments in the geopolitical history of the world, particularly during or following major armed conflicts.

This paper by Ilzetzki, Reinhart and Rogoff is one of a series of studies by these authors, which have been/will be cited in our work, and which deal with the evolution of the (international) exchange rate system and (*de facto*) anchor currencies, including the dominant ones. These papers also present some elements about the relationship between international reserve accumulation and ERRs – a subject on which we will focus more deeply in the next chapter.

Chapter III.

Reserve Accumulation and ERRs:
Literature Review and Empirical Evidence

Introduction

In the previous chapter, we have seen that the dominant reserve currency is at the heart of the IMFS. One cannot talk about the latter without mentioning one of its most important elements, namely the (international) exchange rate system. Indeed, the configurations according to which countries regulate, more or less, the external value of their currencies, *i.e.* exchange rate regimes (ERRs), particularly involve foreign exchange reserves, where the anchor currency, especially the dominant one, plays a role, not only in the functioning of the regime but also in the constitution of accumulated reserves.

But before focusing on the relationship between reserves and ERRs, let us first look at some major differences between the two major classes of regimes: fixed and floating regimes. The choice of an ERR by the monetary authorities belong on their preference (aversion to) for the advantages (disadvantages) associated with the adoption of a particular regime. Theoretically, many advantages are attributed to fixed exchange rates, notably the fact that they provide a nominal anchor for monetary policy in that the anchor currency is used as a stabilizer of domestic prices. From another side, fixed rates stimulate growth in that they reduce or even eliminate the uncertainty inherent in the volatility of the exchange rate which affects negatively the international trade and FDIs. Another advantage of fixed rates is that they make it possible to exclude the possibility of competitive depreciations to which trading partners (competitors) would be tempted, and which are in line with *beggar thy neighbor* policies. Fixity also allows international coordination between monetary authorities for the adoption of parities and stabilization measures in a concerted and optimal way for all.

Another very important difference between the two categories of ERRs is the mode of adjustment of external payments and its relationship with (influence on) internal balances, as well as the consequences for reserve holding. Under fixed rates, monetary authorities intervene on the Forex and must therefore hold reserves to defend the parity (or the tolerated fluctuation band) in the event of downward pressure on the domestic currency value. In the opposite case of upward pressure, reserves increase as a result of the foreign currency purchases made by monetary authorities. Moreover, economic theory states that

adjustment under floating rates removes the external constraint because exchange rate volatility acts as a "shock absorber" for external real and financial shocks; thus, reserve holding for adjustment purpose becomes no longer necessary.

The absence of external constraint under floating rates provides a major advantage in terms of monetary policy autonomy. Monetary authorities become more independent to control money supply (and interest rates). When there are no external adjustment constraints, the only objective of equilibrium becomes internal (price stability and/or economic activity regulation)[72]. Thus, exchange rate flexibility provides to the central bank a great level of seigniorage which corresponds to the discretionary status of money issuing, contrary to certain forms of fixity such as the currency board or the total dollarization. That means that any independent ability to issue or create money disappears since it becomes subordinate to foreign exchange inflows. In addition, the role of the central bank as lender of last resort is strengthened with floating. If there is a liquidity crisis, secondary banks can rely on central bank interventions to provide them with liquidity and thus avoid/mitigate the contagion risk to the entire banking and financial system.

These differences, which often oppose the two categories of ERRs, are not the only ones that the theoretical and/or empirical literature gives. Many studies have focused on the comparative macroeconomic performances of different regimes, particularly in terms of growth, inflation and vulnerability to financial and currency crises. For methodological reasons, we will focus in our work only on studies that more or less directly involves the holding (accumulation) of international reserves under alternative ERRs. This chapter contains three sections. The first two sections try to bring from the existing literature some answers to the issue of the existence, the feasibility and the interest of reserve accumulation under the two categories of regimes. The third section attempts to give empirical evidence by checking the hypothesis that ERRs do not (significantly) influence the accumulation of international reserves.

[72] According to the traditional Keynesian view, monetary policy aims one of the two internal objectives, depending on the economic conjuncture (price stability and/or economic activity regulation), while for Monetarists and New Classics, it must deal only with the first objective.

Section 1. Fixed Exchange Rates and the Need for Reserve Accumulation

In this section, we try to answer this question: *Why do fixed exchange rate regimes, or more generally (rigid and soft) pegs, favor reserve holding / accumulation?* To do this, we present the arguments of the standard theory that fixity is "naturally" more favorable to reserve accumulation. First, this relationship between fixity and accumulation is studied with respect to the differences between payment and adjustment mechanisms through the evolution of the IMS. Next, we look at the weight of interventions in the Forex, and therefore the need to hold reserves, across the ERRs' *continuum*. Finally, we address another argument given by recent studies, and which concerns the role of reserve accumulation in the relaxation of the economic policy "trilemma".

1.1. Payment and adjustment mechanisms through the evolution of the IMS

In the definition of international reserves, the emphasis is put on their use for financing balance of payments' needs and for Forex interventions. Indeed, the importance of international reserves has always been considered to be closely related to the problems of liquidity and the adjustment of payment imbalances through the evolution of the IMS, since 1870-80. The differences in adjustment patterns and the interactions between external and internal balances under fixed and flexible ERRs underline the role and the importance of international reserves holding (and accumulation) by monetary authorities.

1.1.1. Adjustment under fixed exchange rates

Under fixed rates, monetary authorities are responsible for maintaining the parity of the national currency. The role of reserves is fundamental. In the event of payments' imbalance, the adjustment can be done automatically, but not without negative collateral effects. Under the gold-standard system, the mechanism was called the "price-specie flow". For current account payments, the mechanism follows the sequence shown in Figure (3.1.).

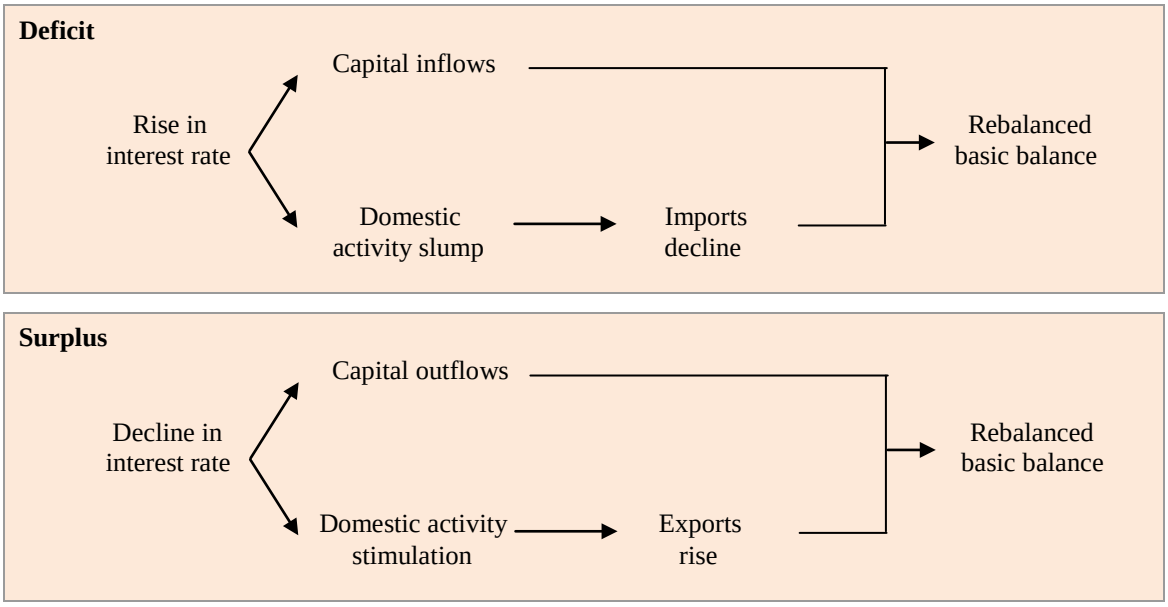
Figure (3.1.): Gold flows and self-regulating mechanism of current account imbalance under the gold-standard system

Deficit >>> Gold outflows >>> Contraction of money supply >>> Internal prices deflation >>> Gains in trade competitiveness >>> Increase in exports >>> Rebalancing of the current account

Surplus >>> Gold inflows >>> Expansion of money supply >>> Internal price inflation >>> Loss of trade competitiveness >>> Decrease in exports >>> Rebalancing of the current account

This automatic adjustment mechanism can be accompanied by central bank measures through the interest rates' manipulation (more particularly the re-discount rates) in order to act on the basic balance (current account balance + long-term net capital inflows or outflows). Figure (3.2.) below describes this.

Figure (3.2.): Accompanying measures for rebalancing the basic balance under the gold-standard system

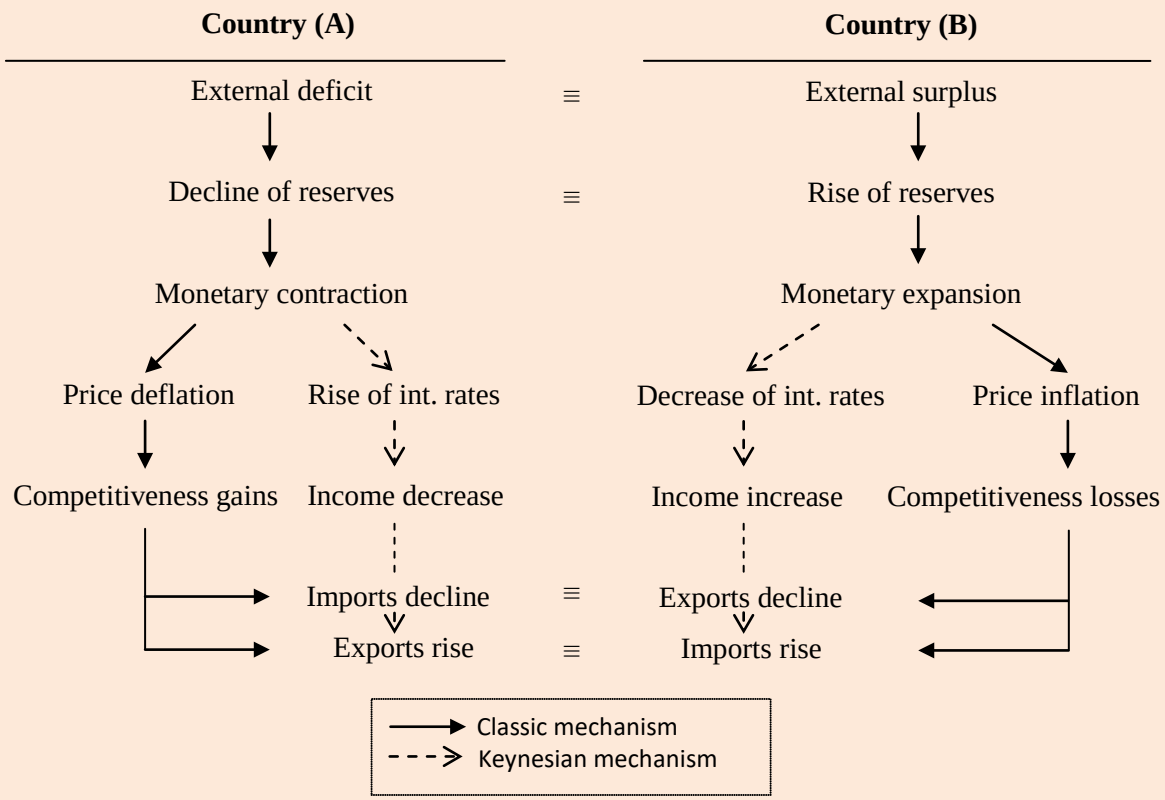


Internal and external variables interact through price-effects, income-effects and quantitative-effects of the money supply changes (in the logic of quantitative theory of money) since the money supply is supposed to be composed by gold and/or notes backed by gold according to a predetermined parity. The deficit (surplus) results in a decrease (an

increase) in the stock of (gold) reserves which allows, according to the described sequence, an automatic return to balance of payments' equilibrium and maintenance of parity.

The fixed ERR is presented by the Classics and the Keynesians as a choice which gives the possibility of automatic adjustment and which does not differ considerably from the automatic mechanism of readjustment under the gold-standard system, except that gold no longer represents the (integral) counterpart of money supply. It is (partially) replaced by foreign exchange reserves. It should be also noted that in a classical logic the internal adjustment is done through changes in prices (and wages) as these latter are supposed to be perfectly flexible, and not through income changes as in a Keynesian logic, since the economy tends towards a full-employment without inflation. The return to external balance for Keynes is achieved by a decrease (an increase) in income in the event of a deficit (surplus). Figure (3.3.) below describes this.

Figure (3.3.): Automatic adjustment under fixed exchange rates



Under BW, the system of fixed parities tolerates a minimal margin of fluctuation of 1% around the official rate. Central banks intervene on Forex to keep rates within margins.

In the case of a deficit, the central bank faces downward pressures on its currency by purchasing it against foreign currencies it holds, thus the reserve level decreases. Monetary policy plays also an important role. If the central bank intervenes, by changing the level of its reserves, it may offset the (negative or positive) difference in its assets classes (monetary counterparts) resulting from the change in the level of reserves by the modification of other counterparts (credits to government or to economy). In addition, to counter the decline in the reserve level in case of a deficit, the central bank can apply a restrictive policy that slows domestic demand and potentially attracts foreign capitals. However, in the case of a surplus and an increase in reserves, symmetrical measures seem not to be effective. In this case, the central bank only has to compensate for this increase by sterilization measures.

In addition, during the BW era, the IMF granted loans to countries in need of financing to reduce their imbalances: "loaned reserves" that are proportional to their quotas. However, a country cannot be in deficit indefinitely. It uses *expenditure- switching* policies such as devaluations, tariff and non-tariff barriers, etc., or for maintaining the parity and the regime it applies *expenditure-changing* policies through restrictive monetary and/or fiscal policies leading to **a** recession or **a** deflation (Choudhry and Hasan, 2007)[73].

1.1.2. Absorptive mechanisms of external shocks under flexible exchange rates

Advocates of flexible rates were inspired by the pioneering papers of Meade (1951), Friedman (1953), Mundell (1961), Fleming (1962), etc. With flexible exchange rates, external shocks are absorbed through the volatility of the nominal exchange rate, not by internal adjustments as unemployment or inflation. Thus, "*... depreciation can take the place of unemployment when the external balance is in deficit, and appreciation can replace inflation when it is in surplus*." (Mundell, 1961, p 657)

For example, in the event of a negative trade shock, the latter reduces both the current account (deficit worsening) and income (with the assumption that the fall in imports caused by that of income does not cancel out the deterioration of the current

[73] "*Expenditure changing policy, which takes the form of fiscal or monetary policy, aims to affect income and employment with the goal of equating domestic expenditure, or absorption, and production. Expenditure switching is a macroeconomic policy that affects the composition of a country's expenditure on foreign and domestic goods. More specifically, it is a policy to balance a country's current account by altering the composition of expenditures on foreign and domestic goods. Not only does it affect current account balances, but it also can influence total demand, and thereby the equilibrium output level.*" (Ito, 2008, p. 398)

account). As a result, this effect leads to the deterioration of the balance of payments, which in turn causes the depreciation of the currency, and thus drives to an improvement in the country's price-competitiveness. Exports increase and imports decrease, improving the current account and income (Edwards and Levy-Yeyati, 2005). This trend leads to an appreciation of the currency and consequently to a rebalancing of the (overall) balance of payments. The external shock is absorbed through an *expenditure-switching* effect. The expenditure boosts exports and stabilizes income, as originally stated by Friedman, Mundell, or Fleming, summarize Towbin and Weber (2011). The condition, in this case, is domestic prices' flexibility, allowing a change in relative prices (Engel, 2002).

In terms of financial shocks, flexible rates also play the role of an adjustment variable in the event of a reversal in net capital flows (due to increases in foreign interest rates, expectations of the country's currency depreciation, or a negative evolution of the economic or political climate). For example, when foreign interest rates rise, they lead to capital outflows and thus to financial account deterioration. This tendency results in a depreciation of the local currency and improves the country's price-competitiveness. The improvement of the current account provokes a similar effect on the balance of payments, thus restoring (automatically) the external balance, and to an increase of national income. Theoretically, the external equilibrium constraint being evinced, the monetary authorities are no longer obliged to intervene on the Forex to support the national currency. Thus, there will be no need for holding reserves, explain Chaudhry and Hasan (2007).

1.2. Forex Interventions

Beside meeting balance of payments financing needs, the IMF's functional definition of international reserves indicates that these latter can be used by the monetary authorities to intervene in Forex with the aim of influencing the exchange rate of the national currency. Under a dichotomous classification of ERRs (fixity and floating), it is clear that interventions on Forex concern only the fixed regime. However, there are in fact several configurations of regimes which can be grouped under three main categories: fixed, intermediate and floating. In Frankel's (1999) "*Continuum* of Flexibility", summarized below, we can see that interventions and therefore the need for holding reserves have a great importance.

1.2.1. The role of international reserves in the ERR *Continuum*[74]

A. Fixed exchange rate regimes

A.1. Monetary union

This is the case where several countries (at least two) use the same currency, thus forming a single monetary area. The currency used may be common. In this case, countries keep their national currencies and irrevocably fix their exchange rates. In the extreme case, the currency used becomes the single currency, *i.e.* the countries forming the monetary union definitively abandon the use of their currencies. The reason for holding reserves for intra-regional interventions disappears because of the abandon of national currencies. The right to hold reserves in order to intervene on the Forex shall be transferred to the institution responsible for conducting the union's exchange rate policy *vis-à-vis* the RoW.

A.2. Currency board

A currency board is a monetary institution with an operating principle similar to the pre-1914 gold-standard. In this regime, reserves play the central role. The monetary base in circulation (fiduciary currency and reserve requirements of secondary banks) becomes perfectly equal to the amount of reserves held by the monetary authorities. The increase in the level of reserves leads to the issuance of domestic currency, and their decline means a monetary contraction. In a currency board system, the exchange rate is irrevocably fixed. The domestic currency is perfectly convertible and interest rates must, in principle, be close to those of the standard currency.

A.3. Dollarization

Stricto sensu, dollarization means a total replacement (total dollarization) or a partial replacement (partial dollarization) of a domestic currency by the US dollar, for the three traditional functions of a currency (account unit, exchange means and store of value). *Lato sensu*, this term is used in the case where a currency, other than the US dollar, is used to replace a national currency. Existing foreign reserves (or borrowed from outside) are used to put the new currency into circulation.

[74] Some developments and definitions are taken from a previous work by the author (Zine Elabidine, 2008).

B. Intermediate exchange rate regimes

Unlike fixed regimes that represent a rigid nominal anchor (strict pegging of the nominal exchange rate), or even the use of other currencies, intermediate regimes are arrangements where nominal anchoring is flexible or reviewable. This means that these regimes are also based on the principle of fixity, but the difference is that their fixity is no longer rigid or irrevocable, and that the pegging exchange rate policy does not represent an institutional commitment as is the case with fixed regimes.

B.1. Fixed but adjustable pegs

Fixed but adjustable pegs is a regime similar to that prevailing between the "major" currencies during BW era. This regime is characterized by fixity of the exchange rate but with possibility of parities' redefinition. The modification occurs in the case of payment imbalances to enable the adjustment mechanism. In other words, it is a reviewable nominal anchoring regime. In some cases, the "anchor" could be the real exchange rate, but with a discontinuous adjustment procedure.

B.2. Crawling pegs

The crawling peg regime is a system often used by countries with very high levels of inflation. It can be described as a series of "mini-devaluations" in so far as the monetary authorities seem to defend (continuously) nominal parities. But in reality, exchange rate behavior tries to maintain a stable real exchange rate.

B.3. Basket pegs

A Basket peg is a system that backs the domestic currency on (a basket of) several foreign currencies and not just one. Generally speaking, open countries to international trade with a diversified geographical structure use this system. The basic argument is that fixing to a basket stabilizes the effective exchange rate better than pegging to a single currency in the event of fluctuations between the main partners' currencies.

B.4. Target zone (or fluctuation band)

In this ERR, the monetary authorities commit to defend parity if the exchange rate approaches the limits of a tolerated and pre-announced band of fluctuation (around the

central parity). The European Exchange Rate Mechanism, established in 1979, is an example. There are also possibilities of combination between many intermediate regimes, such as Williamson's (2001) proposal for a system combining the characteristics of the last three intermediate regimes: a crawling band around a central parity pegged to a basket of currencies. This regime is called "Basket, Band and Crawl regime" (or BBC).

C. Floating exchange rate regimes

C.1. Managed floating

Also known as "impure floating", this regime is defined by the central bank's ability to intervene occasionally in the Forex. Interventions are not intended to defend any particular parity or fluctuation band.

C.2. Free floating

Theoretically, monetary authorities allow supply and demand to interact freely on the Forex to determine the nominal exchange rate.

From this brief presentation of Frankel's *continuum* of flexibility, it seems that all configurations, except the free floating, give to reserve holding a more or less important role for interventions on Forex, or consider them as a central element of the regime functioning, as in the extreme case of total dollarization or currency board. Eichengreen et al. (1999) point out more precisely the importance of the level of reserves as one among other determinants of the ERRs' choice. Table (3.1.) shows that the (high or low) level of reserves could be an important determinant of ERRs' choice[75].

Table (3.1.): Reserve level and ERRs' choice

Reserve level	Floating		Band		Peg		Rigid fixity	
	Free	Managed	Wide	Narrow	Crawling	Fixed	Currency board	Monetary union
High	yes	yes	yes	yes	yes	yes	yes	yes
Low	yes	yes	yes	no	no	no	no	yes

Source: Eichengreen et al. (1999); modified by Allegret et al. (2009)

[75] The classification of ERRs used by Eichengreen et al. (1999) is slightly different from the flexibility *continuum* of Frankel (1999) which we have just presented.

In fact, ERRs whose functioning requires significant interventions on Forex, such as the currency board, fixed or crawling pegs, and narrow fluctuation bands, are not suitable for countries with low levels of reserves, note Allegret et al. (2009). These latter give the example of three European countries in transition (Bulgaria, Romania, and Slovenia) which, despite being at the beginning of a macroeconomic stabilization process often requiring nominal anchorage regimes, have "opted" for a managed float due to insufficient levels of the available reserves (at this time).

1.2.2. Central bank intervention mechanisms

In what follows, we will examine the modes of intervention in the Forex by directly using exchange reserves and/or other mechanisms –qualified as indirect interventions.

A. Forex direct interventions

A.1. The principle

Direct intervention in the Forex is like "a walk against the wind". When the value of the currency is depreciating, the central bank purchases it and sells the anchor currency (currencies) until the exchange rate returns to its official parity or within the tolerated fluctuation band. Otherwise, when the currency appreciates, the central bank sells it against the purchase of the foreign currency (currencies) until the return to the official parity or within the band. Thus, the central bank's intervention in the market, using foreign exchange reserves, means that the level of the latter varies by decreasing or increasing. In many cases, interventions take place on spot market. That said, because of the effect on the level of liquidity denominated in domestic currency, interest rates in the money market are also affected, and consequently forward exchange rates. If the currency depreciates, the central bank purchases it and thus reduces the liquidity in the money market, which leads to a rise in short interest rates. Symmetrically, if the currency appreciates, the central bank resells it and therefore increases liquidity, which lowers short interest rates.

A.2. Sterilized interventions

Intervention on the Forex affects money supply and interest rates directly. This could have negative effects on activity and prices. To avoid that, the central bank neutralizes its action through "sterilized" interventions. It consists of offsetting the impact

on the money supply by acting in an opposite way. If the central bank sells its currency when fighting against appreciation, thus increasing the money supply, it can offset this swelling by selling domestic securities it holds (*e.g.*, treasury bills). This operation reduces balance sheet assets after having increased due to the increase of reserve stock. The case of intervention against depreciation implies symmetrically reverse mechanisms. Also, and with the same example (defense against appreciation), the central bank can simultaneously use another technique by carrying out “borrowing swaps" of its currency. This means exchanging foreign currency loans for local currency loans with commercial banks. Thus, the increase in the money supply is immediately offset by a decrease of the same magnitude.

B. Intervention by monetary policy decisions

Manipulation of interest rates can influence exchange rates. An increase in rates leads to an increase in the demand for money in which the returns of investments becomes more attractive, and consequently an appreciation. Depreciation is caused by lower interest rates. However, as shown by Hnatkovska et al. (2008) through a model for a small open economy, the sign of the effect of changes in interest rates on those in exchange rates is not always as clear. An increase in interest rates has three different effects: an increase in the public debt burden, a reduction in income due to higher production costs, and an increase in the demand for domestic monetary assets. The first two effects lead to a depreciation of the currency, while the third acts in the way of appreciation. The net effect of interest rates’ changes on exchange rates depends on the relative weights of the three effects.

In practice, central bank interventions in Forex are supported by an active interest rate policy. The two measures undertaken jointly have a “portfolio effect” through which Forex operators modify the composition of their portfolios in order to optimize their investments. Changes in interest and exchange rates affect the currency composition of portfolios, which further affects the exchange rate.

C. Interventions by “signal” effect

This type of interventions makes it possible to influence the behavior of market operators (which could be mimetic) by sending them signals on the future evolution of the exchange rate, which reflects the expectations about the future economic policy by the

public authorities. So, if the latter disclose information on the markets (statements, etc.), the operators –believing in the credibility of the authorities' indications, will act in the desired direction. Sterilized interventions also represent a signal effect on the markets. Through its action, the central bank reports to the operators the level of the desirable exchange rate (considered as an indicator of future economic policy trends). As a result, the operators follow the central bank because they believe that it hold "more relevant" information.

1.2.3. The defense of the ERR against speculative attacks

Interventions are not made only to counter depreciations or appreciations under "normal" conditions. A currency can also be the subject of speculative attacks, where downward pressures are made massively. A speculative attack is a simultaneous action by speculators anticipating a nominal depreciation of a currency and doing transactions in the sense that their efforts result in the realization of capital gains after the effective depreciation of the currency under attack. At the same time, the central bank intervenes strongly to defend parity, the band, or even the regime against collapse. Foreign reserves shall be used in this respect to purchase the national currency.

The attack can be considered as "successful" if it results in a significant and lasting change in the exchange rate, or "unsuccessful" if the central bank succeeds in defending the currency against the speculators' action. A currency crisis is the consequence of successful attacks, but also of unsuccessful attacks if they generate significant impacts, such as a sharp decrease or quasi-depletion of reserves and/or a significant increase in short interest rates used to counter capital flight (Eichengreen et al., 1994, 1995; Glick and Hutchison, 1999). The consequences of financial and currency crises in the 1990s and early 2000s led to the accumulation of large international reserves with the aim to use them as "war shields" against possible future attacks or new sudden stop episodes.

1.3. Accumulation of reserves and the relaxation of the "trilemma" constraints

Still in the perspective of showing why fixity can promote reserve accumulation according to standard theory, we expose in what follows the argument of the relaxation of economic policy "trilemma" constraints.

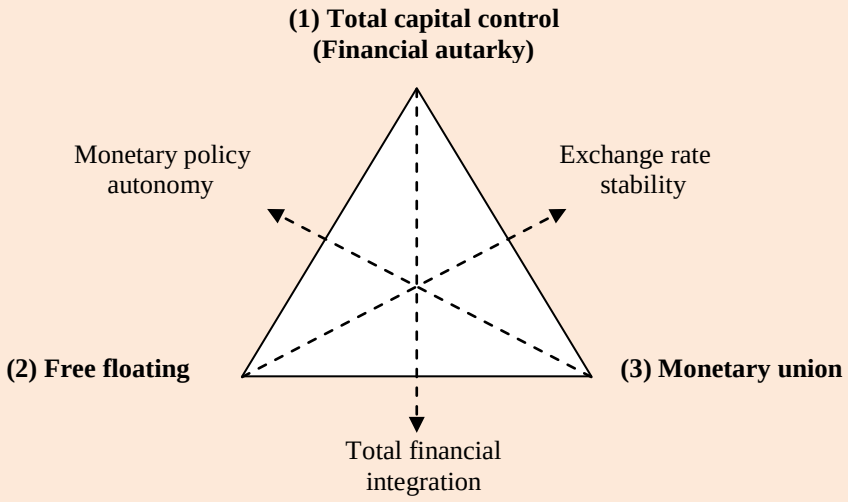
1.3.1. The "trilemma" of economic policy

A. The principle

The "trilemma" of economic policy, also known in the literature as "Mundell's Incompatibility Triangle" or "Impossible Trinity", is a principle drawn from the IS-LM model in open economy. The trilemma suggests that it is impossible (or unsustainable) for a country to achieve, at the same time, more than two of the three (monetary and financial) economic policy's objectives, namely: exchange rate stability, monetary policy autonomy, and financial integration (capital flows freedom). As a result, three possible strategies emerge (Figure 3.4.).

First, exchange rate fixing combined with an expansionary monetary policy leads to capital outflows due to lower domestic interest rates. This results in depreciating pressures on the currency. Thus, safeguarding of parity stipulates the sacrifice of the objective of capital flow freedom by imposing capital and exchange controls. Secondly, if the country prefer to keep monetary autonomy and financial openness as objectives, this would only be possible at the cost of greater exchange rate flexibility. Third, maintaining a fixed regime in a context of significant financial integration removes all discretionary power to the country's monetary authorities. Thus, in a monetary union with strong financial integration, all countries are forced to follow the most restrictive monetary policy adopted by one of the member countries (Aizenman et al., 2008).

Figure (3.4.): The Incompatibility Triangle



Source: Adapted from Aizenman et al. (2008)

B. The trilemma and the debate on ERRs' fragility

The notion of trilemma has been exploited in the debate on ERRs' choice and more particularly by economists who pointed out the fragility of the intermediate regimes, especially during the financial and currency crises of the 1990s. As alternatives, these economists recommended "corner solutions" (free floating or firmly rigid regimes such as a monetary union). Indeed, the supporters of this "bipolar view" (such as Obstfeld and Rogoff, 1995; Summers, 1999; and Fischer, 2001a) explain the vulnerability to currency crises by the fragility of intermediate regimes. The basic argument of bipolarism is the unsustainability of the middle class in the logic of the incompatibility triangle and its inadequacies in terms of credibility *vis-à-vis* the markets. Obstfeld and Rogoff (1995) consider "*... that there is little, if any, comfortable middle ground between floating rates and the adoption of a common currency.*" (Obstfeld et Rogoff, 1995, p. 74)

Frankel (1999) considers that with an increased financial integration, countries are pushed in their choice of ERR towards the base of the triangle (free floating with monetary autonomy or rigid fixity without monetary autonomy). For Fischer (2001a), such a level of integration does not support fixed parities unless countries irrevocably commit themselves to defend their parities and are ready to build on necessary policies and institutions, while sacrificing the monetary tool. Thus, the only alternative becomes free floating. He notes in this sense: "*... soft pegs (intermediate regimes) are crisis-prone and not viable over long periods. This is primarily due to the logic of the impossible trinity.*" (Fischer, 2001a, p. 22)

For Summers (1999), "*... the core proposition of monetary economics is a trilemma: that capital mobility, an independent monetary policy, and the maintenance of a fixed exchange-rate objective are mutually incompatible. I suspect this means that as capital market integration increases, countries will be forced increasingly to more pure floating or more purely fixed regimes.*" (Summers, 1999, pp. 326)

However, the fragility of intermediate regimes, decried by bipolarism advocates and based on the trilemma principle, has not been exempt from criticism. According to Frankel (1999, 2003), this principle, notwithstanding its relevance, does not really give clear arguments about the fragility of intermediate solutions. The theory does not mean that, in a context of financial liberalization, the authorities of a given country cannot choose a solution that ensures a "half-stability" of the exchange rate and a "half-

independence" of monetary policy. Indeed, in a "moderately" flexible regime, *i.e.* intermediate regime, monetary authorities have the possibility of coping with "part" of the fluctuation through their interventions, and letting "the other part" be reflected on the exchange rate. In other words, the principle of the trilemma does not prevent the choices existing between free floating and rigid fixity.[76]

C. Historical evidence on the trilemma

Many studies focused on checking, in a more or less systematic way, the historical relevance of the trilemma principle lessons. For example, Borensztein et al. (2001), Frankel et al. (2002), and Shambaugh (2004) use different data and methodologies and try to determine whether domestic interest rates in the presence of pegged regimes are more responsive to international rates than when adopting floating regimes. They infer that pegs are less favorable to more independent monetary policies, although Frankel et al. (2002) conclude "temporary" monetary autonomy with floating.

Similarly, in a systematic study of the historical links between exchange rates, monetary policy, and capital mobility, Obstfeld et al. (2005) conclude that the trilemma and its consequences are verified historically. For the gold-standard, synonymous with fixed exchange rates and an advanced financial integration[77], they note a rapid transmission of interest rates and thus a low level of monetary autonomy. During the BW era, when international capital mobility was limited, national interest rates did not seem to be significantly constrained. In the post-BW era, marked by increasing financial

[76] Recall that our objective through these latest developments is not to address with the debate on the viability/fragility of the different categories of ERRs. The Bipolar view and Frankel's Criticism (1999, 2003) are mentioned here only because they are based mainly on the trilemma argument, which we explore in this section in the context of the hypothesis that fixed regimes are more favorable to reserve accumulation. That said, for more details about the Bipolar view criticism and/or the support of intermediate regimes, refer to the studies dealing directly or indirectly with this issue, in particular: the possibility of occurrence of speculative attacks even under corner solutions (Williamson, 1998, 2000; Bubula and Otker-Robe, 2003); the persistence of peg regimes in EMEs due to "*fear of floating*" (Calvo and Reinhart, 2000); the non-validity of the hypothesis of "disappearance of intermediate regimes" in facts (Masson, 2000; Bénassy-Quéré and Coeuré, 2000; Bubula and Otker-Robe, 2003). Other studies even advocate a continuous role for intermediate regimes, conditioned by the criteria of optimum currency areas (Frankel, 1999), or by the weakness of external shocks and the channel of interest rates (Bénassy-Quéré and Coeuré, 2002), or in a more sophisticated form such as the Williamson's BBC system (2001), or in a combination with a domestic monetary anchor as an inflation target (Allegret, 2007).

[77] Bordo, Eichengreen and Kim (1998) consider the period of the gold-standard as the first era of financial globalization, comparable to that of today which has gradually grown since the end of the Second World War and intensified since the 1980s.

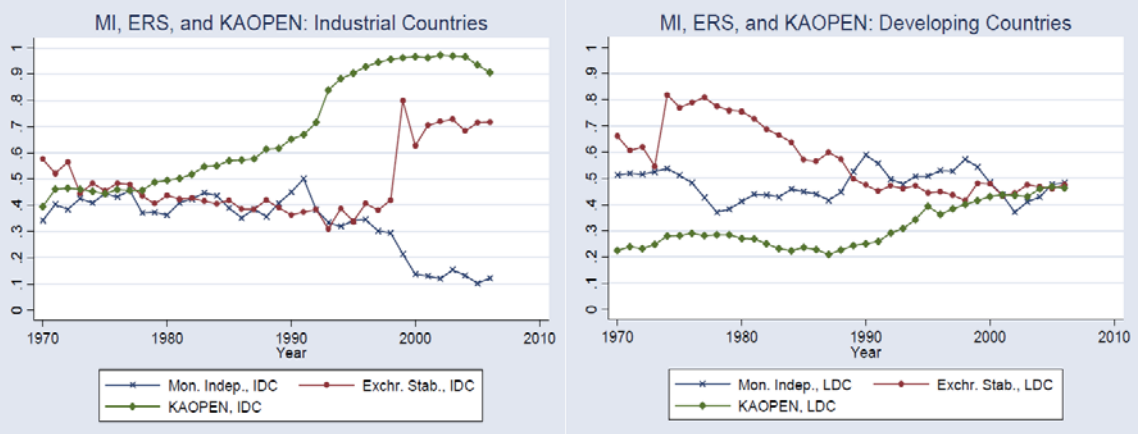
integration, the correlation of interest rates between countries following fixed systems and international rates seemed to be increased (Obstfeld et al., 2005).

In the same way, Aizenman et al. (2008) develop their own measure of the three axes of the trilemma. According to them, history shows that the different IMS have tried to achieve combinations of two of the three economic policy objectives: the gold-standard with its freedom of capital movements and exchange rate stability, and the BW system with its monetary autonomy and exchange rate stability. Also, the authors empirically prove the validity of the trilemma principle for the period 1970-2006: the increase of one of the three variables of trilemma should necessarily imply a decrease of the second or the third, or a combination of the two, in that there is a linear relationship between the three components, and that the weighted sum of the three variables is a constant. Aizenman et al. (2008) also show that there are links between the major shocks of the past four decades (the collapse of BW system, the 1982 debt crisis and the 1997-98 South East Asian crisis) and structural breaks in the trilemma configurations, where the logic of the impossible trinity has not been respected.

1.3.2. From the trilemma to the "quadrilemma": the role of reserve accumulation

By analyzing the trend of the three trilemma axes for AEs and EMDEs between 1970 and 2006, Aizenman et al. (2008) conclude that the general trend in both groups is towards more financial integration and less monetary independence. In addition, there is more exchange stability in the EAs, while the EMDEs are increasingly moving towards less fixed regimes, *i.e.* intermediate regimes.

Figure (3.5.): Evolution of the trilemma indexes in AEs and EMDEs



Source: Aizenman et al. (2008)

Figure (3.5.) shows a "convergence" in the EMDEs towards a "middle ground": a middle level of financial openness, a moderately independent monetary policy, and a managed flexibility of exchange rates (soft pegs)[78]. In reality, it is a configuration comparable to that criticized by the supporters of the fragility of intermediate regimes (*cf.* the bipolar view), especially in a context of increasingly globalized financial system, synonymous with financial instability and greater systemic vulnerability. The decade of the 1990s and the early 2000s are concrete proof of this.

Thus, the high costs of crises and capital outflows led to consider financial stability as an economic policy goal to be added to the trilemma's three goals. Aizenman (2011) speaks about a shift to a "quadrilemma" of economic policy. For EMDEs, protection against financial instability has given a key role to international reserve accumulation, in addition to their role in exchange rate management (Obstfeld et al., 2010). The demand for reserves is made for self-protection against adverse trade shocks when the country is at a less advanced stage of financial opening, but with a more advanced financial integration it is made for self-protection against financial volatility (Aizenman, 2011).

In a logic somewhat comparable to that of Kaminsky and Reinhart (1999), explaining the dynamics of reserves during the twin crises, Obstfeld et al. (2010) explain the usefulness of international reserves against risks associated with financial openness by the fact that potential "*currency mismatches*" [79] and "*double drains*" [80] would give rise to an extraordinary demand from the public for reserves held by the central bank[81].

According to Aizenman et al. (2008), "Diamond Charts", shown in Figure (3.6.), outline the evolution of the combinations between the components of the incompatibility triangle (the trilemma) and reserves for AEs and EMEs over four decades. We have already noted that the AEs have experienced acceleration in financial integration (since the

[78] In Aizenman and Ito (2012, 2013), the authors analyze, more particularly, the effect of trilemma policies' convergence (measured by an index) on growth volatility and crises' probability, taking into account the level of reserves.

[79] According to Eichengreen et al. (2003), "*currency mismatches*" means the difference in the currencies in which assets and liabilities are denominated. This concept should not be confused with "*debt intolerance*" which means the inability of EMEs to manage debt levels that are manageable in EAs, and "*original sin*" which means the difficulty for the EMEs to borrow abroad in their own currencies.

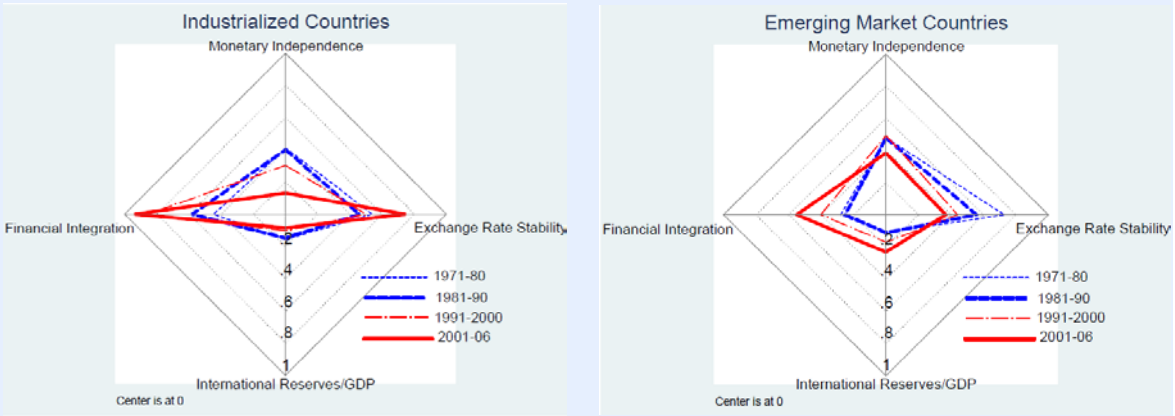
[80] A bank panic (internal drain) combined with a flight to foreign currencies or banks (external drain).

[81] For Kaminsky and Reinhart (1999), the reserves held by the central bank are reduced when the central bank tries to cope with the illiquidity situation in domestic currency.

early 1990s), more stability in exchange rates (especially with the adoption of the euro), as well as a downward trend in monetary independence. In addition, the Reserve/GDP ratio has fallen considerably.

At the same time, in EMDEs, and more particularly in EMEs, the trend has been towards greater financial openness and declining monetary independence, like in AEs, but also towards more flexible regimes, more in EMEs than in non-EMEs, but not towards free floating (mainly intermediate regimes). In addition, there was a clear trend towards more accumulation of international reserves, with a notable acceleration after the 1997-8 crisis especially in the Asian EMEs –led by China.

Figure (3.6.): Evolution of the trilemma and reserves configurations for AEs and EMEs



Source: Aizenman et al. (2008)

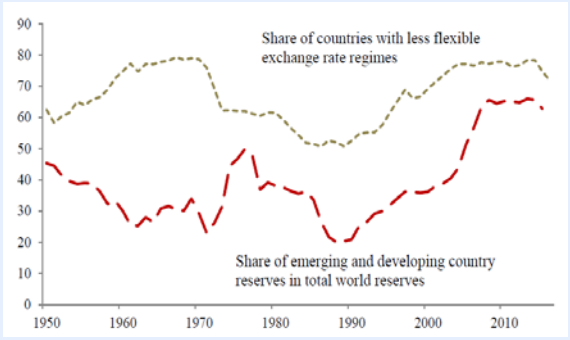
Similarly, Ilzetzki, Reinhart and Rogoff (2017a) study, over a long period (1946-2015), the evolution of ERRs, capital controls and international reserves[82]. The authors underline the relevance of the trilemma to explain the causes of accelerating international reserve accumulation. They argue that reserve accumulation allows a "relaxation" of trilemma constraints (or a "reconciliation" of the three objectives in the incompatibility triangle) by replacing the role of capital control. Countries that want to limit exchange rate instability without resorting to capital controls accept a consistent use of reserves and interest rates (and therefore a more active/independent monetary policy) to achieve their

[82] Several remarks should be noted about the study by Ilzetzki, Reinhart and Rogoff (2017a): the degree of monetary autonomy is not systematically integrated in the analysis of the relationship of reserves with ERRs and capital controls ; greater financial liberalization (abandonment of capital controls or more precisely foreign exchange controls) is measured by the degree of the disappearance of fragmented foreign exchange markets (dual and/or parallel) ; the adopted classification of ERRs is based on Ilzetzki, Reinhart and Rogoff (2017b) –an extension of the famous classification of Reinhart and Rogoff (2002).

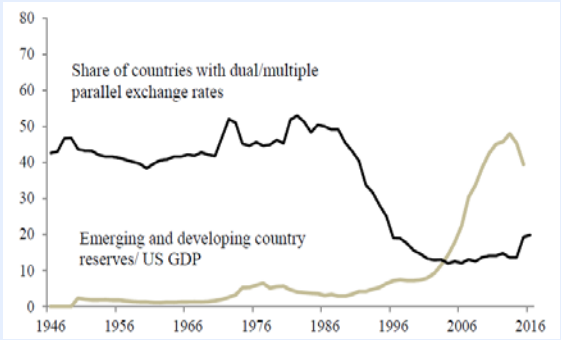
objectives. Figure (3.7.) relates reserve accumulation to the increasing share of countries limiting exchange rate flexibility (Chart A) and the decline in capital control (Chart B).

Figure (3.7.): Reserves, ERRs and capital controls, 1946(50)-2015

A. The incidence of limited exchange rate flexibility



B. Are reserves a substitute for capital controls?



Sources: Ilzetzki, Reinhart, and Rogoff (2017a)

Steiner (2013) also mentions the substitution of the role of capital control by reserve accumulation to explain the mechanism of relaxation of trilemma constraints. For a country that chooses financial liberalization and an active monetary policy for example, the trilemma principle deprives it from the possibility of having fixed exchange rates. An accommodative monetary policy would lead to capital outflows and, consequently, depreciation. But if the central bank has sufficient reserves, it could defend the exchange rate through interventions. By other side, net capital inflows would exert pressure in the direction of currency appreciation, but this effect would be absorbed through an accumulation of foreign assets by the central bank. For Popper et al. (2013), the stability of economic policy represented through different trilemma archetypes seems to have a (positive) connection with reserve holding, but only in the case of low-income economies.

The idea is that, especially for the EMEs who have experienced financial vulnerability in the past, the accumulation of reserves could "relax" the constraints of the trilemma. Moreover, the literature of the 2000s and 2010s, attesting a precaution motive for accumulation (Flood and Marion, 2001; Mendoza, 2004; Jeanne and Rancière, 2006; Aizenman and Lee, 2007; etc.) or analyzing the effect of accumulation as a resilience factor during the 2008-9 crisis (Obstfeld et al., 2009; Llaudes et al., 2010; Frankel and Saravelos, 2012; Bussière et al., 2014; etc.), also supports the idea of a "salvating" role for

reserve accumulation policies. By studying the effect of reserve accumulation on growth and inflation according to the different trilemma configurations, Aizenman et al. (2010) find, among other results, that exchange rate stability is associated with greater volatility of growth, but which can be mitigated by a large reserve accumulation. They calculate a reserve threshold of 21-24% of GDP above which reserves would play this role. The study of the same question for Latin American countries by Rosero (2011) supports globally this conclusion.

Section 2. International Reserve Accumulation and Floating

In the first section, we discussed arguments supporting that reserve accumulation occurs naturally under fixed (and intermediate) regimes. However, until now, we have seen that the only argument which states that floating does not require, or promote, reserve accumulation is based on its theoretical role in external adjustment as an automatic stabilizer in front of external shocks**.** This implies that there is no need for interventions in the Forex, which is considered as the primary reason for holding reserves. In this section, we study the existence of accumulation under floating. We present a literature review on the demand for reserves and its relationship with floating (in comparison with fixed regimes) during and after the BW era, and also more recently. Finally, we analyze the idea that the "*de jure*" classification of ERRs is possibly responsible for a "falsification" of the facts by associating accumulation with "*de facto*" pegs, untruthfully declared as floats.

2.1. Floating exchange rates and holding/accumulating reserves in the literature

2.1.1. Contribution of theoretical literature

Theoretical studies since the post-war period do not lead to common conclusion about the relationship between floating and the level of held reserves. The pioneering contributions on ERRs in the 1950-60s, such as Friedman (1953), Johnson (1958) and Mundell (1961), give floating the merit of diminishing the need to hold reserves. Other studies in the 1970s are in line with the pioneers (Williamson, 1976; Hipple, 1974; Claassen, 1974; Haberler, 1977; Kenen, 1977; Solomon, 1977; etc.). In fact, it is implicitly accepted that the main reason for holding reserves is related to the need under fixed exchange rates to cope with external imbalances (deficits) through interventions in the Forex using reserves. The adoption of floating or less rigid exchange rates would be synonymous with the disappearance (or relaxation) of this constraint.

The position of Crockett (1978) is intermediate. Although it is in line with this group of studies, he also points out that this is not necessarily the case for developing economies. It notes that even with the emergence of new means of financing imbalances, such as IMF conditional loans or borrowing from international capital markets, developing economies, often characterized by very under-developed financial markets, do not consider these alternatives as perfect substitutes for holding reserves.

On the other hand, some theoretical contributions, such as Kreinin and Heller (1974) and Grubel (1977), consider that the adoption of floating does not necessarily lead to a reduction in the volume of international reserves. The demand for reserves may be linked to other considerations in addition to their usefulness in financing payment imbalances. Reserves can be used as a "war chest" for emergencies, or as a guarantee to promote confidence and attract foreign capitals, or even because of the lack of or the difficulty to find domestic investment alternatives (Crockett, 1978).

2.1.2. Empirical studies dealing with the BW era

Among empirical studies exploring the demand for reserves, many include the nature of the ERR or the degree of exchange rate flexibility among the determinants studied. Work such as Kelly (1970), Flanders (1971), Hipple (1974), Makin (1974, 1977) and Edwards (1983) examine the relationship between the level of exchange rate flexibility and the level of reserves, among other variables, during the period before the collapse of BW system. It is interesting to note that most of these empirical studies lead to the conclusion that floating, or more generally less fixed exchange rates, reduce the need (and willingness) to hold large stocks of reserves compared to pegs.

Kelly (1970) uses a dummy for ERRs (peg / no peg) for a sample of 46 advanced and developing economies[83] over the period 1953-65. He concludes a positive link between the fixity of exchange rates and the level of reserves. Hipple (1974) also studies the reserve demand function and uses a dummy for the exchange rate variable with three levels of increasing flexibility, for a sample of 25 advanced and 36 developing economies over the period 1960-5 and 1955-70 for the ERRs. The regressions give a negative and a statistically significant coefficient for the exchange rate variable, especially for the advanced group, which means an inverse relationship between the reserve level and that of exchange rate flexibility, at least for this group of countries.

Edwards (1983) analyzes the demand for reserves of 41 developing countries over the period 1964-72, unlike previous studies dealing with samples composed of advanced

[83] The reader will note that for this part of literature (particularly covering the period before the 1990s and 2000s), we will not use the terms "emerging market and developing economies" (EMDEs) and "emerging market economies" (EMEs) for the obvious reason that the concept of "economic emergence" was only introduced with the financial liberalization of some developing countries since the 1990-2000s. Thus, the distinction will be made here between "advanced economies" and "developing economies".

and developing economies and based on the (implicit) assumption of homogeneity of demand within each group. Indeed, according to Edwards (1983), the demand function as well as the level of reserve holding should be different between countries that exclusively use *expenditure-changing* policies (with a fixed ERR) to deal with payment problems and countries that use *expenditure-switching* policies (through occasional devaluations).

Table (3.2.): Floating and reserve accumulation during the BW era

Paper	Country	Period	Results	Observations
Kelly (1970)	46 advanced and developing	1953-65	Floating reduces demand for reserves	Dummy variable for the ERR : Peg / No Peg
Flanders (1971)	20 advanced + 37 developing	1950-65	Floating reduces demand for reserves	A measure of real devaluation as a proxy for flexibility
Hipple (1974)	25 advanced + 36 developing	1960-5 (1955-70 for ERRs)	Floating reduces demand for reserves	Dummy variable for 3 levels of ER flexibility
Makin (1974, 1977)	Canada	1960-71	Floating reduces demand for reserves	
Edwards (1983)	41 developing	1964-72	Floating reduces demand for reserves	Dummy variable for ER stability: Deval. / No Deval.

Source: Literature review by the author

Indeed, regression results confirm these predictions. Countries that maintain fixed regimes for long periods hold on average fewer reserves than those that devalue more frequently; and these latter make adjustments to "desired" levels of reserves more quickly. This confirms Clark's (1970) hypothesis that there is a relationship between the desired level of reserves and the speed of imbalances' adjustment. However, the study by Edwards (1983) does not check the direction of causality between the level of reserves and the frequency of devaluations. In fact, the direction of causality could be the opposite, *i.e.* countries are forced to devalue because of the decline of their reserves (Lehto, 1994).

2.1.3. Reserve demand stability during BW and after its collapse

The collapse of BW between 1971 and 1973 was synonymous with a shift in many countries from fixed exchange rates to floating, or more precisely, from adjustable pegs to

managed floating. Many studies have focused on the stability of the demand function of reserves to see whether the more or less generalized adoption of exchange rate flexibility has induced a change in reserve holding behavior, *i.e.* a decline. In general, empirical studies about this issue conclude that the demand for reserves remained a relatively stable function during this period (1960s and 1970s), apart from the period of collapse of BW (Lizondo and Mathieson, 1987; Bahmani-Oskooee and Brown, 2002).

Table (3.3.): Reserve demand stability during BW and after its collapse

Paper	Country	Period	Results	Observations
Williamson (1976)	9 advanced and developing	1970-4	No clear evidence: floating does not necessarily reduce demand for reserves	Descriptive methodology
Suss (1976)	9 advanced and developing	1970-4	Some reduction in the use of reserves with floating	The same data used by Williamson (1976) with a test of the demand function
Heller and Khan (1978)	World (6 regions)	1960-76	Floating does not reduce demand for reserves	ARIMA models
Frenkel (1978, 1980, 1983)	22 advanced + 32 developing	1963-75 1963-77 1963-79	Floating does not reduce demand for reserves, but a structural change en 1972	*Quandt's log-likelihood ratio technique – Chow test*
Saidi (1981)	Canada	1950-76	Floating does not reduce demand for reserves	Dummy variable for the ERR : Peg / Flex
Lizondo and Mathieson (1987)	World (6 regions)	1964-84	Floating does not reduce demand for reserves, but a structural change en 1973	
Bahmani-Oskooee and Malixi (1987)	13 advanced	1976-85	Floating reduces demand for reserves	ER Variability: σ log TCER
Bahmani-Oskooee and Niroomand (1988)	13 advanced	1973-85	Floating reduces demand for reserves	log REER
Bahmani-Oskooee (1988)	19 advanced + 17 developing	1973-85	Floating reduces demand for reserves; the 2 oil shocks contribute to the structural change of R demand, not only the BW collapse	

Source: Literature review by the author

Williamson (1976) studies reserve holding behavior in nine countries during the pre- and post-floating period (1973 for most of the sample countries), and then attempts to formalize the relationship between exchange rate flexibility and reserve level. The study does not lead to conclusive results about a difference between the two sub-periods in the use of reserves. Moreover, according to him, a peg could provide credibility to persuade speculators and could, therefore, be synonymous with a lesser need for holding reserves in comparison with the instability inherent in floating. However, he points out that the adopted floating after the BW collapse was more a managed float rather than a free float.

Suss (1976) uses the same data and reserve measurement methodology as Williamson (1976) and tests the stability of the demand function. According to her, the adoption of floating induces some decrease in the use of reserves. However, these results suffer from the problem of considering only the behavior of reserves and assume (implicitly) that factors affecting reserves such as the level of imports and the balance of payments' variability are constant over the two sub-periods, note Heller and Khan (1978).

Heller and Khan (1978) examine the issue for six regions: world, world except oil exporters, world except oil exporters and the US, advanced countries, advanced countries except the US, and developing countries. The period studied is 1960-76 with 1973 as the year of adoption of floating rates. They estimate ARIMA models for the reserves held by the six country groups and they compare model predictions based on 1960-1972 data with actual (effective) reserve data for the 1973-6 sub-period. Results show that there was clearly a change in the demand for reserves in advanced countries, but this did not occur immediately with the change in the ERR (early 1973). For non-oil-producing countries, the demand for reserves did not change significantly in 1973, but rather in 1971-2, which could be explained by the fact that developing countries continued to follow pegs to major currencies. The authors consider that, in general, the reserve demand function has remained stable for advanced and developing countries after the structural change of 1973 (beginning of the floating era).

Thus, the study of the parameters' stability of reserve demand function concludes that the relative weights of explanatory variables did not change significantly between the two sub-periods. Apart from this conclusion, Heller and Khan (1978) note that there is, nevertheless, empirical evidence of a decline in demand for reserves in advanced countries with the adoption of exchange rate flexibility, while for developing countries and

particularly the non-oil-producing countries, the trend is the opposite: reserve holding became more important than during the sub-period of fixity. This could be explained by the fear of a greater variability in balance-of-payments because of floating rates.

Frenkel (1978) also studies the issue of reserve demand stability before and after the BW collapse for a sample of 22 advanced and 32 developing economies. The period studied is divided into two sub-periods: 1963-72 and 1973-5. In another (a later) paper (Frenkel, 1980), the second sub-period extends to 1977. Using Quandt's log-likelihood ratio technique and Chow test, Frenkel (1978, 1980) concludes that the demand function is stable for the two sub-periods, but that there is also a structural change for developing and advanced economies, which is in line with results by Heller and Khan (1978).

Frenkel dates this change at the end of 1972, with the transition to managed floats. Also, Frenkel (1980) estimates that prior to 1973, advanced economies expressed a lower demand for reserves than developing economies, while since 1973 there has been no significant difference between the two groups. This is contrary to the results of Heller and Khan (1978). However, Frenkel points out that the structural change has not been as important as was expected with the major change experienced by the IMS with the collapse of BW system, which, according to him, means that the economic behavior of countries, and in particular the demand for reserves and foreign exchange policy, remained more stable than official commitments. In other words, the relative stability observed across the two regimes is due to the fact that the fixity period was rather characterized by an "adjustable pegs" regime, and that the floating period was, in fact, a "managed float"[84]. Thus, the behavior of central banks has not changed significantly.

Later, Frenkel (1983) uses the same stability tests in panel data for the same sample of countries and extends the study to 1979. He uses data on real reserves (not nominal as in the previous studies). That said, the same conclusions are drawn: a structural change is taking place after the change in the IMS in 1973 for both country categories.

Saidi (1981) studies the demand function of Canada's reserves for 1950-76. The Canadian experience is different from that of many countries in that Canada was floating during 1950-61 and fixing during 1963-76. Saidi estimates the demand for real reserves as

[84] This remark concerning the true nature of the change in ERRs following BW collapse is also pointed out in IMF (1974) and Williamson (1976).

a function of real income and (permanent) variability in payments. He finds that there is evidence of "Inventory-Theoretic Square-Root Law" for the two phases of ERRs: the income-elasticity of the demand for reserves remains stable. He also finds a structural change in demand in 1961-2: floating ended in the third quarter of 1962. This structural change appears through a greater reactivity of reserves to the payments' variability under fixity than under floating. Saidi (1981) also notes that there was no structural change in Canadian demand for reserves around the 1972-3 (during the major shift in IMS).

Lizondo and Mathieson (1987) re-examine the study of Heller and Khan (1978) with the six country groups but they extend data to 1984. They find almost the same results as Heller and Khan, notably the dating of structural change in reserve demand: 1972 for developing economies and 1973 for advanced economies. On the other hand, Lizondo and Mathieson (1987) show that there was also another structural change in the early 1980s as a result of the major disruptions in world capital markets during this period. The change in the structure of the reserve demand in developing economies during this period was more pronounced than in advanced economies, unlike at the time of the BW collapse. This is due to the difficulty of developing economies to borrow on capital markets in the early 1980s.

Overall, studies on the stability of reserve demand in the aftermath of IMS change in 1972-3 agree on two major points: 1) there has been a significant structural change in reserve demand with the shift to floating rates, more particularly in advanced economies, but 2) the demand for (actual or desired) reserves does not decrease significantly. This last point is opposite to the conclusions of the aforementioned empirical studies on BW era (Kelly, 1970; Flanders, 1971; Makin, 1974; Hipple, 1974; Edwards, 1983), as well as the theoretical contributions (Claassen, 1974; Haberler, 1977; Crockett, 1978; etc.).

Bahmani-Oskooee and Malixi (1987) are in line with studies concluding that the demand for reserves is negatively correlated with exchange rate flexibility. They estimate the demand function of 13 advanced economies between 1976 and 1985. Exchange rate variability is measured by the standard deviation (in percent) of the change in real effective exchange rate over the previous eleven quarters relative to the current quarter. The results show that there is indeed a negative correlation between real reserves and the level of exchange rate flexibility. Bahmani-Oskooee and Niroomand (1988) reach the same conclusion by analyzing data from the 13 economies countries from 1973 to 1985 but using another technique.

While supporting the hypothesis that floating after the BW collapse has reduced the demand for reserves, Bahmani-Oskooee (1988) revisits the issue of the demand function stability. Using quarterly data between 1973 and 1985 from 19 advanced and 17 developing economies, he finds that the structural change in the demand is caused not only by the abandonment of BW fixed but adjustable pegs, but also by the 1973 oil shock which had a significant effect on import demand and consequently on the balance of payments' variability in importing countries. The second oil shock (1980) is another explanation to the change in the structure of reserve demand observed for 1980-1[85].

2.1.4. Comparisons in (more) recent empirical studies

The literature of the 2000s continues to focus on the determinants of demand for reserves including the degree of exchange rate flexibility (while studying more or less different issues). Once again, there is no unanimity on the relationship between ERRs and reserve accumulation.

A first group of studies deduces, among other things, that significant exchange rate flexibility, or even floating, reduces reserve holding (Flood and Marion, 2001; Disyatat and Mathieson, 2001; Aizenman and Marion, 2003, 2004; Edison, 2003; etc.). These studies include samples from developing economies, except Flood and Marion, 2001, which study 44(56) advanced and developing economies over periods ending with the late 1990s, and coinciding with the Asian crisis and its implications [86].

At the same time, another group concludes that floating does not reduce or negatively influence the holding of international reserves (Sidaoui, 2005; Choudhry and Hasan, 2007; Bastourre et al., 2009; Delatte and Fouquau, 2012; Steiner, 2013; etc.). For example, Bastourre et al. (2009) found that countries with flexible ERRs accumulate more reserves (as a share of GDP) than countries with fixed regimes. This is explained, according to them, by the fact that at an intermediate level of development, (emerging) countries that tend to adopt more flexibility are more exposed to uncertainty of capital flows. As a result, the reserve accumulation becomes more important in order to achieve

[85] For a good review of previous studies on the stability of the demand for reserves, see Bahmani-Oskooee and Hagerty (2011).

[86] Silva and da Silva (2004) focus on Brazil and find the same inverse relationship between the level of exchange rate flexibility and reserve needs, but their study covers a more recent period (1995-2004).

successful financial integration. Thus, exchange rate flexibility is seen as a complement to reserve accumulation, not as a substitute (Bastourre et al., 2009).

Table (3.4.): Flexibility and accumulation – (more) recent comparisons

Paper	Country	Period	Results
Flood and Marion (2001)	44 (56) advanced and developing	1960-98	ER volatility reduces needs for reserves
Disyatat and Mathieson (2001)	15 developing		A greater ER flexibility reduces needs for reserves
Lane and Burke (2001)	102 advanced and developing	1981-95	No clear evidence
Aizenman and Marion (2003)	125 developing	1980-96 (99)	ER volatility reduces needs for reserves
Edison (2003)	122 developing	1980-96	Flexibility (and volatility) reduces reserve holdings
Aportela, Gallego, and Garcia (2003)	115 // 6 advanced	1970-97	No clear evidence (with remarks)
Silva and da Silva (2004)	Brazil	1995-2004	Floating reduces needs for reserves
Sidaoui (2005)	Mexico	1995-2003	Floating does not reduce needs for reserves
Choudhry and Hasan (2007)	Kenya, Mexico, Philippines	1972-2003	Floating does not reduce needs for reserves
Choi & Baek (2008)	127 advanced and developing	1980-2000	Inverted U-shaped relationship
Cheung & Wong (2008)	174 advanced and developing	1957-2004	Inverted U-shaped relationship
Bastourre, Carrera, and Ibarlucia (2009)	136 advanced and developing	1973-2003	Floating does not reduce needs for reserves
Cheung and Ito (2009)	>100 advanced and developing	1975-2005	No clear evidence
Delatte and Fouquau (2012)	20 emerging and developing	1981-2007	Floating does not reduce needs for reserves
Steiner (2013)	180 advanced and developing	1970-2010	Floating does not reduce needs for reserves
Aizenman, Cheung, and Ito (2014)	>100 advanced and developing	1999-2012	No clear evidence

Source: Literature review by the author

What might seem a little intriguing with the second group of studies, which are much more recent than the first, is the fact that they cover relatively more advanced periods in the 2000s. This observation is important in that one could explain (intuitively) the opposite results of the two groups by the fact that the post-Asian crisis period was marked by a tendency towards more floating, on the one hand, and on the other hand, this period was also marked by a greater motivation for reserve accumulation (whether for precaution motive or thank to terms of trade improvement in favor of many EMDEs).

In addition to these two groups of studies with contradictory results, a third group conclude that there is no clear evidence of any influence of ERRs on reserve accumulation behavior (Lane and Burke, 2001; Aportela et al., 2003; Cheung and Ito, 2009; Aizenman, Cheung and Ito, 2014). However, some very interesting comments are made by Aportela et al., (2003): although the transition from a fixed or semi-rigid regime to a floating regime induces a reduction in (official) reserves, the results are not that clear, because it depends on the empirical methodology used, and also on the monetary regime of countries. For example, an inflation targeting policy (adopted with a floating regime) would reduce official reserve holdings in favor of reserves held by the private sector.

The results of some studies, focusing on the relationship between ERRs and reserves either directly or through the study of reserve demand determinants, make it possible to remove some ambiguity about this relationship. The use of empirical data which distinguish between AEs and EMDEs, sub-periods, and *de facto* ERRs seems very useful in this respect. Cheung and Ito (2009) examine a wide range of reserve demand determinants from over 100 countries over the period (1975-2005). Countries are divided according to their level of development (AEs or EMDEs) and the overall study period is divided into three sub-periods (1975-81, 1983-93, and 1999-2005). A dummy variable is assigned to the ERRs (fixed pegs, crawling pegs**,** intermediate regimes, and floating)[87]. For AEs, the study gives statistically significant results only for the sub-periods 1983-93 with a negative sign for fixity and 1999-2005 with a positive sign for crawling pegs. For EMDEs, only fixity has a significant result (with a negative sign) for the third sub-period.

Aizenman, Cheung, and Ito (2014) focus on the period 1999-2012, with three sub-periods (1999-2006, 2007-9, and 2010-2), and use the RR classification for ERRs. The

[87] Cheung and Ito (2009) use the first version of the ERR classification designed by Reinhart and Rogoff (2002), noted RR hereafter.

results corroborate those of the latter[88]. Indeed, among more than 100 countries, only the EMDEs' group shows significant results, with a negative sign for fixity and a positive sign for the intermediate class in the regression that considers the overall period. For the sub-periods, 1999-2006 gives a negative sign for fixity, and 2007-9 gives a positive sign for the middle class.

A very interesting remark emerges from these results: rigid pegs (fixed regimes) are negatively correlated with reserve demand, unlike with more flexible pegs (intermediate regimes). In the same vein, Choi and Baek (2008) provide more refined conclusions by using data from 127 countries for the period 1980-2000 and the RR classification for ERRs. The authors find that there is an "inverted U-curve" shaped relationship between the level of exchange rate flexibility and the demand for reserves. Polar regimes (rigid fixity and free floating) require fewer reserves than the intermediate class[89].

This result seems to be in line with the hypothesis of the fragility of intermediate regimes (the *bipolar view*) according to which this category is linked to a greater vulnerability to financial and/or currency crise**s** that pushes countries with these class of regimes to hold more reserves for self-protection purposes, including defending the soft parity (and the regime) against speculative attacks. Cheung and Wong (2008) have a similar finding: intermediate regimes are associated with greater demand for reserves; except that with this study, floating is associated with less demand than rigid fixity, contrary to the results of Choi and Baek (2008).

2.2. Why do floaters accumulate reserves? -"Functional" explanations

First of all, there is an important argument, which we have already pointed out, and which shows that with the collapse of BW system, the change in ERRs did not happen by moving from rigid fixity to free float, but rather by moving from adjustable pegs to managed floats (IMF, 1974; Williamson, 1976; and Frenkel, 1980). That said, besides the usefulness of reserves as a means to protect against real or financial external shocks and also as a means of intervention to reduce exchange rate volatility or against speculative attacks (even under floating), there are other "functional" reasons for holding/accumulating

[88] Aizenman, Cheung and Ito (2014) use a methodology comparable to that of Cheung and Ito (2009) to assess the determinants of the reserve demand.

[89] More specifically, fixed systems are linked to a lower demand for reserves than floating.

reserves under this kind of ERRs. Also, some choices (and/or fears) of economic policy, or even some institutional weaknesses, could explain the relationship "reserves–floating".

2.2.1. The probability of a return to fixity

The expectation (or the fear) of a return to fixed rates would influence the country's monetary authorities that have adopted floating to hold a reserve level comparable to that before in order to support parity again (IMF, 1974; Saidi, 1981). This situation, like the volatility inherent in floating, is synonymous with uncertainty in front of which it would be rational to have larger amounts of reserves, notes Williamson (1984).

2.2.2. Payment of external debt

Reserves can be used for external debt payment as in the case of Mexico after the 1994-5 crisis, and Russia and Algeria in the mid-2000s. The role of reserves is also important upstream of the external borrowing process. In fact, the level of reserves serves as a signal to investors (or lenders) and international rating agencies, who consider high levels of reserves as a sign of low risk of insolvency or default (Sidaoui, 2005). It is a signal to international debt markets that allows domestic (public or private) borrowers to access external financing (IMF, 1974; Saidi, 1981; Sidaoui, 2005). Bahmani-Oskooee and Brown (2002) speak about "collateral" for debt. Also, Dooley et al. (2004, 2007) and Gourinchas and Jeanne (2007) give an interpretation of the level of reserves as collateral for FDI flows to EMEs. As a reminder, Dooley et al. (2022) use this collateral role (of reserves to attract FDIs in EMEs) in their argument that the sanctions on Russia in 2022, including the freeze of part of its reserves, would not lead other accumulators to liquidate their dollar-denominated reserve assets, threatening the hegemonic status of the dollar as a reserve currency (*cf.* Chapter 2 – Section 2).

2.2.3. Bail-out of national banks

The central bank can act as a lender of last resort of foreign currency to domestic banks in difficulty in order to avoid bankruptcy, or even the propagation of systemic crises (Sidaoui, 2005). Also, in times of crisis or not, the central bank can use its reserves to bail-out state-owned banks by injecting liquidity to increase their capital. The transfer of assets can be done in foreign currencies to avoid pressures on the national currency. In the mid-

2000s, the Central Bank of China (PoBC) recapitalized several state-owned banks as part of banking sector reforms (ECB, 2006).

2.2.4. International transactions of the public sector

The central bank may also carry out transactions in foreign currency on behalf of government institutions or state-owned companies to prevent them from doing transactions directly in the Forex and causing unwanted volatility (Sidaoui, 2005). Similarly, in the case of foreign exchange receipts obtained from export transactions by (state-owned or even private) companies, the central bank may require the transfer of (all or part of) these receipts to it against a counterpart in national currency.

2.2.5. Unification of official and parallel exchange rates

Restrictions on foreign trade and strict controls on foreign exchange (and capital flows in general) create foreign exchange demand that exceeds the supply of the official market, and consequently leads to the emergence of parallel Forex (Agénor, 1994). These markets are very persistent, and give rise to large gaps from official exchange rates. This is the case of developing countries with less open financial account, as well as the case of advanced countries in Europe during and after the World War II. The unification of the two markets could involve a free float of the official exchange rate and would require less capital and foreign exchange controls, which would initially lead to a sharp depreciation of the official as well as the parallel exchange rates. In this case, the monetary authorities should provide enough foreign exchange liquidity to control the depreciation of its currency, and above all unify the two rates. In order to do so, it would be necessary to have sufficient foreign exchange reserves.

2.3. The problem of ERR classification

The problem of the relationship between international reserve accumulation and ERRs also confronts the question of the classification of these latter. In fact, although we have noted a lack of consensus in theoretical and empirical literature about if reserve accumulation is possible under floating as well as under fixity, we should emphasize the importance of associating “correctly” regimes classified as floating or fixed regimes with data on international reserves.

There is a considerable probability to consider, for example, a country which has a more or less significant accumulation over a period of time during which it officially declares following a float while it intervenes actively on Forex to control its exchange rate, as an evidence of accumulation associated to a floating regime; and *vice versa*. Thus, it is crucial t**o** consider only the real (or *de facto*) behavior of the exchange rate and not that officially declared (*de jure* regime) if one wants to correctly study the relationship between reserve accumulation behavior and ERRs. Eichengreen et al. (1999), for example, are clearly asking the question whether accumulation is not linked to *de facto* pegs.

Section 3. Empirical Evidences

In the two previous sections, we have set out the arguments given by the literature on the relationship between international reserve accumulation and ERRs' typology. We were able to conclude that there is no consensus on the issue. In this last section, we propose an empirical study in order to know whether reserves are accumulated only under fixed regimes, or even under intermediate regimes, as stipulated by the standard theory, or that floating is also likely to allow it, and thus conclude that there is no systemic relationship between our two variables.

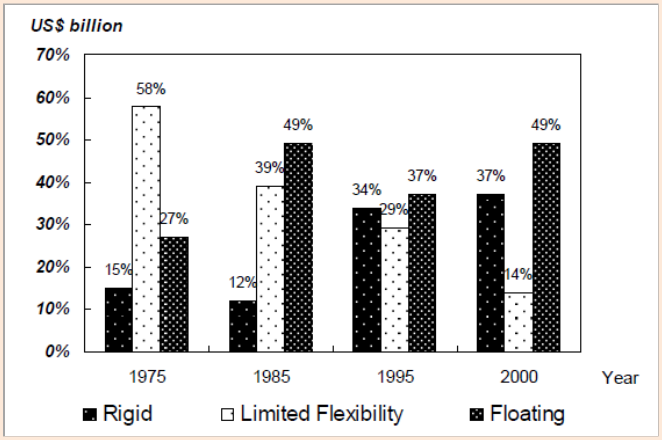
For a first look at this question, we begin with a presentation of stylized facts showing clearly that reserve "holding" (in global shares or absolute values) is done both by countries following floating regimes as well as countries with fixed and intermediate regimes. Then we present the empirical definition of the variable "ERRs" and the classification used. After that, we indicate the data sources and the spatiotemporal coverage of the study. Finally, we explain the empirical methodology used to test the relationship between reserve "accumulation" and ERRs. We use the one-factor variance analysis technique (One-way ANOVA) to check the existence of a relationship between a quantitative explained variable (accumulated reserves) and a qualitative explanatory variable (the ERR). The results of the analysis are discussed at the end of this section.

3.1. Some stylized facts

3.1.1. Post-BW era until 2000

First, we reproduce some empirical observations from Cheung and Wong (2008) about the period after the collapse of BW system until 2000. The authors use the RR classification and calculate the shares of global reserves held by countries with different ERRs. Cheung and Wong (2008) group ERRs into three categories (rigid, limited flexibility and floats), which is not very different from the grouping usually done in the literature (fixed, intermediate, and floating regimes). The authors compare reserve shares across the three regime groups at four different dates (1975, 1985, 1995, and 2000).

Figure (3.8.): Shares of international reserves held under different ERRs, 1975-2000



Source: Cheung and Wong (2008)

Figure (3.8.) shows clearly that (free or managed) floating was associated with the largest shares of reserves held between 1985 and 2000 (between 37% and 49%). The share of accumulated reserves by countries with limited flexibility, and which after having been the largest in the wake of BW system collapse (58% in 1975), has declined and became the smallest share among the three categories of ERRs' since 1995 (29% and 14% in 1995 and 2000 respectively).

The share of reserves in countries with "rigid" regimes showed a positive evolution between 1985 and 2000, rising from 12% to 37%, which places them in the second position after floating regimes. Even if this data ends with 2000, it is possible to draw up an initial idea on the relationship between reserve holding / accumulation and ERRs.

3.1.2. Recent data

The findings of Cheung and Wong (2008) relate to the quarter century following the collapse of BW system. This is the era of proliferation of floating exchange rates, but also of intermediate regimes. It is well known that from the early 2000s the accumulation of reserves experienced a significant acceleration, especially in countries with intermediate regimes, such as China. Table (3.5.) shows ERRs of the world's largest international reserve (excl. gold) holders at the end of 2019.

Table (3.5.): Largest international reserve holders (end of 2019) and ERRs during the three last years

		Reserves (excl. gold) bln. USD - End 2019	Exchange rate regimes		
			2019	2018	2017
1	China	3,127.49	Inter	Inter	Inter
2	Japan	1,284.97	Flot	Flot	Flot
3	Switzerland	804.00	Inter	Inter	Inter
4	Saudi Arabia	499.14	Fix	Fix	Fix
5	Taiwan	478.13	Inter	Inter	Inter
6	Russia	443.97	Flot	Flot	Flot
7	Hong Kong	441.25	Fix	Fix	Fix
8	India	432.38	Inter	Inter	Inter
9	Korea (Rep.of-)	403.70	Flot	Flot	Flot
10	Euro area*	386.57	Flot	Flot	Flot
11	Brazil	353.59	Flot	Flot	Flot
12	Singapore	279.24	Inter	Inter	Inter
13	Thailand	216.82	Inter	Inter	Inter
14	Mexico	177.18	Flot	Flot	Flot
15	United Kingdom	158.38	Flot	Flot	Flot
16	Czech Rep.	149.46	Inter	Inter	Inter
17	Israel	126.01	Inter	Inter	Inter
18	Indonesia	125.34	Inter	Inter	Inter
19	United States	118.44	Flot	Flot	Flot
20	Poland	117.20	Inter	Inter	Inter
21	U.A.E.	107.26	Fix	Fix	Fix
22	Malaysia	101.73	Inter	Inter	Inter

* Reserve holdings by the Eurosystem comprising the ECB and the national central banks of the euro area.

Source: By the author; based on IFS (IMF,2022a) for reserve holdings, Central Bank of the Republic of China (Taiwan) for data on Taiwan, and Ilzetzki, Reinhart and Rogoff (2021) for the ERR *de facto* classification.

Although the world's largest holder of reserves at the end of 2019 is China with more than USD 3,127 bln, *i.e.* more than 23% of global reserves, and following an intermediate (or fixed) ERR for several decades, Japan which is the second largest reserve holder with more than USD 1,284 bln at the end of 2019, adopts a free float since 1978. We should also remember that Japan was until 2005 the country that held the largest stock of reserves in the world and the first country to have exceeded USD 100 bln (in 1994).

Table (3.5.) shows that among the 22 largest reserve holders with a stock exceeding USD 100 bln at the end of 2019, eight countries follow one of the two floating configurations (free or managed) for several years –considering the euro area as a single economic entity with a free float *vis-à-vis* the Row's currencies. In addition to Japan, other floaters such as Russia, Korea (Rep.) and the euro area rank among the top 10 reserve holders with the 6th place (USD 443.97 bln), the 9th place (USD 386.57 bln) and the 10th

place (USD 386.57 bln), respectively. Mexico, the UK and the US, all of them floating countries, are lower in the ranking of the largest holders.

It should also be said that (only) three countries following fixity (Saudi Arabia, Hong Kong and the UAE) are in the list and that a half of countries (11 / 22) are following intermediate regimes. This is not strange to the global distribution of ERRs where the middle class is the most followed. However, it is also remarkable that, despite being the least widely followed in the world compared to the other two groups, floating has a significant share in the top 22 of the largest holders of whose stocks exceed USD 100 bln at the end of 2019: one third of the reserve stock of all 22 economies is held by floaters.

3.2. Definition of Variables and Data Sources

In what follows, we will present a systematic study of the relationship between ERRs and international reserve accumulation by more countries and over a longer period of time, but before doing so, we begin with the presentation of the two variables. Chapter one provided a detailed definition of international reserves, but for an easy reference, it is summarily repeated here. We also give an overview of the concept of classification of ERRs before presenting the one used in our study.

3.2.1. International Reserves

International reserves, as defined by the BPM6 (IMF, 2009), are "those external assets that are readily available to and controlled by monetary authorities for meeting balance of payments financing needs, for intervention in exchange markets to affect the currency exchange rate, and for other related purposes." International reserves include monetary gold, SDRs, the position at the IMF, and foreign exchange reserves. Gold is often excluded from reserve statistics.

3.2.2. ERRs' Classification

A. Classification approaches

The distinction between "*de jure*" and "*de facto*" classification approaches has gained prominence in the literature and IMF reports since the late 1990s. For example, in the context of the great debate of the second half of the 1990s on the relevance of the

"bipolar view" and the "hypothesis of disappearance of intermediate solutions", Calvo and Reinhart (2000) use a *de facto* classification. They have drawn the conclusion that it is incorrect to claim that countries are moving further away from intermediate regimes. They deduce that a trend towards peg regimes persists, especially among EMDEs. They explain this trend by what they call the "*fear of floating"* – a hypothesis that became later very famous in the literature.

Other studies, most often dealing with the macroeconomic performances or the fragility of ERRs, propose different *de facto* classifications, notably: Ghosh et al. (1997), Bubula and Otker-Robe (2002), Bailliu et al. (2003), Ghosh et al. (2003), Reinhart and Rogoff (2002), Levy-Yeyati and Sturzenegger (2005). The latter two classifications are the most widely used in the empirical studies on ERRs. Their databases are frequently updated, especially the RR classification. A brief presentation of the main differences between *de jure* and *de facto* approaches is provided below.

A.1. The *de jure* approach

Prior to 1999, the IMF was the main source of data on foreign ERRs. Its classification of the regimes followed by its member countries was based on official announcements made by their monetary authorities. This *de jure* or "official" approach does not take into account the actual (real) behavior of exchange rates on Forex. The official declarations of a regime reflect the intentions officially announced by monetary authorities with regard to their exchange rate policy. This approach has the advantage of data availability, thanks to a large database developed by IMF services for most member countries, and over a long period.

At the same time, the *de jure* approach adopted by the IMF prior to 1999 also has several shortcomings, the most important of which is the mismatch between "words" and "deeds". In other words, monetary authorities often have intentions about their exchange rate policies, but they do not correspond exactly to the actual conduct of it. For example, in an "official" fixed ERR, frequent changes of parity transform *de jure* fixity into an effective flexibility. Conversely, announced flexibility can hide in facts a policy of pegging to a currency or a (secret) basket, or a policy of flexibility managed according to a predetermined trajectory.

A.2. The *de facto* approach

Since 1999, the IMF has adopted a *de facto* classification approach in parallel with classifications in academic papers which we have just quoted. The *de facto* approach is based on the assessment of the actual behavior of each country's exchange rate policy and not only relying on official statements. Thus, the *de facto* approach makes it possible to detect the real conduct of the exchange rate and movements on the Forex.

However, this approach also has shortcomings. Firstly, there can be confusion between exchange rate stability through a nominal anchor system (peg regime) or an active intervention policy, on the one hand, and stability resulting from an absence of (monetary, financial or real) external shocks, on the other hand. Moreover, the size and structure of external trade differs from a country to another, so that they are not affected in the same way by external shocks. A small open country with a narrow export structure (small number of export products) and following a float, would suffer significant effects in the event of shocks and a high volatility of its exchange rate. However, a large open country with a diversified trade structure and following a floating regime, would be less affected by external shocks, and therefore would not face significant exchange rate volatility. In this example, under the *de facto* approach, the small country is "correctly" classified as having a floating regime, and the large country is "incorrectly" classified as having a more fixed (or a less flexible) regime. In addition, the *de facto* approach is retrospective. It takes into account the actual behavior of the exchange rate from a historical perspective. This does not, therefore, permit to take into account the monetary authorities' intentions which may affect the behavior of the exchange rate itself.

B. The "Natural" classification of Reinhart and Rogoff

The *de facto* classification developed by Reinhart and Rogoff (2002), known as RR Classification, is one of the most widely used classifications in empirical research dealing with ERRs in the recent years. It differs from other (*de jure* or *de facto*) classifications and brings several innovations, notably the fact that it uses monthly data in addition to annual data, and thus gives the ERR followed each month during the covered period. It also uses these monthly data for parallel market exchange rates and dual/multiple exchange rate systems, when they exist. The idea is that the exchange rate (often floating) in a dual/multiple or parallel ERR is a better "barometer" for monetary policy than the official

rate and also a better economic indicator. Another novelty in the RR classification is that, in addition to exchange rate statistics, it also uses extensive chronologies of the history of ERRs and other related factors, such as exchange controls, monetary reforms, and monetary crises.

Reinhart and Rogoff (2002) describe their classification as "natural", not "artificial". The term is taken from biological sciences where the classification of (living) species is made according to a system of natural taxonomy based on the characteristics of the species to group them. To establish the ERR classification, Reinhart and Rogoff (2002) begin by checking whether there is a parallel or dual/multiple Forex in each country. If yes, they then proceed to a statistical classification based on changes in the nominal exchange rate (in percentage) and the probability that it remains within a predetermined band of fluctuations. Finally, where there is only one Forex, the classification of the actual regime is given by a comparison between the statistical analyses of the *de facto* regime and the official statements. The algorithm of the RR natural classification is given in (Annex 1).

Table (3.6.): RR *de facto* classification of exchange rate regimes

	Fine grid	Coarse grid	
- No separate legal tender (Monetary union or dollarization)	1	1	Fixed regimes
- Pre announced peg or currency board arrangement	2	1	
- Pre announced horizontal band that is narrower than or equal to +/-2%	3	1	
- De facto peg	4	1	
- Pre announced crawling peg	5	2	Limited flexibility
- Pre announced crawling band that is narrower than or equal to +/-2%	6	2	
- De facto crawling peg	7	2	
- De facto crawling band that is narrower than or equal to +/-2%	8	2	
- Pre announced crawling band that is wider than or equal to +/-2%	9	2	
- De facto crawling band that is narrower than or equal to +/-5%	10	3	Managed floating
- Moving band that is narrower than or equal to +/-2% (*i.e.* allows for both appreciation and depreciation over time)	11	3	
- Managed floating	12	3	
- Freely floating	13	4	Freely floating
- Freely falling	14	5	Freely falling
- Dual market in which parallel market data is missing.	15		

Source: Reinhart and Rogoff (2002)

The first version of the RR classification (in 2002) covers 153 countries over the period 1946-2001 and allows, in addition to its innovative methodology, to take into account periods of severe macroeconomic disturbances. The natural classification gives a set of 14 (fine grid) ERRs grouped into 5 categories (coarse grid). The observation noted "Freely Falling" is not considered *per se* as an ERR, but is attributed to the period when inflation exceeds 40%. Usually, such a situation is linked to major monetary troubles, if not a currency collapse, but could, depending on the aims of the study conducted, be assimilated to a free floating. The last 15th category is not an ERR, but is assigned to cases where dual/multiple or parallel market data are missing

3.2.3. Data Sources

Our study uses data on international reserves and *de facto* ERRs of 117 AEs and EMDEs over the period 1977-2016 (40 years). The list of countries, given in Annex 2, corresponds to those countries for which data (reserves and ERRs) are available for the whole period under study. The latter is chosen to begin after the official end of the BW system in 1976 (announced by the Jamaica Accords) and covers almost the entire coexistence era between fixed, intermediate and floating ERRs.

Reserve data used in our study comes from the International Financial Statistics – IFS database (IMF, 2022a), which we have used throughout this work. These data represent international reserve stocks (excl. gold) and are expressed in current USD for each year and for each country. The reserves held at the end of 2016 by the 117 selected countries in our study represented nearly 85% of world reserves.

For ERRs, we use an updated version of the original RR classification edited with the paper by Ilzetzki, Reinhart, and Rogoff (2017b), noted below "IRR classification". The latter includes, *inter alia*, the classification of ERRs of 201 countries and territories during the period 1946-2016. A more recent version was published with the paper by Ilzetzki, Reinhart, and Rogoff (2021) and covers the period 1940-2019. We did not use data given by this last edition because it does not contains annual data frequency of classified ERRs, but just a monthly frequency, which differs from the data frequency of reserves given in IFS database.

In addition, for the purposes of our study, we are grouping the fine grid regimes somewhat differently from what is established in the coarse grid of RR/IRR classification. We include configurations from 1 to 4 in the category we call "fixed regimes", similarly to what is done in RR/IRR coarse grid, configurations from 5 to 11 in the category "intermediate regimes", and configurations 12 and 13 in the category "floating regimes".

This choice of grouping is motivated by our intention, let us recall, to know whether or not (managed and free) floating is conducive for international reserve accumulation compared to fixed and intermediate regimes which, theoretically, should be more. *A priori*, it might seem appropriate to include configuration 14 (Freely Falling) among floats since it is attributed to periods of major monetary troubles that give rise to high exchange rate volatility (especially depreciation) which could be considered as a free floating. However, we consider that it is more appropriate to exclude this configuration from floats (and more generally from the three major groups of ERRs) because, so often, during the years of monetary troubles, the country can either lose a lot of reserves (under the effect of speculative attacks, etc.), or, by contrary, receive external financing (IMF loans or others) which makes it possible to re-balance its external position and/or "artificially increase" its reserves. In the latter case, we can cite the example of Algeria in 1994 – for which the regime is classified as "freely falling" and the country experienced a payment crisis followed by an IMF intervention: the variation in Algeria's reserves at the end of 1994 was positive: USD (+1.2) bln.

In addition, it should be noted that it is also possible to group all configurations outside of the 12, the 13 (and the 14) under a "non-floating regimes" banner.

3.3. Methodology

3.3.1. Presentation of the empirical strategy

To check whether there is an effect of the followed ERR on international reserve accumulation, we use the technique of one-factor variance analysis (One-way ANOVA), which is a statistical model used to compare samples' means. This test is applied to measure the influence of one or more categorical explanatory variables (variability factors) through their different modalities (levels) on the law of a continuous explained variable. One-factor analysis of variance occurs when the analysis is based on a model described by

a single variability factor; and two-factor analysis or multifactor analysis occurs when there are two or more explanatory factors. In other words, the analysis of variance makes it possible to study the behavior of a quantitative variable to be explained in relation to one or more qualitative nominal variables.

In our case, the analysis of variance makes it possible to compare the levels' means of the factor (ERRs) in order to see whether the variability of the regimes influences reserves accumulation or not.

Statistical hypotheses are formulated in that the null hypothesis (H_0) admits that there is no difference between the means of the three groups, *i.e*. the adoption of an ERR group (among the three) does not influence the accumulation of international reserves.

The alternative hypothesis (H_1) admits that there is a difference between the means of the three groups, which makes it possible to infer that the factor "ERRs" represents a cause of accumulation.

Annual observations of ERRs for the 117 countries, initially presented according to the fine (detailed) grid of the IRR classification, are first grouped under the three main groups (fixed, intermediate and floating) as already mentioned.

Annual changes in reserves (excl. gold) are calculated for the 117 countries for each year and represent the year's accumulation:

$$\Delta R_{it} = R_{i\,t} - R_{i\,t-1}$$

Data are then combined so that each observation gives the nominal value of the change in reserves and the ERR followed during the year (t). For our sample containing 117 countries with 40 observations of reserve annual change for each country (except for China during the first year: 1977 due to lack of data on reserves), a total of 4,679 observations are recorded, of which 1,920 observations as fixed regimes, 1,873 observations as intermediate systems, 571 observations as floating, 272 observations as freely falling (configuration 14), and 43 observations as missing data for the parallel market (configuration 15). Since these latter two configurations are to be excluded from the overall observations for the reasons we have already pointed out, a total of 4,364 observations remains to be exploited.

3.3.2. The analysis of the variance

The analysis of the variance involves two steps:

A. The decomposition of the variance

We start with the decomposition of the total variance. That means explaining the total variance on all samples (called *Observations* hereafter) according to the variance due to the factor (the variance explained by the model or "*between groups* variability") and of random residual variance (the variance not explained by the model or "*within groups* variability").

The total sum of squared deviations (SS_{Total}) is a linear composition of the sum of squared deviations of the explanatory variable (SS_{Factor}) and the sum of squared deviations of residuals (SS_{Errors}), with:

$$SS_{Total} = SS_{Factor} + SS_{Errors}$$

B. Fisher Test

The variance (mean squares noted MS) is obtained by the ratio of the sum of the squared deviations by the degrees of freedom. The number of the degrees of freedom *between groups* is the number of levels (groups) minus one (p-1), and the number of the degrees of freedom *within groups* is the number of samples (observations) minus the number of the degrees of freedom *between groups* (n-p) :

$$MS_{Factor} \text{ (}\textit{between groups}\text{ variance)} = SS_{Factor} / (p\text{-}1)$$

$$MS_{Errors} \text{ (}\textit{within groups}\text{ variance)} = SS_{Errors} / (n\text{-}p)$$

With the assumption that the variable (ΔR_{it}) follows a normal law, the sum of squared deviations SS follow X^2 with k degrees of freedom and with p the number of levels of the variability factor and n the total number of observations.

Thus, the ratio of the two variances must follow Fisher's law since the latter is defined as the ratio of X^2 laws. So we have:

$$F = \frac{MS_{Factor}}{MS_{Errors}} = \frac{SS_{Factor} / (p\text{-}1)}{SS_{Errors} / (n\text{-}p)} \sim F(p\text{-}1, n\text{-}p)$$

The calculations presented in the variance analysis Tables (3.8.) and (3.10) are obtained by this procedure and allow to draw conclusions about the validity of the Ho hypothesis or its rejection. To do that, the table offers two ways: comparing the observed *F*-value with the critical *F*-value, or to compare the probability (p-value) with the risk-value (0.05):

- If the observed *F*-value is higher than its critical value, then Ho is rejected, which means that there is at least a difference between the means of groups.

or:

- If the p-value (which is the alpha error, *i.e.* the probability or risk of making an error by declaring that there is a difference between the 3 groups) is less than the risk-value of (0.05), then Ho is rejected.

3.4. Results and Interpretation

3.4.1. Positive and negative annual changes in reserves

The table (3.7.) below provides brief descriptive statistics:

Table (3.7.): ERRs and (+ / -) Reserve changes
- Summary descriptive statistics

Groups	*Number of samples (obs. by group)*	*Sum*	*Mean*	*Variance*
Fix	1,920	1.9879E+12	1.0353E+9	1.3647E+20
Inter	1,873	4.7248E+12	2.5226E+9	9.1205E+20
Float	571	2.3022E+12	4.0318E+9	3.1057E+20

Source: Author's calculation

Descriptive data show that the intermediate class of regimes has the largest sum of (positive and negative) changes in reserves, followed by floating regimes and then fixed regimes. This order is not in accordance with the representativeness of regime observations which gives a greater presence for fixity, then intermediate regimes and finally floats. This could be explained by the weight of large reserve holders with this category of regimes, headed by China for a long time.

However, in terms of means, floating shows the best performance with an average accumulation of just over USD 4.0 bln *per* floating country *per* year during which it followed this group of ERRs, followed by intermediate regimes with an average of just over USD 2.52 bln, and finally fixed regimes with an average of just over USD 1.03 bln. It is likely that this order is influenced by the position of some large holders who have followed floating for much of the duration of the study, such as Japan, which until 2005 was the largest holder of international reserves, as we already said.

The variance shows a ranking for ERRs which is comparable to that for the accumulated sums: the intermediate regimes are by far the regimes for which there is the greatest variability of reserve holding. This is eventually due to the fact that it is the class of regimes which requires the most of interventions for exchange rate control, and consequently gives rise to greater variability in terms of reserve stocks.

Table (3.8.) below shows the variance analysis:

Table (3.8.): ERRs and (+ / -) Reserve changes
- ANOVA table

Source of variations	*Sum of squares*	*Degree of freedom*	*Mean of squares*	*F*	*Probability (p-Value)*	*F Critical value*
Inter groups	4.6366E+21	2	2.31834E+21	1.710601172	0.090452071	2.997791096
Within groups	2.1462E+24	4,361	4.92153E+20			
Total	2.1509E+24	4,363				

Source: Author's calculation

The observed *F*-value is found to be 1.710601172 and therefore is lower than the critical *F*-value: 2.997791096. In addition, the p-value is equal to 0.09045207 and therefore represents a value higher than the 5% risk. These results lead us to invalidate the alternative hypothesis (H_1), according to which there is a difference between the means of the three groups of the factor, and thus the null hypothesis (H_0) is accepted: there is no difference between the means of the three groups.

As a first observation, we can say that the analysis of variance using data on international reserves changes for 117 countries during the period 1977-2016 allow to deduce that, generally, the adoption of ERRs among the three categories (fixed, intermediate and floating regimes) does not have a statistically significant influence on the (positive or negative) performances of reserve accumulation, measured here by annual changes.

3.4.2. Positive annual changes in reserves

We will now focus only on the positive values of annual changes in reserves. This is closer to the logic of accumulation, because from a global point of view, the period which our study covers was not only a period of a continuous accumulation. In other words, the phenomenon of reserve accumulation is not linear over time, both at the individual (country) and global levels. Phases of accumulation are followed by other phases of "de-accumulation", and *vice versa*. During the period covered by our study, the global economic and monetary landscape experienced a lot of conjunctures that certainly had an impact on accumulation trend: several oil shocks and counter-shocks (1979, 1986, 2003, 2014); several regional or global financial crises (developing countries' debt crisis in 1982, EMS crisis in 1992-3, EME crises in the second half of the 1990s, the GFC in 2008-9); several bull and bear cycles of major reserve currencies, including the dollar; etc.

Thus, we remove now all negative values among the 4,364 observations that were used with the first ANOVA test. A total of 2,818 observations remains and corresponds to the cases (year-regime) where the 117 countries have really accumulated reserves (*i.e.* they have experienced a positive annual change in their reserve stock) among the 40 years covered by the study and were following one of the three groups of ERRs. Thus, we have: 1,193 observations under fixity, 1,253 under intermediate regimes, and 372 under floating.

Table (3.9.): ERRs and (+) Reserve changes
- Summary descriptive statistics

Groups	*Number of samples (obs. by group)*	*Sum*	*Mean*	*Variance*
Fix	1,193	2.9516E+12	2.4741E+9	1.9179E+20
Inter	1,253	6.4620E+12	5.1572E+9	1.0455E+21
Float	372	2.8940E+12	7.7795E+9	4.2182E+20

Source: Author's calculation

Descriptive data in Table (3.9.) show that, similarly to the first test, the intermediate ERRs have the greatest sum of (positive) changes in reserves, but unlike the first test, fixed ERRs follow in the second place, and then the floating ERRs. Overall, the order here also is consistent with the representativeness of the three groups' observations. However, contrary to the previous results, there is no great difference between what has been accumulated under fixity and floating, despite the fact that the number of observations under the first category is more than three times as large as that relating to the second.

In terms of means, the float also shows in this table the largest value with an average accumulation of more than USD 7.7 bln *per* floating country *per* year during which it followed this regime group, then intermediate regimes with nearly USD 5.16 bln in average, then fixed regimes with more than USD 2.47 bln in average. Once again, and like the first test, which took into account the positive and negative changes in reserves, we think that this ranking is probably influenced by the size of some large holders with a floating ERR such as Japan. The variance results also show that the intermediate regimes are by far the regimes with the most important variability in terms of reserve holding, followed by floats and fixity, respectively.

The analysis of the variance given in Table (3.10.), and based on positive observations of reserve changes only, shows that the observed *F*-value of 2.800534392 is lower than the critical *F*-value of 2.998922605. Also, the p-value is equal to 0.071843011 and therefore higher than the risk of 5%. Thus, the null hypothesis, according to which there is no difference between the means of the three groups of the factor (ERRs), is accepted. The alternative hypothesis (H_1), which means that there is at least a difference between the means of the groups, is therefore rejected

Table (3.10.): ERRs and (+) Reserve changes - ANOVA table

Source of variations	*Sum of squares*	*Degree of freedom*	*Mean of squares*	*F*	*Probability (p-Value)*	*F Critical value*
Inter-groups	9.389E+21	2	4.69450E+21	2.800534392	0.071843011	2.998922605
Within groups	1.69412E+24	2,815	6.01818E+20			
Total	1.70351E+24	2,817				

Source: Author's calculation

The analysis of the variance, using data on international reserve accumulation (*i.e.* positive annual changes in reserves) for 117 countries during the period 1977-2016, shows that this accumulation is not influenced by the adoption of specific groups of ERRs. The descriptive data show, as already noted, that, effectively, there have been an accumulation of reserves under the different classes of ERRs, and that the floating seems even to be accompanied by the highest performance in terms of average annual changes, when the three groups are considered separately. Average changes under floats are also higher than those under non-floats (fixed and intermediate regimes) taken together.

Conclusion

After having explained in the first two sections the arguments given by a wide range of literature on the relationship between reserve accumulation and ERRs (or at least the degree of exchange rate flexibility), we found that there was no consensus on this issue. In the last section, we attempted to empirically check whether the holding/accumulation of international reserves is more favored with the adoption of peg regimes (fixed and intermediate regimes), and consequently, is not or less done under floating regimes.

After a brief reminder of the meaning of our study's central concept, namely international reserves, we have given a more detailed presentation of the classification of ERRs. Indeed, the distinction between *de jure* and *de facto* classifications is crucial in that a wrong classification of the different configurations of ERRs would inevitably lead to misleading conclusions. Moreover, that is not exclusive to studies focusing on the relationship between reserves and ERRs. The literature of the early 2000s on the macroeconomic performances of ERRs evoked the importance of the *de facto* approach in empirical investigation. In addition, the use of *de jure* classification in earlier empirical studies questioning the link between reserve demand and ERRs could explain why this studies have not led to a common conclusion in this regard. The *de facto* classification of Rogoff and Reinhart (with several updates) is among the most widely used in recent years in the empirical literature dealing with issues focusing on ERRs.

The one-factor variance analysis method (One-way ANOVA) was used in our empirical investigation. The method consists in checking the existence of an effect of a categorical (qualitative) variable with several modalities on a continuous (quantitative) variable. For a large sample of economies (117 AEs and EMDEs), we attempted to check whether annual (positive and negative) changes in international reserves (excl. gold) over 40 years (1977-2016) are explained by the adoption of particular ERRs among the three major groups (fixed, intermediate and floating ERRs).

The results of the variance analysis gave us a confirmation of the null hypothesis that there is no difference between the means of the three modalities (groups) of "ERR" factor, which indicates that, generally, the followed regimes do not particularly influence international reserve changes. When taking into account only observations of positive changes in reserves, which, in a sense, could be quantitatively better adapted to the concept of accumulation, we get the same conclusion: there is no statistically significant effect of the adopted ERR on the accumulation behavior of international reserves.

Apart from the analysis of the variance, the descriptive data show also some interesting facts. A greater level of variation (and accumulation) is linked to intermediate ERRs, followed by fixed and then floating regimes. The order appears to be consistent with the representativeness of the observations of regimes in the sample of countries used in our study. In terms of averages, floating regimes show the higher average of accumulation, followed by intermediate and then fixed regimes. It is likely that this ranking is influenced by the position of some large holders who have adopted floating for much of the covered period by our study, such as Japan, which until 2005 was the largest holder of international reserves. The variance shows that the intermediate regimes are by far the regimes for which there is the greatest variability in terms of reserve holding, probably because this category of regimes is the most involved in interventions on foreign exchange markets.

General Conclusion

In this general conclusion, we give an overall summary of what has been developed in the three chapters, before presenting some research perspectives that our work results could prelude. But before that, we begin with a reminder of the research problem and the questions we worked on.

Our study focuses on a research problem in open monetary and financial macroeconomics. We have been interested in an issue that has been debated in theoretical and empirical literature for a long time, namely whether the nature of the ERRs followed by countries affect their behavior of international reserve accumulation. The question materializing the research problem of our study was formulated as follows: *Would the accumulation of international reserves be influenced by the adoption of specific exchange rate regimes*? *Would it be favored only by fixed exchange rates, as mentioned in open macroeconomics textbooks?* From this main question arose two other (secondary) questions: a) *Why do countries accumulate reserves under fixed regimes? and b) Is there really no need to accumulate reserves when following floating? and if so, why?*

Before focusing on these questions and proposing theoretical and empirical elements of answer, we thought it useful to start with studying some important themes (and aspects) related to the central concept in our study, namely international reserves. Indeed, the first two chapters have allowed us to understand quite well the phenomenon of accumulation and issues relating to reserve currencies, including the dominant one which is at the *core* of the international monetary and financial system.

In the first chapter, we presented the concept of international reserves, their components, and other related concepts (international liquidity and international investment position). We also analyzed the trend of reserve accumulation globally and by economic development level (AEs and EMDEs). Trends of accumulation have been analyzed in terms of values, GDP shares, annual changes, in comparison with world trade

evolution, and in the light of global and local conjunctures. This allowed us to note some observations, notably: the acceleration of the global trend of accumulation from the beginning of the 2000s, especially by the EMEs and oil exporters; China's position is at the top of the largest accumulators since 2005; the usefulness of reserves for accumulating countries during the 2008-9 crisis; a slowdown/reversal of the global trend of accumulation in 2014-6 due to the oil counter-shock and a slowdown in Chinese activity.

We also examined the evolution of the four components of international reserves. This allowed us to note: a weakening of the shares of SDRs and position at the IMF over time; the AEs have a preference to hold gold as reserve assets more than the EMDEs; etc. The analysis of the currency composition of foreign reserves and their evolution show: a continuous domination of the US dollar as a reserve currency, although declining since the GFC; a quasi-stagnation of traditional currencies (euro, yen, and sterling); a rise of non-traditional reserve currencies (Canadian and Australian dollars, Chinese renminbi).

The second chapter is a continuation of the first, starting from the reality of the dollar historical domination as an international and reserve currency. The international hegemony of the dollar for reserves, but also for financial and trade transactions, is closely linked to the sustainability of the American external financial position, which is structurally deficient. Thus, addressing the question of the dollar status durability required us to study the debate on the sustainability of the US persistent net debtor status. This issue has been debated since the 1960s, and has been continually renewed, but never came into an academic consensus. In fact, the "eternal" debate on this issue could be summarized by the following two questions: *could the financing of US deficits be perpetuated? and, thus, the dollar, could it keep its domination indefinitely?*

Through the second chapter, we proposed a review of the questions from a (quasi-) historical perspective. We first focused on the genesis of the debate during the BW era (with the Triffin dilemma) where the focus was on the fiscal deficits and the ability of the US to finance them (*i.e.* the exorbitant privilege), then the re-emergence of the controversy in the 2000s with the debate on the global imbalances' phenomenon and the new Triffin dilemma (Triffin II) focusing on a period marked by widening twin deficits for the US on the one hand, and great current account surpluses in other countries with a substantial accumulation of international reserves, on the other hand. Later, the controversy continued between supporters and opponents of the hypothesis of an imminent "end of privilege"

(and therefore the status of the dominant currency) in the light of recent economic and geopolitical developments, like the conflict in Ukraine in 2022 and the ensuing sanctions on Russia, including its reserve freeze.

Indeed, strategic and geopolitical considerations of reserve currency issuers and reserve accumulators could also have important effects on the hierarchy of reserve currencies. Other changing parameters in the current global landscape could also impact the durability of the dollar hegemonic status as an international and reserve currency. Iancu et al. (2020) summarize them by: the probable effects on trade and industrial relocations due to the Covid-19 pandemic, the development of non-dollar debt markets, the credibility of economic policies in debt issuing countries, and the progress of FinTech, including the emergence of public and private digital currencies.

But at the same time, several factors remain in favor of a sustained domination of the dollar: financial links, pegging to the dollar, trade links (and invoicing practices), network and inertia effects, etc. Also, a retrospective observation over the long run, allows us to note that during the last five decades there have been many major events in which the dollar has been heavily involved (the BW collapse, the events of 9/11, the GFC of 2008-9, etc.), but which have not significantly or durably impacted the US economic domination neither the hegemonic status of the dollar. The latter has always remained *primus inter pares* in the international monetary and financial system.

The third chapter focuses on another central element of the international monetary and financial system, namely the international system of exchange rate regimes, by relating them to the international reserve accumulation phenomenon. This chapter was written in a way that allows us to provide answers to the question(s) asked in light of our research problem. First, we outlined the arguments of the standard theory that exchange rate fixity is naturally more favorable to international reserve accumulation. Textbooks give the differences between regimes in terms of adjustment of external imbalances. Then, we focused on the weight / importance of interventions on the Forex through Frankel's regime *continuum*, and consequently the level of reserve needs with these different regimes. We also analyzed the role of reserve accumulation in the relaxation of the "trilemma" of economic policy. This hypothesis, mainly supported by (Aizenman et al., 2008; Obstfeld et al., 2010; and Ilzetzki, Reinhart and Rogoff, 2017a), emphasizes that the international reserve accumulation, especially in EMEs, has enabled them to "relax" the trilemma

constraints. This is to say that the large levels of reserves allowed these countries to avoid costly financial and currency crises, such as those of the 1990s, despite the fact that they followed peg policies and some monetary autonomy in a context of financial openness.

After that, we questioned the existence of (and the reasons for) reserve accumulation under floating regimes. A review of theoretical and empirical literature has also allowed us to examine several aspects of reserve demand and its relation to floating (compared to fixed or intermediate regimes). This literature is rich and covers a long period. However, the conclusions are not unanimous. The pioneering contributions by Friedman (1953), Johnson (1958), and Mundell (1961) attribute to floating rates the merit of reducing reserve needs. The theoretical literature of the 1970s (Williamson, 1976; Hipple, 1974; Claassen, 1974; Haberler, 1977; Kenen, 1977; Solomon, 1977; etc.) also agree with this view. It was accepted that the reserves are held mainly to correct the payment deficits through intervention on the Forex, and therefore under fixed ERRs. The adoption of more flexible rates or a floating regime would be synonymous with the disappearance (or relaxation) of this constraint. In parallel to this, others, such as Kreinin and Heller (1974), Grabel (1977), and Crockett (1978), consider that the adoption of flexible rates does not necessarily lead to a decrease in international reserve stocks. The demand for reserves may be related to other considerations besides financing imbalances.

Empirical studies are not consensual either. Kelly (1970), Flanders (1971), Hipple (1974), Makin (1974, 1977) and Edwards (1983) study the period before BW collapse and conclude that the float, or more generally a less stable rates, reduces the need (and the desire) to hold large reserve stocks compared to pegs. Others, study the stability of reserve demand during and after the BW era. For Heller and Khan (1978), Frenkel (1978, 1983), Saidi (1981), Lizondo and Mathieson (1987), etc., floating does not reduce the demand for reserves. On the other hand, Suss (1976), Bahmani-Oskooee and Malixi (1987), Bahmani-Oskooee (1988), and others argue that floating has reduced the reserve demand.

The lack of consensus also marks the empirical literature in the 2000s. On the one hand, Flood and Marion (2001), Disyatat and Mathieson (2001), Aizenman and Marion (2003, 2004), Edison (2003) conclude that significant flexibility of the exchange rate, or even floating, reduces the need for holding reserves. On the other hand, Sidaoui (2005), Chaudhry and Hasan (2007), Bastourre et al. (2009), Delatte and Fouquau (2012), Steiner (2013), among others, find that floating does not negatively affect reserve holdings.

In this state of the art, we conducted our empirical investigation. We started with the presentation of relatively old data and also very recent examples that show that the countries that are accumulating are not only those that follow fixed or intermediate regimes and that many large accumulators were floaters for a long time. Then, we used One-factor variance analysis method (One-way ANOVA) for a systematic empirical investigation. This method allows testing if a qualitative variable with several modalities affects a quantitative variable. For a sample of 117 AEs and EMDEs, we attempted to test whether the annual (positive and negative, then only positive) changes in international reserves (excl. gold) during 40 years (1977-2016) are explained by the adoption of fixed, intermediate and floating ERRs. The analysis of variance allowed us to confirm the assumption that the followed ERRs do not influence differently changes in reserves.

This conclusion could be positioned in line with studies which conclude that there is no clear evidence of influence of the regime choice on the accumulation behavior (Lane and Burke 2001; Aportela et al., 2003; Cheung and Ito 2009; Aizenman, Cheung, and Ito, 2014), or even with studies we just cited and concluding that there is no negative correlation between floating and reserve holding (Sidaoui, 2005; Chaudhry and Hasan, 2007; Bastourre et al., 2009; Delatte and Fouquau, 2012; Steiner, 2013).

The results obtained from our study lead us to further investigation by questioning the effective determinants of the demand for reserves. The economic literature has focused on this question through the study of the demand for and the accumulation of reserves as well as through the debate on the accumulation motives, which are empirically intercepted by the demand function coefficients, and of which we presented a short outline in the introduction of this work and through some developments in Chapters 1 and 3.

Indeed, the “traditional” theory of demand for reserves, built on a large number of studies in the 1960-80s, tried to explain it by different determining factors. The least controversial are the level of imports (and its variability), the propensity to import, the opportunity cost of holding reserves and the domestic supply of money (Bahmani-Oskooee and Brown, 2002). In addition, other determinants have also been studied in many work: the level of exchange rate flexibility (which we discussed in Chapter 3), the level of real

income (as a scale variable like imports or population), lagged reserves, expected export receipts, developing countries' debt, terms of trade, gold price, etc. (Xu, 1992).

With the 2000s and renewed interest in the study of the phenomenon of international reserve accumulation, some "new" determinants have been empirically tested in many studies, among which was an interest for: other macroeconomic variables (export volatility, commodity prices volatility, reserve volatility), or institutional variables (leftist government, effectiveness of anti-corruption measures), or dummy variables (financial crises), etc.

However, the financial variables have attracted particular attention: the level of financial account openness, the short-term debt, the net liabilities, the level of the banking system vulnerability, etc. This interest for financial variables has emerged with the idea that the financial liberalization in EMEs (openness to capital flows) since the 1990s has increased their vulnerability to financial account shocks. That means that the "precautionary motive" no longer signifies self-protection against current account shocks, on which the traditional theory focused, but also those caused by the volatility of capital movements, especially short ones (hot money).

In addition to the precautionary motive, the "monetary mercantilism" is the other major motive discussed in the literature of the 2000s. The mercantilist motive corresponds to the monetary and exchange rate policies followed by some EMEs and conceived in the logic of export-led growth models. These policies are based on undervalued currencies to enhance international competitiveness. The undervaluation is based on sustained Forex interventions, and leads to an increase in the stock of reserve holding. The mercantilist motive is empirically intercepted through variables measuring undervaluation of the domestic currency. A part from that, there are other motives discussed in the literature: the collateral motive for FDI or for external borrowing, the intergenerational saving motive, etc. Several variables are used to proxy these motives.

That said, in addition to the interest of working on a wide range of reserve demand determinants, one could also be interested in the fact that accumulation motives, especially precautionary and mercantilist motives, are real economic policy choices. Certainly, even if the issues of "optimal" reserve level and reserve "adequacy" remain rather problematic, even they have been debated for a long time, and that the accumulation with a mercantilist

motive can be considered as “by-product” of interventions for currency undervaluation, this does not preclude that with these two main motives, the authorities of a country choose in a discretionary way to accumulate reserves. We make this remark in order to contradict the widespread opinion that in all cases the reserves represent only a “residual variable”. In reality, this opinion is based on a (simplistic) balance of payments accounting logic, according to which the reserves (or more precisely their variations) come from surpluses of the current and / or the financial accounts.

However, the notion of a residual variable may seem more relevant if we consider some structural aspects of developing countries, notably hydrocarbon exporters, such as Algeria, which have experienced a large reserve accumulation during the upward phases of oil cycles. This accumulation behavior cannot be explained by motives which can be relevant only for EMEs (more financial openness and more trade competitiveness). In other words, this accumulation is not justified by a precautionary motive to face capital outflows, nor by a mercantilist motive related undervaluation policies, but rather by a low internal “absorptive capacity” to large external receipts resulting from positive trade shocks. This structural characteristic is due to the weakness of banking and financial system (due to its inefficiency to enhance saving and investment adequacy), or the lack of industrial policies, as highlighted by Talahite and Beji (2013) and Hadj Nacer (2009), which we have briefly mentioned in the first Chapter.

Thus, it would be very interesting to include these parameters (weakness of the domestic absorptive capacity and financial system underdevelopment) among the determinants of reserve demand or accumulation, by quantifying them or expressing them as dummy variables, and test their significance. This would allow us, particularly in the case of developing economies, to distinguish between what might be called “discretionary or policy-motivated accumulation” and a real “residual accumulation” of international reserves.

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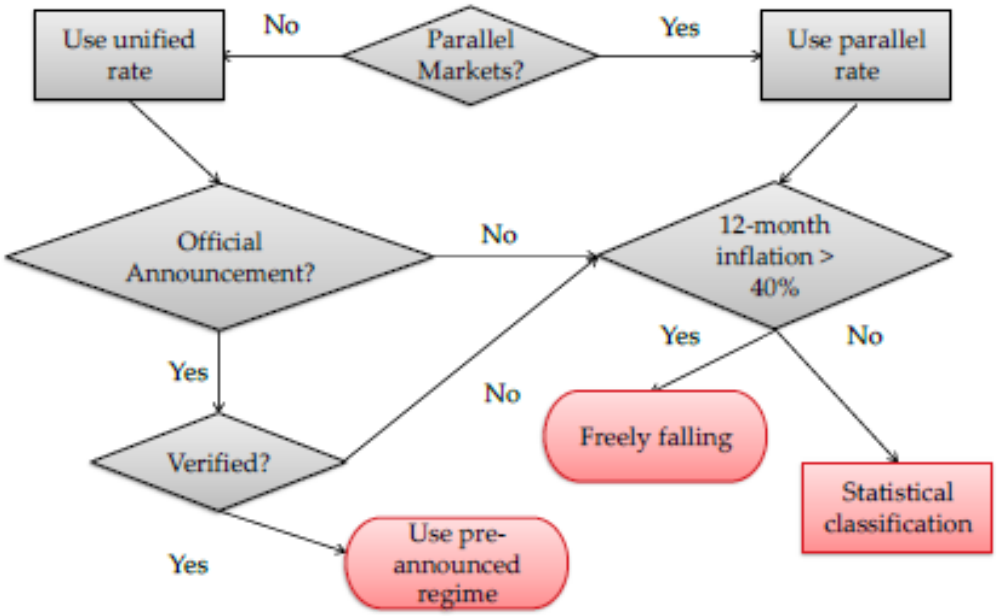
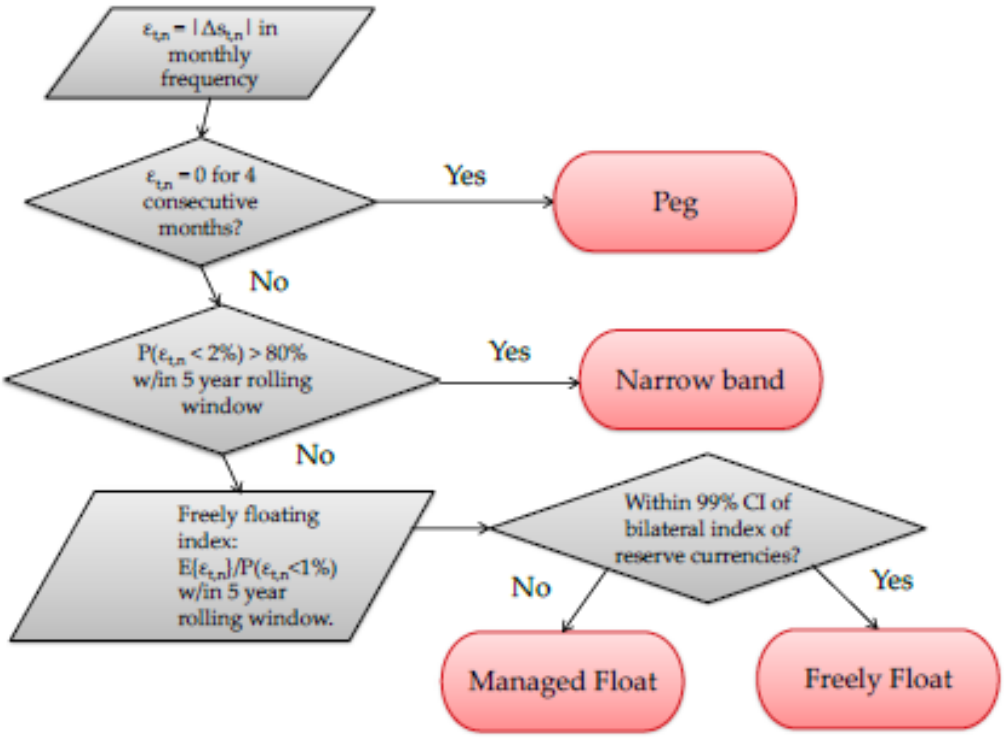
ANNEX 1. Algorithm for IRR classification of exchange rate regimes

Sequence and general scheme



Statistical tests



Source: Ilzetzki, Reinhart, and Rogoff (2017b)

ANNEX 2. Country List

Algeria	Gambia	Oman
Antigua & Barbuda	Germany	Pakistan
Argentina	Ghana	Panama
Australia	Greece	Papua New Guinea
Austria	Grenada	Paraguay
Bahamas	Guatemala	Peru
Bahrain	Guyana	Philippines
Bangladesh	Haiti	Portugal
Barbados	Honduras	Qatar
Belgium	Iceland	Romania
Belize	India	Rwanda
Benin	Indonesia	Salvador
Bolivia	Ireland	Samoa
Botswana	Israel	Saudi Arabia
Brazil	Italy	Senegal
Burkina Faso	Jamaica	Seychelles
Burundi	Japan	Sierra Leone
Cabo Verde	Jordan	Singapore
Cameroon	Kenya	South Africa
Canada	Korea	Spain
Central African Rep.	Kuwait	Sri Lanka
Chad	Lebanon	St Lucia
Chile	Libya	St Vincent & Grenadines
China, PR	Madagascar	Sudan
Colombia	Malaysia	Suriname
Congo Rep. of	Maldives	Swaziland
Costa Rica	Mali	Sweden
Côte d'Ivoire	Malta	Switzerland
Cyprus	Mauritania	Thailand
Denmark	Mauritius	Togo
Dominica	Mexico	Trinidad Tobago
Dominican Rep.	Morocco	Tunisia
Ecuador	Myanmar	Turkey
Egypt	Nepal	United Arab Emirates
Ethiopia	Netherlands	United Kingdom
Fiji	New Zealand	United States
Finland	Niger	Uruguay
France	Nigeria	Venezuela
Gabon	Norway	Zimbabwe

TABLE OF CONTENTS

Chapter II. THE DOMINANT RESERVE CURRENCY AND THE INTERNATIONAL MONETARY AND FINANCIAL SYSTEM

International Reserve Accumulation and Exchange Rate Regimes

Abstract

This thesis deals with a topic in open monetary and financial macroeconomics, and focuses on an issue that has been debated in the economic literature, namely whether the exchange rate regimes influence countries' international reserve accumulation. Indeed, we try to answer the following question: *Is international reserve accumulation possible only under pegged regimes, i.e. fixed and intermediate regimes, as learned in open macroeconomics textbooks?* On the one hand, theoretical and empirical literature on this issue does not give a unanimous answer. On the other hand, some facts show that accumulating countries are not only those with fixed or intermediate regimes and that many large accumulators have followed floating regimes for a long time. Empirical treatment of data, from a sample of 117 advanced and developing economies over 40 years (1977-2016), suggests that the adoption of particular regimes does not influence changes and accumulation of reserves, and that countries do accumulate reserves even if they float.

Key words: Open Macroeconomics; International Reserves; Accumulation; Exchange Rate Regimes; Pegs, Floats; International Monetary and Financial System.

Accumulation des réserves internationales et régimes de change

Résumé

Cette thèse traite d'un sujet dans le domaine de la macroéconomie monétaire et financière ouverte, et se focalise sur une question qui a fait l'objet d'un débat dans la littérature économique, à savoir si les régimes de change suivis des pays influencent-ils leur accumulation de réserves internationales. Ainsi, nous essayons de répondre à la question suivante: *l'accumulation de réserves internationales n'est-elle favorisée que sous des régimes d'ancrage, i.e. régimes fixes et intermédiaires, comme stipulé par les manuels de macroéconomie ouverte ?* D'un côté, la littérature théorique et empirique sur ce sujet ne donne pas une réponse unanime. D'un autre côté, quelques faits montrent que les pays accumulateurs ne sont pas seulement ceux qui ont des régimes fixes ou intermédiaires, et que de nombreux gros accumulateurs ont suivi des flottements pendant longtemps. Le traitement empirique des données d'un échantillon de 117 économies avancées et en développement sur une période de 40 ans (1977-2016) suggère que l'adoption de régimes de change particuliers n'influe pas sur les variations et l'accumulation des réserves et que les pays accumulent des réserves même s'ils flottent leurs taux de change.

Mots clés : Macroéconomie ouverte ; Réserves internationales ; Accumulation ; Régimes de change ; Ancrages ; Flottements ; Système monétaire et financier international.

مراكَمة الإحتياطيات الدولية و أنظمة سعر الصرف

ملخص

تتناول الأطروحة موضوعًا في مجال الاقتصاد الكلي النقدي والمالي المفتوح، وتركز على مسألة أثارت اهتمام الأدبيات الاقتصادية، ألا وهي ما إذا كانت أنظمة الصرف المتبعة من طرف الدول تؤثر في تراكم احتياطياتها الدولية. نحاول الإجابة على السؤال التالي: هل مِن غير الممكن مراكمة الاحتياطيات الدولية إلا تحت أنظمة ربط للعملة (أي الأنظمة الثابتة و الوسيطة) كما نصت عليه كتب الاقتصاد الكلي المفتوح ؟ من ناحية ، لا تعطي البحوث النظرية و التطبيقية إجابة مُجمعٌ عليها حول هذا الموضوع، و من ناحية أخرى، تشير بعض الوقائع إلى أن الدول المراكِمة للاحتياطيات ليست فقط دُوَلاً تتبع أنظمة ثابتة أو وسيطة، وأن بعض أكبر الدول المراكِمة للإحتياطيات تتبع أنظمة صرف معوم منذ مدة طويلة. تشير معالجة البيانات المتعلقة بعينة من 117 إقتصادا متقدما ونامیا على مدار 40 عامًا (1977–2016) إلى أن أنظمة الصرف المعتمدة لا تؤثر على تغيرات و مراكَمة الاحتياطيات وأن الدول قد تراكم احتياطيات على الرغم من إتباع نظام صرف معوم.

كلمات مفتاحية : الاقتصاد الكلي المفتوح ؛ إحتياطيات دولية ؛ مراكمة ؛ أنظمة سعر الصرف ؛ أنظمة ربط العملة ؛ أنظمة تعويم ؛ النظام النقدي والمالي الدولي.