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# The third currency war as an effect of post-crisis changes in the international currency system. The risk aspect – the case analyses of Brazil

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## Abstract

**Aim/purpose** – The objectives of the paper include: identification of factors that influence the directions of fluctuations of foreign exchange rates seen as manifestations of *currency wars*; description of the most important forms of *currency wars* conducted in the contemporary global economy (including in particular the currently observed third *currency war*); analysis of risks to contemporary financial markets and national economies posed by the third *currency war*.

**Design/methodology/approach** – The paper uses the method of critical analysis of the literature on the subject, as well as US-China and Brazil case analyses. The Propensity Score Matching method was used in the study.

**Findings** – The research findings confirmed the following hypotheses: contemporary fluctuations of foreign exchange rates in the largest economies of the world confirm that the third *currency war* is ongoing; the risk of consequences of the *currency war* destabilises the international and local financial markets and trade transactions among them.

**Research implications/limitations** – The limited scope of the research performed is due to the fact that emerging economies have no control of devaluation or revaluation processes in their respective countries. However, large economies, such as China or Japan, are able to create the value of their respective currencies, thus artificially controlling the competitiveness of their products and services. These differences between small and large economies limit and distort the scope of the research done.

**Originality/value/contribution** – Identification, analysis and results of the risks to contemporary financial markets and national economies posed by the third *currency war*.

**Keywords:** foreign exchange rate, currency war, risk, financial crisis, easing.
**JEL Classification:** E52, E58, F41, G3, G10.

## 1. Introduction

The contemporary global economy, including the established economic relationships, has offered a large scene for competition. The FX market has been included in the contemporary international competition, as manifested in sovereigns' control of devaluation of their respective currencies, which certain academics deem the trigger of *currency wars*. Numerous economists even suggest that we are now witnessing a *global currency war*. The literature provides arguments both for and against this statement (Angeloni et. al., 2011, pp. 4-8; Bergsten, 2013; Gagnon, 2013; Łasak, 2013; Włodarczyk, 2014, pp. 301-302). The concept has been more and more often appearing in academic papers because the phenomenon is not clearly defined, and new mechanisms and actions keep emerging. At the beginning of 2013, the notion of *currency war* was used repeatedly around the world (The Economist, 2010, 2012, 2013; Moura, Pereira, & Attuy 2013; Wolf, 2010). Academics, market practitioners, politicians and the media were debating the spillover effects of expansionary monetary policies, adopted since the Great Recession.

Other important issues concern determinants of disturbances in the contemporary FX markets and the question whether those disturbances result from a process of globally coordinated counteracting to economic crises by means of a mild monetary policy, or from attempts at gaining commercial advantages of cheaper money on international FX markets. Although the amount of this literature is still very limited, a growing body of recent studies has indicated that these interventions tend to be more effective than those of developed countries (Adler & Tovar, 2011, pp. 8-9; Berganza & Broto, 2012; Egert, 2007; Kamil, 2008, pp. 9-12; Tapia, Tokman, Landerretche, & Rigob, 2004).

The global nature of the phenomenon is confirmed by the fact that it is not only sovereign currency issuers and their central banks that participate in the contemporary *currency wars*. There are other participants, too, including multilateral global institutions, such as the International Monetary Fund, the World Bank, the Bank for International Settlements and the United Nations, as well as private entities such as hedging funds, global corporations and the richest individuals. Regardless of whether private institutions act as speculators, risk hedging entities or market manipulators, their effect on the FX fluctuations is as material as that of the sovereign issuers. Therefore, the need to monitor the scale of risk on the financial markets and counteract the creation of bubbles in the markets of tangible and financial assets is emphasised more and more often (Adler & Tovar, 2011; Chen, Watanabe, & Yabu, 2012; Fatum & Hutchison, 2010; Iwata & Wu, 2012).

The basic objective of the paper is to analyse consequences of the currency wars that have taken place to date, with a special focus on the risk posed by the third *currency war* to the global economy in the wake of the 2007 global crisis. The Propensity Score Matching method has been used in the study.

The paper is divided into five sections. After this first one (*Introduction*), the second section contains a review of literature on *currency wars*, including a review of to-date developments and implications of the third *currency war*. The third one presents the research methodology used, while the fourth section is devoted to the research findings and discussion thereof. The paper ends with final conclusions.

## 2. Literature review

### 2.1. The gist of the currency war

*The currency war* is not a new phenomenon in the global economy. The term has been appearing for some time in academic debates (Angeloni et. al., 2011; Bergsten, 2013; Łasak, 2013; Włodarczyk, 2014, pp. 301-302). The literature suggests various approaches to the definition of this phenomenon on the background of the current global economy. The *currency war* is a situation when a state deliberately depreciates its currency thus becoming more competitive, while its trade partner, quite naturally, becomes less competitive. Should this refer to two states only, it would be easier to determine which of the states, to what extent and by how much (excessively) depreciated its currency. However, in the contemporary global economy it is hardly possible to define appropriate equilibrium exchange rates.

The review of the literature should be preceded by an analysis of currency war progress from the economic perspective.

The simplest approach defines the *currency war* as steps taken up by central banks or certain governments aimed at pursuing their national interests through activities on the currency market. Some describe the *currency war* as steps taken by monetary authorities or government of one country aimed at depreciating (devaluing) the national currency in response to similar actions of another country, an important trade partner. The term may also be understood as passing the costs of getting out of the recession on other market players through currency depreciation (devaluation) designed to enhance the state's competitiveness. Still other authors treat the *currency war* as the aftermath of global coordination of liquidity.

In an attempt to improve the competitiveness of their local goods and services, states often consciously devalue or depreciate their own currency, most often through the issuance of additional money. Devaluation refers to an economy where fixed exchange rates apply; currency is devalued when its value decreases against other currencies. This is currently the case of China or Belarus. Depreciation refers to an economy where fluctuating exchange rates apply; currency is depreciated when, again, its value decreases against other currencies. Fluctuating exchange rates are used in most contemporary states. While devaluation is always a result of a knowledgeable decision of the central bank or another monetary authority, depreciation may result from various factors, even without governments' or central banks' interference in foreign exchange rates. However, governments and central banks sometimes intentionally try to lower the value of their local currencies.

Following depreciation/devaluation, the import of goods and services proves relatively more expensive than before. In the same time, exported goods and services are after depreciation/devaluation relatively cheaper than before. In fact, some states based their economic development strategy on intentionally keeping their own currencies undervalued against other currencies for a long time. This in particular refers to states which hope to achieve economic growth owing to high exports. The majority of East-Asian economies, including the largest ones, like China or Japan, follow such economic policy. For many, many years the Middle Kingdom has been accused by Washington or Brussels, or even other developing countries (e.g., Brazil) of unfairly and deliberately maintaining yuan exchange rate below the equilibrium level, that is the level that would be reached by yuan if it was controlled by natural market forces only.

In certain periods, interference with exchange rates became stronger. Economists identified two such periods in the 20th century when numerous states all over the world were for a number of years deliberately keeping their currencies undervalued to such extent that those periods were called *currency wars*. It should be mentioned that economists define various start and end dates of those two global *currency wars*. The first of such broadly meant *currency war*, the period of intense intentional weakening of national currencies would be the years 1921-1936. An expansionary monetary policy applied by individual countries was crucial for that period. The immediate reason for using the term 'currency war' is a series of devaluations of currencies by countries that at that time played a leading role in the global economy. First, it was France, which devalued the French franc in 1925. Switzerland, the Netherlands, and Belgium followed the same pattern. In response to emerging problems, the United Kingdom devalued the pound in 1931, while the United States devalued the US dollar in

1933.The second global *currency war* took place in 1967-1987. The war began with the problems of the British pound and the devaluation of this currency under the Bretton Woods System, as well as public attacks on the US dollar. The following facts follow: the creation of SDR (a new international unit of account), the suspension of the exchangeability of the US dollar for gold and the end of the Bretton Woods System, as well as the transition to a floating exchange rate system (Łasak, 2013). Thus, we can see that *currency wars* may be very long and the history shows that they are noting exceptional. Unfortunately, the history also shows that like every other war, a *currency war* may play quite a havoc. During the first global *currency war*, one country after another tried to weaken its currency to its own benefit and detriment of the others. Economists even coined a special term for this process, calling it 'beggar-thy-neighbour policy'. It, however, proved that in the long run this policy had not helped anybody but only created confusion and chaos in the global economy.

During the first and second *currency wars*, numerous interventions in the currency market were recorded (Table 1). This is a clear evidence that the both wars actually took place in the periods indicated.

**Table 1.** Main currency interventions in the context of the first and second *currency wars*

| Country | Currency interventions | Country | Currency interventions |
|---|---|---|---|
| First *currency war* (1921-1936) | | Second *currency war* (1967-1987) | |
| Argentina | November 1929 | Argentina | January 1969 |
| Australia | March 1930<br>March 1936 | Australia | May 1970 |
| Brazil | December 1929 | Brazil | September 1980<br>June 1984 |
| British India | September 1931<br>February 1934 | India | July 1985 |
| Canada | September 1931<br>July 1935 | Canada | February 1973 |
| Chile | June 1932<br>December 1934 | Chile | December 1983 |
| China | September 1929<br>November 1935 | China | March 1982<br>July 1985, 1986 |
| France | September 1936 | France | November 1975 |
| Germany | July 1931 | Germany | August 1980 |
| Hong Kong | October 1929 | Hong Kong | April 1970 |
| Japan | December 1931<br>August 1936 | Japan | February 1979 |
| Mexico | July 1931<br>April 1935 | Mexico | March 1982 |
| The Soviet Union | November 1935<br>March 1936<br>October 1936 | The Soviet Union | November 1985 |
| Switzerland | September 1936 | Switzerland | October 1987 |
| The United Kingdom | September 1931 | The United Kingdom | July 1985 |
| The United States | April 1933 | The United States | July 1986 |

Source: Adapted from *Annuaire Statistique de la Societe des Nations* (1942/1944, 1990, pp. 234-239).

In September 2010, Guido Mantega, then Brazil's Minister of Finance, was first to publicly use the notion of *currency war* after the 2007-2008 crisis. It was his reaction to 'quantitative easing' in the United States (Menkes & Znojek, 2011). Mantega criticised the Federal Reserve's unconventional monetary policy applied to counteract deflation and stimulate economy in crisis (Eichengreen, 2013, p. 234). The notion has often been used since then. The mechanisms referred to by Mantega are so material that they were widely discussed during the G-20 Summit held in Moscow in February 2013.

Korinek observes that when the national regulators may optimally control the externalities they have generated, coordination is not advisable (Korinek, 2012, p. 112). However, as pointed out by Bengui (2011, p. 234), in the multinational structure of banking regulations, certain importance of coordination among national regulators may be expected. He also argues that liquidity on the global interbank market is a global public good. If such global externalities exist, reasons may exist for global coordination of liquidity (Korinek, 2012, p. 112). In turn, Persson & Tabellini (1995, p. 67) show that coordination of national fiscal and monetary policies is necessary if countries wish to apply these policies to combat monopolistic forces active in setting international prices (Elsake, 2009, p. 99; Genberg, 2009, pp. 221-229; Włodarczyk, 2014, pp. 301-302).

In many cases, *currency war* operations included not the depreciation of the national currency, but suppression of its appreciation. In general, the currency of a country characterised by growing productivity should appreciate, reflecting decreasing production costs on export markets. This enables the country to import goods at lower costs. China is an example of a country that has suppressed economically reasonable appreciation of its own currency (Darvas & Pisani-Ferry, 2010, p. 45; Portes, 2012; Gagnon, 2013, p. 89).

Since the beginning of the 21st century, numerous instances have been observed on the currency markets of phenomena which to a lesser or larger extent are symptoms of a *currency war*. Activities of the People's Bank of China are a perfect example, because the bank has for several years been maintaining a fixed CNY/USD exchange rate, underestimating its own currency by up to 50%.

Based on the above data, two groups may be defined of countries intervening in order to counteract excessive appreciation. The first one consists of developed countries, whose currencies play the role of 'safe havens' in uncertain times; the other includes developing economies that experience inflow of capital in the times of global excessive liquidity of the financial system. In the group of industrialised countries, protection against excessive appreciation took form of a direct intervention in Switzerland, whose economy was the first in Europe to cope with deflation in the beginning of 2009. The measures undertaken since

March 2009 to weaken the Swiss franc were also driven by its strong appreciation starting from the occurrence of the first crisis symptoms in the second half of 2007. Due to a high liquidity of the market and the tradition of Switzerland's political neutrality, the Swiss franc is considered a *safe haven* currency, that is currency relied on heavily in periods of higher risk aversion. Another example of protection against appreciation pressure is also the intervention of the Bank of Japan in September 2010, aimed at weakening yen against the US dollar.

**Table 2.** Contemporary currency war – conflict, mechanism, form

| Contemporary currency war | Feature | Form |
|---|---|---|
| Currency war | Area of politics | 1. Blocked agreement on changes in functioning of the international currency system.<br>2. Delegitimisation of policy of countries aiming at currency and exchange rate stabilisation |
| | Area of economy | 1. Long-term zero interest-rate policy.<br>2. Suspension of currency exchangeability |
| | | 1. Systemically overestimated exchange rate.<br>2. Systemically underestimated exchange rate.<br>3. High devaluation or fast and high depreciation of currency |

Source: Adapted from Dunin-Wąsowicz (2012).

Nowadays the notion of *currency war* should be understood slightly more broadly than in the past – as a combination of a political and economic conflicts (Table 2). The notion covers every intervention in foreign exchange rates by governmental institutions of any country, aimed at deliberate and active weakening of the home currency. An example is a long-term zero interest-rate policy that leads to weakening the currency of a country concerned.

Among numerous factors driving the emergence of *currency wars*, Brahmbhatt identifies the results of the 2007-2009 financial crisis (Brahmbhatt, Canutto, & Ghosh,, 2010, pp. 1-5). This statement is in a way developed in a book on the subject, written by Rickards, an American lawyer and economist (2012, pp. 97-113). He believes that the third *currency war* started in 2010 and it will be developing in the following years. Moreover, in Rickards's opinion, *currency wars* have a global reach and are fought in all important financial centres of the world simultaneously, on a 24 × 7 basis.

To sum up the above discussion, we may divide contemporary currency interventions into 'just wars' designed to protect the domestic market and maintain

the economic stability; and 'unjust wars', where a country attempts to improve its competitiveness by means of foreign exchange dumping at the expense of its trade partners.

## 2.2. Theoretical aspects of the course of *the third currency war*

The third *currency war* is believed to have commenced in 2008. The first actions in the new war were performed by the Fed, that is the US central bank, and consisted in the implementation of the first round of what is known as quantitative easing (QE1), which meant that the central bank purchased securities from banks or the government for newly issued money, fresh 'out of print'. In the contemporary global economy, money predominantly takes an electronic form (i.e., the form of records on accounts), while banknotes and coins account for only a small proportion of money in circulation. Thus, while from the professional perspective we should not speak about issuance of new money, it is still commonly referred to as money 'printing'. Economists themselves often use this expression to emphasise its adverse long-term consequences (Eichengreen, & Irwin, 2009).

The first round of US dollar printing (QE1) took place from November 2008 to March 2009. During QE1, the US central bank issued 1,750bn new US dollars, including USD 300bn expensed to repurchase US treasuries, that is Treasury bills and bonds issued by the US government. During the second round of quantitative easing (QE2), from November 2010 to June 2011, the Fed issued USD 900bn. It should be emphasised that all US dollars issued under QE2 were used to repurchase US treasuries. On September 13th 2012, the Fed announced a new round of quantitative easing, QE3. Contrary to QE1 and QE2, for QE3, the Fed did not announce the final date of issuance of new money, thus implying that this round of US dollar 'printing' may be longer than the previous two. Under QE3, 40 billion of new US dollars is to be issued a month. The Fed intends to use the money to purchase mortgage-backed securities (MBS) from banks. In mid-December 2016, the Fed again announced additional US dollar 'printing'. The economic press called this move of the US central bank QE4 or QE3X (expanded). The Fed announced that within QE4/QE3X it would issue additional USD 45bn a month to spend it on repurchasing US treasuries (Furgacz, 2013, pp. 83-110; Narodowy Bank Polski [NBP], 2010, p. 7; Tchorek, Gromiec, Kuziemska, & Nawrot, 2011, pp. 28-29; Woźniak, 2013, p. 12).

It should be emphasised here that with every new round of the Fed's quantitative easing, the 'new dollars' have been to a growing extent allocated to repur-

chase US treasuries. This leads numerous economists to believe that the objective of such policy is not only to enliven the US economy (as officially declared) and depreciate the US dollar, but also (if not mainly) to monetise the US sovereign debt. In the historical perspective, states have solved the problem of excessive debts in three different ways: getting rid of creditors (their banishment, elimination or conquering), declaration of partial or full bankruptcy, or debt monetisation, that is deliberate weakening of the money issued, so that the real purchasing power of the currency at the time of debt repayment is smaller than at the time when the same debt was incurred. Obviously, monetisation of debt is adverse to creditors, while favourable to debtors.

Long time ago, when money was silver or golden coins, monetisation of debt was achieved through minting new worse coins with the same face value but a smaller content of precious metals. Now monetisation of debt has the form of issuing new paper money.

Nowadays numerous states struggle with high debt of the public sector. It is the case of not only South-European countries, but also Ireland, the United Kingdom and global players: the US, Japan, and China.

At the time of economic downturn and serious problems with servicing their own sovereign debts, countries have already two very strong incentives to issue new money and weaken their own currencies. While the American central bank trails this path, it is not the only central bank to do so. Numerous major economies have been following the pattern since 2008. Increased issuance of new money was performed by the Bank of England, the Bank of Japan, the European Central Bank and the Swiss National Bank. Measures taken by the People's Bank of China serve a perfect example here because for several years now the bank has been maintaining a fixed CHY/USD exchange rate, underestimating its own currency by up to 50%. Similarly, the American Fed has since 2007 been following the quantitative easing policy (until September 2012: USD 2.1 trillion issued, then USD 85bn a month, and since June 2014: USD 35bn a month). Also the Bank of England had repurchased bonds worth GBP 375bn by autumn 2012. The Bank of Japan has been implementing similar measures since April 2013; it implements the programme of infusing JPY 70 trillion into the economy. The fundamental objective is here to double money supply in the economy over two years. Also in the Eurozone, by December 2011 the ECB had granted to commercial banks low-cost credit facilities totalling EUR 500bn and since February 2012 – another EUR 400bn. In September 2011, the Swiss National Bank decided to launch a programme of unlimited purchase of foreign currencies at the maximum EUR/CHF exchange rate of 1.2, with the EUR/CHF market rate of 1.1 (Bussiere, Pérez-Barreiro, Straub, & Taglioni, 2010).

Although numerous most important economies follow a similar policy in this respect, they seem to have various reasons to do so. In the US, the most important reason for following the ultra-easy monetary policy is perhaps an attempt to monetise debt and depreciate the US dollar, in the hope of reducing the persistently high US trade deficit. The Bank of Japan seems to have the same reasons, but with the utmost objective being assistance to Japanese exporters (which has always been the priority in Japan), followed by monetisation of the sovereign debt. Monetisation of the debt would mainly affect Japanese entities that hold 95% of outstanding Japanese treasuries. The Americans are more keen on monetising their sovereign debt because approximately a half of the US State Treasury's debt is held by foreign creditors (mainly from the Far and Middle East). The Bank of England and the European Central Bank are not so interested in depreciating the pound sterling and euro, respectively, but rather in helping the banks which they supervise and whose financial standing is poor.

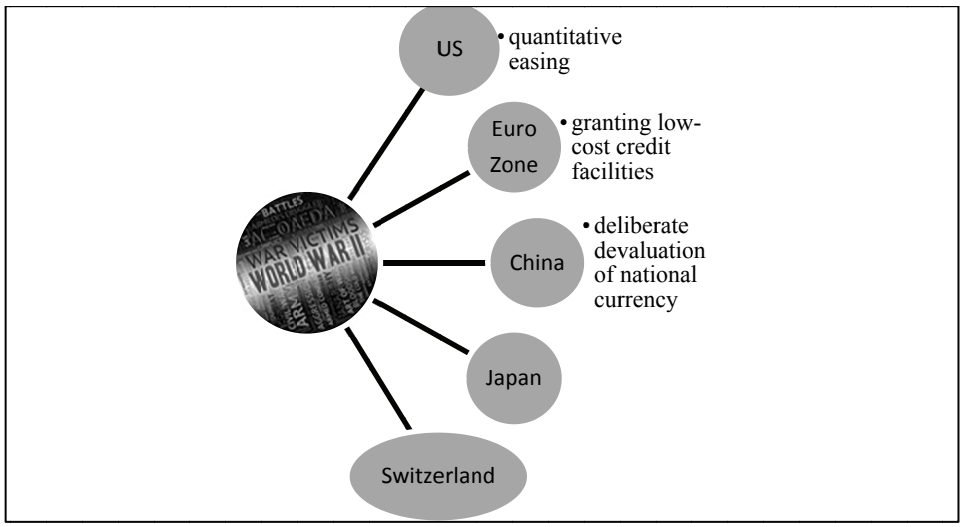
Still other reasons drive the central banks in Switzerland, Norway and Australia. The Swiss franc, Norwegian crown and Australian dollar are considered safe havens: assets whose value grows, or at least does not fall, in periods of various financial, economic or political turbulence.

It is not surprising, then, that since the outbreak of the crisis, when widespread risk aversion was observed among investors and speculators, these currencies have strengthened significantly.

At certain time the appreciation was so significant, that it became a material disadvantage to the Swiss, Norwegian and Australian companies' competitive position on global and domestic markets. The central banks in Switzerland, Norway and Australia decided to 'print' more francs, crowns and dollars, to reduce the appreciation pressure on their currencies.

Currently, the three super-currencies, that is the US dollar, euro and yuan, play dominating and leading role in the third currency war. These currencies are issued by the largest global economic powers: the United States, the European Union and the People's Republic of China. In today's global economy, governments and central banks use various mechanisms that determine the essence of currency wars. Among them, attention should be paid to the deliberate depreciation of the domestic currency, the application of a soft monetary policy, the central bank's granting preferential loans to commercial banks, the deliberate reduction of official interest rates by central banks, and the intervention of central banks in the form of printing additional domestic money (Figure 1).

**Figure 1.** The currency war mechanisms in selected countries




Source: Author's analysis.

This is furthered by the combined gross domestic product of the United States, the European Union and China, which accounts for 65% of the global GDP and is a kind of a centre of gravity, orbited by all other economies and currencies. Thus, the most important areas of the current currency war are: the Pacific basic, where the US dollar and yuan clash with each other; the Atlantic basic, where the US dollar and euro fight each other, and the huge Euro-Asian continent, the battleground for competition between the euro and yuan.

In the Pacific, Atlantic and Euro-Asian areas, the third *currency war* was preceded by major developments in Brazil's, Russia's, Middle East and Asian countries' fiscal policies. Still, it is not the future of the real or rouble that is at stake in this war, but the relative value of the euro, US dollar and yuan, which will affect the future of both their issuers and the issuers' trade partners.

The frictions between China and the United States, and more precisely, between the yuan and US dollar, are the hottest issue in the global finance society and the main trouble spot in the third *currency war*. Tension has been growing gradually since China emerged from its quarter-century economic isolation, accompanied by social chaos and dogmatic blockade of the free market by the communist regime.

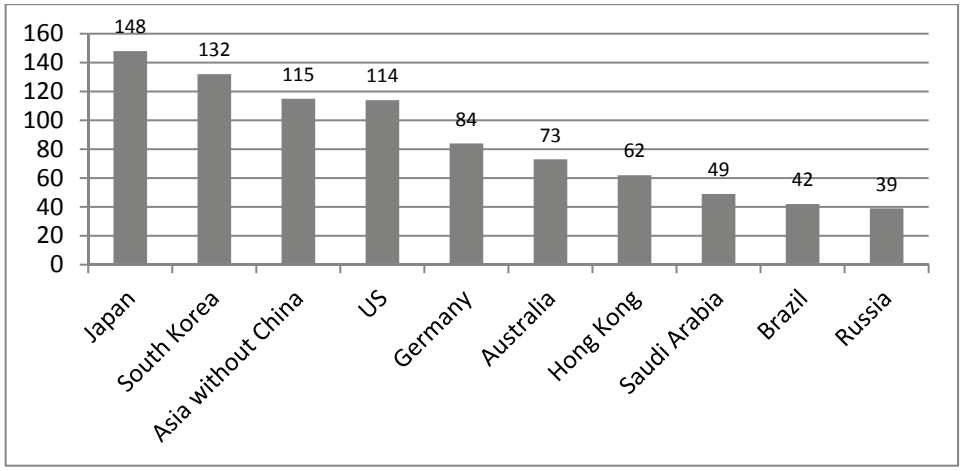
In the Pacific area, among the causes of the third *currency war*, there is the accusation that China has been underestimating its currency. China exports its internal deflation to the United State by controlling the yuan exchange rate, which poses a risk of falling prices in the US. The problem stems from the Chi-

nese fixed CNY/USD rate policy. Unlike USD, EUR, GBP, JPY and many other convertible currencies, the Chinese currency is not freely traded on international currency markets. Its use and availability for transaction settlement is closely supervised by the People's Bank of China (PBOC), which plays the role of the central bank. The process of absorption of all USD surpluses inflowing to the Chinese economy, in particular after 2007, has had a few unintended side effects. The largest problem was that the PBOC did not accept ordinary USD deposits, but bought up surpluses of the US currency paying for them with newly printed yuans. In other words, when the Fed was printing dollars and American importers were buying Chinese goods for such dollars, the PBOC had to print yuans to absorb surpluses. Thus China shifted the burden of conducting monetary policy onto the US central bank: the more money the Fed printed, the more money the PBOC had to print in order to maintain a fixed CNY/USD exchange rate.

China's another problem was what to do with the US dollars it already had. The People's Bank of China had to invest its reserves somewhere and earn satisfactory profit. The surplus from trade with the US was growing and China gathered a huge volume of American treasury bonds. In 2016, Reuters estimated the Chinese reserves denominated in various foreign currencies at USD 3.85 trillion, including USD 950bn invested in American treasury bonds. It practically means that the US and China sit on a 'monetary powder keg' that may go off any time. Therefore, the US desperately insisted that China should appreciate the yuan and thus help to reduce both the US's growing trade deficit and the rate of accumulating US dollar assets by the PBOC.

The US's interventions proved to little avail, though. For this reason the US's gravest and most frequently voiced accusation against China is that it manipulates its currency in order to maintain low prices foreign purchasers pay for Chinese products. The entire situation poses a threat to countries whose foreign trade balance rests heavily on natural resources (Russia Australia, Chile, the Republic of South Africa and Canada): a decrease in Chinese demand may bring about further reductions of crude oil, copper and silver prices. The weakening of the yuan may have a negative impact not only on the countries exporting raw materials, but above all on Japan, South Korea, the US and Germany. This in turn may drive the authorities of these countries to weaken their home currencies, which in the case of the US dollar and the euro may prove ineffective. In the event of a 'hard landing' in China, the economies of Germany, Japan and Korea are likely to enter recession (Figure 2).

**Figure 2.** Ten most important countries of origin for Chinese imports in 2016 (billion USD)




Source: Adapted from the Macro Connection Group (2016).

The progress of the third *currency war* in the Atlantic area should perhaps be seen as interrelations between the US dollar and euro rather than their confrontation. It stems from a scale and scope of mutual connections between the US and European capital markets and banking systems, significantly larger than in case of analogous financial relationships between other parts of the world. Such connections have never been more manifest than after 2008. The US is fully involved in the *currency war* on the Atlantic front, but does not fight to strengthen the European currency too much, but to ensure that the euro and US dollar do not part completely. Daily fluctuations of the both currencies result from technical factors, short-term relationship of supply and demand, fear of insolvency or disintegration of the Eurozone, and relaxation after completed rescue operations and capital infusion into near-bankrupt banks. The euro and US dollar go together through such disturbances and they do not part more than necessary.

In 2010 the system of government finance in Europe had a form of an intricate network of cross debts. Greece owed USD 236bn to its creditors, including USD 15bn to UK entities, USD 75bn to French ones and USD 45bn to German creditors. Ireland's debt amounted to USD 867bn, including USD 60bn due to French creditors, USD 188bn to UK ones and USD 184bn to German entities. Spain's debt totalled USD 1.1 trillion, including USD 114bn owed to UK creditors, USD 220bn to French ones and USD 283bn to German entities. Italy, Portugal and other extremely indebted countries in the Eurozone followed the pattern. Italy then recorded the highest debt to a single country: it owed USD 511bn to French creditors. In the very centre of the huge debt crisis, Europe was not left

alone. Both the United States and China helped to rescue European banks and while they did it for different reasons, they both were protecting their own interests (Gregory, Henn, McDonald, & Saito, 2010; Rickards, 2012, pp. 97-113).

Europe is a very large market for American goods. A strong euro drives up the European demand for goods produced in the US. A collapse of the euro would clearly mean a breakdown in the trade between these two global economic giants. US subsidies, swap lines and rescue programmes for such institutions as for instance Fannie Mae, were a part of a multi-aspect long-term programme of euro strengthening.

China, too, was interested in strengthening the euro, but for political reasons. The European debt crisis was for China a good opportunity to diversify reserves and investment portfolios, and partially replace the US dollar with the euro, as well as to purchase numerous state-of-the-art systems which the US would not sell to it and to develop platforms supporting a large-scale technology transfers to China.

In the Euro-Asian area, the relationship between the euro and yuan is a mere dependence, but not confrontation. China is becoming a potential 'saviour' of several European countries, such as Greece, Portugal or Spain because it is willing to partially redeem their sovereign bonds. The European Union is as a whole a larger trade partner for China than the United States. With its involvement in Europe, China wishes to diversify its reserves and ensure that they include more euro-denominated assets, as well as win respect and acceptance of European countries which it assists by buying their bonds. In such circumstances, China can lose nothing, while achieving security on the European front during an open confrontation with the United States (Rickards, 2012, pp. 97-113).

Below is a short description of a series of recent events evidencing the existence of the third currency war manifest in the fluctuations in exchange rates on the US and Chinese currency markets on January 4th and 5th 2017.

*Washington D.C., the evening of January 4th 2017*

The publication of reports on the Fed's meetings shows to the world that the US is willing to raise interest rates even faster than ever if Donald Trump's policy is to increase its budget deficit (and all assume that this will be the case).

*Beijing, the morning of January 5th 2017*

The Chinese central bank authorities assume that investors will, having read the Fed report, conclude that price of the US dollar will grow faster because the related interest rates will increase faster. This means that the yuan will faster depreciate against the dollar, which will in turn render debt service by all indebted Chinese companies more difficult. The Chinese central bank decides to stop the depreciation of the yuan. To this end, it cancels the weekly transaction of

extending CNY credit facilities to banks. Banks have to repay the facilities contracted a week earlier and may not contract new ones. As a result, CNY 140bn disappear from the Chinese banking market. Since the beginning of the week, this loss has amounted to CNY 435bn or over USD 60bn.

*Hong Kong, the morning of January 5th 2017*

In that financial market offering the best access to yuan to foreign capital (better than in Shanghai), market players are preparing to again make the same profitable transaction: borrow the yuan from Chinese banks, sell them by exchanging into US dollars, wait for the yuan to lose value, then buy back the yuan for the dollars at a much better rate, and then give back the borrowed yuan to the banks, keeping the spread. Profit is measurable and risk is moderate because the downward trend in the yuan value is clear. This time, however, it turns out that there is no one from whom to borrow yuan. Chinese banks that own the yuan offer the currency at a high price. The interest rate on the one-day loan is already over 30 percent per annum. Such a cost of credit contradicts the sense of the whole transaction, which thus ceases to pay off. If nobody sells the yuan, its price stops falling. All those who have previously borrowed the yuan, sold it and have been waiting for a better price for repurchase now panic because instead of earning money they start to suffer losses. They decide to withdraw from the transaction and return the yuan borrowed. So they want to buy the yuan at any price in order to return the borrowed money. Their demand is driving up the Chinese currency, with its exchange rate against the US dollar hitting its historic high. There is a clear panic on the market. Now that you can make money by buying the yuan, suddenly everyone on the market wants to buy it. As a result, market interest rates on one-day loans increase up to 96 percent. The Chinese central bank in Beijing jubilates. It has shown that speculation in the yuan is not a one-sided play and that it involves a much higher risk than it had seemed to. In the meantime dollar is becoming more and more expensive all the time. For the first time since 2009, its interest rate on the interbank markets has gone up to one percent and may continue to grow.

*Post Scriptum: Mexico City, the afternoon of January 5th 2017*

The situation as a whole disturbs most the governments of countries, bankers and businesses with USD denominated debt in Brazil, Chile, Mexico and Turkey. These are the countries and foreign exchange market players recording the highest increase in the USD-denominated debt to GDP ratio over recent years. As a result, the Central Bank of Mexico is forced to intervene in the currency market in defence of the Mexican peso.

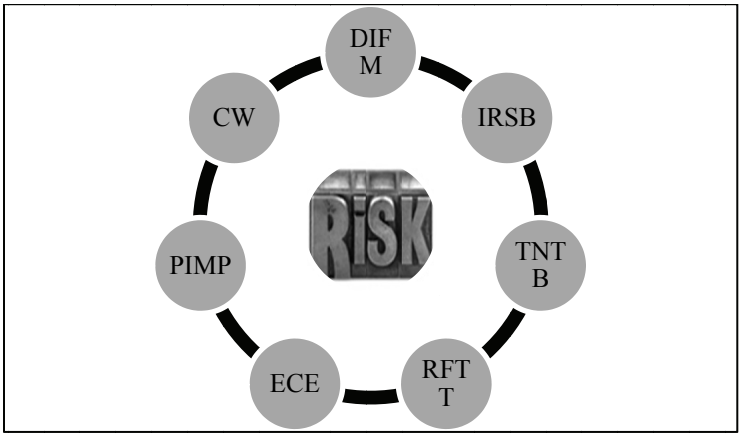
## 2.3. Analysis of the risks posed by results of the third *currency war* to contemporary financial markets and national economies

Nowadays, an important part of the scholarly discussion is devoted to assessment of consequences of the risk resulting from *currency wars* to individual countries and the entire global economy. The development of the *currency wars* poses a particular threat to the emerging markets. It is due to the fact that when the quantitative easing measures started, the emerging markets faced the problem of overvalued national currencies, while now, at the time of weakening dynamics of quantitative easing, they have to cope with a sudden depreciation of those currencies. The *currency war* mechanism brings about the risk of lost benefits to the emerging markets, both in the period of implementing tools of the currency war (inflow of speculative capital, strong appreciation and temporary loss of competitiveness) and during the withdrawal thereof (outflow of speculative capital, strong depreciation of currencies and decreased prices of assets).

Should the currency wars continue, emerging markets (e.g., Brazil or India) could retaliate with import duties, which they have already threatened to impose.

The literature points out to numerous negative risk-related effects, including increased fluctuations of asset prices with resulting enhanced instability on international financial markets; increased risk of speculative bubbles on various asset markets; stronger monetary and credit expansion and resulting risk of occurrence of monetary impulses; stagnation of foreign trade for fear of growing risk of introducing numerous restrictions on trade, e.g. custom duties (Figure 3).

**Figure 3.** Currency war mechanism – the risk aspect

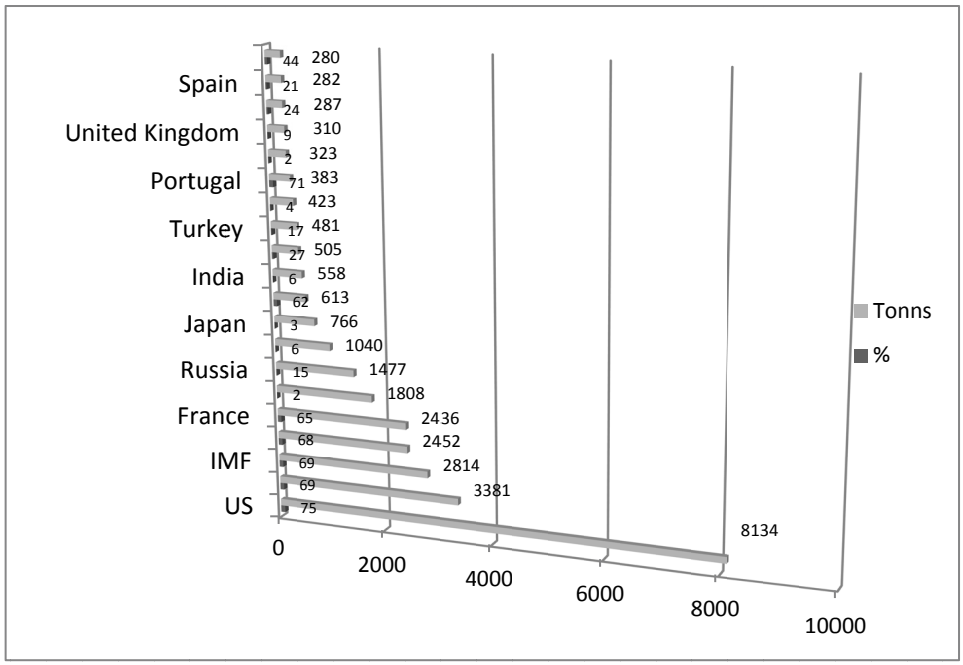



Legend: DIFM – destabilisation of international financial markets; IRSB – increased risks of speculative bubbles; TNTB – retaliation with tariff and non-tariff barriers; RFTT – reduction in foreign trade turnover; ECE – excessive credit expansion; PIMP – pro-inflation monetary policy; CW – costs of withdrawal of the tools.

Source: The author's analysis.

The inequalities revealed during the ongoing third *currency war* in the form of the US deficit in trading with China and accumulation of the US public debt in China pose a material risk and threat to further evolution of the Bretton Woods system (the largest gold resources in the world are illustrated in Figure 4) It would surely be a shock to the US economy. For now, it generates a major problem and risk: the possibility of real-time settlements and amount of the US trade deficit render the Americans unaware of the scale of deterioration of the US finance.

**Figure 4.** Percent shares of gold in the value of reserves and stocks of gold in tonnes around the world




Source: Adapted from the World Gold Council (2016).

The risk of escalation of the third *currency war* was visible on the raw material markets. After the devaluation of the yuan, the prices of copper and crude oil fell to their six-years' lows. A negative response was also observed on European stock exchange markets, where the German DAX and French CAC40 indices lost more than 3% each. Investors were selling stocks of European exporters, for which China has recently become the most important and fastest growing market.

The risks and implications related to the third *currency war* threaten countries with large resources of raw materials (Russia, Australia, Chile, the Republic

of South Africa or Canada): reduction of demand from China poses a threat of even a larger reduction of prices of crude oil, copper and silver. In 2016 China spent over USD 3.2 trillion on imported goods. In terms of value, larger imports were only recorded by the European Union (USD 3.3 trillion) and the US (USD 3.4 trillion) (Subacchi, 2016, p. 8).

The policy of increased money issue followed by countries for internal purposes lead to global tensions. The *currency wars* do not differ much from trade wars. If the current policies are continued, the threats posed by the former will be the same as posed by the latter. As the crisis of 2007 proved, government interventions resulting in financial parameters staying away of the equilibrium for a long time bring about the creation of speculative bubbles, owing to excessive growth of asset prices, artificially inflated consumption and artificially maintained export profitability.

The deeper are governments' and central banks' interventions in basic economic parameters, the larger is the risk of the next crisis. Therefore, the current developments give grounds for forecasting a major stock exchange crash within three to six years after the US dollar strengthening started, that is in 2017-2020.

## 3. Research methodology

In addition to the three main fronts of the currency war: the Pacific (US dollar vs. yuan), Atlantic (euro vs. US dollar) and Eurasian (euro vs. yuan) ones, there are several other hot spots around the world where currency skirmishes are taking place. The Brazilian front is now of the greatest importance. The case of Brazil is very important, given its territory, population and economic scale (Table 3). Brazil had maintained its currency fixed to the US dollar until 1994. However, the global turmoil caused by the Mexican peso crisis in December 1994 affected the Brazilian real (BRL) and forced the Brazilian government to defend it. As a result of the Russian and Asian crises, in January 1999 Brazil suffered a massive speculative attack with huge losses of international reserves and decided to abandon the crawling peg regime with horizontal bands, one of the building blocks of the inflation stabilisation was the Real Plan (currently, 'real' is the name of the Brazilian currency) and let the exchange rate be defined by the market forces. In July of the same year, the Central Bank adopted the Inflation Target Regime. In order to preserve the price stability objective, the monetary authority is obligated to sterilise all interventions in the foreign exchange market (rebalancing the monetary base to its starting pre-intervention point). Having the traditional channel only and facing the infeasible trinity (i.e.,

the infeasibility of having a fixed exchange rate, free capital mobility and an independent monetary policy at the same time), the authority had to see to it that no intervention has any effect on the exchange rate.

**Table 3.** Brazilian exchange rate regimes and economic fundamentals – yearly averages

| Indicators | Multiple exchange rates | Pegged exchange rates | Pegged exchange rate with managed devaluation | Crawling peg with horizontal bands | Free floating |
|---|---|---|---|---|---|
| | *1953-1964* | *1965-1968* | *1969-1994* | *1995-1999* | *2000-2011* |
| GDP Growth (%) | 6.76 | 5.30 | 5.33 | 2.59 | 3.36 |
| Inflation (%) | 37.98 | 43.20 | 602.15 | 12.70 | 9.52 |
| Unemployment (%) | n.a. | n.a. | 9.57 | 10.33 | 10.09 |

Source: Adapted from Moura, Pereira, & Attuy (2013).

The Real Plan was developed, which provided for a series of deliberate devaluations of the Brazilian currency against the US dollar. As a result, the value of the real fell by 30% between 1995 and 1997. In the wake of the 1997 crisis, in the following years Brazil fully freed up its currency and allowed free movement of capital. Between 2003 and 2010, Brazil significantly increased its exports of natural resources and modernised its technological and production base. Between 2009 and 2010, the real appreciated against the US currency: the US dollar price dropped from BRL 2.40 to BRL 1.69. The revaluation of the real by 40% over two years had a highly adverse impact on Brazilian exports. As Brazil did not have such reserves or surpluses as China, it could not maintain a stable real exchange rate by purchasing all the US dollars coming into the country. So it got stuck between currency appreciation and inflation.

The recent period of abundant liquidity in financial markets, together with the good perspectives of the Brazilian economy, as well as of numerous emerging economies, might be attributed to a capital inflow that enters the country with the primary objective being not to take advantage of the high interest rates, but to seek returns on longer-term assets. In this context, and since sterilised operations occur through restoring the interest rate level to levels prevailing before the purchases/sales of US currency, sterilised interventions may not be sufficient to avoid nominal and actual appreciation effects on the exchange rate.

The study was carried out on the example of Brazil. The reason for choosing this country was that it was the first to oppose the US policy of quantitative easing in the third *currency war*. This policy brings about the impoverishment of the neighbour countries. In the case analysed, it resulted in large inflows of capital to developing countries, increased inflation and appreciation of their currencies and thus a loss of competitiveness of their economies. Brazil was one of the

victims of that mechanism and the country's situation served an example confirming the operation of the mechanism. As a result of this operation, the Brazilian real appreciated by almost 40% against the US dollar over the two years since the beginning of 2009.

The second effect of the United States' policy was the weakening of the US dollar. The yuan weakened as well. The Chinese currency was in fact linked to the US dollar at fixed peg exchange rate. As a result, the Brazilian currency appreciated against the Chinese yuan. This in turn brought about a loss of competitiveness of Brazilian goods on the Chinese market, while China has been one of Brazil's most important trading partners over recent years. This was another reason for Brazil accusing the US of illicit devaluation of the US dollar.

In the specific case of Brazil, the exchange rate has been an important tool of the country's policy since Brazil became a republic in 1889. Since World War II, the exchange rate of the Brazilian currency has been subject to five different exchange rate regimes (Table 3).

Before the end of the Bretton Woods system (1973), the Brazilian economy went through two exchange regimes. The first one, from 1953 to 1964, suffered discontinuity due to the political environment and the abrupt change in economic conditions. During that period the Brazilian economy had a multiple exchange rate regimes which aimed to boost exports and discourage non-essential imports. In the years that followed, from 1964 to 1968, year after year, the economic growth forecasts had to adjusted. The exchange rate regime prevailing then was a pegged exchange rate with continuous adjustments due to the disparity between the Brazilian and US inflation rates.

After 1968, there have basically been three exchange rate regimes. Just before the end of the Bretton Woods system, the regime changed to a pegged exchange rate with managed devaluations. At first, it followed the strategy of regular and sporadic mini-devaluations on the pretext of handling speculation. In between, there were two maxi-devaluations: the first one, in December 1979 (with a 32.7% month-to-month devaluation), caused by the second oil shock and the second, in February 1983 (with a 38.6% month-to-month devaluation), a result of the debt and balance-of-payments crisis that affected most emerging economies. Before 1994, Brazil saw the end of the dictatorship regime in 1985, and simultaneously struggled to solve the hyperinflation problem, manifest in numerous heterodox economic plans. In the early 1990s, the country faced a trade liberalisation that preceded the plan (known as the Real Plan;) and succeeded in achieving price stability. Since the early 2000s, the Central Bank has been intervening not to control volatility or to choose a level, but to recompose interna-

tional reserves and reduce the government's exposure to the US dollar exchange rate fluctuations with a view to avoiding sudden stop risks.

The main objective of the research reported on herein is to analyse the impact of the Central Bank of Brazil's (CBB's) interventions in the exchange rate market. Due to the broad range of analysis and a lack of sufficient data, the study does not cover a detailed analysis of the effect of currency interventions on international trade and financial markets.

The Propensity Score Matching (PSM) method is used to this end. The purpose of the PSM technique is to create a control group consisting of entities as similar as possible to those included in the experimental group. The PSM approach uses a propensity score – an estimated probability of being a part of the treatment group – thus reducing the multi-dimensional problem to a one--dimensional one.

Tests using the PSM method were run in the following three stages:

1. The first was the calculation of propensity score values which should be estimated. A logistic regression model was used for this purpose, in which the dependent variable is *Yt*. The various independent entities are attributes which are intended to affect, on the one hand, the outcome (*Y*) and, on the other hand, the actual occurrence/non-occurrence (*D*) of currency issue.
2. The second step was to select entities for the control group based on the calculated propensity score. The selection to the control group was carried out using the nearest neighbour method. It is based on matching the most similar entities and the closest propensity scores. The intention is to receive a group control variables that are expected to have a balanced balance of all observable variables used in the probability model. The set of characteristics used to select the control group is similar to that describing the treated group.
3. The third stage was the analysis of effects based on a comparison of the treated group with the control group created.

Denote by *Dt* our binary treatment variable, where $Dt = 1$ if the Central Bank intervened at date $t$ and $Dt = 0$ if it did not. Considering that *Yt* is our variable of interest, it may, for instance, indicate the return or volatility of the exchange rate at time $t$. We can assume this variable to be affected by the treatment variable $Yt(Dt)$. Therefore, assuming that an intervention occurred at time $t$, we would compute the effect of the intervention as (size of the effect per unit):

$$\tau_i = Y_i(1) - Y_i(0),\ i = 1, \ldots, N. \tag{1}$$

Thereafter the 'average treatment effect on the treated' (ATT) is estimated, where ATT is the effect estimated only for those dates on which the treatment occurred (in the case, exchange rate intervention). The ATT is expressed in the

following formula (average stimulus effect for the individuals for whom the intervention was applied):

$$\tau_{ATT} = E[Y(1)|T = 1] - E[Y(0)|T = 0] = E[\tau|T = 1] \quad (2)$$

where $E[Y(1)|T = 1] - E[Y(0)|T = 0]$ is the bias selection (minimising the hypothetical value of the difference).

$$\tau_{ATT} = E[\tau|T = 1] = \tau_{ATT} + E[Y(0)|T = 1] - E[Y(0)|T = 0] \quad (3)$$

If we opt to use $E[Y(0)|D = 0]$ instead of $E[Y(0)|D = 1]$ in equation (2), we would probably incur a self-selection bias. If the Central Bank's decision to intervene were random, then the selection bias, $E[Y(0)|\mathrm{T} = 1] - E[Y(0)|\mathrm{T} = 0]$, would be zero. Variables were selected using *propensity score* $D = 1$, estimated with respect to the vector of variables X:

$$P(\mathrm{X}) = P_r(D = 1) \mid X) \quad (4)$$

where:
$0 < P(D = 1|X) < 0$; $P_rY = 1 \mid X) = F(X, \beta)$, $P_rY = 0 \mid X) = 1 - F(X, \beta)$,
$\beta$ is the vector of parameters that reflects the impact of changes in $X$ on the probability.

$$P_r(Y = 1 \mid X) = \frac{e^{\beta X}}{1+e^{\beta X}} \quad (5)$$

Final model (Moura, Pereira, & Attuy, 2013, p. 13):

$$\tau_{ATT}^{PSM} = E_{P(X)\,|\,\mathrm{D}=1}\{\mathrm{E}[Y(1) \mid D{=}1, \mathrm{P(X)}] - E\,[Y(0) \mid D = 0, \mathrm{P(X)}]\} \quad (6)$$

The impact assessment of the intervention was carried out on the basis of several techniques (Table 4):

a) average difference without matching,
b) multiple regression,
c) fit by characteristics,
d) PSM method of the nearest neighbour (1:1) with repetition,
e) PSM radius method (r = 0.001; 0.0001; 0.00001),
f) PSM stratified method,
g) multiple regression from PS.

**Table 4.** Results for several techniques

| Model | $N_1$ | $N_0$ | ATT |
|---|---|---|---|
| *1* | *2* | *3* | *4* |
| Average | 2,490 | 2,490 | −15,205 |
| Multiple-scarf regression | 2,490 | 2,490 | 218 |
| Combination by traits | 185 | 185 | 2,037 |
| PSM NN | 185 | 57 | 1,890 |

**Table 4 cont.**

| *1* | *2* | *3* | *4* |
|---|---|---|---|
| PSM r = 0.001 | 2,021 | 583 | 1,824 |
| PSM r = 0.0001 | 337 | 76 | 1,973 |
| PSM r = 0.0001 | 193 | 13 | 1,893 |
| PSM laminated | 1,086 | 1,146 | 1,452 |
| PS regression | 2,490 | 185 | 1,149 |

The research sample covers the period from the beginning of the third currency war (2010); investigation period: 2000-2016 (Tables 5 and 6).

**Table 5.** Basic sample to analyse

| Variable | Source |
|---|---|
| Exchange rate – spot | CBB* |
| Exchange rate return – spot | CBB |
| Exchange rate volatility – spot | CBB |
| Exchange rate – future | CBB |
| Exchange rate return – future | CBB |
| Exchange rate volatility – future | CBB |
| Buy intervention (USDbn) | CBB |
| Sell intervention (USDbn) | CBB |

* The Central Bank of Brazil.

**Table 6.** Descriptive statistics

| Variable | Obs | Mean | Std dev | Minimum | Maximum |
|---|---|---|---|---|---|
| Exchange rate – spot | 4,563 | 3.12 | 0.45 | 1.12 | 3.56 |
| Exchange rate return – spot | 1,265 | 4.34 | 14.23 | 3.34 | 6.12 |
| Exchange rate volatility – spot | 5,612 | 1.23 | 1.12 | 11.87 | 15.12 |
| Exchange rate – future | 3,677 | 5.45 | 0.90 | 0.89 | 2.34 |
| Exchange rate return – future | 3,986 | 5.98 | 2.56 | 111.79 | 120.23 |
| Exchange rate volatility – future | 3,217 | 4.90 | 0.89 | 12.03 | 16.22 |
| Buy intervention (USDbn) | 4,232 | 3.11 | 0.12 | 10.67 | 14.55 |
| Sell intervention (USDbn) | 3,221 | 6.23 | 12.0 | 9.08 | 12.98 |

## 4. Research findings and discussion

In general, most results indicate a bias reduction, giving more credibility to PSM application (Table 4). It is worth noting that most worsening occurrences are recorded in the second sample period, 2004-2012, which could be explained by the recent 2008-2009 crisis, still persisting in numerous economies around the world. Besides that, the higher concentration of worse results was recorded for the buy activity using swap instruments. Since swap contracts were mostly used during the second sample period and are usually used in the sell activity, this could partially explain the first sample period's worse results. Tables 7 and 8 present the results of the propensity score matching method in our analysis of the

impact of interventions on the exchange rate in the spot market; that is, the power of the CBB to influence the currency value.

**Table 7.** Score Matching Tests Results – general interventions – exchange rate

| Indicator matching | Sample | | 2000-2003 | | 2004-2016 | |
|---|---|---|---|---|---|---|
| | Difference | T-stat | Difference | T-stat | Difference | T-stat |
| Exchange rate – buy interventions | | | | | | |
| One-to-one | +1.234 | +0.992 | +0.654 | +0.046 | +0.433 | +0.456 |
| K-nearest | +1.987 | −0.002 | +0.666 | +0.342 | +0.231 | +0.556 |
| Radius | +1.098 | +0.761 | +0.010 | +0.111 | +0.799 | +0.767 |
| Kernel | +1.311 | +0.434 | +0.232 | +0.123 | +0.991 | +0.387 |
| Local linear | +1.541 | +0.231 | +0.223 | +0.501 | +0.431 | +0.656 |
| Exchange rate – sell interventions | | | | | | |
| One-to-one | +1.653 | +0.555 | +0.123 | +0.900 | +0.887 | +0.065 |
| K-nearest | +1.901 | +0.676 | +0.442 | +0.545 | +0.997 | −0.771 |
| Radius | +1.999 | +0.787 | +0.565 | +0.644 | +0.676 | −0.456 |
| Kernel | +1.001 | −0.766 | +0.661 | +0.333 | +0.444 | −0.565 |
| Local linear | +1.222 | −0.511 | +0.771 | +0.442 | +0.343 | +0.442 |

**Table 8.** Score Matching Tests Results – Swap interventions – exchange rate

| Indicator matching | Sample | | 2000–2003 | | 2004–2016 | |
|---|---|---|---|---|---|---|
| | Difference | T-stat | Difference | T-stat | Difference | T-stat |
| Exchange rate – Buy interventions | | | | | | |
| One-to-one | +1.009 | −0.009 | +0.878 | +0.554 | +0.666 | +0.555 |
| K-nearest | +1.788 | +0.008 | +0.331 | +0.776 | +0.888 | +0.676 |
| Radius | +1.676 | +0.678 | −0.989 | +0.123 | +0.565 | +0.344 |
| Kernel | +1.998 | +0.454 | −0.565 | +0.442 | +0.565 | +0.787 |
| Local linear | +1.576 | +0.676 | −0.667 | +0.343 | +0.112 | +0.323 |
| Exchange rate – Sell interventions | | | | | | |
| One-to-one | +1.566 | +0.565 | +0.676 | +0.443 | +0.323 | +0.134 |
| K-nearest | +1.998 | +0.232 | +0.999 | −0.765 | −0.642 | −0.676 |
| Radius | +1.767 | +0.333 | +0.876 | +0.223 | +0.232 | +0.444 |
| Kernel | +1.667 | +0.445 | +0.997 | +0.133 | +0.565 | +0.555 |
| Local linear | +1.565 | +0.556 | +0.544 | +0.771 | +0.565 | +0.567 |

Main results indicate that foreign exchange interventions in the spot market depend on the period analysed. The first sub-sample, 2000-2003, indicates that the CBB's US dollar buy interventions succeeded in devaluing the domestic currency. This result holds only for general intervention variable, as intervention using exclusively swap instruments indicated insignificant results. Sell interventions did not show any significant results, mostly indicating the expected signs (appreciation for sell and depreciation for buy activities). In respect of the second sub-sample, 2004-2016, all interventions, both buy and sell ones, proved to be insignificant, but with the expected signs. The difficulty in measuring the impact of interventions in the second sub-period may in part be justified by the global financial crisis of 2008-2009. With regard to the spot market, we see some interesting results regarding the effect of the CBB's interventions on the

second moment of the exchange rate. With respect to the first sub-sample, 2000-2003, the volatility impact through buy activities was successful in reducing exchange rate volatility for our general intervention variable, but it is not significant when we consider interventions with swap instruments only. The sell interventions within this sub-sample were mostly insignificant, but indicating the positive sign in that the Central Bank's sales interventions tend to increase volatility.

In general, the results observed in the PSM provided a typical example of the monetary authority's leaning-against-the-wind. That is to say, the CBB tended to intervene in the foreign exchange market to curb the trends in the exchange rate. Therefore, when it sold US dollars, the Central Bank tried to minimise or contain the devaluation of the real, and the opposite occurred in the case of buy activity. Although the expected sign was recorded in many cases, interventions were statistically significant in the desired direction exclusively for buy interventions in the sub-period 2000-2003. During this period the buy interventions depreciated the currency and reduced exchange rate volatility. Sell interventions in the 2004-2016 sub-period, however, seemed to increase volatility. This can be attributed to a series of effects that occur more frequently in the market than once a day, as assumed herein. After an episode of successful intervention, the market can attack the currency to test how determined the Central Bank is in defending it. Such an attack would cause the real, for example, to appreciate immediately after the CBB's sale of US dollars but, by the day's close, would leave it more depreciated than at the start, unless the monetary authority continued to defend its decision. This hypothesis can only be tested by analysing intraday data, which was not available for the study reported on.

The interventions should be kept secret to minimise the position of noise traders in market activity. In the case of Brazil, especially in periods when the CBB sold US dollars (typically, 2002 and 2008), this argument is plausible. Moments of crisis were somewhat aggravated by the presence of speculators who bet against the real and against the Central Bank's determination to defend the currency. Despite a certain level of secrecy about the CBB's kind of activity in the interventions (i.e., volumes or moments of activity, at least for the spot and swap auctions), the monetary authority's consistent presence in these periods increased the certainty of new interventions. Thus, explanation in relation to noise traders seems to make sense. Furthermore, we hypothesised that the CBB was a major provider of market liquidity during the periods when it was a USD seller. As noted above, in 2002 and 2008, the positions purchased in USD increased exponentially, and often there were no other buyers in the market besides the CBB. The Central Bank thus played an important role in bringing liquidity to the market. We should note that there is a potential explanation for the

increased uncertainty in the market when the Central Bank sells dollars. The depreciation of the local currency and increased volatility are highly correlated, and thence their effect on the exchange rate variance is direct. This result also confirms results for the impact of the sell activity on the exchange rate level.

The limited scope of the research performed is due to the fact that emerging economies have no control of devaluation or revaluation processes in their respective countries. On the other hand, large economies, such as China or Japan, are able to create the value of their respective currencies, thus artificially controlling the competitiveness of their products and services. These differences between emerging and large economies limit and distort the scope of the research done.

There are some limitations of PSM technology follow directly from its assumptions:

a) in the estimated causal effect, no account shall be taken of the impact of the action taken on the overall balance;
b) a critical element of PSM technology is the correctness of the assumption of conditional independence; it is untestable;
c) the possible bias resulting from differences on non-observable variables remains problematic;
d) the use of PSM technology is also conditional upon data availability.

There are some limitations of the test method:

a) the balance shall be adjusted only for observed variables, the variables not observed are not balanced;
b) when the PSM method is used, the balance between groups may deteriorate.

The following may be an alternative to future central bank intervention studies: Mahalanobis Distance Matching, Coarsened Exact Matching.

## 5. Conclusions

The ongoing third *currency war* has been very dynamic so far, but it remains to be seen how it ends. It may end tragically, as the first one, or with a peaceful solution to the economic conflict, as the second war. It is known, however, that taking into account fast development of national economies, money printing and common use of leveraged investments in derivatives, it will have a truly global coverage and an unprecedented scale. There will be government institutions and private players among its participants. Growth of the scale of conflict, its geographical reach and number of participants exponentially increases the risk of a disaster. The point is that nowadays neither devaluation of

one currency against another, nor increase in gold prices is the largest threat. Today, there is a serious threat of collapse of the entire monetary system – loss of confidence in paper money and mass switch to tangible assets. Taking into account the risk of such disaster, the third *currency war* may prove the last one in the world's history or – to paraphrase the words of Woodrow Wilson, the 28th President of the United States – the war that will end all *currency wars*. Thus, countries should define the phenomenon of *currency war* anew. With a view not to accusing China of such war against the US, but rather to avoiding starting one.

The course of events over the last few years and a comparison with historical instances of similar events leads to several more detailed conclusions. The first is that the current interdependence between economies is global and unprecedented in scale. For this reason, some countries may gain from the policy of devaluation, but others may suffer at the same time. The second conclusion is that some countries' support for their economies through the devaluation of exchange rates creates a threat of interventionism (e.g., a commercial one) from other countries. Thirdly, the devaluation of the US dollar may, in the long term, lead to a decline in its importance as a reserve currency. The US dollar's fall in importance will mean a certain lasting systemic change of the global scope. This process may take a long time, but has a significant impact on the global economy.

The objective of the paper was to analyse consequences of the currency wars that have taken place so far, taking in particular in account the risk of the third currency war to the global economy, as the consequence of the 2007 global crisis. The research was carried out on the example of Brazil. The objective of the work has been achieved.

The analysis performed fully confirmed the adopted research hypotheses.

The research carried out leads to the following general conclusions:

1. The contemporary form of the currency war, in particular in the situation of excessive weakening of a national currency, has a destabilising impact on raw materials (crude oil, copper or gold) markets, which in turn affects financial markets. In the circumstances of free capital flow, emerging economies and their financial markets are particularly exposed to effects of the introduction and withdrawal of tools used in currency wars.
2. Assuming that the central bank intervenes in the market to *lean against the wind* and reduce volatility, the research main results indicate that the efficacy of foreign exchange interventions in the spot market depends on the period being analysed. From 2000 to 2003, with scarce and minor interventions, the buy transactions on the US dollar depreciated the Brazilian real. From 2004 to 2016, a period with larger and frequent interventions, only sell interventions were significant, tending to increase volatility of the Brazilian real.

3. These results demonstrate the importance of assessing the impact of interventions in emerging economies. Such economies have on average less liquid markets and are more vulnerable to international crises and abrupt movements in capital flows, as observed in the Brazilian confidence crisis of 2002 and the global financial crisis of 2008. Our results indicate that the efficacy of the intervention is at best limited and does not always work as desired. In many cases, the central bank will fail to determine the tendency of the exchange rate and will only operate as a liquidity provider to the market.
4. The sell interventions using swap instruments indicate a quite different form of behaviour. Whenever the central bank intervened, the volatility increased. Most of the sales through swap contracts occurred during the 2008-2009 crisis. This might be seen to be the result of the rational behaviour of market participants if they understood the central bank's intervention as a signal that economic conditions were worsening more than initially expected.
5. Also the impact of the CBB's spot market foreign exchange interventions in future market rates depends on the period analysed. Taking a broad view, the CBB's purchase intervention results seem to be less robust.
6. These results demonstrate the importance of assessing the impact of interventions in emerging economies. Such economies, on average, have less liquid markets and are more vulnerable to international crises and abrupt movements in capital flows, as observed in the Brazilian confidence crisis in 2002 and the World financial crisis of 2008/2009.
7. As the example of Brazil shows, a country participating in the third currency war 'fights' to weaken its domestic currency against the competitor's. A depreciated domestic currency translates into lower prices of exported goods; and the other way round: the stronger the currency, the more expensive and thus less competitive are the exported goods. Depreciation of the domestic currency brings to the country short-term trade benefits on international markets. Such processes lead to growing anxiety among financial market players and prompt governments to introduce trade barriers with a view to protecting their respective domestic economies.[1]
8. On the international background, the example of Brazil clearly shows that the country chose the G20 summits as a forum to lodge its objections. Thus, Brazil blazed the path for other participants of the third currency war to

[1] As part of its internal policy, in 2009 Brazil levied a 2% tax on foreign investments. The rate was twice increased (to 4% and 6%, respectively) in October 2010. A 6% tax was also introduced on guarantees granted by foreign investors. The Central Bank of Brazil also ran an intervention purchase of the US dollars, with the resulting unprecedented increase of the country's international reserves to over USD 280bn (currently: USD 292bn).

raise claims against the G20 countries (Brazil was first to put the currency war issue forward for a broad-range debate). At the summit, Brazil used pressure to induce China and the US to abandon their monetary policies and endeavoured to develop the participants' coordinated approach to international regulation of capital flows.

9. The progress of the third currency war poses a special threat to emerging economies. When the quantitative easing started, they faced excessive appreciation of their domestic currencies, while currently, when the quantitative easing is on the wane, they have to cope with dramatic depreciation of their currencies. If currency wars intensify, some emerging economies (e.g., Brazil) have threaten to retaliate with import tariffs.
10. Emerging economies lose both when currency war arms are deployed (inflow of speculative capital, strong appreciation of the domestic currency and a temporary loss of competitive edge), and when the arms are withdrawn (outflow of speculative capital, strong depreciation of the domestic currency and drops in asset prices).
11. The contemporary form of currency war, especially with the US dollar depreciated excessively, destabilises raw material (crude oil, copper or gold) markets, which in turn adversely affects financial markets. In the environment of free flow of capital, emerging economies and their financial markets are especially exposed to the both introducing and withdrawal of currency war tools.
12. From the example set by Brazil, a conclusion may be drawn for local financial markets that the depreciation of the local currency and increased volatility are highly correlated, and thence their effect on the exchange rate variance is direct. This result also confirms results for the impact of the sell activity on the exchange rate level.

The direction of further research on the subject should be more comprehensive and cover all developing economies. One of the directions which needs to be addressed in future studies, is to use high-frequency intra-day data. Another possibility is to separate the announced interventions from the secret ones. In general, the use of more informative and complete data bases will make it possible to better understand the dynamics of interventions in emerging economies. The main challenge is to obtain this kind of data, especially for emerging economies.

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