UNIVERSITY OF HOHENHEIM

Hohenheim Discussion Papers in Business, Economics and Social Sciences

INTERNATIONAL DIGITAL CURRENCIES AND THEIR IMPACT ON MONETARY POLICY – AN EXPLORATION OF IMPLICATIONS AND VULNERABILITY

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11-2019

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Discussion Paper 11-2019

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ISSN 2364-2084

International Digital Currencies and their Impact on Monetary Policy – An Exploration of Implications and Vulnerability

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Abstract:

The objective of this discussion paper is to explore the consequences for monetary policy from the establishment of an international digital currency modeled like Libra. For this purpose, a basic assessment of the behavior of economic agents is conducted and possible conflicts with monetary policy are analyzed. Furthermore, a simple approach is developed to estimate the nature and extent of vulnerability for 42 currencies. The results suggest that currencies from developing countries and from developed nations are vulnerable in different ways. In the end, a stronger convergence of central bank policies could result. Thus, the introduction of an international digital currency represents a turning point for monetary policy.

JEL Classification*: E42, E52, E58*

Keywords: *Monetary policy, digital currency, blockchain, effective lower bound*

This version: October 2019

* I would like to thank Judith Siedler and the participants of the W&W Economic Jour Fixe for useful comments.
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1. Introduction

Possible useful applications of the blockchain technology are currently among the most discussed topics in the financial industry. So far, the only use of bigger scale is the origination of crypto currencies like its archetype Bitcoin. But this currencies have not played a significant role for payment transactions right now, remaining a niche for technology enthusiasts and highly volatile speculative objects. As a result, Bitcoin and its successors have not played a role for monetary policy theory, either.

That situation may have changed after social network Facebook announced the intention to issue a digital currency named Libra in mid-June 2019.[1] Two aspects suggests, that Libra can overcome the niche status and gain some significance for consumers and companies. At first, the prospect to serve 2.2 billion active Facebook users worldwide is a strong incentive for the profit-oriented member companies of the Libra Association to establish applications.[2] Furthermore, the fact that Libra is planned as a "stable coin" speaks in favour of a good acceptance of Libra or similar projects by private households and companies. The blockchain technology is only used for documentation purposes, but unlike existing crypto currencies, there will be no limitation in the issue of Libra. Instead a collateralization with conventional currencies is planned, which will be explained in greater detail in section two. The decisive point is that price volatility caused by scarcity and speculation as a major disadvantage of existing crypto currencies should vanish.

In face of the probable new baseline it seems necessary to gain some fundamental understanding of the implications that the introduction of an international digital currency might bring for the monetary sphere. Dealing with an outstanding novel aspect implicates, that some of the following contemplations remain comparatively basic and contain speculative assumptions. Only practice can show whether they really apply. But the cursory explorations are also legitimated by the possible high relevance of the topic.

The need for a fundamental assessment can also be seen by the vague and contradicting statements of central banks and its representatives. For example, the Deutsche Bundesbank recently published an article, dealing in great detail with the blockchain technology in the financial sector.[3] It is noteworthy that the Bundesbank avoids speaking of crypto or digital currencies

[1] Libra Association (2019): *An Introduction to Libra. White Paper. From the Libra Association Members*.
[2] The founding members of Libra Associations include important companies like Ebay, Visa and Mastercard.
[3] Deutsche Bundesbank (2019): *Krypto-Token im Zahlungsverkehr und in der Wertpapierabwicklung*, in: Monatsbericht Juli 2019, 39-60.

and instead uses the rather unusual term "crypto token". This is apparently to make clear that Bitcoin, Libra and similar approaches are only seen as a kind of voucher or club money, but not as a currency. Later, Burkhard Balz, member of the board of directors of the Bundesbank, predicted in an interview that Libra will not play a significant role in industrialized countries in the medium term.[4] But Libra could become relevant for emerging countries and could have a certain disciplining effect on them. On the other hand, the President of the Swiss National Bank, Thomas Jordan, warned that Libra could impose a threat to the swiss monetary policy,[5] hence the monetary policy of a well developed, industrialized country.

The objective of this discussion paper is to give answers to the implied questions: Which countries could be affected by the introduction of Libra or another international digital currency with similar construction features, and, not less important, how will they be affected? For this purpose, following up, the expected behavior of private economic agents and their motives are specified. The third section of this paper contains a summary of the supposed reaction patterns. Section four is dedicated to possible conflicts with national monetary policies. As it will be shown, the introduction of an international digital currency can imply far-reaching consequences for central banks in different ways. A small approach to assess the vulnerability of national currencies is presented in the fifth section. The sixth chapter presents the results and the seventh part finally sums up the characteristics of vulnerable currencies.

2. Motives for use of an international digital currency and currency characteristics

The Libra Association stated its intended introduction of a digital currency with the aim of giving people in developing countries with only limited access to financial services a low-cost option for money transfers.[6] But in light of the broad spectrum of profit-oriented partner companies and the global strategy of Facebook as the driving force behind Libra, the creation of applications for international use and also for national markets in developed countries can be expected. Pioneer costumers could include migrant workers who regularly transfer money to

[4] Michael Rasch/Neue Zürcher Zeitung (2019): *„Libra könnte stabiler sein als manche Währungen in den Schwellenländern“*, https://www.nzz.ch/wirtschaft/libra-koennte-stabiler-sein-als-manche-waehrungen-in-den-schwellenlaendern-ld.1504355

[5] Thomas Fuster/Neue Zürcher Zeitung (2019): *SNB-Präsident Thomas Jordan warnt: Libra könnte die Wirksamkeit der Schweizer Geldpolitik beeinträchtigen*, https://www.nzz.ch/wirtschaft/facebook-geld-libra-snb-praesident-jordan-warnt-vor-auswirkungen-ld.1506748

[6] Libra Association (2019), 1-2.

relatives in their home countries and private households who buy in abroad online shops. If more and more opportunities arise to pay domestically, the use of the digital currency is likely to gradually expand. It will increasingly make sense not only to exchange money from national currency into an international digital currency for certain transactions, but also to have a continuous credit balance in it and, if applicable, to accept payments in this currency.[7] The first and closest motive for using digital currencies as some store of value is therefore convenience in everyday payment transactions. This type of deposit can have a monetary policy effect if payment transactions increasingly take place outside the systems operated and monitored by central banks.[8] However, this presumably creeping effect, will not be discussed further below.

Even more important for monetary policy could be situations in which economic units can make conscious choices between their national conventional currency and an international digital currency. This is possible in different situations and for different reasons.

A first plausible and drastic example are countries with acute currency devaluation. Savers get a reason to commit capital flight at least temporarily. Strong devaluations of local currencies do not only mean a loss of purchasing power abroad. They are often accompanied by higher inflation rates, hence a decline in domestic purchasing power.[9] In future, savers will have the convenient opportunity to avoid the expected loss of purchasing power in these situations by transferring their money into an international digital currency. If the use of it will have become ordinary for day-to-day payment transactions, there will be even advantages over typical safe haven-currencies like the U.S. dollar or the Swiss franc: The deposit in a digital currency can be gradually consumed later, so that a costly re-change into the home currency is not necessary. Secure storage is also likely to be cheaper than hoarding foreign notes. In addition, there are fewer access hurdles because of transactions via the Internet. To sum it up, an international digital currency will cut the transaction costs for capital flight.

Further situations than the drastic example of an acute currency crisis are imaginable which could make an international digital currency attractive for private households. This is the case if the national currency is expected to depreciate only slightly but continuously. The higher

[7] In a statement published in mid-August 2018, the tax administration of New Zealand permitted salary payments in crypto currencies under certain conditions.
[8] Reference is also made to this by Deutsche Bundesbank (2019), 57.
[9] For example, from early 2014 to late 2015, the Russian rouble depreciated by 66% against the US dollar, with consumer prices rising 25 % within this time. In 2018, the Argentine peso and Turkish lira depreciated by 51% and 28%, respectively, with consumer price increases of 48% and 20%, respectively. Own calculations based on data from FRED Economic Data - St. Louis Fed.

the share of demand for consumer goods that is covered abroad, the more unpleasant a chronic depreciation might be. Additionally speculative holdings could become lucrative.

The suitability of an international digital currency as an alternative store of value is basically determined by its construction features. They lead to the fact that Libra and possible similar approaches are not merely payment tokens as claimed by the Bundesbank. It is true that the Libra Association does not want to pursue a monetary policy.[10] But private households and companies could perceive Libra as a fully-fledged currency for two reasons.

First, there will be some kind of a flexible exchange rate, which usually does not exist for vouchers or club money. The Libra Association will use the received capital from Libra holders to form a reserve or rather to collateralize its digital currency. Therefore, the reserve can be described as a currency basket. The value of one unit in the digital currency measured in a specific national currency will result from the exchange rate development of this currency compared to the currencies in the reserve. If savers expect a depreciation of their national currency against this basket, it may be advantageous to transfer money into the international digital currency.

Second, even if there the assumption of a stable exchange rate between the national and the digital currency prevails, a transfer of deposits to an international digital currency can be attractive. This is the case if savers expect the real interest rate on deposits in the digital currency to be higher than on deposits in their national currency.

Before proceeding with that aspect, different possible features of the considered digital currency must be taken into consideration. The Libra Association stated that it will not pay interest or dividends for deposits in its digital currency.[11] However, it is likely that inflation will also occur in the digital currency. Therefore, the real return on deposits will usually be negative. Against this background, the interest motive described above may apply only if nominal interest rates for deposits in the national currency are close to zero or negative. This will depend, of course, on different inflation rates in both currencies and on interest sensitivity of savers, too. Conversely, the interest motive is not applicable as long as deposits in the national currency will generate some interest payments and therefore compensate at least for parts of inflation losses. Overall, the result would be an asymmetric reaction pattern of capital owners.

[10] Libra Association (2019), 7; Libra Association/Christian Catalini et. al. (2019): *The Libra Reserve*, 4.
[11] Libra Association (2019), 7; Libra Association/Christian Catalini et. al. (2019), 1ff. At the same time, no negative interest rates are planned.

The establishment of an international debt market in the new currency would change this baseline. As a consequence, an interest rate for loans and the possibility of interest payments on deposits would emerge. The asymmetry described above would be eliminated and deposits in the digital currency could be more attractive even when deposits in the national currency enable a positive, but smaller yield.

In general, an international digital currency can be an alternative store of value for savers depending on exchange rate developments as well as differences between real yields.

But this is not the end of possible implications. If there will be a debt market in the international currency, the perspective of borrowers must be considered, too. In this case, both motives described above must be seen in reverse. If borrowers expect a lower level of real interest rates in their national currency, they will tend to borrow in that currency. In contrast, if the real interest rate level in the national currency is higher, the international digital currency appears to be more advantageous for borrowing. Expectations regarding exchange rate developments must also be taken into account. If a borrower is expecting the national currency to depreciate under otherwise identical circumstances, he or she is likely to opt for debt in this currency and vice versa.[12]

3. Reaction patterns at a glance

The expected reaction patterns described above can be summarized as follows: The behavior of economic agents is influenced by two factors: first, expectations regarding real interest rate differentials between the national currency and the international digital currency, and second, expectations regarding the development of the exchange rate. Since two different variants are possible for each aspect, the result is a matrix with four possibilities, which is shown in the schematic below.

[12] In practice, however, liquidity risks would have to be taken into account. The freedom of choice for private households and companies is increased if they reliably receive payments in both, in conventional and in digital currency, thus securing interest and principal payments.

Schematic 1: Expected reaction patterns of economic agents

Expectations of economic units	National currency appreciates against int. digital currency	National currency depreciates against int. digital currency
Real interest rate higher in national currency	(A) Borrowers increasingly use int. digital currency and savers retain nat. currency	(C) Contradictory effects. Extent of reactions unclear.
Real interest rate higher in international digital currency	(B) Contradictory effects. Extent of reactions unclear.	(D) Savers increasingly use int. digital currency and borrowers retain national currency.

Source: Own draft.

If expectations among savers prevail that their national currency will offer a higher real interest rate and will appreciate against the international digital currency, they will have a strong incentive to retain their national currency as a store of value. The situation shown in field (A) will be also an incentive for borrowers to incur debt in the digital currency if a credit market has developed. Exactly the opposite is true in field (D). If the digital currency is likely to generate higher real interests and at the same time there is an expectation of an appreciation for it, then its attractiveness for savers increases, while borrowers are likely to prefer the national currency.

For the two fields (B) and (C), the effects of the two aspects are contradictory. If the wealth effect of a higher real interest rate in the international digital currency is expected to be eliminated by its devaluation (field (B)), then both currencies should at least theoretically be equally attractive for savers and borrowers. The same would apply in the opposite case if a higher real interest rate in the national currency is offset by its devaluation (field (C)). In practice, however, either the real interest rate motive or the exchange rate motive could predominate for economic agents, depending on transaction costs and competition on capital markets. The nature and extent of the reactions are therefore unclear.

The expected reaction patterns of savers and borrowers have implications for national financial markets. The characteristic of field (A) would ceteris paribus be a high supply of savings combined with weak demand for credit. In field (D), on the other hand, a weaker supply of capital would be expected locally, but the demand for credit would tend to stay high.

4. Currency competition and conflict with national monetary policy

So far, central banks have largely enjoyed a monopoly in the creation of money supply. They can therefore align their monetary policy with their individual objectives of a certain inflation rate, employment level or exchange rate peg. Any undesirable effects of rising or falling central bank rates have so far had to be accepted by the economic agents.

As described above, the proliferation of an international digital currency would make it easier for economic units to evade the undesirable consequences of monetary policy decisions. This becomes particularly clear in the case of savers, who can switch to the international digital currency in anticipation of lower real interest rates in their national currency. This would mean that the natural interest rate floor, the so-called "effective lower bound" ore “zero lower bound”, would no longer be influenced solely by private households' ability to hold cash. A digital currency might get a similar impact and could influence currently discussed approaches to deal with that problem.[13]

Additionally, with a debt market in the international digital currency, borrowers could have a strong incentive to use this alternative if national monetary policy were to raise key interest rates.

Due to the resulting currency competition, the establishment of an international digital currency ultimately leads to a reduced room for manoeuvre in monetary policy. If a central bank were to attempt to compensate for the diminishing impact of its policy decisions with stronger adjustments in its key interest rate, it would only increase the incentive for the affected borrowers or savers to use the digital currency.

Central banks must therefore reckon with a loss of significance. Under the new regime, it could become probable that monetary policy will be less oriented towards previous objectives. Instead, interest rate setting may be more oriented towards keeping differences of real yields as low as possible and avoiding exchange rate movements as far as possible. The result could be an international convergence of monetary policy. Maybe this situation can best be compared with the monetary policy regime of the gold standard in the second half of the 19th century respectively at the beginning of the 20th century. At that time, the central banks had to

[13] Katrin Assenmacher und Signe Krogstrup (2019*): Monetary Policy with Negative Interest Rates: Decoupling Cash from Electronic Money*, IMF Working Paper 18/191.

adjust their interest rates to maintain the indirectly fixed exchange rates due to the gold peg of the currencies. It was hardly possible to pursue domestic policy goals.[14]

5. Empirical testing of the vulnerability of currencies

So far, it is open to what extent the expected reaction patterns described above are relevant for practice. To give an answer, an empirical study with 42 currencies for which data is available will be carried out below.

First, it is necessary to operationalize the two identified influencing factors. A particular hurdle is that there is no international digital currency that can be observed. Alternatively, a proxy must be used. Suitable for this purpose are special drawing rights (SDRs) of the International Monetary Fund (IMF), an artificial currency created in 1969 for transactions between central banks. It is constructed as a basket of currencies and thus resembles in its basic features the approach of an international digital currency. The exchange rate of the SDRs results from the exchange rate fluctuations of the participating national currencies.

The SDR-basket currently contains only five currencies: the U.S. dollar, the Euro, the Japanese yen, the British pound and, since the beginning of October 2016, the Chinese renminbi yuan. In this respect there may be a difference to the intended digital currency Libra. Its reserve could be made up of significantly more currencies. In the case of Libra no concrete plans have yet been presented. However, since the five currencies in the SDR-basket play a very important role in international trade, it is likely that the exchange rate of the SDRs will come quite close to the performance of an international digital currency.

A second hurdle in operationalisation is, as mentioned above, that reactions of economic agents depend on their own expectations. Although financial institutions make forecasts for exchange rates and interest rates, no time series on the expectations of private households and companies are available. Instead, only data on past exchange rate and real interest rate developments can be used. However, this is not a disadvantage. If it is assumed that economic agents

[14] For the diffusion and the rules of the international gold standard see Peter Spahn (2001): *From Gold to Euro: On Monetary Theory and the History of Currency Systems*, Berlin a.o., 97ff.

do not have complete rational expectations, but only adaptive ones,[15] then past developments can be used as estimates of future expectations.

For expectations regarding the exchange rate development between the national currency and the international digital currency, the past exchange rate development between the national currencies and special drawing rights is considered. It seems suitable to observe several years. Therefore the average change in the exchange rate of a currency (Δq^c) is calculated on the basis of calendar year changes in this currency (Δq_t^c) of a number of years (n). The five-year period 2014 to 2018 will be considered.[16]

$$(1) \qquad \Delta q^c = \sum_{t=1}^{n} \frac{\Delta q_t^c}{n}$$

The same procedure is used for the average absolute real interest rate of every particular currency (r^c). The real interest rate for each calendar year is calculated by subtracting the consumer price inflation for the respective period at the end of the year (π_t^c) from the key policy rate in force (i_t^c), i.e. the official interest rate or the most important interest rate of the respective central bank.[17]

$$(2) \qquad r^c = \sum_{t=1}^{n} \frac{(i_t^c - \pi_t^c)}{n}$$

This approach leads only to a rough picture of reality for various reasons: consumer price indices are calculated using different methods in different currency areas and the composition of consumer baskets differs from one another.[18] In addition, central banks make use of different

[15] For the terms rational expectations and adaptive expectations see John F. Muth (1961): *Rational Expectations and the Theory of Price Movements*, in: Econometrica 29/3, 315-335; Peter Spahn (2009): *Geldpolitik: Finanzmärkte, neue Makroökonomie und zinspolitische Strategien*, 2. überarbeitete Auflage, München (2009), 106.

[16] The exchange rate trend is calculated on the basis of the exchange rate at the end of each calendar year. Data from the Bank for International Settlement and St. Louis Fed FRED Economic Data is used for this purpose. The exchange rates of the particular currencies to special drawing rights are calculated as cross rates using the exchange rates of the U.S. dollar.

[17] For consumer price inflation and the key policy rate, data from the Bank for International Settlement and the International Monetary Fund (World Economic Outlook Database April 2019) was used, as well as data from individual central banks in some cases.

[18] This can be easily demonstrated by the situation in Germany. The Statistisches Bundesamt publishes two consumer price inflation rates: It calculates one figure according to the rules of the European Harmonized Index of

instruments as key policy rates. In some currency areas only very short-term money market rates are managed, while in others short- to medium-term rates are in place.[19] In addition, some instruments are more focused on refinancing activities of commercial banks and others on capital markets.[20] For this reason, and due to different levels of competition in the financial sector, even in currency areas with identical key interest rates, different nominal interest rates may exist for economic units.[21] However, these deficits in the calculation of real interest rate developments have to be accepted due to the lack of internationally perfectly comparable data.[22] Second, it would be useful to make two observations for each currency, since the market interest rate for savers is usually below the key interest rate and the market interest rate for borrowers is above it. However, there are again restrictions with regard to data availability, so that for simplification only the key policy rate will be used.

6. Presentation of the evaluation results

As a result of the calculations presented in section 5, there are two metrics for each currency. They are included in Table A1 in the appendix. The results can also be presented graphically. The basic structure of Table 1 above is used for this purpose. This means that the expected exchange rate development determines the horizontal position. The past average exchange rate (Δq^C) is used for this purpose. On the other hand, the expected development of the real interest rate, expressed by the past average real interest rate (r^C), determines the vertical position.

Consumer Prices and another according to a national method. Both numbers often deviates from each other considerably. For example, in July 2019 the Bundesamt reported an increase in consumer prices of 1.1% year-on-year according to European rules and of 1.7% according to national rules.

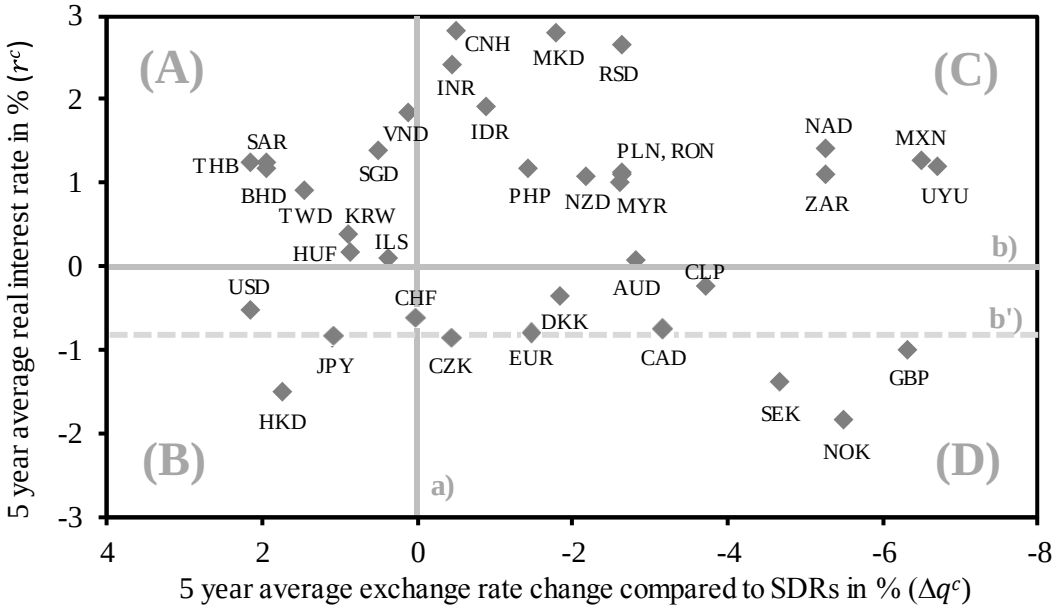
[19] For example, the Czech central bank uses a 2-week repo rate and the Indonesian central bank a 7-day reverse repo rate. In China, the 1-Year lending rate is the key policy rate.

[20] An example for affecting a money market rate is the Federal Reserve System. In the United States a target band for the Federal Funds Rate is used. The European Central Bank, on the other hand, directly influences the refinancing costs of commercial banks by allocating central bank money by main refinancing operations and targeted long-term refinancing operations.

[21] There is a mentionable difference for the People's Republic of China, where the 1-year benchmark lending rate is officially considered the key policy rate (currently 4.35%), while the deposit rate for savers is significantly lower (currently 1.5%). This must be taken into account when interpreting the results.

[22] A further simplification is the use of the key policy rate at the end of the year, which does not take account of changes within each year.

Chart 1: Observed currencies by development of their exchange rate against Special Drawing Rights (SDRs) and real yield 2014-2018



Source: Own calculation according to formula (1) and (2) based on data of the Bank for International Settlements, International Monetary Fund, World Economic Outlook Database April 2019, St. Louis Fed FRED Economic Data, Central Banks. See also table A1 in the appendix.
Note: Not plotted in the graph because outside the display area are ARS, BRL, COP, RUB, TRY and UAH. See table A1 in the appendix for details.

The four fields (A), (B), (C) and (D) in the graphic above result from the transfer of the arrangement according to Table 1. The common characteristic of the currencies in field (A) is the appreciation against SDRs on average for the calendar years 2014 to 2018, as well as a calculated positive real interest rate in this period. Currencies from East Asia and the Middle East are particularly affected. With respect to the figures used here, there are no incentives for savers to prefer SDRs or a similarly structured international digital currency for investments. At the same time, borrowers could have improved their situation by using the alternative currency, if possible. For that reason, the introduction of an international digital currency would make it more difficult for the central banks of these countries to implement a restrictive monetary policy if needed.

For the few currencies in field (B), the U.S. dollar, the Hong Kong dollar and the Japanese yen, the result is basically ambiguous. The negative real interest rate is combined with an appreciation against SDRs. Ideally, both effects neutralize each other from the perspective of savers and borrowers. As a result there is no reason for a currency flight by domestic residents.

The same applies in principle to field (C). However, here for some currencies the positive real interest rate can only compensate to a small extent the average depreciation. For Namibia, South Africa, Mexico and Uruguay, for example, the average depreciation of their currencies reached between 5.3% and 6.7% per year, with a calculated real interest rate of only 1.1% to 1.4% per year. It may therefore appear attractive for savers to prefer a capital investment in an international digital currency over the national currency. That is even more significant for the Russian rouble, the Brazilian real and the Argentine and Colombian pesos, which depreciated between just under 10% and 42% per year and are therefore not shown in the chart above.

Field (D) contains currencies that depreciated against SDRs in recent years and would therefore probably have depreciated against an international digital currency. At the same time, they had a negative real interest rate for this period. The establishment of an international digital currency implicates that borrowers in such constellations will continue to prefer the national currency. In contrast, savers have a strong incentive to use the digital currency, depending on the transaction costs. It is therefore risky for central banks of these countries to implement an expansive monetary policy if necessary.

As explained above, generally two different cases are possible for the yield motive, depending on whether a debt market in the international digital currency originated or not. For that reason, actually two divergent consideration have to been made. The presented calculations aimed at the absolute real interest rate level of each currency and thus represent the case without debt market.[23] The horizontal demarcation between the four fields in the above chart was drawn at a real interest rate of 0.00% with line b). If, on the other hand, a capital market originated, then the real interest rate level of the national currencies would have to be considered in relation to the real interest rate level of the international digital currency, respectively here to SDRs. A notional real interest rate level of minus 0.83 % can be calculated for SDRs in the period 2014 to 2018.[24] This negative value shifts the horizontal boundary slightly downwards. It is shown with the dotted line b') in the diagram.

Despite the resulting reduction in the size of the quadrant, some currencies remain in field (D). These include the British pound, which was burdened above all by the Brexit problem.

[23] The contemplations on the behavior of borrowers made here would be obsolete in this case.

[24] This value is derived from the respective key policy rate of the central banks of the currencies included, taking into account their weight in the currency basket less a notional inflation rate for Special Drawing Rights. The second was calculated using the consumer price indices of the currencies in the basket, the respective weights and the formula of Paasche. Slightly different numbers would result from the use of other methods.

In addition, the Swedish and Norwegian crown in particular have shown a remarkably low level of real interest rates over the past five years, while the external value has sunken at the same time. This applies to an even greater extent only to Turkey and Ukraine, which experienced currency crises as a result of political events and which could not be shown in the chart.

Interestingly, the Swiss franc is the currency which, according to the calculation method applied, has been the most similar to SDRs in the last five years.[25] Compared to all other countries, Switzerland's monetary policy would have been least restricted by the introduction of an international digital currency.

7. Structural characteristics of vulnerable currencies

The distribution of currencies among the four fields is not random. Rather, it seems to follow certain patterns that depend on the structural characteristics of the countries and their currencies. This observation allows general conclusions to be drawn. For example, the fields (A) and (C) with positive real interest rates contain almost exclusively currencies of developing and newly industrialized countries, including some with Currency Board. In contrast, fields (B) and (D) are almost exclusively occupied by the currencies of developed countries.

This classification is probably due to two reasons. First, the governments of developed economies tend to have better credit ratings. This results into a lower yield level of government bonds on international capital markets. Apparently, this in turn affects the general interest rate level in these countries and thus also the environment for interest rate decisions by central banks.[26] Second, especially in developed economies, the long-term neutral interest rate may be lower than in emerging markets due to the lower rates of real economic growth.[27]

Irrespective of whether these explanation approaches are correct, the visible link between the stage of development of an economy and its place in one of the four fields is likely to pose new challenges for some central banks. In developing countries with typically higher rates of economic growth and higher inflation, there may be more often a need for a restrictive

[25] The position of the special drawing rights in the diagram corresponds to the intersection of lines a) and b').
[26] In this respect, the empirical findings point to an aspect that usually does not play a role in monetary policy theory. For the close relationship between rating and real interest rate level, see Chart A1 in the appendix. For the Taylor rule as the common explanatory approach for the key interest rate level, see Spahn (2009), 213ff.
[27] An up-to-date compilation of current estimates for the low neutral real rate of interest for the United States of America can be found in the online appendix of a speech by Jerome H. Powell (2019): *Challenges for Monetary Policy*, Jackson Hole, Wyoming. https://www.federalreserve.gov/newsevents/speech/powell20190823a.htm

monetary policy. But an international digital currency would limit the chances of their implementation. On the opposite, central banks in developed countries have tended to have a greater need to support economic growth with a more accommodative monetary policy in recent years. Low inflation rates allowed very low interest rates. Here, an international digital currency would limit the positive effects of easing measures, since savers could react with capital flight.

The results of the evaluation permit a second prediction: As central banks with a need for easing can only conduct their monetary policy to a limited extent while other central banks are prevented from implementing a more restrictive monetary policy, an international convergence of monetary policy could result, as already explained in section four.[28] So far, clusters of geographically neighbouring currency areas can be identified easily in chart 1 through their small graphical distance.[29] Monetary policy in neighbouring countries appears to influence the national real interest rate and exchange rate development. The establishment of an international digital currency and the associated greater integration of the capital markets suggests that these clusters will converge.

8. Conclusion

An international digital currency like Libra would lack some features of existing currencies, for example a central bank with its own monetary policy. But if the digital currency is covered by a reserve of conventional currencies and its exchange rate results from the development of this currency basket, it appears as an individual currency from the perspective of consumers and companies and not just like a payment token. Depending on the degree of use, transaction costs, sensitivity of economic agents and the establishment of a capital market in the digital currency, an alternative would emerge for savers and possibly for borrowers. This would eliminate the money supply monopoly of national central banks, which has so far offered them great freedom in implementing their monetary policy.

The above evaluation of 42 currencies in conjunction with the assumptions made about the behavior of savers and borrowers reveals the nature and scope of risks. In countries with above-average real interest rates and appreciating currencies, especially in newly industrialized

[28] If monetary policy cannot adapt to current conditions in the respective country, an increase of frictions, caused by too high or too low interest rates could be the consequence.

[29] For example, in the Arab region SAR and BHD, in Asia INR and IDR, in Africa NAD and ZAR, in Latin America MXN and UYU and in Scandinavia SEK and NOK.

countries, the possibility of implementing a restrictive monetary policy will be reduced. In countries with comparatively low or negative real interest rates and with currencies that tend to depreciate, policy makers could lose the possibility of further easing. The natural interest rate floor, the "effective lower bound", can shift upwards. This could also generally reduce the central banks' ability to have a dampening effect on the whole economic cycle. Moreover, an international convergence of monetary policy can be expected. The introduction of an international digital currency thus represents an important turning point for monetary policy.

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Appendix

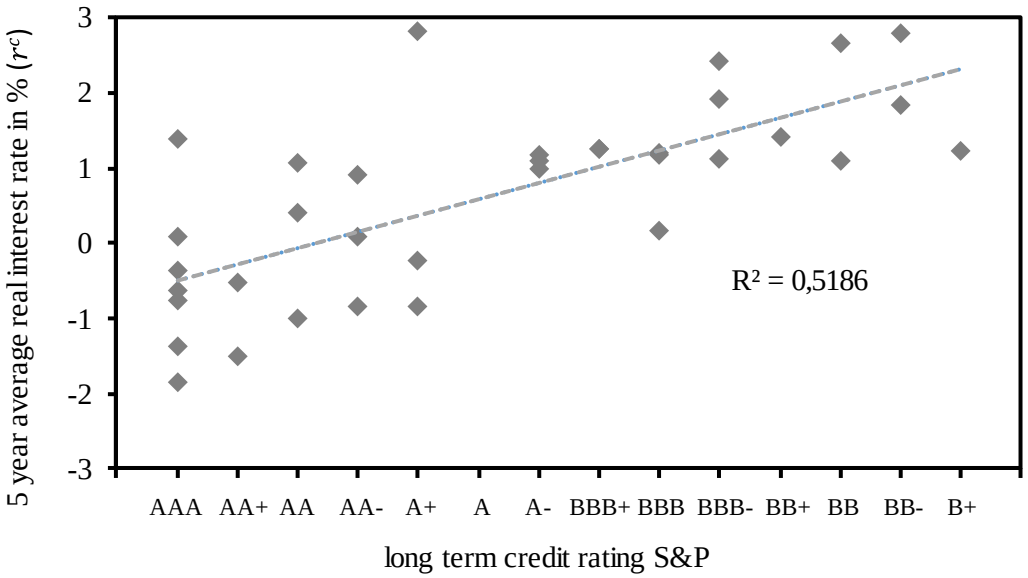
Table A1: Results for observed currencies

Country	Currency	ISO-code currency	Five-year average- real interest rate in %	Five-year average- exchange rate change against SDRs in %	Plotted in quadrant
Argentina	Peso	ARS	2,8	-41,6	B**
Australia	Dollar	AUD	0,1	-2,8	B
Bahrain	Dinar	BHD	1,2	1,9	A
Brazil	Real	BRL	4,5	-10,1	B**
Canada	Dollar	CAD	-0,8	-3,2	D
Chile	Peso	CLP	-0,2	-3,7	D
China (People's Republic)	Renminbi Yuan*	CNH	2,8	-0,5	B
Comobia	Peso	COP	0,6	-9,4	B**
Czech Republic	Koruna	CZK	-0,8	-0,4	D
Denmark	Crown	DKK	-0,4	-1,8	D
Eurozone	Euro	EUR	-0,8	-1,5	D
Hong Kong	Dollar	HKD	-1,5	1,7	C
Hungary	Forint	HUF	0,2	0,9	A
India	Rupee	INR	2,4	-0,4	B
Indonesia	Rupiah	IDR	1,9	-0,9	B
Israel	New Shekel	ILS	0,1	0,4	A
Japan	Yen	JPY	-0,9	1,1	C
Malaysia	Ringgit	MYR	1,0	-2,6	B
Mexico	Peso	MXN	1,3	-6,5	B
Namibia	Dollar	NAD	1,4	-5,3	B
New Zealand	Dollar	NZD	1,1	-2,2	B
North Macedonia	Denar	MKD	2,8	-1,8	B
Norway	Crown	NOK	-1,8	-5,5	D
Philippines	Peso	PHP	1,2	-1,4	B
Poland	Zloty	PLN	1,1	-2,6	B
Romania	New Leu	RON	1,1	-2,6	B
Russia	Ruble	RUB	3,6	-17,4	B**
Saudi Arabia	Riyal	SAR	1,2	1,9	A
Serbia	Dinar	RSD	2,7	-2,6	B
Singapore	Dollar	SGD	1,4	0,5	A
South Africa	Rand	ZAR	1,1	-5,3	B
South Korea	Won	KRW	0,4	0,9	A
Sweden	Crown	SEK	-1,4	-4,7	D
Switzerland	Franc	CHF	-0,6	0,0	C
Taiwan	Dollar	TWD	0,9	1,4	A
Thailand	Baht	THB	1,2	2,2	A
Turkey	Lira	TRY	-1,2	-17,8	D**
Ukraine	Hrywnja	UAH	-4,3	-28,3	D**
United Kingdom	Pound	GBP	-1,0	-6,3	D
United States	Dollar	USD	-0,5	2,2	C
Uruguay	Peso	UYU	1,2	-6,7	B
Vietnam	Dong	VND	1,8	0,1	A

* offshore ** not plotted in graph due to graphic restrictions

Sources: Own calculation based on data from International Monetary Fund: World Economic Outlook Database April 2019, Bank for International Settlements Statistics, St. Louis Fed FRED Economic Data, Central Banks

Chart A1: Long term credit rating and real interest rate of 36 observed currencies



Sources: Own calculation based on data from International Monetary Fund: World Economic Outlook Database April 2019, Bank for International Settlements Statistics, St. Louis Fed FRED Economic Data, Central Banks, Börsen-Zeitung

Note: Not included are all currencies from the sample with a five-year average depreciation against special drawing rights of more than 8 %, i.e. those with currency crises (ARS, BRL, COP, RUB, TRY, UAH).

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