From policy rates to invoicing : the monetary drivers of the global use of dollar

Valentin Auplat, Jules Vérin

July 28, 2023

ABSTRACT

In the wake of the covid-19 crisis and the global slowdown that followed, the return of inflation at global level has pushed the policy rate of the Fed to levels unseen since the 2008 financial crisis. One question this raise carries is the future of dollar outside the US which could be impacted by the higher cost of dollar on global financial markets. This working paper uses quantitative econometrics to investigate the drivers of the use of dollar in international trade between 2000 and nowadays. The first part focuses on the relationship between the US policy rate across time and the volume of dollar credit in a set of countries. We use panel regressions to quantify the relationships. In a second part, we try to quantify the impact of dollar credit on the use of dollar as a denomination currency for international trade. Most of the data is coming from the Bank of International Settlements, but the data for the invoicing are from the IMF, the OECD, and the ECB. The results are for the vast majority of them not significant statistically speaking.

1 INTRODUCTION

The scientific literature dealing with international trade at global scale widely agrees today on what is called the dominant currency paradigm forged by Gopinath et al., *Dominant Currency Paradigm*. This model, in opposition to the producer currency paradigm, states that international exchanges generally use a very thin range of currencies to sold the payments, regardless of the two partner countries. For more than 70 years, the first of these "vehicles currency" has been the US dollar, which still dominates the international monetary system. More than that, some studies find a stability of the dollar's role even while the share of the US in global trade is decreasing[1]. One key explanation is financial : the centrality of the US in the global financial system could be one of the reasons why the dollar is still widely used as a mean of payment. In this research project we try to investigate the drivers of the global use of dollar.

The most common indicator of the use of the USD as vehicle currency is the share of dollar in invoicing, in other words the share of dollar-denominated trade in the total trade. In this research project we use this indicator as dependent variable to investigate the determinants of dollar use as a vehicle currency.

[1] Faudot and Ponsot

An abundant theoretical literature about what makes a currency a vehicle currency is available. One of the most influential contribution is the one of Grassman, "Currency Distribution and Forward Cover in Foreign Trade". He first mitigates the relevance of the dominant currency paradigm but he acknowledges the fact that the situation differs between developed countries he studies and developing countries. What's more, according to Faudot and Ponsot, "The Dollar Dominance", (2016), is that dollar use as a vehicle currency has gained ground since the seventies, including in developed countries. However, it is still true that developing countries are much more likely to use the USD for their global transactions what ever the kind of relations they have with the USA.

According to Faudot and Ponsot there are two types of explanations to the global domination of dollar as vehicle currency in developing economies. The first one, highlighted by Grassman, comes from the fact that developing countries have rarely convertible currencies. As a result, there is less confidence in these currencies' stability. Such an argument looks outdated nowadays as the USD is not convertible anymore. However, it is still possible to say that trust is the cornerstone of dollar dominance. The USD is a claim on the first world power and the world leading economy, and it also benefits from the monetary governance of the Fed. As a result, the USD is the currency fulfilling the best the traditional functions dedicated to money. It plays the role of global unit of account, it is used as a reliable mean of payment for international trade and it is used as reservation of value.
The second reason why the dollar is used as vehicle currency is the centrality and the level of development of the US financial markets. It leads many financial services to be available in the US dollar that are not in other currencies. It is one key explanation of the difference between developed and developing economies regarding invoicing. The latter have generally less diverse economies and are likely to be very dependent of the export of natural resources, for which global prices are very volatile. As a result they resort on hedge to stabilize their income, which is possible in a small number of currencies, the USD at the lead of them.

These approaches are focusing on the reasons why the dollar is attractive as invoicing currency. But we think reflection on this issue needs to take into account the constraints dollar invoicing carries. They are numerous. The first is the lack of sovereignty the use of a foreign currency implies. But the constraint we focus on in this research project is the ease of acquisition of the dollar. Indeed, the counterpart of dollar invoicing is the need to obtain dollar, which is not free of charge. To this extent the availability of dollar in the global financial system is a crucial point. The same is true for the cost of the acquisition, which makes the interest rate a key variable. Aldasoro and Ehlers, "Global Liquidity: Changing Instrument and Currency Patterns" and Avdjiev, McGuire, and Peter, "International dimensions of EME corporate debt" show that the dollar was previous to 2020 the first currency in global credit. A contribution of our work would be to link this state of fact with the status of vehicle currency

As a result, we are trying in this project to find an empirical link between the dollar availability and its use in the international trade. The latter is estimated using the share of dollar in invoicing. Our research hypothesis is that a higher cost of dollar on financial markets is reducing the volume of dollar global liquidity, which reduces the incentives to use dollar as an invoicing currency. We aim to find an effect of dollar cost on invoicing, but also to understand to what extent this effect could be due to the variation of dollar liquidity.
Finally, we get two causal relations to investigate and three variables for which an indicator is

required. We investigate both with panel regressions in first differences. In the first section we investigate the impact of dollar cost on global dollar liquidity. We reproduce the methodology of R. N. McCauley, McGuire, and Sushko, "Global Dollar Credit" who find a significant coefficient by regressing the dollar credit on the policy rate gap. In the second section we try to use a similar method to establish an effect between the volume of dollar global liquidity and the share of dollar in invoicing.

Some results in the literature makes the case for the relation we try to highlight. This is notably the case with Patel [2022] [2] who highlights a link between the rise of the US policy rate and a decline in dollar denominated exchange of manufactured goods between non US residents. Our work aims to investigate the causes of such a link as it takes as research assumption that the intermediate causal factor is the availability of dollar liquidity.

2 SECTION 2

In this section, we want to evaluate the effect of the dollar cost on the variation of dollar global liquidity. We use panel regressions in first differences.
We follow the methodology of R. N. McCauley, McGuire, and Sushko, "Global Dollar Credit" who run a similar analysis on 22 countries between 2000 and 2015. Our sample includes less countries but a higher number of years.

2.1 How to estimate dollar global liquidity and dollar cost ?

We aim to run a panel regression using two series of data : on one hand an indicator for the volume of dollar credit in a set of economies across time (dependent variable), on the other hand an estimation for the dollar cost of access (explaining variable). We need a proxy for both variables.

As a global liquidity indicator we use the dollar credit to non resident US which is the amount of dollar denominated debt in several geographical area. More precisely, the data we have access to allow us to distinguish 13 countries.[3].
The most simple way to estimate the access cost of dollar at global scale is to use the US federal policy rate, because it is supposed to determine the whole structure of interest rates. Nevertheless, the incentive to use the USD as vehicle currency results from an arbitrary between the cost of dollar and the cost of the local currency [4]. Because of this our explaining variable is the gap between the US policy rate and the other country's policy rate. [5]

2.2 Outlook and summary statistics

2.2.1 Domestic and offshore dollar credit

All the global dollar credit does not come from the US. On the contrary US creditors are nowadays a minority on the global dollar market, at the very least concerning dollar credit outside the US [6]. According to He and McCauley this is primary due to the activity of the US central bank in

[2] Dollar Invoicing, Global Value Chains, and the Business Cycle Dynamics of International Trade
[3] Data are available in the BIS database
[4] we assume others candidates as vehicle currency to be always less attractive than dollar
[5] Policy rates historical data are available in the BIS database on a quarterly basis.
[6] This is even more true when we consider only dollar denominated bank loans

swaps agreements. The Fed is very committed in preserving an abundant dollar offer on global markets in order to avoid dollar global shortage to interfere with the US internal monetary policies. Dollar emitted against other currencies in the context of swaps agreements become assets of non US financial institutions and are recycled in dollar credit all around the world.
Furthermore, since the global financial crisis of 2008, dollar flux even goes from the rest of the world to the US more than it cross the border in opposite direction(R. N. McCauley, McGuire, and Sushko, "Global Dollar Credit")[7]. Consequently dollar credit outside the US is not dependent of the tendencies followed by the US in term of liquidity volume. It is more correct to see the fluctuations of offshore USD credit as the result of an arbitrary by financial actors at global scale between the investment of their assets in our out the US. On key element of this arbitrary is then the gap of the yields of credit in the different geographical areas. It is this relation we are try to measure.

For the rest of this research project we will refer to "dollar denominated debt" as the debt whose borrower is located outside the US.

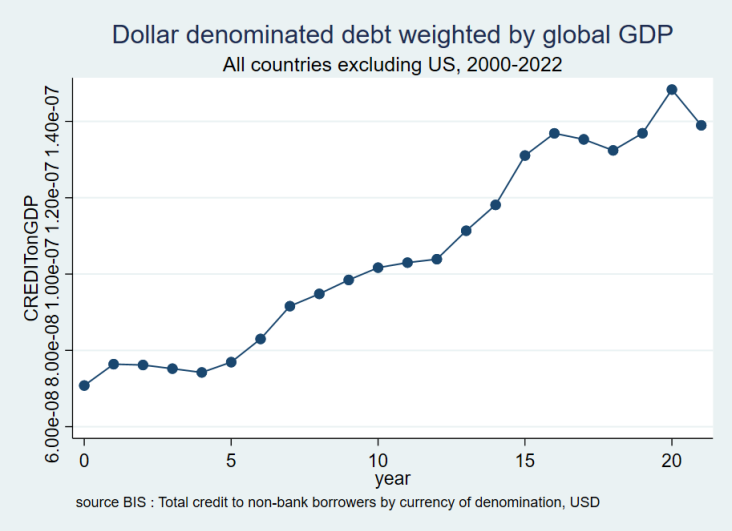
2.2.2 Tendencies of dollar denominated debt since 2000

Global dollar credit can be divided in two components. On one side US dollar bank loans, on the other side debt securities. In both cases, the data we take in the BIS statistics warehouse take only into account the credit to non banks On this point our data differ from McCauley and al because these authors use for bonds the credit to non financial sector while we use credit to non banks ans the borrower we use as reference is the ultimate borrower [8].

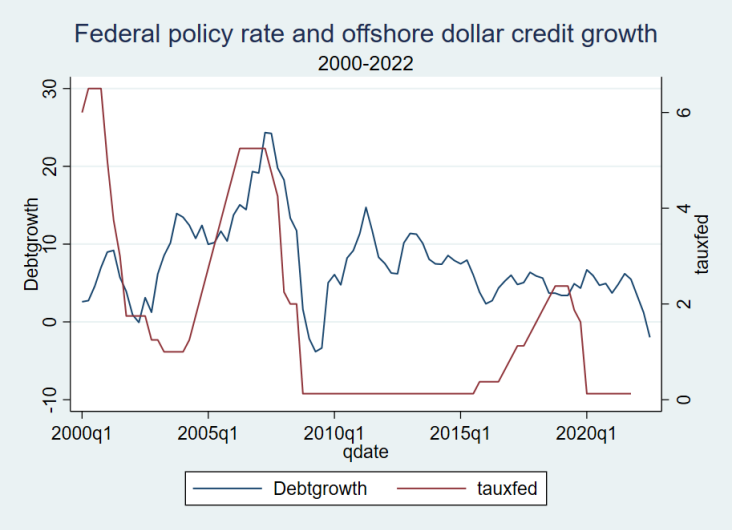
In september 2022, the volume of dollar denominated debt in all countries other than the US was 13 059 billions of USD. The graph below shows the evolution of the ratio dollar denominated debt outside the US over World GDP. The use of a ratio occurs for the fact that a nominal increase of dollar credit can be linked to a growth in the size of the world GDP.

[7] "banks headquartered outside the US shifted after the global financial crisis from a "net due to" position vis-à-vis their branches in the US to a "net due from" these branches" McCauley, McGuire and Sushko

[8] who has much less chance to be financial



As it can be seen, the growth of dollar denominated debt exceeds the growth of GDP most of the time. A key point to note is that there is no visible effect of the 2008 crisis (except a slowdown of dollar debt growth).
Regarding our research hypothesis, we should compare the dollar denominated debt graph with the evolution of the federal monetary policy stance. The policy rate of the fed is supposed to be the best proxy we get to estimate the cost of dollar. As a result we expect to see the volume of dollar denominated debt to grow when the federal policy rate is low.



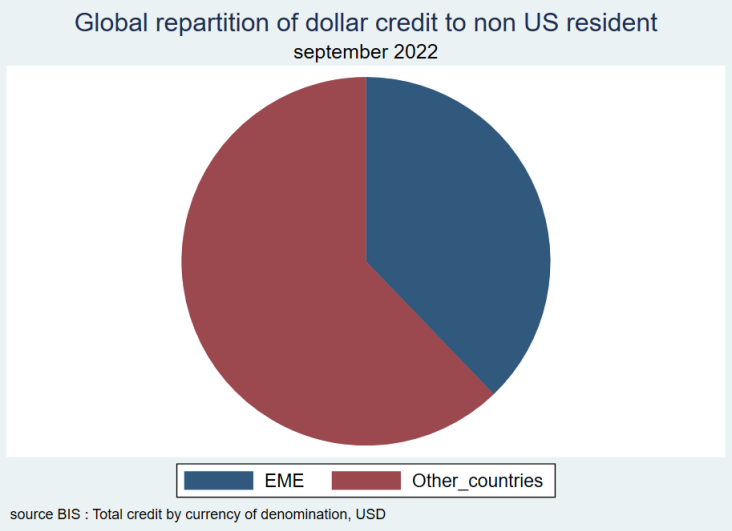
On the graph above, we overlay the quarterly evolution of dollar credit to non resident growth and the evolution of the policy rate of the federal reserve.
As it is possible to see there is no clear link between the two variables. Sometimes they seem to move together but it is probably linked to hidden variables, first of them being the GDP. We could

assume the very low policy rate to be responsible for the recovery of dollar credit after 2008 but there is no evidence when looking at the entire graph.

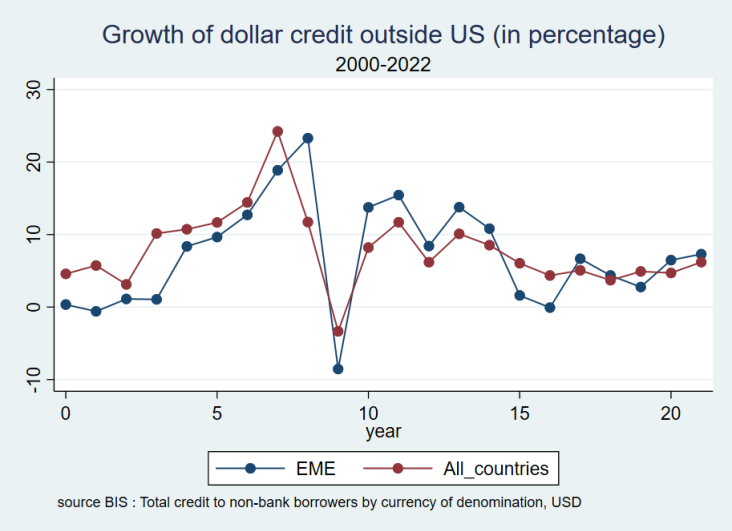
Of course, it is not enough to claim that the policy rate has no effect on offshore dollar credit. Indeed the incentive to borrow US dollar is not only linked to the cost of USD but also to the cost of domestic currencies. It is a pitfall we face in our empirical investigations by using policy rate gaps as explaining variable.
An other reason is the presumable existence of hidden variables. The most evident of them is the GDP growth rate. For example it is logical to see both dollar credit growth and policy rate fall between 2008 and 2010, these movements are consequences of the recession. Whatever, hidden variables and omitted variable bias are issues we will have to reckon with.

2.2.3 Composition of dollar denominated debts

Once the distinction between US and non US credit has been made, it is possible it is possible to elaborate the distribution of US dollar credit all around the world.

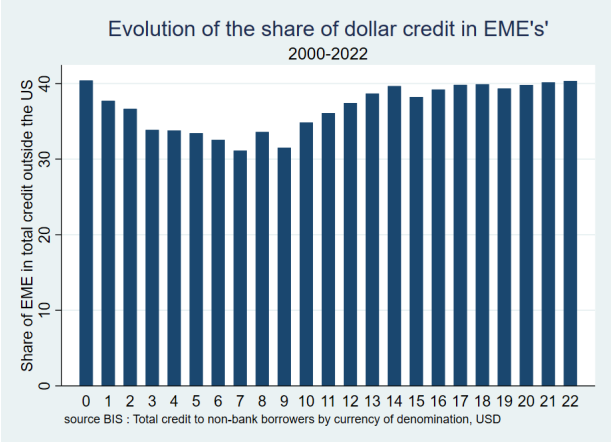


When it comes to the geography of dollar credit outside the US, there are also several patterns and tendencies to point out. What is very interesting to us and echos to the disparities in invoicing is the dichotomy between developed and developing countries.
As it is possible to see, 40 % of dollar denominated debt in september 2022 was located in Emerging markets and developing economies.



Before the great financial crisis of 2008, the growth of dollar credit in this type of countries was below the global average. It is possible to see on figure 5 that the growth of dollar credit was at its edge in 2007. In 2008 the fall does not occur first in EME's but it is even more brutal for them, which accounts for the fact that EME's are more dependent of the US market's mood but where hit in a second place. The very high growth of dollar credit in 2007 for EME's (25 % growth) could even be explained by a fly to quality effect, emerging economies being used as refuge markets for dollar assets. The 2008 crisis has a long term effect on the growth of dollar offshore credit, which never goes higher than 20 % for both groups of countries since then. However, dollar credit to EME's recovered much quicker than the total in the immediate post crisis period. However, both areas seems to converge toward a low growth at the end of the decade.

Previous depictions are consistent with the evolution of the share of EME's in the volume of global dollar denominated debt. As it can be seen on the graph below, the share of EME continuously decreases from 2000 to 2009, it recovers in the immediate aftermaths of the crisis to become stable at the end of the decade.



There is then every indications that the incentive for EME's to borrow dollar was particularly low before the 2008 crisis and particularly high from 2010 to 2014. We assume (and try to demonstrate) that this is linked to the cost of dollar. What we may look out to put this assumption to the test is the evolution of the federal monetary policy. Indeed the policy rate is the best proxy we can get for the global cost of dollar.

According to R. N. McCauley, McGuire, and Sushko, "Global Dollar Credit" the main destination of dollar credits is at least since 2008 the emerging economies having a relatively high interest rate. An example that has been particularly studied is China where various authors found that the federal policy rate is the best explaining variable for US dollar Credit Growth [9]. In the same vein Brzoza-Brzezina, Chmielewski, and Niedźwiedzińska, "Substitution between Domestic and Foreign Currency Loans in Central Europe. Do Central Banks Matter?" studied the impact on decisions of central banks in central and western Europe and concluded that the increase of policy rates was correlated to a higher use of foreign currency. These contributions suggest that a higher cost of domestic currency is an incentive to use foreign currency. On the contrary, Europe and Japan, where the monetary policy aimed to maintain the interest rate close to zero after the 2008 crisis are countries where dollar credit has lost ground in the last decade.

2.3 Methodology and data

2.3.1 Empirical strategy

A simple regression using these two series would face the problem of the existence of confounding variables, which is likely to cause an omitted variable bias. In order to face this difficulty there are several procedures available :

- We could introduce in the estimation equation variables that are the most likely to be omitted variables. However, the very high complexity of the processes we study makes very difficult to define the relevant variable to control by because the candidates are very numerous. We would then have no certainty the results are valid. Moreover, an empiric model which would take into account all the relevant variables would probably be too complex compared to the small sample we get.

[9] See for example Tang and Ng (2012)

- We could use an instrumental variable estimation, but this imply to find a variable causally linked to the interest rate gap but with no correlation to the dollar credit. We have no idea which variable could make the deal.
- It looks more practical to us (we follow on this McCauley, McGuire and Sushko) to use a first differences regression. It allows us to control all the confounding factors that are constant over time for a given country

In parallel, we use time dummies to control for specific events affecting each period of time and that are by definition not taken into account by the first differences. We also use country dummies to control for others factors that risk to affect the relation between policy rate gap and credit variation and are constant across time for each country.

At the end we try to estimate the following equation :

$$CRED_{it} = \alpha + \beta_0 PGAP_{it} + \text{Fixed effect} + \beta_{it} DUM_{it} + u_{it} \tag{1}$$

Where PGAP refers to the policy rate gap and DUM

The first differences method makes use of variation on the dependent variable and the fixed effect disappeared. At the very end we estimate :

$$\Delta CRED_{it} = \alpha + \beta_0 + \beta_{it} DUM_{it} + u_{it} \tag{2}$$

It is this last equation we use finally. The following paragraph details the transformation we apply to the data to make them suitable for a first difference regression.

2.3.2 Data treatment

The data we use for the dollar denominated debt variations outside the US comes from the BIS public database global liquidity, dollar credit to non resident by currency of denomination. These are good quality data available on a quarterly basis between 2000 and 2022. Several geographical areas are distinguished among which 13 countries, most of them being developing economies [10]. It is less than the sample of McCauley and al which contains 22 economies, some of them being developed countries.
It would have been possible to obtain a wider range of country by having access to private data from the BIS. Unfortunately, the access was denied to us. We also try to rebuilt the data we missed for developed countries. According to the methodology shared by the BIS **ref du doc** dollar credit to non resident US comes from the aggregation of three components : cross border bank loans in USD, debt securities is USD and local loans in USD. We found in the BIS data warehouse the two first components, but local loans are available only for five countries [11]. The aggregation procedure was then complex for little benefits concerning the size of the sample. We therefore choose to use only the data directly available in the BIS database.

As a result, our sample includes less countries than the one used by McCauley, McGuire and

[10] China, India, Brazil, South Africa, Argentina, Chile, Malaysia, Mexico, Korea, Indonesia, Russia, Saudi Arabia, Turkey

[11] Japan, UK, Switzerland, France, Germany

Sushko and there is no developed countries in it. [12] We use however a higher number of years because our data stop in 2022 instead of 2015.

To makes the dollar credit to non resident US usable as dependent variable of a first differences we weight the data for each period with the GDP. We then calculate the quarterly variation f this ratio for each period. The GDP weighting is useful to suppress the increase tendencies in the dollar credit that are due to long term increase of the size of economies.

The formula for the dependent variable is then the following :

$$\Delta CRED_{it} = \frac{CRED_{it}}{GDP_{it}} - \frac{CRED_{i,t-1}}{CRED_{i,t-1}} \tag{3}$$

Concerning the policy rate gap, the only transformation we try to apply is to put a lag[13]. The results are described

2.4 Results

2.4.1 Results for the variation of Credit over GDP ratio

We conduct analysis on the ratio of the dollar credit to non US residents on GDP on the sample presented above. We try to identify heteroskedasticity in our observations by conducting Breusch-Pagan tests and autocorrelation by conducting Cook-Weisberg tests. The results table are available in the annex section. Regarding these results, we conduct appropriate regression methods to address these issues. First of all, we intend to identify a relationship between the dollar credit to non US residents and the difference bewteen the key interest rate of the domestic central bank of each country and the key interest rate of the Federal Reserve. This regression conducted on panel data is subject to omitted variables bias. Therefore, these results (table 1) are not robust enough to be taken in account, but they pave the way for further analysis as they suggest our approach is not absurd.

	Credit/GDP
KIR Diff.	0.00335*
	(2.56)
_cons	0.571***
	(3.72)
N	838

R2=0.0116 t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001

table 1

Even though the coefficient is equal to 0.00335, the use of the difference between the key interest rates as the explanatory variable seems relevant according to the test's results.

[12] The case of Korea might be discussed

[13] McCauley, McGuire and Sushko use a one quarter gap in their study. It is what the best result according to them.

Our main analysis use the first differences method in order to control for all the confounding factors that are constant over time for a given country. In addition, we compare the results we get from regressions without control variables with those we get from regressions with time and country dummies to better understand the part of the explanatory variable's effect absorbed by shocks and countries' specificities.
From now on, we use the variation of the previous ratio from a period to the next one, i.e. $\frac{Credit_{i,t}}{GDP_{i,t}} - \frac{Credit_{i,t-1}}{GDP_{i,t-1}}$ as the explained variable. We use two different explanatory variables to conduct several regressions. We firstly use the difference bewteen the key interest rate of the domestic central bank of each country and the key interest rate of the Federal Reserve in order to recreate the results found by R. N. McCauley, McGuire, and Sushko, "Global Dollar Credit". Then, we use the credit-to-GDP gap statistic computed by the Bank of International Settlements in order to identify the effect of the difference between the credit-to-GDP ratio and its long-run trend on its variation on the short-run. The results are presented in the table bellow (table 2).

Results summary

Explained variable	Explanatory variable	F-stat	p-value	Coefficient	R2	Dummies
Debt over GDP	KIR difference	0.011	0.011	0.003*	0.012	No
Var. Debt over GDP	KIR difference	0.877	0.877	0.000	0.000	No
Var. Debt over GDP	KIR difference	0.000	0.239	0.001	0.321	Yes
Var. Debt over GDP	lag KIR difference	0.000	0.422	0.000	0.319	Yes
Var. Debt over GDP	Var. KIR difference	0.000	0.053	0.003	0.322	Yes
Debt over GDP	Credit to GDP Gap	0.000	0.000	0.008***	0.068	No
Var. Debt over GDP	Credit to GDP Gap	0.000	0.000	0.0011***	0.021	No
Var. Debt over GDP	lag Credit to GDP Gap	0.078	0.078	0.001	0.005	No
Var. Debt over GDP	Credit to GDP Gap	0.000	0.003	0.0010**	0.323	Yes

table 2

Var. Debt over GDP is the variation of the ratio $\frac{Credit_{i,t}}{GDP_{i,t}}$ from a period to another, KIR difference is the difference between the key interest rate of country i's central bank and the Federal Reserve's one, lag KIR difference is the same variable but at the period t-1, Var. KIR difference is $KIRdifference_t - KIRdifferencet - 1$, Credit to GDP Gap is the credit-to-GDP gap statistic, and lag Credit to GDP Gap is the same variable but at the period t-1. The first line of table 2 corresponds to the regression presented in table 1.

Firstly we regress Var. Debt over GDP on the KIR difference, such that we find values for:

$$\Delta\frac{Credit}{GDP} = \alpha + \beta_1(lag)KIRdifference(+\beta_i DUM_i) + u$$

.

Results for KIR difference

Explained variable	Explanatory variable	F-stat	p-value	Coefficient	R2	Dummies
Debt over GDP	KIR difference	0.011	0.011	0.003*	0.012	No
Var. Debt over GDP	KIR difference	0.877	0.877	0.000	0.000	No
Var. Debt over GDP	KIR difference	0.000	0.239	0.0006	0.321	Yes
Var. Debt over GDP	lag KIR difference	0.000	0.422	0.000	0.319	Yes
Var. Debt over GDP	Var. KIR difference	0.000	0.053	0.003	0.322	Yes

table 3

Without the dummies to control for countries' specificities and shocks over time, the correlation is statistically insignificant with a p-value of 0.877 and a coefficient approaching zero. Therefore, we can not conclude that a variation in the difference between the domestic central bank's key interest rate and the Federal Reserve's key interest rates impacts significantly the change in the ratio $\frac{Debt}{GDP}$ from a period to the next one. We see in this case that useful dummy variables used to control for heterogeneity don't change this conclusion. When regressing $\Delta\frac{Credit}{GDP}$ on the KIR difference and the country and time dummies, we find a statistically insignificant correlation between $\Delta\frac{Credit}{GDP}$ and the KIR difference. The downside of this analysis is it makes the model less generalizable, but it was not our goal in the first place. Thus, we can conclude that a variation of one percentage point in the KIR difference has statistically no impact on the variation in the ratio $\frac{Credit}{GDP}$ between two periods, with nearly 24% risk.
It can also be noted that our results differ from McCauley, McGuire and Sushko's ones: the relationship bewteen $\Delta\frac{Credit}{GDP}$ and lag Kir difference is less significant for our sample than for theirs. The coefficient we find is even lower than the coefficient they find. This can be explained by the way the samples we use differ from theirs: ours includes less countries, which are all developing countries, and the period we study goes up to 2020 while theirs stops in 2015. Therefore, either developing countries' indebtedness is less sensitive to a variation in the KIR difference, or the relationship they find changes overtime after 2015.
In addition, unlike McCauley, McGuire and Sushko, we find that regressing $\Delta\frac{Credit}{GDP}$ on the $KIRdifference_t$ might be more relevant than regressing $\Delta\frac{Credit}{GDP}$ on $KIRdifference_{t-1}$. It can be assumed that, because of the central banks' tendency to display information on their policies in advance, agents are able to anticipate the KIR difference of the next period, which would explain why they would take in account $KIRdifference_{t+1}$ instead of $KIRdifference_t$, explaining why we found this difference in significancy bewteen $KIRdifference_t$ and $KIRdifference_{t-1}$. This hypothesis needs further investigation to be verified.
Eventually, it can be noted that applying first differences to KIR difference, i.e. regressing $\Delta\frac{Credit}{GDP}$ on $\Delta KIRdifference$, gives more significant results, producing a coefficient equal to 0.003 and reducing the p-value from 0.239 to 0.053. This can be related to a potential non-stationarity of the KIR difference series, but this point also needs further investigation.

Secondly, we regress Var. Debt over GDP on Credit to GDP Gap, such that we find values for:

$$\Delta\frac{Credit}{GDP} = \mu + \beta_1'(lag)CredittoGDPGap(+\beta_i'DUM_i) + u$$

Results for Credit to GDP Gap

Explained variable	Explanatory variable	F-stat	p-value	Coefficient	R2	Dummies
Debt over GDP	Credit to GDP Gap	0.000	0.000	0.008***	0.068	No
Var. Debt over GDP	Credit to GDP Gap	0.000	0.000	0.0011***	0.021	No
Var. Debt over GDP	lag Credit to GDP Gap	0.078	0.078	0.001	0.005	No
Var. Debt over GDP	Credit to GDP Gap	0.000	0.003	0.0010**	0.323	Yes

table 4

The regression of $\frac{Credit}{GDP}$ on the credit-to-GDP gap is likely to be as biased as the first regression presented in this section because it does not apply the first differences model to the ration $\frac{Credit}{GDP}$. Therefore, it has the same goal as the first regression, and paves the way for further analysis. Without the dummy variables controlling for countries' specificities and time, the correlation between $\Delta\frac{Credit}{GDP}$ and the credit-to-GDP gap is statistically significant. A variation of one unit in the difference between the current and long-run ratio $\frac{Credit}{GDP}$ implies a positive variation of 0.0011 unit in the difference between the ratio $\frac{Credit}{GDP}$ from a period to the next one. Therefore, a change in the indebtedness trend from the long-run trend has a small impact on the variation of indebtedness from a quarter to the next one. Adding dummy variables to control for countries and periods seems to comfort that conclusion because it slightly impacts the significancy of the relationship and slightly changes the coefficient associated to the credit-to-GDP gap variable.
In addition, we shed the light on the statistical insignificancy of the relationship between $\Delta\frac{Credit}{GDP}$ and the lagged credit-to-GDP gap. It could imply that past information on the deviation from the indebtedness long-run trend are less taken in account than the agents' anticipations of their future needs in terms of USD stocks. This hypothesis would need further investigations in order to be tested.

From our first analysis, we learn that the variation of the $\frac{Credit}{GDP}$ ratio from a period to another, i.e. the variation of dollar indebtedness of non US residents weighted by the GDP, might not be impacted by the difference between the domestic central bank's key interest rate and the Federal Reserve's key interest rate, but is affected by the credit-to-GDP gap. Even if the influence of the explanatory variables are on the $\frac{Credit}{GDP}$ ratio seems limited, the correlations remain statistically significant. The analysis might also benefit from a wider and diversified sample of countries. Our contribution to this research field is finding these results with a sample composed of developing countries, on a longer time period than the one used in previous works. In addition, we found a robust correlation between $\Delta\frac{Credit}{GDP}$ and the credit-to-GDP ratio that had not been investigated before. Eventually, we propose improvement paths for further research on that matter.

3 Section 3

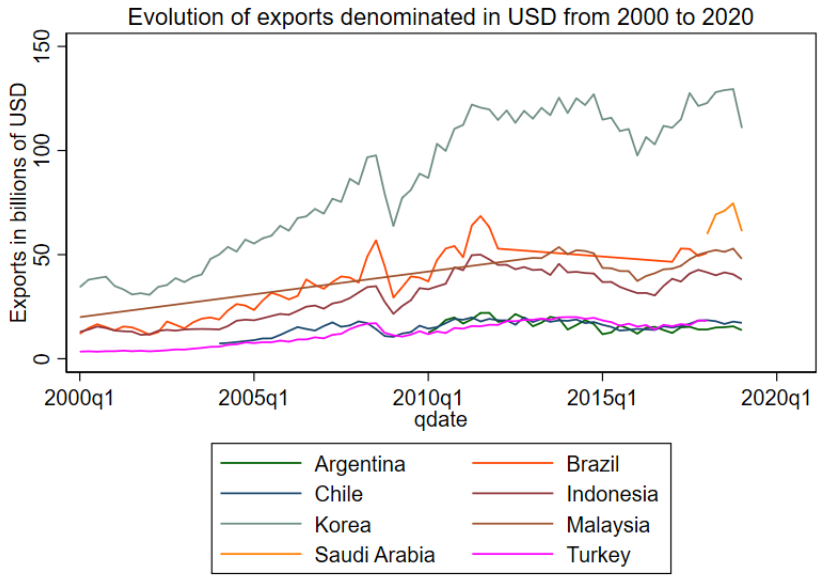
The second part of this project consists of understanding the relationship existing between the dollar invoicing, assimilated to the part of the exports denominated in USD for each country of our sample, and the variations of the Credit over the GDP. We assume a higher dollar liquidity makes more easy to get dollars which is an incentive to use the USD as a vehicle currency. We use similar

analysis in this section than in the previous one : panel first differences.

3.1 'Invoicing quarterly' dataset:

The invoicing data are less easy to find than global liquidity indicators. The most accurate database available comes from the IMF. However this database provides annual data (with in addition many missing values). What we decided to do was then to rebuilt a quarterly database to make the invoicing data match with the dollar liquidity data.

As a result one of this paper's contributions is the creation of an original dataset based on Boz et al., "Patterns of invoicing currency in global trade: New evidence"'s yearly invoicing dataset. We use their contribution and the UN Comtrade data to construct the yearly nominal values of the dollar invoicing for Boz and al.'s set of countries. Then, we construct the quarterly data by linearly linking the values of each first quarter of each year. This method could imply bias such as autocorrelation or could generate correlations that would not exist otherwise. We intend to address these issues with the regression method we use to deal with autocorrelation and heteroskedasticity. In addition, this dataset is valuable because it provides much more useful observations than the original one by Boz and al., allowing us to conduct more accurate regressions. Because of the reduced set of countries we use, we have data for eight countries listed in the graph below. A wider dataset can be reproduced while reproducing this paper's results.



We are pretty confident in the estimates we obtain from the series including many yearly values. For example, the quarterly data we obtain for Korea, Brazil, Indonesia, Argentina, and Turkey seem accurate. We can notice the 2008-2009 drop we were expecting because if the financial crisis which crippled international trade. Nevertheless, some data would benefit from further investigation, such as the quarterly estimates for Malaysia or Saudi Arabia.

3.1.1 Results for yearly dollar invoicing

The second part of this project consists of understanding the relationship existing between the dollar invoicing, assimilated to the part of the exports denominated in USD for each country of our sample, and the variations of the Credit over the GDP. In addition to identify a possible robust correlation between these variables, we intend to estimate the significancy to apply the results of the regressions of $\Delta\frac{Credit}{GDP}$ to the regressions of the variations of the dollar invoicing. The results we came up with are presented in table 5 below:

Results for Invoicing Yearly

Explained variable	Explanatory variable	F-stat	p-value	Coefficient	R2	Dummies
Var Export USD	Var. Debt/GDP	0.000	0.000	0.0005***	0.232	No
Var. Export USD	Var. Debt/GDP	0.000	0.172	-7.986	0.419	Yes
Var. Export USD	KIR difference	0.074	0.074	0.000	0.037	No
Var. Export USD	KIR difference	0.000	0.515	0.016	0.429	Yes

table 5

Var. Export USD is the variation of the part of the exports denominated in USD in the total exports of each country of our sample (i.e. $\Delta Invoicing$), Var. Debt/GDP is the variation of the credit denominated in USD over the GDP (i.e. $\Delta\frac{Credit}{GDP}$), and KIR difference is the difference between the central banks' key interest rate and the Federal Reserve's key interest rate.

Firstly, we analyse the relationship between $\Delta Invoicing$ and $\Delta\frac{Credit}{GDP}$. This relationship is part of our fundamental hypothesis. We use variations as variables in order to use a first differences model for the same reasons as previously because we assume the nonstationarity of the credit, the GDP, and the invoicing. We regress $\Delta Invoicing$ on $\Delta\frac{Credit}{GDP}$, such that we find values for:

$$\Delta Invoicing = \lambda + \delta_1 \Delta \frac{Credit}{GDP}(+\delta_i DUM_i) + u$$

Results for Var Debt/GDP

Explained variable	Explanatory variable	F-stat	p-value	Coefficient	R2	Dummies
Var Export USD	Var. Debt/GDP	0.000	0.000	0.0005***	0.232	No
Var. Export USD	Var. Debt/GDP	0.000	0.172	-7.986	0.419	Yes

table 6

The correlation between $\Delta Invoicing$ and $\Delta\frac{Credit}{GDP}$ is statistically significant, without dummy variables to control for countries' specificities and periods. If we accept a 17.2% risk, we can assume that the correlation is statistically significant with the dummy variables. Adding controls to the regressors slightly impacts the p-value associated to $\Delta\frac{Credit}{GDP}$ changing it from 0.000 to 0.172. Coefficients associated to $\Delta\frac{Credit}{GDP}$ are the highest we got from the tests we conducted yet. If the relationship were statistically significant, the impact of a one unit variation in $\Delta\frac{Credit}{GDP}$ would generate a diminution of approximatively 8 percentage points in the part of exports denominated in USD in the total exports of each country of our sample. Something might be happening here, therfore this attempt is paving the way for further investigations. We assume it would benefit from the larger sample, and more observations we could get by constucting a dataset with quarterly invoicing values instead of yearly values. In addition, identifying other relevant variables might increase the accuracy or our approach.
We note that the sign of the coefficient we get is not what we expected. We assumed that an increase in the credit denominated in USD would imply an increase in production and in the part of exports denominated in USD. Thus, either the correlation is not significant at all, or our hypothesis need to be improved: for example, we could assume that the new credits contracted were used elsewhere (on stock markets, or to import instead of producing). Then, we could work this regression out again with more variable to increase its accuracy. This path could be investigated in further research.

Secondly, we regress Var. Export USD on the KIR difference in order to estimate a possible relationship between the variation of the dollar invoicing and an explanatory variable we used to explain the variation in the credit on GDP ratio. We find values for:

$$\Delta Invoicing = \lambda' + \delta_1' KIRdifference(+\delta_i DUM_i) + u$$

Results for KIR Difference

Explained variable	Explanatory variable	F-stat	p-value	Coefficient	R2	Dummies
Var. Export USD	KIR difference	0.074	0.074	0.000	0.037	No
Var. Export USD	KIR difference	0.000	0.515	0.016	0.429	Yes

table 7

The correlation between $\Delta Invoicing$ and the KIR difference is not statistically significant with and without the dummy variables. When we implement dummies as regressors, the regression gets more accurate, and the p-value associated to the KIR differences increases from 0.074 to 0.515. The KIR difference might not have an impact on the variation of dollar invoicing. Therefore, to pretend to extend the results we get from the regression of $\Delta\frac{Credit}{GDP}$, we would need to improve the accuracy of the first regressions in order to explain the larger part of the variation of the Credit over GDP

ratio overtime. By doing so, we would be able to understand the role of each explanatory variable in the variation in dollar invoicing, assuming the regression of $\Delta Invoicing$ on $\Delta\frac{Credit}{GDP}$ is effectively promising.

3.1.2 Results for quarterly dollar invoicing

In this section, we use the dataset we constructed to estimate the quarterly values of the dollar invoicing. We remind the reader that these estimates are not always the most accurate, but we consider they are accurate enough to provide telling results. We conduct the same analysis than the ones we conduct on the yearly values of dollar invoicing. Table 8 presents these results.

Results for Invoicing Quarterly

Explained variable	Explanatory variable	F-stat	p-value	Coefficient	R2	Dummies
Var Export USD	Var. Debt/GDP	0.000	0.000	-1.41e+10***	0.045	No
Var. Export USD	Var. Debt/GDP	0.000	0.254	3.72e+09	0.505	Yes
Var. Export USD	KIR difference	0.074	0.204	-1.70e+10	0.002	No
Var. Export USD	KIR difference	0.000	0.383	2.09e+07	0.512	Yes

table 8

These results seem to be consistent with the one we get from the regressions conducted on the yearly dataset. In other words, we find that $\Delta\frac{Credit}{GDP}$ seems accurate to understand the variations of the dollar invoicing overtime, whereas the KIR difference seems to be slightly less likely to impact $\Delta\frac{Credit}{GDP}$

The coefficient we get from the regression of $\Delta Invoicing$ on $\Delta\frac{Credit}{GDP}$ seems odd regarding our hypothesis due to its negative sign. This contradiction is corrected when we add dummy variables in order to control for heterogeneity. Even though this correlation is not statistically significant, the high coefficient might indicate that this relationship is worth exploring this path: if we accepted a risk of 25%, we might say that an increase of 1% in the ratio $\Delta\frac{Credit}{GDP}$ would provoc an increase of $3,720,000,000 of the exports denominated in USD. This value seems high, but is actually in line, if not moderate, with the values of exports denominated in USD in our sample. In addition, This result seems to match our expectations regarding the relationship that might exist between credits denominated in USD and the dollar invoicing in international trade. Nevertheless, this analysis would probably benefit from further investigation, especially with a wider sample and more control variables.

The correlation between $\Delta\frac{Credit}{GDP}$ and the KIR difference suffers from the same contradiction than the previous one regarding the sign of the coefficient. It seems to be corrected in the same way by adding dummy variables. The p-value is higher than the previous one, reaching 0.383. Nevertheless, the coefficient associated to the KIR Difference is consistent with our hypothesis, and finding a way to make the correlation more accurate migth be beneficial for our analysis. In addition, keeping in mind our hypothesis and previous analysis, it does not seem absurd that an increase in 1% in the

KIR Difference might imply an increase of $20,900,000 in the exports denominated in USD. We suggested this might be caused by and increase in an increase in $\frac{Credit}{GDP}$ overtime, itself caused by an increase in the KIR Difference as stated in the literature, but we could not prove it in this paper for the reasons we mentioned above.
Still, these results seems promissing, and almost in line with our hypothesis, encouraging us to pursue our investigations.

3.2 Discussion of the limitations

As it has been said, our results are not very significant. What's more we fail to reproduce the results of R. N. McCauley, McGuire, and Sushko, "Global Dollar Credit". Several reasons can be advanced to explain that fact.

First of all, our data differs from those of the authors. Indeed we can account for less countries and more years. The lack of diversity in our sample must have an effect on the estimators accuracy, while it is possible (but we have no way to demonstrate it) that the years between 2014 and 2022 makes the result for previous years obsolete. In the same vein, we have been forced to rebuilt the data for quarterly GDP by our own calculations, a work McNauley and al. presumably not have to do by themselves. It is possible for us to have made mistakes in the process. These are ways to explore. However it will not be possible to face any of these issue without a wider range of countries in our sample.

An other point to highlight deals with the limits of the first differences method. This method control only for the confusing factors that are constant for the countries over time. If their is still endogeneity in the error term beyond the fixed effects, it implies a bias in the estimator. It is always the same problem of the identification of omitted variables that is very difficult.

However, one solution would be to take into account the variations of total credit (and not only USD credit). Indeed, most of the confusing factors that might impact the US dollar credit in a given country are also likely to have an impact on the global volume of credit. Some variations of dollar credit could then be attribute to variations of the whole credit, it would get out of the analysis. To run this method we could use the change in non USD credit as a control variable in our regressions. Otherwise, we could change the dependent variable from the change in the volume of dollar credit to the change in the share of USD in total credit.

The explaining variable we use is also questionable. The policy rate is a synthetic indicator of the cost of a currency, as it is supposed to impact the whole rate structure. However, this indicator also have limitations. It does not account for the variety of interest rates in an economy and there is no reasons to think that the way it impacts the rate structure is the same over time and space. That's a clear problem because if a given level of policy rate doesn't impact the cost of dollar the same way at two different periods of time, then we are running a regression on variable that doesn't make sense.

A similar issue is the one of the scale of the gap effect. It is possible that a 6 rate points gap

has a grater impact on dollar credit than a 3 rate points gap but this effect do not have to be 3 times bigger. And a gap between interest rates of 1 and 4 is not necessarily equivalent to a gap between 10 and 13. To put it differently, the relation we are looking at might be nonlinear. In this case, the solution would be to apply a log to the explaining variable but this leads to other problems such as : how to apply a log to a variable that which takes negative values and inferior to one values.

The last problem we face concerning the explaining variable is the non conventional monetary policies issue. Since 2008 there have been several periods during which the federal policy rate remained stuck to the zero lower bound. In this context, the policy rate doesn't account for the fluctuation of the monetary policy stance. But the cost of dollar liquidity is still impacted by the non conventional monetary policies. As a result our estimation of the cost of dollar is presumably wrong for the last decade.
To overcome this issue, we would need a indicator taking into account the non conventional monetary policies. The size of the Federal Reserve balance sheet is a possibility but it is necessary to make it sizable with the policy rate variations, which are after all the best indicator we get for the years without non conventional monetary policy. What's more, these policies are larger than quantitative easing and difficult to apprehend .

Whatever, these reflections do not explain why we fail to reproduce the result from the article of McCauley, McGuire and Sushko.

4 Annex:

Tests for heteroskedasticity and autocorrelation Credit over GDP

Regression	Heteroskedasticity test p-value	Heteroskedasticity	Autocorrelation test p-value	Autocorrelation
Credit/GDP on KIR Diff.	0.000***	YES	0.000***	YES
var. Credit/GDP on KIR Diff.	0.082	YES	0.049*	YES
var. Credit/GDP on KIR Diff. & Dummies	0.085	YES	0.009**	YES
var. Credit/GDP on lag. KIR Diff. & Dummies	0.118	UNSURE	0.009**	YES
var. Credit/GDP on var. KIR Diff. & Dummies	0.065	YES	0.009**	YES
Credit/GDP on Credit to GDP Gap.	0.234	UNSURE	0.000***	YES
var. Credit/GDP on Credit to GDP Gap.	0.007**	YES	0.073	YES
var. Credit/GDP on lag. Credit to GDP Gap.	0.000***	YES	0.087	YES

Heteroskedasticity test: Breusch Pagan/Cook Weisberg test for heteroskedasticity/H0=Constant variance;
Autocorrelation test: Wooldridge test for autocorrelation in panel data

Tests for heteroskedasticity and autocorrelation Invoicing Yearly

Regression	Heteroskedasticity test p-value	Heteroskedasticity	Autocorrelation test p-value	Autocorrelation
var. Export USD on var. Credit/GDP	0.000***	YES	0.000***	YES
var. Export USD on KIR Diff.	0.033*	YES	0.004**	YES
var. Export USD on var. Credit/GDP & Dummies	0.055*	YES	0.012*	YES

Heteroskedasticity test: Breusch Pagan/Cook Weisberg test for heteroskedasticity/H0=Constant variance;
Autocorrelation test: Wooldridge test for autocorrelation in panel data

Tests for heteroskedasticity and autocorrelation Invoicing Quarterly

Regression	Heteroskedasticity test p-value	Heteroskedasticity	Autocorrelation test p-value	Autocorrelation
var. Export USD on var. Credit/GDP	0.156	UNSURE	0.782	NO
var. Export USD on KIR Diff.	0.0001***	YES	0.695	NO
var. Export USD on var. Credit/GDP & Dummies	0.0006***	YES	0.753	NO

Heteroskedasticity test: Breusch Pagan/Cook Weisberg test for heteroskedasticity/H0=Constant variance;
Autocorrelation test: Wooldridge test for autocorrelation in panel data

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