FINANCIAL DOLLARIZATION AND BUSINESS CYCLE UNCERTAINTY: EVIDENCE FROM THE DEMOCRATIC REPUBLIC OF THE CONGO

By

KIZIR, Jonathan

THESIS

Submitted to

KDI School of Public Policy and Management

In Partial Fulfillment of the Requirements

For the Degree of

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Committee in charge:

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Financial Dollarization and business cycle uncertainty: Evidence from the Democratic Republic of the Congo

Abstract

This thesis estimates the stochastic relationship between financial dollarization and business cycle uncertainty using quantile regression technique over the period 2000 to 2015. We do not find strong evidence of a significant effect of business cycle uncertainty on financial dollarization in the Democratic Republic of the Congo. Inflation negatively affects dollarization from lower quantiles to higher quantiles. However, the effect is statistically insignificant. The oil price index has a positive influence on dollarization but the effect is statistically insignificant as well. Other control variables have no significant effect on dollarization (net exports, investment and government consumption). We attribute dollarization hysteresis in DRC to a memory effect in economic agent's mind: lack of trust in monetary authorities due to past hyperinflation and macroeconomic instability back in the 1990s and the early 2000s. We also attribute dollarization inertia to positive network externalities. Constant exchange rate depreciation is another cause of dollarization hysteresis. On top of all, political instability in DR Congo is a serious cause of dollarization inertia. We recommend a sustainable dedollarization process in DRC.

Keywords: Financial dollarization, business cycle uncertainty, quantile regression.

Acknowledgements

I would like to thank Professor Choi Tae-Hee for his willingness to supervise this thesis in spite of his busy schedule. I am also grateful to Professor Shin Jaeun for being a member of the POS committee.

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Financial Dollarization and business cycle uncertainty: Evidence from the Democratic Republic of the Congo

1. Introduction

The main objective of our thesis is to explore the effect of business cycle uncertainty on financial dollarization in the Democratic Republic of the Congo (DRC). Financial dollarization is captured through foreign currency deposits. In order to capture business cycle uncertainty, the inflation rate (consumer price index) and the oil price index are employed.

Most developing countries are confronted with financial dollarization (Banos, 2014). Latin America has been affected by dollarization since the 1970s (Argentina, Peru, Bolivia, Belize, Costa Rica, Dominican Republic, El Salvador, Mexico, Nicaragua, Panama, etc.). This phenomenon also occurred in the Middle East and Africa in the 1980s and 1990s (Angola, Egypt, Lebanon, Zambia, Liberia, Zimbabwe, Zaire (former name of DRC) (Duchêne and Goujon, 2006; Lindenberg and Westermann, 2010). Dollarization is persistent in DRC despite the government and the central bank's efforts to dedollarize the economy. This situation results from macroeconomic instability and hyperinflation the country went through back in the 1990s as well as in the early 2000s. In spite of disinflation from 2000 to 2015 thanks to a good policy mix, the deposit dollarization rate has sky-rocketed from 53% to 83%.

As figure 1 shows, the economy of DR Congo is highly dollarized.

Figure 1: Recent trends in deposit dollarization in DR Congo (2000-2015)
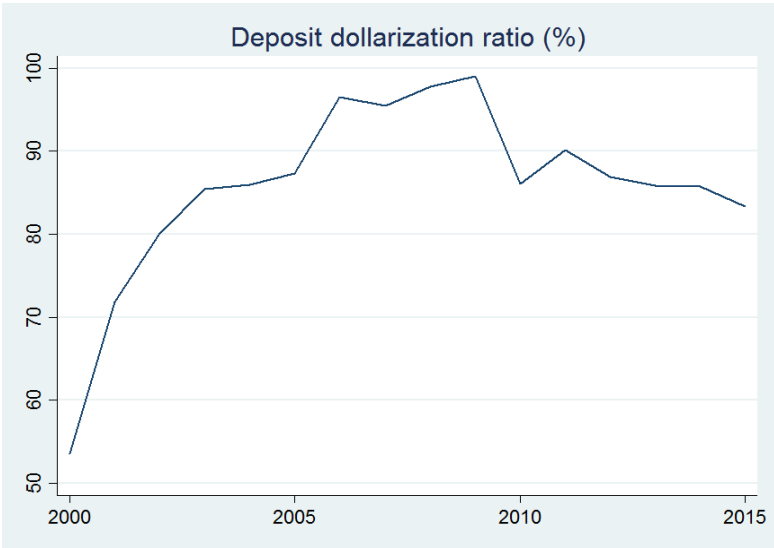
Source: Central Bank of Congo

As figure 2 shows, a good policy mix allowed for disinflation in DRC. However, as above-mentioned, the dollarization rate has still been increasing.

Figure 2: Inflation rate in DR Congo (2000-2015)

Source: Central Bank of Congo

Financial dollarization occurs when part of assets or liabilities of residents are held in a foreign currency (Ize and Yeyatti, 2003).The foreign currency could be any currency being

used frequently in a country instead of the local currency, not necessarily the US dollar (Reinhart, Rogoff,α Savastano, 2003)."Large macroeconomic imbalances and hyperinflation" have been identified by some researchers as possible causes of dollarization. They argue that this severe instability results in the substitution of the local currency for a foreign one (Galindo and Leiderman, 2005; Herrera and Valdés, 2005, as cited in Duma, 2011, p 5). "Financial repression and capital controls" have also been pointed out as other possible causes of dollarization (Reinhart et al, 2003, p43).

Kokenyne, Ley and Veyrune (2010) argue that dollarization continues even after macroeconomic stability gets re-established because economic agents do not trust the local currency. Dollarization causes the central bank of the relevant country to lose control of its monetary policy and its exchange rate policy. A dollarized country loses its seignorage revenue which gets diverted to the homeland of the foreign currency. Foreign exchange risk increases in the financial system and other sectors of the economy(Duma, 2011; Kokenyne et al, 2010).

There has been increasing interest in better understanding the determinants of dollarization. Deposit dollarization is said, by several researchers, to be determined by inflation, the expectation of exchange rate depreciation and interest rate spreads between local and foreign currency deposits (Clements and Schwartzs, 1992; Adam, 2013). Neanidis and Savva (2009) establish that banks matching of domestic loans and deposits, institutional quality and financial integration are the main drivers of short-run loan dollarization. They further assert that both deposit dollarization and loan dollarization are determined by interest rate spreads. Banos (2014)finds that economic development in Latin America is negatively affected by dollarization. Edwards (2001) investigates the economic performance of fully dollarized economies. He finds that in comparison to other countries, dollarized countries have a lower growth rate and lower inflation. Edwards and Magendzo (2001) examine the relationship

between dollarization, lower inflation and faster growth. They find that dollarized nations have a lower inflation and lower rate of GDP per capita growth. However, little is known about financial dollarization and business cycle uncertainty in DRC to date. This study attempts to fill this gap in the existing body of literature and contribute to the ongoing debate in regard to dollarization. The results of this study will have some policy implications for the authorities of DRC in the matter of dedollarization.

The hypothesis we would like to test is: whether business cycle uncertainty affects dollarization in DRC.

The research methodology is based on quantile regression.

This paper is organized as follows: in chapter two, we present the existing body of literature on financial dollarization. In chapter three, we present the data used. In chapter four, we present the methodology used. In chapter five, we present the main results of our study.

2. Literature review

2.1. Overview

2.1.1. Dollarization

a) Types of dollarization

Reihnart, Rogoff and Savastano (2003) observe that before the Asian financial crisis in the 1990s, the main charasterisitc of a dollarized country was the fact that residents' assets are held in a foreign currency. They further point out that after that period, the concept "dollarization" was also described as the situation of a country officially deciding to substitute a foreign and stable currency for the local one.

They additionally assert that there are two types dollarization: *partial dollarization* (financial dollarization) and *full or official dollarization*. The former refers to the situation of a country where part of residents' assets (or liabilities) is held in one or several foreign currencies. The latter refers to the situation of a country where a foreign currency is officially substituted for the local currency.

Table 1 shows the types of dollarization and gives examples of countries where it occurred.

Table 1: Types of dollarization

Official dollarization (using US dollar)	Official dollarization (using other currencies)	Partial dollarization (using US dollar)	Partial dollarization (using Euro, Russian ruble)
a) **Dependent States**: East Timor, Marshall Islands, Micronesia, Palau, Panama, Ecuador, El Salvador b) **Independent Territories**: Pitcairn Islands (New Zealand), Cocoa Islands (Great Britain), British Virgin Islands c) **Us Territories** Guam, American Virgin Islands, Puerto Rico, American Samoa, North Mariana Islands	a) **Independent States**: Andorra (euro), Liechtenstein (Swiss franc), Monaco (euro), Nauru (Australian dollar), San Marino (euro), Tuvalu (Australian dollar), Vatican (euro); b) **Dependent States**: Cocoa Islands (Australian dollar), Cook Islands (New Zealand dollar), Greenland (Danish Krone), Niue (New Zealand dollar), Norfolk Island (Australian dollar), St. Helena (British pound), Tokelau (New Zealand dollar) c) **Other regions**: Montenegro (euro), Kosovo (euro)	Argentina, Bolivia, Mexico, Peru, Armenia, Azerbaïdjan, Georgia, Russia, Ukraine, Hong-Kong, Mongolia, Mozambique, Romania, Turkey, Vietnam, etc.	Former French Colonies in Africa (euro), Balkan states (euro), Bielorussia (Russian ruble)

Source: Central Bank of Congo

b) Disadvantages of dollarization

Disadvantages from the perspective of the dollarizing country

Economic costs

Dollarization causes the local currency to lose its traditional functions. It loses its function of store of value because economic agents would rather hold their assets (e.g. deposits) in US dollar, euro, Russian ruble, etc. The function of medium of exchange is lost as well because US dollar or euro or any other strong foreign currency is mainly used as means of payment. The local currency also loses its function of unit of account because prices and wages are set in a foreign currency in order to preserve the purchasing power.

Mwase and Nkumah (2015), indicate that a high level of dollarization is likely to weaken the monetary policy because central banks cannot play their role of lender of last resort in foreign currency. Some researchers present arguments to emphasize that in a highly dollarized economy, central banks lose their seignorage revenue. Seignorage stands for the amount of revenue by which the nominal value of a currency exceeds its cost of production. Therefore, dollarization ends this revenue. The dollarizing country loses its monetary sovereignty (loss of independent monetary policy and exchange rate policy in case of full dollarization as well as inefficient monetary policy in case of partial dollarization) (Cohen, 2000; Duchêne and Goujon, 2006).

Political costs

Cohen (2000), further points out that dollarization has a political cost. First, it causes a loss of national identity because citizens are reminded of the connection to their nation by using their own currency. Second, seignorage revenue can be helpful in case of an urgent situation in a country (e.g. natural catastrophee, war, etc.). This revenue is lost in case of dollarization.

Finally, in terms of foreign policy, dollarization implies more dependence and reliance on the foreign currency country (loss of independence). The foreign currency country gets more influence in the dollarized country. For instance, in 1988, the Reagan administration froze Panamaian assets and prohibited dollar payments and transfers to Panama. As a result, the Panamaian economy was demonetized and highly devastated (Cohen, 2000).

Disadvantages from the perspective of the foreign currency country

Economic costs

The foreign currency country is exposed to liquidity shocks in the dollarizing country. This can lead to an increase of short-term macroeconomic volatility in the foreign currency country. This is a threat to the conduct of monetary policy in the foreign currency country (Cohen, 2000).

Political costs

Dollarization also causes political risks to the foreign currency country. What happens over time is that the dollarized country might pressure the foreign currency country to take into account its priorities while setting policy goals. The central bank of the foreign currency country might be obliged to extend its role of lender-of-last resort to financial institutions of the dollarized economy. As time passes, the dollarized country might seek representation in the central bank of the foreign currency country. Finally, dollarization may lead to moral hazard: expectation of bailout from the foreign currency country in case of a financial crisis (Cohen, 2000).

c) **Advantages of dollarization (*full dollarization*)**

Advantages from the perspective of the dollarizing country

Transaction costs of managing a separate national currency get reduced when there is dollarization. There are less currency conversion expenses. This allows the dollarizing country to develop a stronger financial sector. In fact, the financial sector of the dollarizing country gets integrated into that of the foreign currency country (e.g. into the US financial sector). This will allow more financial stability (development of the banking system and increase in financial intermediation). Dollarization also allows for a decrease in the interest rate on assets denominated in the local currency. Local borrowers can enjoy lower interest rates. The central bank of the dollarizing country also benefits from the high credibility of the foreign currency country and its policy (e.g. the Federal Reserve's credibility). Lower interest rates in the dollarizing country result in more investment and economic growth in the future. Dollarization can eliminate devaluation risk and indirectly mitigate the default risk (Cohen, 2000).Foreign exchange risk is mitigated and inflation control is facilitated.

Advantages from the perspective of the foreign currency country

Insofar as the economic advantage is concerned, the foreign currency country enjoys a rise in seignorage revenue which is lost by the dollarizing country (for instance, full dollarization in Panama is very beneficial to the US economy in terms of seignorage revenue). Politically speaking, the foreign currency country gets more status and prestige in the international political arena (e.g. the US dollar and its hegemony). The foreign currency country has more fiscal policy opportunities since it can issue additional currency in case of an emergency. Its citizens and those of the dollarizing country are bound to accept the new currency issued. In terms of diplomacy, the foreign currency country's influence gets broadened (Cohen, 2000).

d) Causes of dollarization

Several causes of dollarization have been identified in the existing body of literature: macroeconomic volatility, inflation, exchange rate depreciation, spreads between domestic and foreign interest rates, capital control, financial repression (reserve requirements) as well as institutional quality (Galindo and Leiderman, 2005; Herrera and Valdés, 2005; Berg and Borensztein, 2000, as cited in Duma, 2011, p 5; Reinhart et al, 2003; Mwase and Nkumah, 2015).

In addition, even after the stabilization of the exchange rate, dollarization is still continuous in some countries. Oomes (2003), holds the position that dollarization hysteresis is related to network externalities. Positive network externalities or bandwagon effect can explain the persistence of dollarization: the more a foreign currency is used within a network, the more its value increases among members of the network (Besanko and Bratigaeum, 2014).

Duma (2011) presents two motives moving residents of a country to use foreign currency: currency substitution and asset substitution. As for currency substitution, after a long period of hyperinflation in a country, people tend to seek refuge in a more stable currency that they can use as means of payment (medium of exchange and unit of account).When it comes to asset substitution, economic agents of a country characterized by macroeconomic uncertainty end up choosing foreign currency as a store of value instead of the local currency afteran assessment of risk and return (Duma, 2011).

e) Measuring deposit dollarization

Several measures of deposit dollarization are presented in the existing literature. The dollarization rate can be obtained by computing the ratio of foreign currency deposits to money supply M2. M2 includes cash and checking deposits (M1 elements) as well as savings deposits, other time deposits, money markets securities and mutual funds (narrow

money).However, this first indicator is criticized because it only includes local currency in the denominator (Adam, 2013). The dollarization rate can also be obtained by computing the ratio of foreign currency deposits to total deposits. Total deposits include foreign currency deposits and local currency deposits (Duchêne and Goujon, 2006).

Mwase and Kumah (2015) argue that these 2 approaches do not exclude exchange rate movements. They further assert that it is necessary to remove the effects of these movements. Therefore, they use foreign currency deposits as a share of total deposits and derive an index of real deposit dollarization.

2.1.2.   Business cycle uncertainty

Economists generally distinguish 4 types of fluctuations in economic activities: expansion (increase in output and employment), peak (maximum level of economic activity), contraction (decrease in GDP and employment) and through (minimum level of economic activity). These economic fluctuations are called business cycle and they are caused by shocks in aggregate supply and aggregate demand (Mankiw, 2015).

Uncertainty really matters because it affects decision-making in all sectors of the economy, mainly households, firms, financial institutions as well as the government. When a company is acquired by another, its employees feel uncertain about their future pay. When there is a change of regime in a firm's export market, the firms becomes more uncertain about the level of future orders from that market. Since there is always uncertainty about future economic activities, the central bank is in charge of publishing forecasts related to growth and inflation in order to inform people on the level of uncertainty (Haddow, Hare, Hooley and Shakir 2013).

A probability density function (pdf) can be used to shed more light on uncertainty.

Figure 3: Stylised probability of uncertainty and confidence shocks on expectations of GDPgrowth
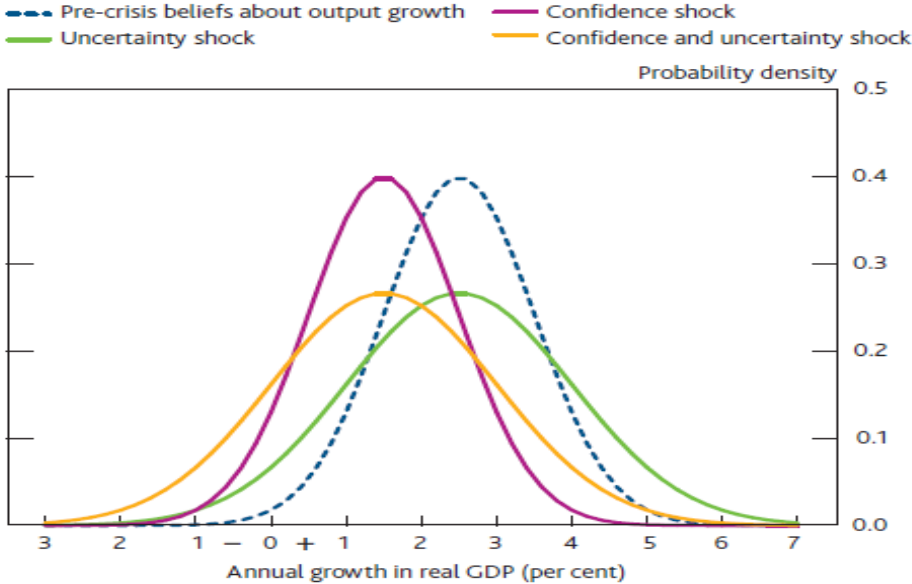
Source: Haddow et al, 2013

The dashed blue line stands for the firm's initial beliefs about future GDP growth, represented by the mode – which is 2.5%. The minimum growth rate the firm expects is 0% and the maximum is 5%: this interval of confidence describes the way the firm perceives uncertainty. If the firm gets more uncertain about the future economic climate, the width of the pdf increases up to the green line, causing the interval to range between -2% and 7%. Meanwhile, the firm still believes that it is highly likely to have a 2.5% growth rate. A change in confidence may occur after a financial crisis. The firm may have lower expectations of growth (lower mode). Therefore, the pdf will shift leftward, up to the magenta line. It may happen that the firm gets both uncertain and less confident about the future economic climate. In this case, the pdf is going to widen first and then shift to the left, as it is described by the orange line (Haddow et al, 2013).

Economic activity is affected by uncertainty shocks by means of several channels. Aggregate demand is affected by means of consumption and investment (Romer, 1990; Benito, 2004; Dixit and Pindyck, 1994 as cited in Haddow et al,, 2013). Aggregate supply is affected through productivity growth (Disney, Haskell and Heden, 2003; Bloom, 2009 as cited in Haddow et al, 2013). Table 2 summarizes the channels through which uncertainty affects economic activity.

Table 2: Channels through which uncertainty affects the economy

Sector	Channel	Description	Economic variable affected
Households	Precautionary savings	Households unsure about labour income and postpone consumption to insure against temporary shocks to income	Consumption
Firms	"Wait and see"	Firms uncertain about future sales and profits postpone production and investment until uncertainty is resolved.	Investment and productivity
	"Entry and exit"	Firms postpone entering new markets, including export markets. These firms are likely to be the most productive.	Productivity and exports
	"Labour market distortions"	Households unwilling to search for more productive jobs, firms unwilling to post vacancies so the resulting matches are less productive	Productivity
All sectors	Financial	Uncertainty over future asset price volatility raises risk premium and the cost of credit to households and companies.	Credit, consumption and investment

Source: Haddow et al, 2013

Measuring macroeconomic uncertainty: indicators

Several indicators of uncertainty are presented in the body of literature. Business cycle is not easy to quantify. However, some indicators allow us to measure it. They result from surveys or financial market information. Economists also use mass media references to uncertainty in economic activity in order to measure it. Table 3 shows a set of uncertainty indicators for the Spanish economy.

Table 3: Indicators of economic uncertainty for the Spanish economy

1	**Financial Markets**	Frequency
	IBEX-35 volatility	Daily
	IBEX-35 volatility index	Monthly
	$/£ exchange rate volatility index	Monthly
	Brent price volatility index	Monthly
	10 year bond price volatility index	Monthly
2	**Disagreement**	
	Disagreement about GDP forecasts	Every two months
	Disagreement about private consumption forecasts	Every two months
	Disagreement about capital goods investment forecasts	Every two months
	Uncertainty about unemployment outlook over next 12 months	Monthly
	Uncertainty about industrial order books	Monthly
	Uncertainty about industrial production expectations	Monthly
3	**Economic Policy Uncertainty**	
	Current political situation indicator	Monthly
	Political expectations indicator	Monthly
	Political risk indicator	Monthly
	National parliamentary fragmentation index	Monthly
	Economic Policy Uncertainty (EPU)	Monthly
	Disagreement about budget deficit forecasts	Every two months

Source: Gil, Pérez and Uranus, 2017

Table 4 shows us indicators of economic uncertainty for the United Kingdom

Table 4: Indicators of economic uncertainty for the United Kingdom

Variable	Data type	Sector
FTSE option-implied volatility	Financial market	Whole economy
Sterling option-implied volatility	Financial market	Whole economy
Dispersion of company earnings forecasts	Financial market/survey	firm
Dispersion of annual GDP growth forecasts	Financial market/survey	Whole economy
GfK unemployment expectations balance	Survey	Household
CBI 'demand uncertainty limiting investment' score	Survey	Firm
Number of press articles citing 'economic uncertainty'	Media	Whole economy

Source: Haddow et al, 2013

2.2.   Empirical literature review

2.2.1. Determinants of dollarization

Adam (2013) attempts to find the determinants of dollarization in the Maldives from 1990 to 2010. Using cointegration technique, he points out that dollarization is influenced by inflation, unofficial restrictions on foreign exchange and tourism inflows in the long run. He uses an error correction model to establish the short term determinants. He advocates the view that dollarization is influenced by all the variables aforementioned as well as trade openness.

The analysis of Clements and Schwartz (1992) maintain that dollarization is caused by the expectation of exchange rate depreciation as well as interest rate spreads between local and foreign currency deposits in Bolivia (boliviano and dollar). They use monthly data from 1986 to 1991 to find the determinants of dollarization.

Some researchers have also confirmed that interest rate spreads between local and foreign currency deposits, exchange rate depreciation, anticipated exchange rate, maximum exchange rate of the previous period, institutional quality, inflation volatility, and macroeconomic instability are determinants of dollarizationin in a country (Mc Nelis and Rojas-Suarez, 1996; Mongardini and Mueller, 2000; Duchêne and Goujon, 2006; Sasse, 2011).

Bahmani and Oskooee (2003) indicate that other than inflation and exchange rate depreciation, dollarization is also caused by under-developed capital markets, financial crises and ineffective stabilization efforts. In addition to macroeconomic factors they also show that institutional factors affect the dollarization process in a country: economic agents' willingness to save in foreign currency is greater when there is more political uncertainty.

Neanidis and Savva (2009) study the short-run determinants of financial dollarization in transition economies. They establish that banks matching of domestic loans and deposits, institutional quality and financial integration are the main drivers of short-run loan

dollarization. Deposit dollarization and loan dollarization are both determined by interest rate spreads as well as desired dollarization deviations.

2.2.2. Effect of dollarization

Banos (2014) explores the effect of financial dollarization on economic development in Latin America using quantile regression. He finds that economic development is negatively affected by financial dollarization and the effect is significant. However, that negative effect declines the more the country gets developed. Edwards (2001) investigates the economic performance of fully dollarized economies using panel data. He finds that in comparison to other countries, the growth rate and the inflation rate are significantly lower in dollarized countries. Edwards and Magendzo (2001) use a matching estimator technique to examine the relationship between dollarization, lower inflation, and faster growth. They find that dollarized nations have a significantly lower inflation and "statistically lower rate of GDP per capita growth than non-dollarized ones" (p 13).

2.2.3. Dollarization hysteresis

Kokenyne, Ley and Veyrune (2010) argue that dollarization persists even after the reestablishment of macroeconomic stability. Several researchers have studied dollarization hysteresis or its persistence. They find out that depreciation risk, constant remembrance of past hyperinflation (memory effect), currency substitution, relative prices instability as well as real exchange rate volatility explain the inertia of dollarization (Savastano, 1996; Guidotti and Rodriguez, 1992; Mc Nelis and Rojas-Suarez, 1996).

2.2.4. Impact of uncertainty on economic activity

Gil et al. (2017) assessed the impact of uncertainty on Spain's economy using VAR models. They establish that Spain's GDP declines with the occurrence of uncertainty shocks.

They also find that consumption and investment decrease when uncertainty increase. Haddow et al, (2013) also studied the impact of uncertainty on UK's economy with VAR models. They observe that UK's GDP is negatively affected by increased uncertainty. Other researchers also concluded that demand and output are negatively affected by increased uncertainty (Bloom, 2009; Rabanal and Sandri, 2010; Lee, Rabanal and Sandri, 2010 as cited in Haddow et al, 2013).

3. Data and sample

3.1. Sample

This work attempts to assess the stochastic relationship between financial dollarization and business cycle uncertainty over the period 2000 to 2015 in the Democratic Republic of Congo. We use annual data obtained from the Central Bank of Congo, the World Bank Development Indicators as well as the IMF commodities price.

The regressand is the dollarization rate which is the ratio of foreign currency deposits to total deposits. Two indicators of business cycle uncertainty are used in this study as regressors. We use the consumer price index (CPI) and the oil price index. We include a set of control variables, mainly: (1) net exports (% of gdp), (2) government consumption (% of gdp), (3) investment (% of gdp).

3.2. Descriptive analysis

Table 5: Descriptive Statistics

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
dr	16	85.69	11.02	53.54	99.01
cpi	16	69.18	154.6	0.857	550
oil_index	16	120.8	57.02	45.60	196.8
exp	16	28.48	11.05	11.45	45.36
gov	16	9.038	3.982	2.058	15.02
inv	16	14.25	4.447	6.704	21.64

Table 5 reports summary data of variables. In the first row, we see that on average the

dollarization rate is about 85.69 % from 2000 to 2015. The highest dollarization rate during

this period is 99.01 % in 2009. The lowest dollarization rate is 53.54 % in 2000.

In the second row, we see that on average the inflation rate is about 69.18 % from 2000 to

2015. The highest rate this period is 550 % in 2000. The lowest rate during this period is 0.9 %

in 2012

In the third row, we see that on average the oil price index is about 120.8 from 2000 to

2015. The highest oil price index during this period is 196.8 in 2014. The lowest index is

45.6in 2000.

In the four throw, we see that on average net exports represent about 24.48 % of the

Congolese gdp from 2000 to 2015. The highest rate this period is 45.36 % in 2011. The

lowest rate is 11.45 % in 2000.

In the fifth row, we see that on average government consumption represents about 9 % of

the Congolese gdp from 2000 to 2015. The highest rate this period is 15 % in 2011. The

lowest rate is 2 % in 2000.

In the six throw, we see that on average investments represent about 14 % of the

Congolese gdp from 2000 to 2015. The highest rate this period is 21.64 % in 2011. The

lowest rate is 6.7 % in 2000.

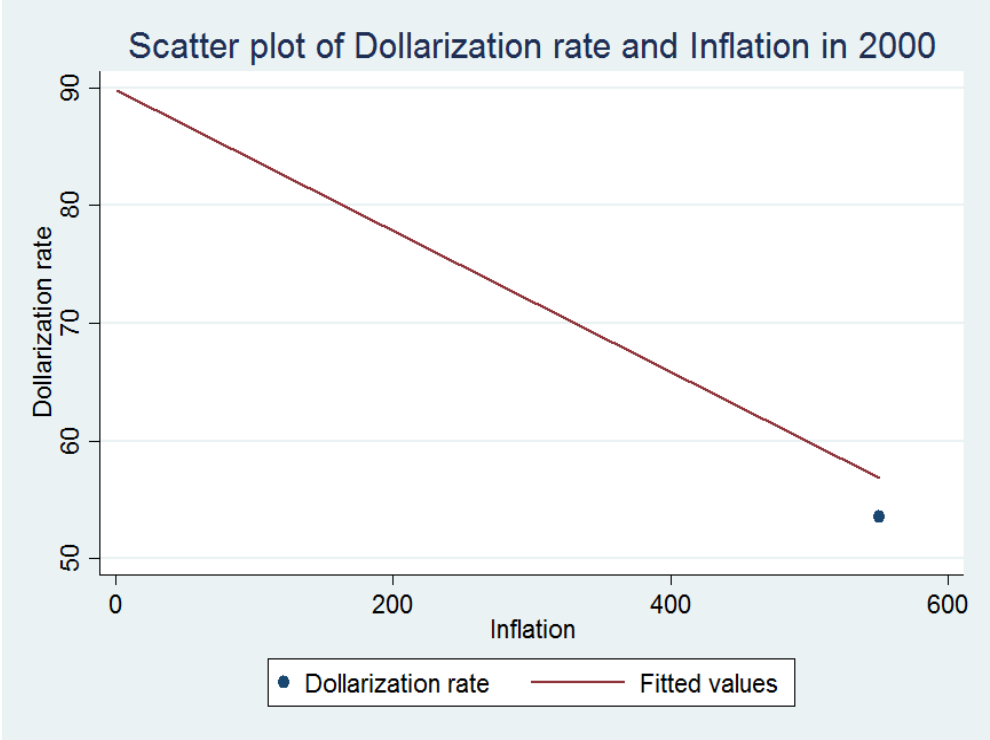**Figure 4: Scatter plot of dollarization rate and inflation in 2000**

Figure 5: Scatter plot of dollarization rate and inflation in 2008
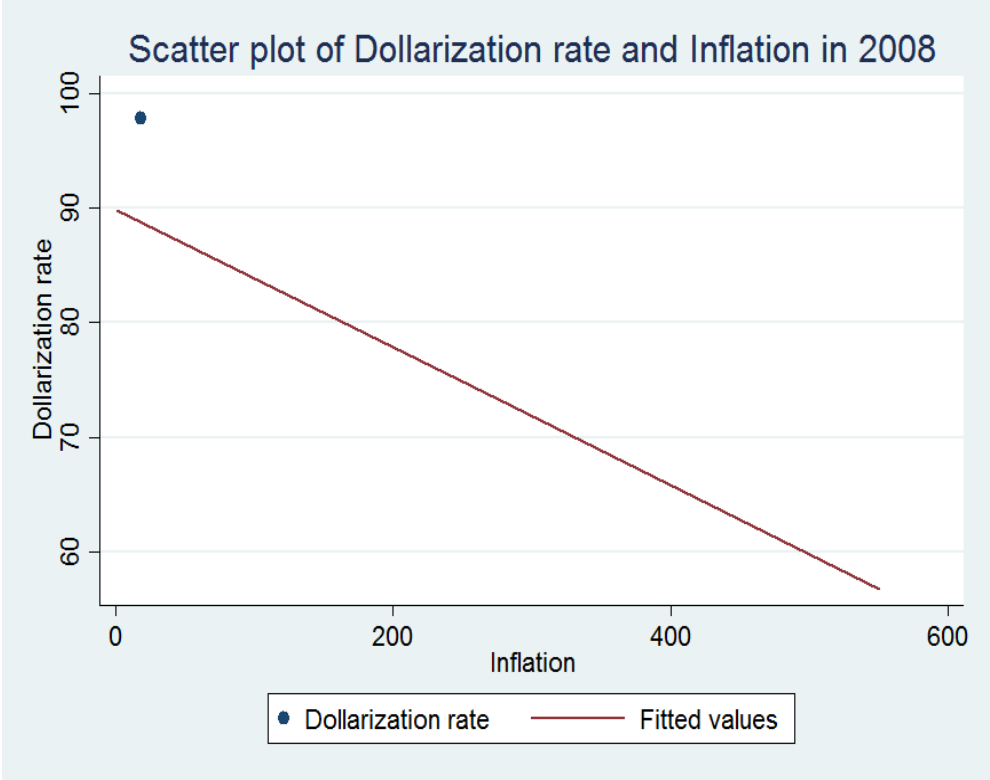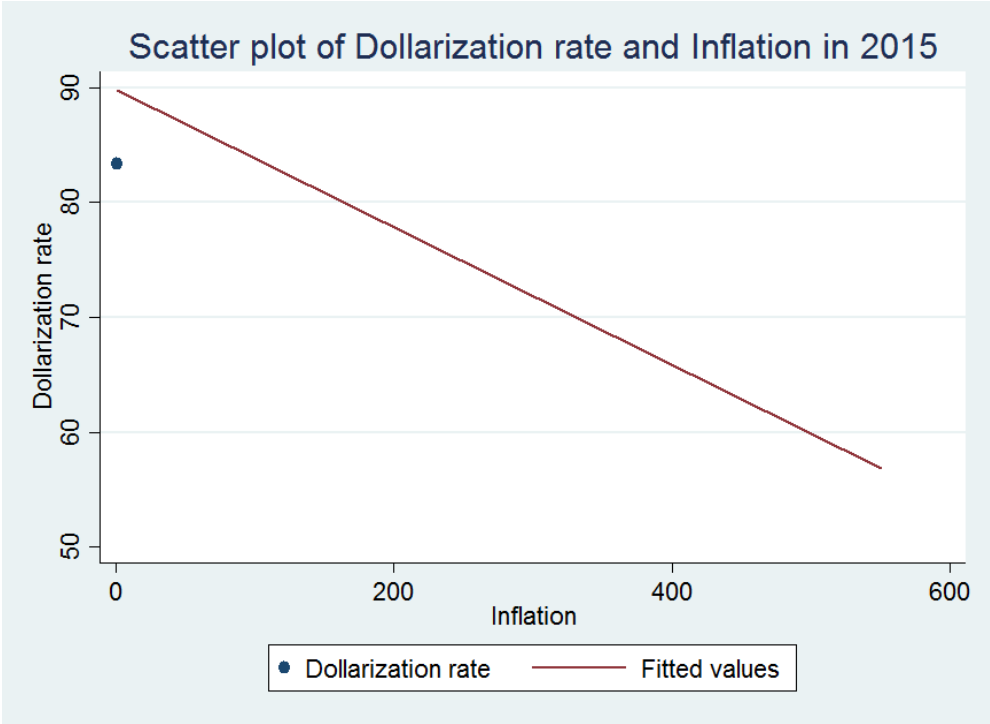

Figure 6: Scatter plot of dollarization rate and inflation in 2015

Figures 3, 4 and 5illustrate a negative correlation between dollarization rate and inflation respectively in 2000, 2008 and 2015.

4. Methodology

We estimate the stochastic relationship between financial dollarization and business cycle uncertainty using quantile regression. This method is a robust and consistent alternative to standard linear regression techniques. It was first used by Koenker and Bassett (1978). Standard linear regression techniques only give a partial view of the relationship between regressors and the regressand. The disadvantage of these standard techniques is they only give the mean effect. They sum up the relationship between the outcome and the regressors based on the conditional mean function E(y/x)   .

Quantile regression allows researchers to estimate the distributional effect. The relationship between variables can be described at several points in y's conditional distribution. Economists can also find out the effects on the whole distribution. Quantile regression provides an exhaustive statistical analysis of the stochastic relationship between the regressors and the regressand. When it comes to outliers in the response measurement and non-normal errors, compared to ordinary least squares (OLS), quantile regression estimates are more robust. OLS does not allow to easily identify wild observations (outliers).

Let's consider the relationship between the regressors and outcome using the conditional median function Qq(y/x) where the median is the 50th percentile, or quantile q, of the

distribution. The quantile $q \in (0, 1)$ is that y which splits the data into proportions q below

and 1- q above:

$$F(y_q) = q \tag{1}$$

and

$$y_{q} = F^{-1}(q) \tag{2}$$

for the median, $q = 0.5$.

Considering that ϵ is the model's error, we know that OLS minimizes

$$\sum_i e^2_{i..} \tag{3}$$

Least-absolute-deviations regression (median regression) minimizes

$$\sum_i /e_{i.}/ \tag{4}$$

Quantile regression minimizes a sum that gives asymmetric penalties $(1-q)/e_i/$ for

overprediction and $q/e_i/$ for underprediction. In addition, the quantile regression estimator is

asymptotically normally distributed and its computation requires some linear programming

techniques. Quantile regression is invariant to monotonic transformations such as log(.). Since

assumptions about the parametric distribution of the error process are avoided, quantile

regression is semiparametric.

Some examples of quantile

- q(0.10): the first decile, 10th percentile
- q(0.25): the first quartile, 25th percentile

- q(0.5): median, 50th percentile

- q(0.75): the third quartile, 75th percentile

- q(0.90): the ninth decile, 90th percentile

Conditional quantiles of the joint distribution of y and x can be modelled by using quantile regression.

Let us consider $\hat{y}$ (x) the predictor function and

$$e(x) = y - \hat{y}\ (x) \tag{5}$$

the predictor error. Therefore,

$$L(e(x)) = L(y - \hat{y}\ (x)) \tag{6}$$

indicates the prediction loss' associated errors.

If $L(e) = e^2$, we have squared error loss and OLS is the optimal technique to use. If $L(e)$ = /e/, then the optimal technique is median regression. The optimal predictor is that β which minimizes

$$\sum i\ /yi - x'_{i}\beta/ \tag{7}$$

Implementation of quantile regression

The quantile regression estimator minimizes the following function:

$$Q(\beta q) = \sum_{i:yi \geq x'i\beta}^{N} q|yi - x'_{i}\,\beta q| + \sum_{i:yi < x'i\beta}^{N}(1 - q)|yi - x'_{i}\beta q| \tag{8}$$

Boostrapped standard errors are often used in place of analytic standard errors. The Simplex algorithm is used to minimize this function.

In our model, the regressand is the dollarization rate which is the ratio of foreign currency deposits to total deposits. Two indicators of business cycle uncertainty are used in this study. We use the the consumer price index (CPI) and the oil price index. We include a set of control variables, mainly: (1) net exports (% of gdp), (2) government consumption (% of gdp), (3) investment (% of gdp).

5. Findings

We present our estimation results in this section. We employ quantile regression to estimate the stochastic relationship between financial dollarization and business cycle uncertainty. We do not find strong evidence of a significant effect of business cycle uncertainty on financial dollarization in the Democratic Republic of the Congo. Inflation negatively affects dollarization from lower quantiles to higher quantiles. However, the effect is statistically insignificant. The oil price index has a positive influence on dollarization but the effect is statistically insignificant as well. Other control variables have no significant effect on dollarization (net exports, investment and government consumption).

These results are consistent with Kokenyne, Ley and Veyrune's work (2010). They argue that dollarization continues even after macroeconomic stability gets re-established because economic agents do not trust the local currency. These findings are also consistent with the reality in DRC. As mentioned above, dollarization is persistent in DRC despite the government and the central bank's efforts to dedollarize the economy. A good policy mix has

allowed for disinflation (figure 2) but the deposit dollarization rate has been increasing over the last years (figure 1).

During the period in review, the share of net exports in the GDP of DRC increased. As a result, the government had some more foreign exchange reserves allowing them to intervene in the foreign exchange market in order to stabilise it. Investments increased as well. So, the government happened to have some more foreign exchange reserves as well. Over the last years, credits to the government have been granted on a much rational basis. This might explain why the 3 control variables have no significant.

These results suggest that that the causes of dollarization hysteresis go beyond the business cycle or economic activity. We attribute dollarization inertia in DRC to a memory effect in economic agent's mind. As a matter of fact, DRC went through a period of hyperinflation and macroeconomic instability during the 1990's and in the early 2000's. This severe crisis lead economic agents to lose trust in the government and monetary authorities. From that time until today, most economic agents have been keeping their assets and liabilities in the US dollars which is a much stable and secure currency.

We also attribute dollarization inertia to network externalities (positive network externalities or bandwagon effect): the more a foreign currency is used within a network, the more its value increases among members of the network. That is exactly what happens in DRC. The more people use US dollars, the higher its value in the economy.

Instability of the Congolese franc also explains dollarization persistence (constant exchange rate depreciation). The weak value of the Congolese franc relative to the US dollar causes people to rely more on the latter than the former. Currently,1 US $ is worth 1550,67 CDF (Congo Democratic Franc).One year ago, 1 US $ was worth 920 CDF. So, the population tends to use the US $ a lot more than the Congolese franc.

On top of all, we can also mention political instability in DR Congo as a main cause of dollarization hysteresis. Since 1996, DRC has been very unstable politically. The country experienced a terrible war in its eastern part between 1996 and 2003 which caused millions of deaths and refugees. Although the war officially ended in 2003, the situation in eastern Congo remains volatile with small rebel groups often trying to cause trouble from time to time. Even though our study has covered the period from 2000 to 2015, dollarization is still rampant in Congo and we cite the current political crisis as another factor. Elections were supposed to be held in December 2016 at the end of President Joseph Kabila's second term. Unfortunately, the government failed to organise elections. This crisis is still going on and people usually protest all over the country. As a result, being aware of the extremely volatile situation of DRC, economic agents have almost no trust in the Congolese franc and would rather keep their assets in US $ just in case.

Table 6: Estimation results

OLS and QR

	OLS	Q(0.10)	Q(0.25)	Q(0.50)	Q(0.75)	Q(0.90)
cpi	-0.05**	-0.04	-0.05	-0.05	-0.05	-0.04
	(-3.18)	(-0.31)	(-0.36)	(-0.24)	(-0.33)	(-0.20)
oil_index	0.10	0.06	0.09	0.10	0.14	0.07
	(1.43)	(0.58)	(0.32)	(0.79)	(0.88)	(0.26)
exp	-0.06	0.16	-0.03	-0.05	-0.22	-0.05
	(-0.22)	(0.47)	(-0.05)	(-0.10)	(-0.53)	(-0.11)
gov	0.21	0.23	-0.00	0.09	-0.04	2.32
	(0.24)	(0.11)	(-0.00)	(0.04)	(-0.02)	(0.59)
inv	-1.09	-0.58	-0.99	-1.24	-1.28	-0.89
	(-1.47)	(-0.60)	(-1.57)	(-0.87)	(-0.61)	(-0.43)
_cons	92.72***	78.91***	91.66***	93.10***	97.59***	81.24**
	(12.48)	(11.20)	(4.68)	(7.14)	(4.89)	(3.58)
N	16	16	16	16	16	16
R-sq	0.786					

t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Figure 7: Graphical representation of quantile regression estimates
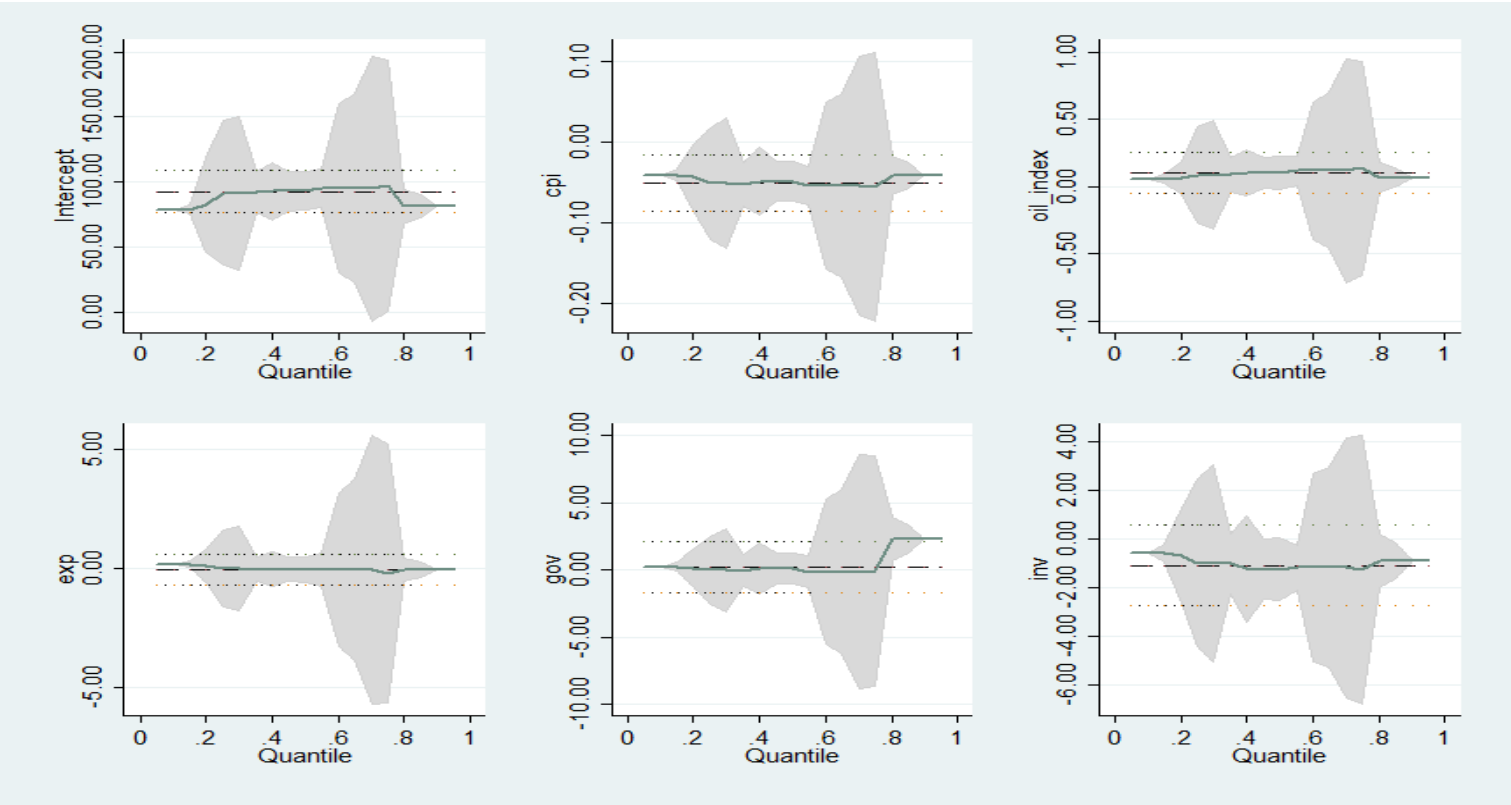
6. Conclusion and policy implications

What is the effect of business cycle uncertainty on financial dollarization in the Democratic Republic of the Congo? In order to answer this question, we attempted to establish the stochastic relationship between financial dollarization and business cycle uncertainty using quantile regression over the period 2000 to 2015. We used annual data obtained from the Central Bank of Congo, the World Bank Development Indicators as well as the IMF commodities price.

We do not find strong evidence of a significant effect of business cycle uncertainty on financial dollarization in the Democratic Republic of the Congo. Inflation negatively affects dollarization from lower quantiles to higher quantiles. However, the effect is statistically insignificant. The oil price index has a positive influence on dollarization but the effect is statistically insignificant as well. Other control variables have no significant effect on dollarization (net exports, investment and government consumption).

These findings suggest that the causes of dollarization hysteresis go beyond the business cycle or economic activity. We attribute dollarization hysteresis in DRC to a memory effect in economic agent's mind: lack of trust in monetary authorities due to past hyperinflation and macroeconomic instability. We also attribute dollarization inertia to positive network externalities: the more people use the US dollars, the higher its value in the economy. Constant exchange rate depreciation is another cause of dollarization hysteresis. On top of all, political instability in DR Congo is a serious cause of dollarization inertia.

We recommend policies to foster a sustainable dedollarization process in DRC. The first step should be **macroeconomic stabilization**: *reducing and stabilizing inflation* in a sustainable way. A stable macroeconomic framework will cause appreciation of the exchange rate. As a result, economic agents will gradually stop protecting themselves against inflation via foreign currency. The Congolese franc will become more and more attractive to economic agents.

Other than macroeconomic stabilization, additional measures need to be taken in order to foster dedollarization in DRC (**market-based policies**). In order to discourage financial dollarization, monetary authorities should adopt a *flexible exchange rate policy*. *Efficient liquidity management* by the central bank is another market-based strategy that will accelerate dedollarization. By keeping an appropriate level of official reserves and developing a stable foreign exchange market, the need to protect oneself against inflation via foreign currency will diminish.

In addition, *developing a strong local financial market* will foster dedollarization. In order to decrease dollarization, *the development of financial securities denominated in local currency* will increase investment opportunities other than those in the US dollar. There should also be *indexation to local prices of securities denominated in local currency*. As a result, economic agents will avoid taking refuge in foreign currencies.

Furthermore, an **effective macroprudential regulation** will decrease dollarization. Commercial banks should be freed from controls related to interest rates determination. Banks

should be able to *increase interest rates on local currency deposits and decrease interest rates on foreign currency deposits*. Monetary authorities should *introduce banknotes with large denominations* in order to fit economic agents' needs in the market. *Government transactions should be done in local currency*: taxes should be raised in CDF, payments should be made in CDF, as well as purchasing goods and services in local currency. DRC is a post-conflict country and there is a lot of foreign aid flowing in. *Using foreign aid in the local currency* will also foster dedollarization. *Reserve requirements on foreign currency deposits should be very high*. Therefore, monetary authorities will oblige banks to attract more local currency deposits. *Reserve requirements on local currency deposits should be low.* In order to discourage payments in foreign currency, the Congolese government should consider *levying taxes on foreign currency payments*.

Finally, dollarization is so embedded in the Congolese economy that some ***authoritative government intervention*** is needed. For instance, *all prices should be listed in CDF and all payments should be made in local currency* in order to discourage dollarization in DRC. The central bank should also consider *limitations on lending in foreign currency*.

Appendix

Table 7: Correlation matrix

```
. pwcorr dr cpi oil_index exp gov inv , sig
```

	dr	cpi	oil_in~x	exp	gov	inv
dr	1.0000					
cpi	-0.8418	1.0000				
	0.0000					
oil_index	0.5203	-0.4880	1.0000			
	0.0388	0.0551				
exp	0.5809	-0.5846	0.8350	1.0000		
	0.0183	0.0174	0.0001			
gov	0.5114	-0.6211	0.7428	0.6504	1.0000	
	0.0429	0.0102	0.0010	0.0064		
inv	0.1667	-0.2740	0.7654	0.5505	0.7700	1.0000
	0.5372	0.3045	0.0005	0.0271	0.0005	

Table 8: Multicollinearity check

```
. reg dr cpi oil_index exp gov inv
```

Source	SS	df	MS		Number of obs	=	16
					F(5, 10)	=	7.36
Model	1433.27479	5	286.654958		Prob > F	=	0.0039
Residual	389.709049	10	38.9709049		R-squared	=	0.7862
					Adj R-squared	=	0.6793
Total	1822.98384	15	121.532256		Root MSE	=	6.2427

dr	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
cpi	-.0501873	.0157634	-3.18	0.010	-.0853104	-.0150642
oil_index	.0989303	.0690814	1.43	0.183	-.0549925	.2528532
exp	-.0640736	.2914151	-0.22	0.830	-.7133868	.5852396
gov	.2065233	.8587791	0.24	0.815	-1.706956	2.120002
inv	-1.090597	.7407839	-1.47	0.172	-2.741166	.5599727
_cons	92.72114	7.427454	12.48	0.000	76.17174	109.2705

```
. vif
```

Variable	VIF	1/VIF
oil_index	5.97	0.167428
gov	4.50	0.222178
inv	4.18	0.239421
exp	3.99	0.250517
cpi	2.29	0.437438
Mean VIF	4.19	

The variance inflation factor (VIF) values are less than the upper limit of 10. This indicates

that the regressors are not strongly correlated.

Table 9: Dedollarization policies for DRC

Macroeconomic stabilization	Reducing and stabilizing inflation
Market-based policies	Adopting a flexible exchange rate policy
	Promoting efficient liquidity management
	Developing a strong local financial market
	Developing financial securities denominated in local currency
	Indexation to local prices of securities denominated in local currency
Effective macroprudential regulation	Increasing interest rates on local currency deposits
	Decreasing interest rates on foreign currency deposits.
	Introducing banknotes with large denominations
	Doing government transactions in local currency
	Using foreign aid in the local currency
	Setting very high reserve requirements on foreign currency deposits
	Setting low requirements on local currency deposits
	Levying taxes on foreign currency payments
Authoritative government intervention	All prices should be listed in CDF and all payments should be made in local currency
	Considering limitations on lending in foreign currency

Source: Kokenyne et al, 2010; The author.

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