Growth and inflation tradeoffs of dollarization: Meta-analysis evidence☆

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A R T I C L E   I N F O

A B S T R A C T

We examine 585 estimates for macroeconomic effects of dollarization reported in 43 studies, codify 39 aspects of study design that may influence the estimates, and use Bayesian model averaging to take into account model uncertainty in meta-analysis. The results indicate that dollarized countries on average display slower and more volatile output growth, and a lower inflation rate than non-dollarized countries, but the estimates vary widely both within and across studies. Fully dollarized countries on average exhibit slower growth than non-dollarized and partially dollarized economies. Dollarization measurement, empirical method selection and authors' affiliation systematically affect reported dollarization effects. The empirical results also suggest that limited control over foreign currency's money supply in dollarized economies reduces the central banks' ability to effectively conduct monetary policy and adjust to macroeconomic shocks.

1. Introduction

Dollarization, in the full sense, refers to doing away with a country's own currency and adopting a foreign currency of particular importance for the country, which is usually the US dollar. Instead of the US dollar, a country can opt for the Euro or any other currency with an international reserve feature. This particular strain of the literature gained momentum originally when many Latin American countries in the 1970 s and 1980s experienced rapid inflation and economic instability and there was a widespread demand for foreign currency deposits, particularly US dollars (Levy-Yeyati, 2006; Berg and Borensztein, 2000), and when countries in Central and Eastern Europe began their economic transition. Moreover, there are several heavily dollarized countries in other regions of the world: e.g. Cambodia (Menon, 2008), and Sub-Saharan Africa (Ajide et al., 2019).

The economic debate around opting for another sovereign currency has several dimensions. First, as price stability requires a nominal anchor, inflation or exchange rate targeting, among others, provide a goal to commit monetary policy. However, the "rules

versus discretion" and the "time-inconsistency" literature provides ample evidence that, in the absence of a commitment mechanism, policymakers will be tempted to deviate from stated policy goals. (Schmitt-Grohe and Uribe, 2001). Another commitment mechanism that eliminates monetary discretion is a currency board where the domestic currency is completely backed by a foreign currency and the domestic currency is pegged to that foreign currency. The monetary authority commits to exchanging the domestic currency for the foreign currency at the established fixed rate (Schwartz, 1993). However, a currency board does not entirely solve the time-inconsistency problem as it is always possible to abandon the currency board arrangement. Argentina may serve as a good example in this case (Hughes Hallet, 2007; de la Torre et al., 2003). Official or full dollarization goes one step further and by adopting a foreign currency, it provides a stronger commitment mechanism than a currency board as a dollar held by the public has no chance of being abrogated, short of confiscation (Jácome and Lönnberg, 2010).

Second, since monetary policy cannot be formulated independent of fiscal policy, the absence of monetary discretion necessitates fiscal discipline. Fiscal dominance (Blanchard, 2004) has been a key determinant of inflation, leading some countries to full dollarization in the 1990s. The topic has gained importance as the covid-19 pandemic lead to an unprecedented increase in public debt in emerging countries, including dollarized economies. Dollarization constraints populist policies and lowers fiscal dominance (Cachanosky et al., 2022). The discussion has now turned to possible de-dollarization strategies of partially dollarized economies (Hofman et al., 2020).

Moreover, as dollarization eliminates the risk of devaluation, it has the potential of reducing the country risk premium on foreign borrowing. In other words, under dollarization, the country can potentially obtain funds at lower interest rates, can increase capital inflows with positive effects on domestic investment and economic growth. The elimination of exchange rate risk can increase trade and financial integration affording the economy an increase in trade and financial flows as a common currency is vital for real and financial market integration. However, one must bear in mind the elimination of currency risk does not eliminate default risk or high volatility of sovereign spreads. As such, GDP volatility may in fact increase. On the other hand, by eliminating monetary discretion, a dollarized economy can potentially deliver price stability. While dollarization can be expected to shield the economy against nominal shocks, it does not help against foreign real shocks (Stockman, 1999).

On the downside, giving up monetary discretion through dollarization has several drawbacks. It may have costs in terms of economic stability and losing a key instrument in dealing with a slack economy. This may exacerbate the problem if the economy is facing real shocks or has nominal rigidities. Second, doing away with domestic currency involves the loss of seigniorage revenues (Schmitt-Grohe and Uribe, 2001). Measurements issues and definitions aside, there are many advantages and disadvantages of dollarization. The answers to these questions are complex and ultimately depend on each country's circumstances. The principal objective of this paper is to offer a systematic analysis of the evidence regarding dollarization by assessing the results of previous research regarding macroeconomic performance under dollarization. The issue is germane as dollarization rates are relatively high in developing and emerging economies (see Reinhart et al, 2014). This is partially driven by macroeconomic instability and high inflation concerns as foreign currency deposits shield the negative effects of inflation and uncertainty. While dollarization affords domestic residents benefits in terms of avoidance of the inflation tax and reduced uncertainty, it tends to make monetary policy more complex and potentially less effective. Given the lack of precise definition of dollarization and empirical support for the proposed hypotheses, there is no consensus on the effects of dollarization.

The effects of full dollarization on output and inflation are particularly important to consider in countries opting for official dollarization and for optimum setting of macroeconomic policies in partially dollarized economies. Ecuador, El Salvador, Montenegro, and Kosovo adopted the U.S. dollar or Euro as legal tender in 2000, 2001, and 2002 (Rochon and Rossi, 2004; Razmi, 2018; Gonzalez et al., 2015), and Guatemala and Nicaragua have considered this step as well (Edwards, 2001). Reinhart et al. (2014) classify 90 countries to have some degree of dollarization of assets. For these countries, it is vitally important to understand the macroeconomic effects of dollarization.

Our findings also relate to the de-dollarization debate on the exit strategies of dollarization, which reflects the heterogeneity in presented macroeconomic effects of dollarization (Reinhart et al., 2014; Ize and Levy-Yeyati, 2005; Catão and Terrones, 2006; Jameson, 2003; Imam, 2020). On one side, Aghion et al. (2001) show that in the presence of dollarized liabilities, an exchange rate devaluation can produce adverse outcomes on output. While depreciation can have positive effects on exports, it produces negative domestic balance sheet positions. With liability dollarization, an exchange rate depreciation increases costs of the dollar debt, which can trigger corporate and bank bankruptcies and potentially cause output to contract significantly (Calvo and Reinhart, 2002; Céspedes et al., 2002). In this respect, Levy-Yeyati (2006) advises to reflect further on how policy recommendations should be tailored to deal with the different possible mechanisms driving the dollarization process. Chitu (2013) finds that currency mismatches were a key transmission channel of the adverse impact of dollarization to the real economy during the 2007–2009 crisis and highlights a need for stronger macroprudential surveillance of foreign currency lending in emerging economies. On the other side, Reinhart et al (2003) find little empirical support for the view that dollarization hinders monetary policy effectiveness, while Edwards (2001) shows that dollarization helps to reduce inflation.

Given the frequently conflicting results presented in empirical studies, this paper evaluates the current literature on the effects of dollarization on output growth and inflation using meta-analysis. Section 2 presents a brief survey on the macroeconomic effects of dollarization. Sections 3 and 4 discuss data and meta-regression methodology. Section 5 includes publication bias typical of meta-analysis while Section 6 presents a Bayesian Model Averaging approach to meta-regression analysis. The final section offers implications for policymaking and concluding remarks.

2 Literature on macroeconomic effects of dollarization

The word "dollarization" has evolved since 1970s and there is no standard definition of dollarization. The literature early on referred to "currency substitution" when domestic residents held foreign currency deposits. Subsequently, dollarization was coined to describe the demand for foreign currency deposits in these countries. The terms currency substitution and dollarization were interchangeable during 1970s and 1980s. Starting from the 1990s, "dollarization" started to be used for legal adoption of the US dollar as domestic currency (Edwards, 2001). On the other hand, starting with 1990s, there was a strong demand for foreign currency deposits and liability dollarization started to be used to describe borrowing by the private and public sectors in emerging economies, which made them particularly vulnerable to external shocks (Caballero and Krishnamurthy, 2000).

In order to understand the forces at work when it comes to full dollarization, it is instructive to start from the seminal work of Mundell (1961) on "optimum currency areas". Accordingly, gains from a common currency stem from eliminating transaction costs and exchange rate volatility (Cheung et al., 2020a, 2020b; Cao et al., 2020) and the associated gains from trade, whereas gains from retaining a domestic currency are due to the ability to pursue countercyclical monetary policy that can respond optimally to economic disturbances. Moreover, a domestic currency affords the issuer some seigniorage revenues where there are limited funds from taxation. When economic disturbances are common and the business cycles are synchronized, the gains from retaining own currency are minimum at best whereas commitments represented by fixed exchange rates, currency boards, and dollarization are most costly when countries face idiosyncratic shocks. Subsequent work on currency areas as in McKinnon (1963) and Kenen (1969) emphasized "openness" and "product diversification." The question of optimum currency areas returned to the forefront of research in the 1990s when a single currency was being designed for Europe. Subsequently, dollarization as a policy became popular as more countries in Eastern Europe and Latin America adopted it.4F[1]

The move towards dollarization was partly motivated by the excesses as a result of monetary discretion, namely an inflation bias and that countries which give up their currencies are unable to engage in monetary and macroeconomic mismanagement. Whereas fixed exchange rates, hard pegs, and monetary unions represent a wide spectrum in the degree of commitment, all are intended to benefit from limiting exchange rate variability, the discipline afforded by lack of monetary discretion, and the associated increase in trade and cross border investments. Granted these benefits may or may not materialize, there is a literature that argues these conclusions must be qualified. As noted by Frankel and Rose (1998), optimum currency area criteria may be endogenous in that the adoption of a common currency may enhance the structural similarities of participating economies.

On the other hand, Levy-Yeyati (2006) finds that financially dollarized economies display relatively unstable demand for money, are more likely to suffer from banking crises after a depreciation, and have slower and more volatile output growth, without significant gains in terms of domestic financial depth. Similarly, Court et al. (2012) finds deposit dollarization to have a consistent and negative impact on financial deepening. Reinhart et al. (2014) offer a comprehensive survey of partial dollarization and identify trends in the evolution of dollarization in developing and emerging economies. They show that an increase in dollarization, defined as private sector holdings of foreign currency assets and private and public external foreign currency liabilities, does not hinder the effectiveness of monetary policy. While inflation tends to be higher and more volatile in dollarized economies, output volatility is similar across different degrees of dollarization.

There is a strong link between fiscal deficits and inflation, particularly in high-inflation developing countries (Catão and Terrones, 2005). For example, following the debt crisis of the 1980s, many Latin American countries experienced high unemployment, large fiscal deficits, and high inflation rates. When inflation rates reached high levels, they became built into expectations, and economic policies lost credibility. To overcome the credibility problem, stabilize the economy, and reduce interest rates, some countries resorted to extreme measures such as a currency board or full dollarization. While Panama has been fully dollarized since 1904, Ecuador and El Salvador joined the fray and dollarized their currencies in 2000 and 2001, respectively. Other countries did not go this far; Brazil, Chile implemented inflation targeting in 1990s, while Argentina resorted to a Currency Board in 1991. Thus, these policies including full dollarization came to the fore because successful monetary policy necessitated breaking the fiscal dominance (Quispe-Agnoli, 2001; Blanchard, 2004; Ahmed et al., 2021). However, the adoption of a currency board or full dollarization do not necessarily solve the underlying problem of fiscal discipline. In fact, neither full dollarization nor a currency board guarantee fiscal discipline and prevent fiscal dominance. The issue, in turn, can become a trap if growth slows down as in Argentina in 2001 (Hughes Hallet, 2007; de la Torre et al., 2003). This has also been borne out by the experience of Panama which requested 13 IMF programs between 1973 and 1997 (Mishkin and Savastano, 2001). Even though Panama gained in terms of GDP growth, it recorded higher output volatility in the region because full dollarization-increased vulnerability to external shocks (Quispe-Agnoli, 2001). In El Salvador, full dollarization is supported by the country's unique circumstances including its ability to service debt from its oil revenues (Cristo et al., 2016).

The conflicting results on the effects of dollarization can be due to the difference in methodologies as well as different time periods and different countries. Another possibility is model misspecification in general or not controlling for proper variables which can lead to biased results. These issues notwithstanding, the effects of dollarization can be ascertained using meta-analysis where extant effects can be included using all relevant research that investigate the macroeconomic effects of dollarization. Overall, the effects of dollarization depend on many factors where institutional factors, macroeconomic conditions, and the dynamics of money demand play a role in the process.

3 The data set

3.1 Collecting estimates from individual studies

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[1] For example, Kosovo adopted the Euro in 2001; Montenegro adopted first the German Mark in 1996 and the Euro in 2002. Ecuador and El Salvador became fully dollarized economies in 2000 and 2001, respectively.

The first step of any meta-analysis is to gather the empirical studies on the topic, usually referred to as "primary studies", in a non-discriminatory manner to prevent any distortions from publication selection (Stanley, 2001). The aim is to include all relevant research that investigates the macroeconomic effects of dollarization and euroization. In order to collect all relevant studies we start with an extensive search in Google Scholar. We further proceed with a detailed search for primary studies in IDEAS Repec, Science Direct, Wiley online library, Web of Science, JSTOR and Ebsco databases. To identify all relevant studies, we used a variety of search key words5F[2] as of July 2017.

The sample of studies we collect is subjected to three major selection criteria. First, the study must provide an empirical estimate of the dollarization and euroization effects on GDP and inflation. We aim to collect all relevant research and focus on journals as well as working papers, discussion papers and proceedings from international conferences. Our meta-analysis comes as close as possible to reflecting and analyzing all relevant empirical information.

Second, the sample includes studies published in English. In addition, as dollarization is widely spread in Latin America we also collect studies published in Spanish which, however, make a minor part of the dataset. Third, to increase the comparability of the estimated effects, we only include studies where the dependent variable is the growth rate of GDP, the growth rate of GDP per capita, and GDP volatility, and exclude studies which analyze data for GDP in levels. Finally, this meta-analysis follows the standard approach of including all estimates provided by one study (Stanley, 2001; Stanley, 2005; Stanley, 2008).

We find 43 studies that comply with our selection criteria, and we list them in the Appendix (Table A1). These studies report 585 different model specifications, which enter as the dependent variable in the meta-analysis.

3.2. Meta-statistics

Table 1 reports meta-statistics for the overall dataset and selected subsamples using reported coefficients. The descriptive statistics show already several important findings. First, the average estimated impact for dollarization on GDP growth is negative, albeit moderate. We sub-select the data and focus on dollarization effects reported in internationally recognised journals with have a strict publication process, which prevents major empirical shortcomings. The effect of dollarization is even more pronounced in this sub-sample of studies. The meta-sample distribution of reported estimates of dollarization on GDP volatility is positively skewed. This is a surprising result, given that theoretical papers do not clearly predict a positive effect. Berg and Borensztein (2000) argue that in developing countries, the main benefit of dollarization is the prospect of eliminating a currency crisis. Full legal dollarization may establish a firm basis for a sound financial sector and may contribute to economic integration with the United States.

The mean average effect of dollarization on inflation is negative and supports the general motive of several countries to adopt dollarization for the purpose of reducing problems associated with high inflation. Restricting the sample to estimates published in "top" journals support these findings and will be pursued further below in the publication bias section.

Second, the method of dollarization measurement influences reported estimates. Studies analyzing full dollarization on average report a considerably stronger effect of dollarization on reducing GDP growth and inflation compared to the mean effects. Similarly, estimates for a broader category of hard pegs (including dollarization and currency boards) are nearly exclusively negative. In contrast, the average reported coefficients for deposit dollarization show positive inflation effects. Moreover, results vary based on author affiliations. This is particularly relevant for authors affiliated with central banks who document substantially stronger effects on inflation reduction compared to the mean.

4 Meta-regression methodology and sources of heterogeneity

A comprehensive meta-analysis combines a variety of statistical techniques that are useful in reviewing and evaluating the empirical literature in a specific field of research. As such, it is a powerful instrument to assess variation among reported results, thereby determining the impact of study characteristics and providing a type of consensus (Stanley, 2001, among others). Recently, there has been a growing number of meta-analyses on currency union trade effects (Rose and Stanley 2005), and Euro trade effects (Havránek, 2010; Polák, 2019). Crespo Cuaresma et al. (2013); Hake et al. (2014) present meta-analyses on loan dollarization drivers in Eastern Europe and Latin America, respectively. To best of our knowledge, there is no meta-analysis comparing different types of dollarization.

In general, a meta-analysis is based on the regression between a summary statistic (the dependent variable) and a set of study characteristics (the independent variables), drawn from each paper. In our case, a meta-regression model is given by

$$coeff_{ki} = \mu + \sum_{i=1}^{n} \beta_1 D_{ki} + \upsilon_{ki}, \tag{1}$$

where $coeff$ refers to the dollarization impact in study k and D_i represents variables describing selected study characteristics, while υ

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[2] List of key words used to collect relevant studies for this *meta*-analysis: "dollarization" and "growth", "dollarisation" and "growth", "dollarization" and " gdp growth", " dollarisation" and "gdp growth", "dollarization" and "economic performance", "dollarisation" and "economic performance", " hard peg" and " growth", "hard peg" and "economic performance", "currency substitution" and "growth", "currency substitution" and "economic performance", "euroization" and "growth", "euroization" and "economic performance", "dolarización" and "crecimiento", "dolarización" and "crecimiento economico", "dollarization" and " inflation", "dollarisation" and " inflation", "currency substitution" and "inflation", "euroization" and "inflation", " euroisation" and "inflation", "dolarización" and "inflación", " hard peg" and "inflation".

Table 1
Meta-statistics of reported coefficients.

Variables	No of Obs.	Mean	St. Dev.	Min.	Max.
A. Meta-statistics for the total sample					
Dollarization and GDP growth: all estimates	343	−0.194	0.486	−3.452	0.605
Dollarization and GDP growth: top journals	31	−0.463	0.768	−3.452	0.330
Dollarization and GDP volatility: all estimates	57	0.666	0.967	0.0001	4.77
Dollarization and GDP volatility: top journals	10	1.002	1.682	0.007	4.770
Dollarization and inflation: all estimates	187	−1.263	3.123	−12.630	7.661
Dollarization and inflation: top journals	18	−0.581	1.183	−2.850	0.639
B. Meta-statistics by authors' affiliations					
Dollarization and GDP growth					
University	169	−0.379	0.639	−3.452	0.605
Central bank	215	−0.112	0.432	−3.452	0.6
EU institution	70	−0.072	0.025	−0.144	−0.010
IMF	2	−0.002	0.006	−0.006	0.002
BIS	16	−0.017	0.007	−0.038	−0.008
World Bank	22	−0.812	0.237	−1.320	−0.280
Government	12	−0.904	0.657	−1.910	0.130
Dollarization and inflation					
University	117	−0.009	1.978	−6.860	7.661
Central bank	43	−2.246	2.817	−10.026	0.297
IMF	6	−0.067	0.039	−0.126	−0.017
World Bank	15	−6.885	3.668	−12.630	−1.900
Government	6	−5.817	1.065	−6.860	−4.150
C. Meta-statistics by language of publication					
Dollarization and GDP growth					
English	337	−0.198	0.490	−3.452	0.605
Spanish	6	0.013	0.005	0.010	0.020
Dollarization and inflation					
English	181	−1.304	3.166	−12.630	7.661
Spanish	6	−0.037	0.020	−0.060	−0.020
E. Meta-statistics by measurement method					
Dollarization and GDP growth					
Credit dollarization	107	−0.032	0.060	−0.144	0.140
Deposit dollarization	99	0.001	0.091	−0.327	0.574
Full dollarization	64	−0.373	0.784	−3.452	0.605
Hard peg	73	−0.540	0.572	−1.910	0.130
Euroization	72	−0.077	0.040	−0.327	−0.010
Dollarization and inflation					
Deposit dollarization	63	0.599	1.849	−2.309	7.661
Full dollarization	52	−1.889	2.675	−10.026	−0.0001
Hard peg	58	−3.008	3.728	−12.630	0.070
Index	8	0.294	0.285	0.070	0.723
Euroization	4	0.042	0.228	−0.176	0.297
F. Meta-statistics by regional origin					
Dollarization and GDP growth					
Latin America	18	0.006	0.010	−0.019	0.020
Africa	2	0.168	0.574	−0.238	0.574
Eastern Europe	2	−0.235	0.129	−0.327	−0.144
Global study	321	−0.208	0.498	−3.452	0.605
Dollarization and inflation					
Latin America	28	−0.162	0.541	−2.740	−0.0001
Africa	10	0.615	2.109	−2.309	6.101
Asia	25	1.184	2.524	−0.130	7.661
Eastern Europe	2	0.233	0.091	0.169	0.297
Global study	122	−2.196	3.257	−12.630	0.639

Note: Mean effects are also estimated for a subsample of most recognised journals in order to test the robustness of the main results. Journals in this category include Journal of Money, Credit and Banking, Journal of International Money and Finance, Economic Policy, Journal of Policy Modelling and the B.E. Journal of Macroeconomics.
Source: Own estimations.

is the error term.

We expect five variable groups to affect the reported coefficients which include types of dollarization, estimation methods and data, regions, authors, and general publication characteristics. In Tables 2 and 3, using a block-wise version of the from-specific-to-general model selection approach, we first include all blocks of variables individually, and then look for a final preferred specification with variables which are at least marginally significant. The exact variable definitions can be found in the Appendix (Table A2) and descriptive statistics (Table A3). With the exception of the demeaned publication year variable (deviation from the mean publication year), all other independent variables are binary.

Table 2
Meta-regression analysis of reported coefficients, GDP growth.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Credit dollarization	0.475**						
	(0.182)						
Deposit dollarization	0.475**						
	(0.183)						
Dollarization	0.079***						0.413**
	(0.017)						(0.157)
Euroization	−0.170***						
	(0.011)						
Full dollarization	0.088						−0.796***
	(0.245)						(0.201)
Equality test		0.176*					0.515***
		(0.094)					(0.167)
Panel methods		0.203**					
		(0.088)					
IV methods		0.094					
		(0.173)					
Treatment		0.681***					1.090***
		(0.094)					(0.172)
Matching		−0.750***					−0.395**
		(0.179)					(0.180)
5-year averages			0.765***				
			(0.146)				
Quarterly data			0.178**				
			(0.067)				
Time trend (data)			0.006				−0.053**
			(0.006)				(0.020)
Latin America				0.119			
				(0.106)			
Africa				0.280**			
				(0.106)			
Eastern Europe				−0.123			
				(0.106)			
Currency crisis exp.				0.103			
				(0.150)			
Publication year					0.047		
					(0.060)		
Journal					−0.055		
					(0.224)		
Proceeding					0.218		
					(0.135)		
Spanish					0.018		
					(0.109)		
Global fin. crisis					−0.329		1.386***
					(0.508)		(0.326)
Dollarization focus					0.295		
					(0.204)		
Central bank						0.046	
						(0.191)	
EU institution						0.060	
						(0.137)	
IMF						0.176	
						(0.133)	
BIS						0.160	
						(0.133)	
World Bank						−0.634***	
						(0.152)	
Government						−0.726***	−0.537***
						(0.133)	(0.161)
Constant	−0.540***	−0.183*	−0.210**	−0.215*	−0.307	−0.178	−0.632***
	(0.182)	(0.094)	(0.100)	(0.107)	(0.256)	(0.133)	(0.109)
No of obs.	343	343	343	343	343	343	343
Adjusted R^2	0.207	0.201	0.037	0.004	0.097	0.192	0.497

Note: Clustered standard errors at the study level are in parentheses. *, **, and *** denote significance at the 10 %, 5 %, and 1 % level, respectively.
Source: Own estimations.

Table 3
Meta-regression analysis of reported coefficients, Inflation.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Credit dollarization	1.700						
	(1.071)						
Deposit dollarization	1.991*						1.656**
	(1.065)						(0.655)
Dollarization	1.984*						
	(1.062)						
Euroization	1.090						
	(0.964)						
Full dollarization	−0.907						
	(1.054)						
Equality test		0.884					
		(0.834)					
Panel methods		1.008					
		(0.835)					
IV methods		−1.910					
		(2.183)					
Matching		−1.716					
		(1.134)					
Quarterly data			0.805				
			(1.048)				
Time trend (data)			0.066				
			(0.061)				
Latin America				−0.479			1.084**
				(0.820)			(0.435)
Africa				2.247**			
				(0.955)			
Eastern Europe				−0.386			
				(0.750)			
Currency crisis exp.				2.814**			
				(1.042)			
Publication year					0.224		
					(0.221)		
Journal					1.392		
					(1.374)		
Proceeding					2.435**		
					(1.050)		
Spanish					−1.826**		
					(0.797)		
Global fin. crisis					0.274		
					(1.873)		
Dollarization focus					1.031		
					(0.920)		
Central bank						−2.237***	−1.768***
						(0.707)	(0.591)
IMF						−0.058	
						(0.406)	
World Bank						−6.876***	−5.911**
						(2.221)	(2.276)
Government						−5.808***	−4.843***
						(0.406)	(0.621)
Constant	−2.966*	−1.049	−1.341*	−2.195**	−2.681	−0.009	−0.974
	(1.530)	(0.835)	(0.683)	(0.836)	(1.596)	(0.406)	(0.621)
No of obs.	187	187	187	187	187	187	187
Adjusted R^2	0.226	0.0452	0.0331	0.156	0.247	0.447	0.505

Note: Clustered standard errors at the study level are in parentheses. *, **, and *** denote significance at the 10 %, 5 %, and 1 % level, respectively.
Source: Own estimations.

First, Tables 2 and 3 shows that a type of dollarization has an important impact on growth as well as on the inflation rate of dollarized economies.6F[3] Full dollarization (replacement of currency) is associated with a deep negative impact on GDP growth in the dollarized economy. This impact could be slightly lowered for economies using US dollar, while euroization is not robust. Deposit and credit dollarization do not have robust impact on growth of analyzed economies. On the contrary, foreign currency deposits positively contribute to inflation in partially dollarized economies.

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[3] Meta-regression results for the dollarization effect on GDP volatility show that there are nearly no robust determinants of publication on GDP volatility. This is influenced also by the low number of observations. The results are available upon request.
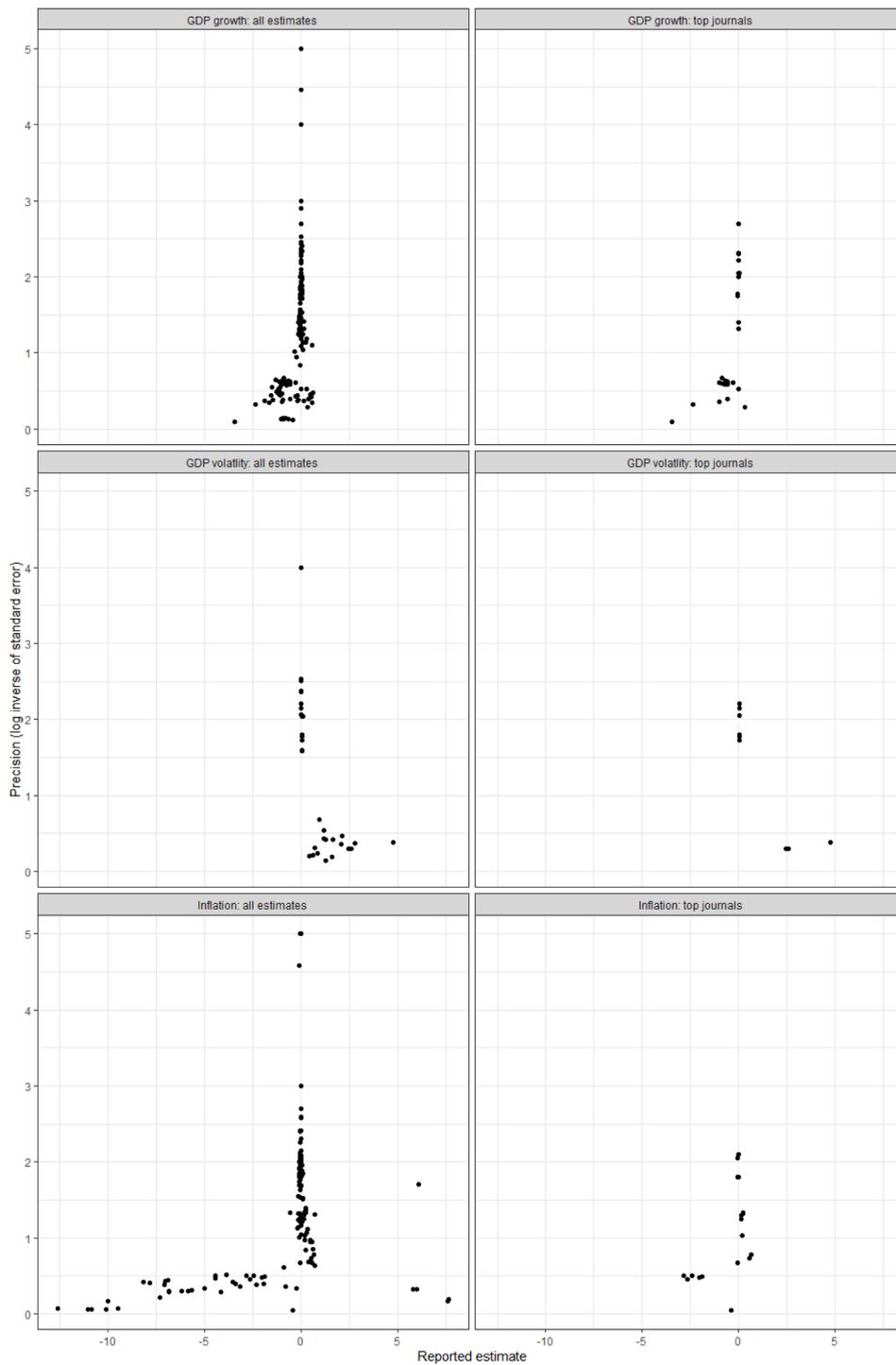
Note: We use decimal logs in order to improve the readability.

Source: Own estimations.

Fig. 1. Funnel plot, reported effect of dollarization. Note: We use decimal logs in order to improve the readability. Source: Own estimations.

Second, the negative impact on GDP growth might be a result of endogeneity problems, which is not well addressed by estimation methods. The evidence on this question is ambiguous: on the one hand, matching models show a more negative impact of dollarization. On the other hand, treatment studies applying mainly the difference-in-difference methodology (DD) report rather positive effects of dollarization. While both approaches attempt to address the endogeneity of the decision to dollarize or not, these methods yield opposite results. It is also interesting to note that the results for treatment studies are more similar to simple mean tests than to matching results.

The studies in our sample employing DD methodology (Gómez-Soler, 2009, Edwards, 2003) construct the estimator for a single treatment dollarization period. With a single treatment period, a typical concern is that contemporaneous trends driven by factors other than the treatment of interest could confound the treatment effect and violate the parallel trends assumption (Baker et al., 2021). Callaway and Sant'Anna (2021) introduced a group-time average treatment effect for estimation with multiple time periods to address the gap in the existing methodology. This may indicate that DD results can be biased because the dollarized countries inherently differ from the remaining sample and/or the parallel trend assumption is not met.

Third, data definitions matter as well. It seems that more recent data sets document a more negative impact of dollarization on the economy. It is also interesting to note that the publication year of the study has a positive but not robust impact. Data definitions, especially five-year averages, may have a positive influence on the results, but this effect is not robust. Fourth, the regional focus of a study may result in cross-country variations, as different countries are expected to be more or less affected by dollarization (Levy-Yeyati, 2006). We can see that Latin American countries faced more positive developments after the dollarization than other world regions in terms of GDP growth, but the coefficient is not robust. In Latin America, foreign currency use raises the inflation rate. This effect is robust and enters the preferred model specification. We also compare countries which experienced currency crises with other countries. We can see that the dummy for currency crisis experience is insignificant in the growth model and not robust in the inflation specification.

Since political interests and expectations of authors may potentially affect the reported results, we also include a set of dummy variables accounting for author affiliations in another group of control variables. We can see that authors affiliated with national governments tend indeed to be more conservative and report rather negative results for GDP growth. Authors affiliated with central banks, the World Bank, and national governments report more favourable results in terms of reduction of inflation than authors affiliated with other institutions. Finally, publication characteristics (including dummies for journals, studies focusing primarily on dollarization, and publication year) are not associated with significant and robust differences in the outcome of dollarization.

In the last column, we present our preferred specification which includes only significant variables. For GDP growth, we include eight variables related mainly to the orientation on US dollar, estimation methods, and government affiliations. Moreover, data time trend shows that the dollarization effects decline over time, but they become higher during a financial crisis. For inflation, the publication results are mainly driven by a focus on deposit dollarization, Latin America, and by author affiliations. These parsimonious specifications explain approximately 50 per cent of result heterogeneity.

5. Publication bias analysis

5.1 Precision of reported results

The previous literature (Card and Krueger 1995, Stanley and Doucouliagos 2012) showed that publication bias is a common phenomenon in empirical research. The publication bias often arises because results are more likely to be selected by the authors or published if they are statistically significant or theoretically desirable. A common approach for detecting publication bias is to analyze the relationship between the reported result and its quality, which is usually associated with its precision. If there is no publication bias, there should be no systematic relationship between reported results and their precision. Conversely, the presence of publication bias will induce a correlation between the estimate and its precision. A conventional proxy for precision of estimated coefficients is the inverse of the standard error, $1/SE$. In some cases, coefficients are estimated very precisely, or possibly the estimated standard errors are deflated by inappropriate estimation methods. This can lead to extremely high values for the inverse standard errors. In order to eliminate the impact of those outliers, we also use log-inverse standard errors. However, an additional problem arises when standard errors are not available for the partial correlation coefficients, which are used in the robustness analysis. Therefore, we will follow Fidrmuc and Korhonen (2018) and Campos et al. (2019) and use the inverse of the number of observations, N, as a proxy for precision. This approach follows also Card and Krueger (1995), who use degrees of freedom as a proxy.

5.2. Funnel plots and funnel asymmetry tests

Publication bias leads to estimates that are ideally asymmetrically distributed around a hypothetical true effect. An intuitive and commonly used method to detect publication bias is an informal examination of a funnel plot. A funnel plot is a scatter diagram of precision versus estimated effects (i.e. partial correlation coefficients or reported coefficients). A large variation among reported estimates is expected at the bottom of the funnel graph.

Using reported coefficients, Fig. 1 is a funnel graph of the effects of dollarization on economic growth, output volatility, and inflation. The funnel plot depicts all reported estimates as well as estimates presented in high-ranked journals where the publication process is very selective, and the potential methodological errors are most-likely prevented.

Several important findings emerge from a visual inspection. First, the figure for GDP growth does not resemble an inverted funnel but appears to be asymmetrically skewed which implies a bias in the surveyed literature. Estimates for GDP growth and per capita

Table 4
Funnel Asymmetry Test.

	GDP growth		GDP volatility		Inflation	
	(1)	(2)	(3)	(4)	(5)	(6)
Publication bias	−0.540***	−0.120***	0.673**	0.220***	−1.023**	−0.612**
	(0.192)	(0.029)	(0.235)	(0.065)	(0.463)	(0.251)
True effect	−0.083	−0.598***	0.328*	1.322***	−0.705*	−2.969**
	(0.061)	(0.134)	(0.153)	(0.312)	(0.373)	(1.131)
PB indicator	st. error	log st. error	st. error	log st. error	st. error	log st. error
No of obs.	343	343	57	57	185	185
R^2	0.304	0.273	0.238	0.441	0.218	0.248

Note: Publication bias is proxied by standard errors and natural log standard errors. ***, ** and * denote significance at 1 %, 5 % and 10 % level, respectively.
Source: Own estimations.

Table 5
BMA analysis of reported coefficients, GDP growth.

	BMA			WALS		
	Coef.	Std. Err.	PIP	Coef.	Std. Err.	t-stat
Constant	−0.447‡‡	0.199	1.000	−0.600	0.223	−2.695***
Credit dollarization	0.020	0.117	0.086	0.228	0.451	0.504
Deposit dollarization	0.021	0.119	0.085	0.259	0.454	0.570
Dollarization	0.353‡	0.131	0.961	0.056	0.388	0.144
Euroization	−0.108	0.247	0.207	−0.589	0.317	−1.860*
Full dollarization	−0.784‡	0.203	0.987	−0.563	0.409	−1.375
Equality test	0.633‡‡	0.141	1.000	0.515	0.127	4.065***
Panel methods	0.045	0.090	0.247	0.100	0.094	1.068
IV methods	0.000	0.016	0.042	0.008	0.076	0.104
Treatment	0.942‡‡	0.172	1.000	0.817	0.173	4.727***
Matching	−0.314††	0.154	0.889	−0.260	0.116	−2.248**
Latin America	0.171†	0.194	0.507	0.156	0.217	0.722
Africa	−0.001	0.058	0.042	−0.308	0.340	−0.906
Currency crisis exp.	0.008	0.049	0.077	0.173	0.162	1.065
Publication year	0.039††	0.027	0.791	0.051	0.028	1.834*
Journal	0.005	0.029	0.102	−0.017	0.069	−0.248
Proceeding	0.015	0.058	0.094	0.203	0.120	1.689*
Spanish	−0.003	0.048	0.047	−0.115	0.206	−0.558
Global fin. crisis	0.665†	0.667	0.568	0.912	0.491	1.857*
Dollarization focus	−0.001	0.048	0.065	0.038	0.174	0.221
Central bank	0.008	0.029	0.100	0.054	0.073	0.738
IMF	−0.032	0.224	0.144	−0.548	0.488	−1.123
BIS	−0.006	0.045	0.058	−0.066	0.209	−0.318
World Bank	−0.272††	0.262	0.571	−0.014	0.262	−0.054
Government	−0.458‡	0.137	0.981	−0.304	0.119	−2.546**
Time trend (data)	−0.037††	0.028	0.789	−0.067	0.031	−2.176**
5-year averages	0.691‡	0.224	0.971	0.547	0.181	3.014***

Note: ***, ** and * denote significance at 1 %, 5 % and 10 % level, respectively. †, ††, ‡, and ‡‡ denote whether PIP indicates: weak significance (PIP above 0.50), positive significance (0.75), strong significance (0.95) and decisive significance (0.99). Some variables were omitted due to perfect multicollinearity.
Source: Own estimations.

growth are skewed to the left with most precise estimates concentrated around 0.

Similarly, we see clear asymmetry in the distribution of reported coefficients for GDP volatility which are skewed to the right. Studies only report positive estimates with most precise estimates (with the lowest standard errors and the highest log-inverse standard errors) are concentrated around 0. Despite this, there are many publications with less precise results, which shows that dollarization raises output volatility. It seems studies focusing on inflation mostly report negative estimates. There are 54 positive coefficients which are, with the exception of Levy-Yeyati (2006), not published in journals with an impact factor. The distribution of coefficients for inflation indicates possible problems with outliers, which we take into account in the robustness check of our main meta-regression results.

Because funnel plots only illustrate asymmetries in published results, we also employ a funnel asymmetry test (FAT) (Card and Krueger, 1995; Ashenfelter et al., 1999) based on a simple regression of available effects and a corresponding precision variable. The FAT approach is based on the expected symmetry of publications around the most precise estimates (the so-called 'true' effect)

$$effect_{ik} = true + \alpha prec_{ik} + \varepsilon_{ik} \tag{2}$$

Table 6
BMA analysis of reported coefficients, Inflation.

	BMA			WALS		
	Coef.	Std. err.	PIP	Coef.	Std. err.	t-stat
Constant	−0.300	0.508	1.000‡‡	−1.215	0.553	−2.197**
Credit dollarization	0.051	0.507	0.049	2.437	2.158	1.129
Deposit dollarization	1.814	0.711	0.940††	2.870	0.661	4.340***
Dollarization	−1.710	0.925	0.865††	−2.145	0.763	−2.811***
Euroization	−7.598	1.504	0.999‡‡	−6.400	1.936	−3.306***
Full dollarization	−0.068	0.336	0.106	0.328	0.664	0.494
Equality test	0.221	0.544	0.189	1.220	0.609	2.004**
Panel methods	1.190	1.182	0.573†	2.167	1.082	2.003**
IV methods	−5.164	0.765	1.000‡‡	−4.426	0.687	−6.443***
Matching	−3.686	0.642	1.000‡‡	−2.377	0.539	−4.412***
Latin America	0.255	0.511	0.255	1.179	0.554	2.129**
Africa	0.052	0.322	0.071	0.868	0.894	0.971
Eastern Europe	0.021	0.376	0.044	1.748	1.893	0.924
Currency crisis exp.	0.386	0.774	0.316	−0.379	0.847	−0.448
Publication year	0.819	0.136	1.000‡‡	0.662	0.157	4.203***
Journal	0.020	0.122	0.065	0.290	0.389	0.746
Spanish	−4.152	1.166	0.989‡	−2.974	1.080	−2.753***
Global fin. crisis	−3.075	1.792	0.879††	−0.640	1.291	−0.496
Dollarization focus	3.639	0.555	1.000‡‡	2.477	0.525	4.718***
Central bank	0.055	0.269	0.100	−0.271	0.575	−0.472
IMF	−0.057	0.391	0.066	−1.390	1.422	−0.977
World Bank	−5.264	0.657	1.000‡‡	−3.919	0.629	−6.231***
Government	−1.861	1.205	0.786††	−1.757	0.741	−2.372**
Time trend (data)	−0.199	0.058	0.991‡‡	−0.267	0.071	−3.749***

Note: ***, ** and * denote significance at 1 %, 5 % and 10 % level, respectively. †, ††, ‡, and ‡‡ denote whether PIP indicates: weak significance (PIP above 0.50), positive significance (0.75), strong significance (0.95) and decisive significance (0.99). Some variables were omitted due to perfect multicollinearity.
Source: Own estimations.

where *effect* stands for reported effect, *prec* is precision of estimate, *true* stands for the underlying macroeconomic performance effect of dollarization (i.e. the so-called 'true' effect) across countries and studies, the coefficient α shows the publication bias and ε is the error term for estimate i in study k. If there is no evidence for publication bias, the coefficient α should not be significantly different from zero. In contrast, a significant coefficient α implies a tendency to report certain parameter values or only significant results. Table 4 confirms significant publication bias for GDP growth, GDP volatility as well as inflation. Moreover, for the dollarization effect on GDP growth it shows that the best precision estimate might be negative, especially if we moderate underestimation of standard errors using their log transformation.

6. Bayesian model averaging meta-regression analysis

We adopt the Bayesian model averaging (BMA) methodology and the Bayesian weighted-average least-squares (WALS) estimator based on the Laplace priors to select the important auxiliary regressors7F[4] in order to assess the degree of model uncertainty attached to the meta-regressions for the impact of dollarization on macroeconomic performance of dollarized economies. This methodology has been increasingly used in meta-analyses in financial economics as the main empirical methodology (Havranek et al., 2016; Fidrmuc and Lind, 2020; Campos et al., 2019). The main advantage of this approach is that it considers all possible combinations of explanatory variables and weighs them according to the model fit. The BMA results are robust to model uncertainty and do not require selecting one individual specification. We follow framework provided by De Luca and Magnus (2011) and consider all possible specifications where dollarization impacts are explained by all possible combinations of explanatory variables. There are 2^k possible models, i.e. there are 2^k possible choices of regressors. We consider up to 39 regressors to be included in the model which gives us a model space with 2^{24}, which is 67,108,864 individual model specifications. The key statistic of BMA is the posterior inclusion probability (PIP) which reflects the importance of each variable. According to the rule proposed by Jeffreys (1961) and developed by Kass and Raftery (1995), the significance of each regressor is weak, positive, strong, or decisive if the PIP lies between 0.5 and 0.75, 0.75 and 0.95, 0.95 and 0.99, or 0.99 and 1, respectively.

Using these criteria, we can see that dollarization and full replacement of local currency, as well as some methodological variables (equality tests, treatment methods, use of five-year averages), and government affiliation of the authors are strongly or decisively important in the posterior GDP growth model. Similar variables (matching, time trend, global financial crisis dummy) have posterior probabilities at least above 50 per cent. In addition, Table 5 also compares the BMA results with the WALS estimator. The alternative results give less importance on full dollarization. Both results are nearly identical with the manual model selection presented in the

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[4] These are implemented using Stata commands *bma* and *wals* from De Luca and Magnus (2011).

Table 7
Robustness analysis – Alternative Methods, GDP growth.

	(1) Preferred	(2) WOLS	(3) MEDR	(4) CRR	(5) REM
Dollarization	0.413**	0.220**	0.190***	0.197***	0.449***
	(0.156)	(0.083)	(0.019)	(0.009)	(0.124)
Full dollarization	−0.796***	−0.557***	−0.768***	−0.821***	−0.588***
	(0.187)	(0.155)	(0.032)	(0.014)	(0.204)
Equality test	0.515***	0.329**	0.508***	0.565***	0.291
	(0.158)	(0.125)	(0.042)	(0.019)	(0.196)
Treatment	1.090***	0.893***	1.026***	1.046***	0.977***
	(0.159)	(0.113)	(0.057)	(0.026)	(0.210)
Matching	−0.395**	−0.352*	−0.531***	−0.505***	−0.563**
	(0.170)	(0.198)	(0.035)	(0.016)	(0.251)
Time trend (data)	−0.053**	−0.041**	−0.074***	−0.079***	−0.032***
	(0.020)	(0.016)	(0.003)	(0.001)	(0.010)
Global fin. crisis	1.386***	0.968***	1.641***	1.738***	0.896***
	(0.318)	(0.323)	(0.063)	(0.029)	(0.238)
Government	−0.537***	−0.722***	−0.840***	−0.919***	−0.545***
	(0.161)	(0.082)	(0.040)	(0.018)	(0.125)
Constant	−0.632***	−0.387***	−0.533***	−0.554***	−0.520***
	(0.107)	(0.107)	(0.018)	(0.008)	(0.130)
No of obs.	343	343	343	343	343
Adj. R^2/Pseudo R^2	0.497	0.451	0.370	0.978	0.489

Note: Preferred - preferred estimation, WLS - weighted (log inverse standard errors) least squares, MEDREG - median regression, CRR - Cook's Distance Robust Regression, REM - random effects model. We report Pseudo R^2 for median regression and overall R^2 for random effects. Clustered standard errors at the study level are in parentheses. *, **, and *** denote significance at the 10 %, 5 %, and 1 % level, respectively.
Source: Own estimations.

Table 8
Robustness analysis – Alternative Methods, Inflation.

	(1) Preferred	(2) WOLS	(3) MEDR	(4) CRR	(5) REM
Deposit dollar.	1.656**	0.606***	0.282	0.158***	1.593**
	(0.655)	(0.214)	(0.353)	(0.032)	(0.623)
Latin America	1.084**	0.321**	0.079	−0.008	0.554*
	(0.435)	(0.152)	(0.443)	(0.040)	(0.311)
Central Bank	−1.768***	−0.730**	−0.462	−0.061*	−1.512**
	(0.591)	(0.271)	(0.387)	(0.035)	(0.660)
Wold Bank	−5.911**	−4.758**	−7.231***	−7.075***	−4.964**
	(2.276)	(2.034)	(0.605)	(0.054)	(2.519)
Government	−4.843***	−5.553***	−5.791***	−5.995***	−4.921***
	(0.621)	(0.163)	(0.897)	(0.080)	(0.534)
Constant	−0.974	−0.254	−0.089	−0.030	−0.896*
	(0.621)	(0.163)	(0.271)	(0.024)	(0.534)
No of obs.	187	185	187	187	187
Adj. R^2/Pseudo R^2	0.505	0.356	0.289	0.993	0.512

Note: see Table 7.
Source: Own estimations.

previous section.

Consequently, the BMA results for inflation in Table 6 show that a focus on dollarization, instrumental variables and matching methodologies, publication year, time trend in data, use of Euro as foreign currency, affiliation with the World Bank and Spanish language publications have a decisive or strong significance in posterior inflation models. Publications after the financial crisis, local government affiliation, use of the US dollar, and deposit dollarization have posterior probabilities above 75 per cent. In addition, Table 6 also presents the results of the WALS estimator. The alternative results are similar to the BMA estimates with the exception of the Latin America region which becomes significant at the 10 % level and the global financial crisis that becomes insignificant.

7 Robustness analysis

7.1. Alternative estimation methods and subsamples

Using our preferred specification from previous empirical assessments, we perform several robustness checks for the GDP growth

Table 9
Robustness analysis – Subsamples, GDP growth.

	(1) Preferred estimation	(2) Before crisis	(3) Outlier adjustment	(4) Regression methods	(5) Onlydollarization	(6) Full dollarization	(7) No focus on dollarization	(8) Focus on dollarization
Dollarization	0.413**	0.423**	0.405**	0.400**			0.415**	1.038***
	(0.156)	(0.166)	(0.161)	(0.158)			(0.162)	(0.213)
Full dollarization	−0.796***	−0.819***	−0.555***	−0.721***	−0.628**		−0.545	−0.547
	(0.187)	(0.246)	(0.170)	(0.211)	(0.278)		(0.316)	(0.408)
Equality test	0.515***	0.613**	0.305**		0.456**	0.339	0.330	0.562*
	(0.158)	(0.231)	(0.130)		(0.207)	(0.267)	(0.289)	(0.266)
Treatment	1.090***	1.101***	0.823***		1.023***	0.889**		1.190***
	(0.159)	(0.227)	(0.137)		(0.227)	(0.298)		(0.293)
Matching	−0.395**	−0.382*	−0.585***		−0.482*	−0.719**	−0.777**	−0.423
	(0.170)	(0.221)	(0.181)		(0.235)	(0.316)	(0.289)	(0.298)
Time trend (data)	−0.053**	−0.057***	−0.045**	−0.054**	−0.022	−0.019	−0.057**	0.054
	(0.020)	(0.020)	(0.021)	(0.020)	(0.022)	(0.024)	(0.023)	(0.048)
Global fin. crisis	1.386***		1.183***	1.413***	0.801	0.641	1.519***	−0.190
	(0.318)		(0.348)	(0.330)	(0.487)	(0.597)	(0.279)	(0.923)
Government	−0.537***	−0.528***	−0.548***	−0.537***			−0.530**	
	(0.161)	(0.169)	(0.165)	(0.163)			(0.178)	
Constant	−0.632***	−0.660***	−0.581***	−0.639***	−0.074	−0.545	−0.663***	−0.749***
	(0.107)	(0.115)	(0.118)	(0.112)	(0.105)	(0.471)	(0.120)	(0.236)
No of obs.	343	255	338	300	196	64	101	242
Adjusted R^2	0.497	0.492	0.564	0.375	0.511	0.442	0.281	0.602

Note: Clustered standard errors at the study level are in parentheses. *, **, and *** denote significance at the 10 %, 5 %, and 1 % level, respectively.
Source: Own estimations.

Table 10
Robustness analysis – Subsamples, Inflation.

	(1) Preferred estimation	(2) Before crisis	(3) Outlier adjustment	(4) Regression Methods	(5) Onlydollarization	(6) Full dollarization	(7) No focus on dollarization	(8) Focus on dollarization
Deposit dollar.	1.656**	1.052	1.559**	1.643*	1.540***		0.801	1.668**
	(0.655)	(0.903)	(0.617)	(0.844)	(0.525)		(0.909)	(0.656)
Latin America	1.084**	2.405***	1.108**	1.131	0.608	0.141**	1.697	0.151
	(0.435)	(0.606)	(0.434)	(0.715)	(0.437)	(0.046)	(1.408)	(0.461)
Central Bank	−1.768***	−2.055*	−1.743***	−1.531	−2.710***	−3.282***	−1.250	−2.787***
	(0.591)	(1.024)	(1.116)	(1.531)	(0.416)	(0.270)	(1.692)	(0.517)
World Bank	−5.911**	−5.917**	−5.486**	−5.963**			−5.959**	
	(2.276)	(2.427)	(2.222)	(2.334)			(2.461)	
Government	−4.843***	−4.849***	−4.828***	−4.895***			−4.891***	
	(0.621)	(0.962)	(0.623)	(0.763)			(0.976)	
Constant	−0.974	−0.968	−0.989	−0.922	−0.545	−0.168***	−0.925	−0.374
	(0.621)	(0.962)	(0.623)	(0.763)	(0.329)	(0.046)	(0.976)	(0.409)
Observations	187	129	185	144	115	52	100	87
Adjusted R^2	0.505	0.503	0.495	0.521	0.410	0.381	0.532	0.436

Note: Clustered standard errors at the study level are in parentheses. *, **, and *** denote significance at the 10 %, 5 %, and 1 % level, respectively.
Source: Own estimations.

and inflation models. Tables 7 and 8 report the results for our alternative estimation methods. The first method is weighted regression where we use the preciseness of coefficients (that is, log inverse standard errors) as weights. This approach focusses on observations which are more influential, because the discussion tends to concentrate on the most significant results. As some methods can lead to comparably low standard errors, we again use log inverse standard errors. We can see that weighted OLS confirms largely the preferred results. The most important change is that matching methods becomes marginally significant in the GDP growth model.

In the next step, we use methods which moderate the impact of outliers. Instead of minimizing the sum of squared residuals as in ordinary least squares regression, the median regression minimizes the sum of absolute residuals to reduce the effect of large outliers on the estimated coefficients. The robust regression which uses Cook's distance to offset the largest outliers (CRR) provides an alternative way to deal with outliers. Both methods confirm preferred results for GDP regression. In the inflation model, median regression does not confirm the deposit dollarization, Latin America and central bank affiliation effects while CRR finds only marginally significant effect for central bank affiliation and insignificant effect for studies focusing on Latin America.

Finally, we present the results including random effects for individual studies. This analysis accounts for possible remaining cross-sectional dependence between observations in the same study. In this specification, the coefficient for equality test in GDP model becomes insignificant, but all other variables remain largely unchanged.

In another sensitivity exercise, we compare our preferred specification estimated for the full sample, reported again in column (1) of Tables 9 and 10, with results for selected subsamples. These subsamples are identified according to criteria which were already addressed in the previous analysis. Therefore, the corresponding variables have to be omitted from the particular sensitivity checks.

First, the 2008 financial crisis has affected many emerging markets significantly. Therefore, we only use results published before 2008. The coefficient for the matching method in the GDP model becomes slightly less significant, but this may rather reflect the fact that this method has only recently become very popular. Deposit dollarization loses significance in the inflation model. As for central bank affiliation, the coefficient is only marginally significant as there is only one study published before the crisis.

Second, we exclude outliers, which are identified as results in the top and lowest percentile of the sample. Again, the results remain virtually unchanged. Third, we include only regression coefficients (that is, we exclude results for equality means, treatment analysis, and matching methods), which again confirm the stability of majority of the results. Here, central bank affiliation, Latin America, and deposit dollarization are insignificant or marginally significant factors in inflation outcomes.

Moreover, we consider possible differences between the reserve currency, which is used in countries in the studies. In particular, we exclude euroization, which is popular especially in Eastern and Southern Europe. Indeed, we can see that time trend and financial crisis variables become insignificant in the growth model, which may reflect the changing role of international reserve currencies (Arslanalp et al., 2022).

Finally, we drop all observations which analyze incomplete dollarization (that is, where dollar is not introduced as the currency), although the resulting sample is relatively small. In this specification, all variables except treatment and matching methods lose significance. The intercept remains negative but insignificant.

In columns (7) and (8), the sample is split according to the focus of the studies, that is, whether they focus on dollarization or dollarization analysis is included as a control variable. To deal with similar source of bias, Havranek et al. (2017 and 2018) , Havranek and Irsova (2011), Havranek (2010), and Havranek and Sokolova (2019) provide comparable robustness checks. The results for GDP are largely similar in both subsamples. Not surprisingly, the coefficient tends to be higher in the subsample with studies focusing on the effects of dollarization. For inflation, estimations are worse in general, but we can see a similar pattern.

Overall, all robustness analyses confirm the stability of the previous results, with possible exception of the use of dollar or other currencies (euro), and Latin American focus of studies. The effect of the World Bank and national government affiliations should be

Table A1

Studies Included in the Data Set.

Study	Year	Publication	Methodology	Region
Aigheyisi, O. S. Currency Substitution, Inflation and Economic Growth in Nigeria: A Simultaneous Equations Analysis. The Empirical Econometrics and Quantitative Economics Letters 4(1).	2015	Journal	2SLS	Nigeria
Ari, A., Yilmaz, A., Cergibozan, R., Özcan. Y. The Inflation Dynamics of the Turkish Economy in 1990–2011 Period. Journal of Financial Researches and Studies 5(9).	2013	Journal	VECM	Turkey
Arteta, C. O. Are Financially Dollarized Countries More Prone to Costly Crises. Board of FED International Finance Discussion Paper 763.	2003	Working paper	2SLS, OLS	International
Bleaney, M., Francisco, M. The Performance of Exchange Rate Regimes in Developing Countries – Does the Classification Scheme Matter? CREDIT Research Paper 07/04.	2004	Working paper	OLS	International
Bleaney, M., Francisco, M. The B.E. Journal of Macroeconomics 7(1).	2007	Journal	OLS	International
Calderon, C., Schmidt-Hebbel, K. Macroeconomic Policies and Performance in Latin America. Journal of International Money and Finance 22(7).	2003	Journal	IV regression	International
Calderon, C., Schmidt-Hebbel, K. Macroeconomic Policies and Performance in Latin America. Central Bank of Chile Working Paper 217.	2003	Working paper	IV regression	Latin America
Chitu, L. Was Unofficial Dollarisation/Euroisation an Amplifier of the "Great Recession" of 2007–2009 in Emerging Economies? Comparative Economic Studies 55(2).	2013	Journal	OLS	International
Chiţu, L. Was Unofficial Dollarisation/Euroisation an Amplifier of the "Great Recession" of 2007–2009 in Emerging Economies? European Central Bank Working Paper 1473.	2012	Working paper	OLS	International
Edwards, S. Dollarization: Myths and Realities. Journal of Policy Modelling 23(3).	2001	Journal	EHT	International
Edwards, S. Dollarization and Economic Performance: An Empirical Investigation. NBER Working Paper 8274.	2001	Working paper	EHT	International
Edwards, S. Strict Dollarization and Economic Performance: An Empirical Investigation. NBER Working Paper 9820.	2003	Working paper	Matching	International
Edwards, S., Magendzo, I. A Currency of One's Own? An Empirical Investigation on Dollarization and Independent Currency Unions. NBER Working Paper 9514.	2003	Working paper	Joint MLE	International
Edwards, S., Magendzo, I. Dollarization, Inflation and Growth. NBER Working paper 8671.	2001	Working paper	EHT, Matching	International
Edwards, S., Magendzo, I. Dollarization and Economic Performance: What Do We Really Know? International Journal of Finance and Economics 8.	2003	Journal	EHT, Matching	International
Edwards, S., Magendzo, I. Hard Currency Pegs and Economic Performance. Conference in honor of Guillermo Calvo at IMF, April 15–16, 2004.	2013	Proceedings	MLE	International
Edwards, S., Magendzo, I. Strict Dollarization and Economic Performance: An Empirical Investigation. Journal of Money, Credit, and Banking (38)1.	2007	Journal	Joint MLE	International
Fabris, N., Vujanovic, N. The Impact of Financial Dollarization on Inflation Targeting: Empirical Evidence from Serbia. Journal of Central Banking Theory and Practice (6)2.	2017	Journal	VAR	Serbia
Gómez-Soler, S. C. La Dolarización Como Política Monetaria En Latinoamérica: Una Aproximación a Partir De La Técnica De "Diferencia En Diferencias". Revista de la Maestría en Derecho Económico 5(5).	2009	Journal	Difference-in-Difference	Ecuador, El Salvador
Gruben, W. C., McLeod, D. Currency Competition and Inflation Convergence. 9th Annual LACEA Meetings in Costa Rica November 4–6, 2004.	2004	Proceedings	OLS, 2SLS	Latin America
Guidotti, P. E., Sturzenegger, F. Villar, A. On the Consequences of Sudden Stops. Economía 4 (2).	2007	Journal	OLS	International
Hallren, R. The Impact of Dollarization and Currency Boards on Income and Inflation: A Synthetic Control Analysis. SSRN Electronic Journal.	2014	Working paper	Matching	Ecuador, Argentina
Karacal, M., Bahmani-Oskooee, M. Inflation and Dollarization in Turkey. Warsaw International Economic Meeting 2008.	2008	Proceedings	ARDL, cointegration	Turkey
Levy-Yeyati, E. Financial Dollarization: Where Do We Stand? Conference on Financial Dedollarization: Policy Options, IADB, Washington, D.C. December 1–2, 2003.	2003	Proceedings	OLS	International
Levy-Yeyati, E. Financial Dollarization: Evaluating the Consequences. Centro de Investigación en Finanzas Documento Working Paper 03/2005.	2005	Working paper	Matching, OLS, IV regression	International
Levy-Yeyati, E. Financial Dollarization: Evaluating the Consequences. Economic Policy 21 (45).	2006	Journal	Matching, OLS, IV regression	International
Levy-Yeyati, E., Sturzenegger, F. Exchange Rate Regimes and Economic Performance. IMF Staff Paper 47.	2001	Working paper	OLS	International
Levy-Yeyati, E., Sturzenegger, F. Exchange Rate Regimes and Economic Performance. SSRN Electronic Journal.	2002	Working paper	OLS	International
Maliszewska, M., Maliszewski, W. Exchange Rate: Shock Generator or Shock Absorber? Center for Social and Economic Research Working Paper 272.	2004	Working paper	OLS	International
Mandadjiev, I. Inflation, Growth and Crisis Performance of Hard Pegged Exchange Rate Regimes. Undergraduate Economic Review 1(1).	2004	Journal	OLS	International
Masunda, S. Is Dollarisation an Answer to Economic Crisis: Evidence from Zimbabwe. 9th African Finance Journal Conference.	2014	Proceedings	ARDL	Zimbabwe
Mengesha, L. G., Holmes, M. J. Does Dollarization Reduce or Produce Inflation? Journal of Economic Studies 42(3).	2015	Journal	Cointegration	Eritrea
Mengesha, L. G. An Investigation of the Macroeconomic and Monetary Effects of Dollarization in Eritrea. Ph.D. thesis. The University of Waikato.	2013	Working Paper	Cointegration	Eritrea
Metin-Özca, K., Us., V. Dedollarization in Turkey after Decades of Dollarization: A Myth or Reality? Physica A: Statistical Mechanics and its Applications 385(1).	2007	Journal	VAR	Turkey

Table A1 (*continued*)

Study	Year	Publication	Methodology	Region
Neanidis, K. C., Savva, C. S. The Effects of Uncertainty on Currency Substitution and Inflation: Evidence from Emerging Economies. CGBCR Discussion Paper 71.	2006	Working paper	GARCH	International
Olayungbo, D. O., Ajuwon, K. T. Dollarization, Inflation and Interest Rate in Nigeria. CBN Journal of Applied Statistics 6.	2015	Journal	Granger caus. test	Nigeria
Payne, J. E. Official Dollarization in El Salvador and the Inflation–Inflation Uncertainty Nexus. Applied Economics Letters (16)12.	2009	Journal	GARCH	El Salvador
Razin, A., Rubinstein, Y., Arellano, M., Corsetti, G. Evaluation of Currency Regimes: The Unique Role of Sudden Stops. Economic Policy 21(45).	2006	Journal	OLS	International
Sadeghi, S. K., Feshari, M., Marvasti, M. B., Ghanbari, Z. Exchange Rate Pass-Through and Inflation in Dollarized Economies: Evidence from the Middle Eastern and North African Countries. Iranian Economic Review 19(2).	2015	Journal	GMM	International
Tas, B. K. O., Togay, S. Effect of Official Dollarization on a Small Open Economy: Ecuador. Turkish Economic Association Discussion Paper 2009/4.	2011	Working paper	OLS	Ecuador
Tas, B. K. O., Togay, S. Efectos de La Dolarización Oficial En Una Pequeña Economía. Investigación económica 73(290).	2014	Journal	OLS	Ecuador
Tas, B. K. O., Togay, S. Effect of Dolarization on Macroeconomic Performance and Money-Price Relationship in Ecuador. TOBB University of Economics and Technology Discussion Paper 08–08.	2008	Working paper	OLS	Ecuador
Zefi, A., Shehu, E. Euroization Impact on GDP Growth and the Appropriate Policy Responses: A QTM Approach. Journal of European Social Research.	2016	Journal	OLS	Albania

Note: ARDL - autoregressive distributed lag, EHT - equality hypothesis test, IV - instrumental variables, GMM - generalized method of moments, MLE - maximum likelihood estimator, OLS - ordinary least squares, VECM - vector error correction model, 2SLS - two stage least squares. *International* denotes large cross-country studies.

treated with caution as they have rather low number of observations. The intercept in all GDP regressions remains negative and significant, except for the subsample of studies focusing on dollarization and full dollarization.

7.2. Partial correlations

In order to control for different empirical methodologies used in individual studies, we calculate a partial correlation coefficient for every reported estimate in a study. Reported coefficients may not be directly comparable across studies when papers employ different empirical methodologies (Doucouliagos et al., 2012). Partial correlations deal with method selection bias and transform estimates to a comparable measure of the size effects (Doucouliagos, 2003; Doucouliagos et al., 2012).

Table B.1 (Appendix B) reports the meta-statistics for the overall dataset and selected subsamples using Fisher transformation of partial correlation coefficients that are calculated from the statistics provided in the individual surveyed studies. In line with the reported results, dollarized countries on average tend to grow slower and have more volatile business cycles. This is confirmed by a separate analysis of the subsample of estimates published in highly recognised journals.

In Fig. 2 (Appendix B), we present funnel plots of the measured dollarization effects. Using the inverse number of observations as the measure of estimate precision, the funnel graph for GDP growth is negatively skewed to the left and has a similar shape to the graph of reported coefficients. We have less observations for partial correlations on output volatility, but the funnel plot, similar to the reported estimates, also suggests a positive effect. The funnel graph for inflation is more symmetric and the mean effect of dollarization on inflation is only marginally negative. However, for some subsamples with low number of observations the means for partial correlations do not precisely match those for the reported coefficients (i.e. the dollarization effect on inflation in the best journals where N = 16). In some cases, it was difficult to obtain exact values for t-statistics and degrees of freedom as studies frequently do not report exact information for their calculation. Partial correlations are therefore only used as one of the robustness tests for the whole sample of estimates along with other sensitivity exercises.

8. Conclusions

This paper provides a quantitative assessment of the macroeconomic effects of dollarization published in the current literature. Understanding the effects of dollarization on inflation, output volatility and output growth is particularly important as this is a widespread practice in Africa, Latin America, Asia as well as in some parts of Europe. Since there is no consensus on the underlying macroeconomic effects of dollarization, there is a need to quantitatively assess the literature in order to document its effects and provide relevant policy conclusions.

The empirical findings presented in this paper suggest that dollarization raises output volatility and reduces growth of dollarized economies. Dollarization also serves as the instrument to reduce inflation which has been confirmed by empirical results presented in this paper. The estimates vary widely within and across studies and depend on the way dollarization is measured, empirical methodologies, and author affiliations. Funnel asymmetry tests reveal a significant publication bias as, for example, no single study reports a negative impact of dollarization on income volatility.

The meta-regression results show fully dollarized economies grow slower than non-dollarized ones as well as compared to partially dollarized economies. Moreover, it seems the use of US dollars improves growth performance compared to other reserve currencies. It

Table A2
Definition of variables.

Variables	Definitions
Dependent variables	
Coefficient	Reported coefficient for the impact of dollarization on GDP growth / GDP volatility / inflation.
PCC	Partial correlation coefficient transformed using Fisher transformation.
Publications	
Publication year	Continuous variable measured as the deviation from the mean publication year.
Journal	Dummy variable: one if a study is published in a journal, zero otherwise.
Top journal	Dummy variable: one if a study is published in a journal indexed in Web of Science with a non-zero impact factor as of July 2017, zero otherwise.
Working paper	Dummy variable: one if a study is published in a working paper, zero otherwise.
Proceeding	Dummy variable: one if a study is published in a proceeding from an international conference, zero otherwise.
English	Dummy variable: one if a study is published in English, zero otherwise.
Spanish	Dummy variable: one if a study is published in Spanish, zero otherwise.
Dollarization focus	Dummy variable: one if a study is focusing on dollarization, zero otherwise.
Global fin. crisis	Dummy variable: one if a study is published after 2007, zero otherwise.
Currency crisis exp.	Dummy variable: one if a study focuses on countries which historically experienced a currency crisis, zero otherwise. Crisis definition is provided by Laeven and Valencia (2020).
Dollarization focus	Dummy variable: one if a study focuses primarily on macroeconomic effects of dollarization / euroization, zero otherwise.
Authors	
University	Dummy variable: one if an author is affiliated with university, zero otherwise.
Central Bank	Dummy variable: one if an author belongs to central bank, zero otherwise.
Banking sector	Dummy variable: one if an author is affiliated with the banking sector, zero otherwise.
EU institution	Dummy variable: one if an author belongs to EU institution (European Commission, European Central Bank), zero otherwise.
IMF	Dummy variable: one if an author belongs to IMF (International Monetary Fund), zero otherwise.
BIS	Dummy variable: one if an author belongs to BIS (Bank of International Settlement), zero otherwise.
World Bank	Dummy variable: one if an author belongs to World Bank, zero otherwise.
Government	Dummy variable: one if an author belongs to Ministry of finance of the local government, zero otherwise.
Measurement methods	
Dollarization	Dummy variable: one if a study focuses on dollarization (foreign currency is USD), zero otherwise.
Euroization	Dummy variable: one if a study focuses on euroization (foreign currency is EUR), zero otherwise.
Deposit dollarization	Dummy variable: one if a study uses the ratio of deposits in USD/EUR/foreign currency to total deposits to measure dollarization, zero otherwise.
Credit dollarization	Dummy variable: one if a study uses the ratio of credit in USD/EUR/foreign currency to total credits to measure dollarization, zero otherwise.
Index	Dummy variable: one if a study uses a dollarization index to measure dollarization, zero otherwise.
Full dollarization	Dummy variable: one if a study uses dummy variable to identify dollarized countries /dollarization periods, zero otherwise.
Hard peg	Dummy variable: one if a study analyzes a broad category of hard pegs, zero otherwise.
Regions	
Latin America	Dummy variable: one for country in Central and Southern America, zero otherwise.
Africa	Dummy variable: one for country in Africa, zero otherwise.
Eastern Europe	Dummy variable: one for country in Eastern European and Balkan countries, zero otherwise.
Asia	Dummy variable: one for country in Asia, zero otherwise.
Global study	Dummy variable: one if a study uses a global sample of countries (more than one region), zero otherwise.
Model classes	
OLS	Dummy variable: one if a study uses ordinary least squares, zero otherwise.
Panel methods	Dummy variable: one if a study is based on a panel regression approach (fixed effects and random effects models, instrumental panel regression), zero otherwise.
IV methods	Dummy variable: one if a study uses instrumental variable methodology (two-stage least squares), zero otherwise.
Equality test	Dummy variable: one if a study uses equality tests (Mean equality test, Median equality test, t-test from bootstrapping), zero otherwise.
Treatment	Dummy variable: one if a study uses treatment methods (Difference in difference, treatment joint regression), zero otherwise.
Matching	Dummy variable: one if a study uses matching methods.
Data	
Quarterly data	Dummy variable: one if a study uses data in quarterly frequency, zero otherwise.
5-year averages	Dummy variable: one if a study uses data transformed by 5-year averages, zero otherwise.
Time trend (data)	Demeaned middle year of the original data sample.

is also interesting to note that partial deposit dollarization, despite the overall negative impact of dollarization on inflation, raises inflation in dollarized economies. We also find an institutional bias due to the author affiliations as, for example, authors affiliated with central banks present significantly more ambitious results on inflation reduction effects of dollarization.

Finally, different methods of endogeneity treatments may lead to largely different effects especially for growth. In particular, studies applying difference-in-difference methodology are similar to simple statistical mean tests, while matching estimations confirm expected negative results. This may indicate that difference-in-difference results can be biased because dollarized countries are inherently different from the remaining sample, as suggested by the recent literature (Callaway and Sant'Anna, 2021).

The results in this paper improve our understanding with regards to the effects of dollarization and provide important policy implications. One of the key issues of full dollarization is the absence of discretionary monetary policy or the limited lender of the last resort function of the central bank. This feature makes it particularly desirable to adopt dollarization in the first place. However, the

Table A3
Descriptive statistics.

Variable	Observations	Mean	St dev.	Min	Max
GDP growth					
PCC	338	−0.140	0.444	−3.551	0.611
Coefficient	343	−0.194	0.486	−3.452	0.605
Credit dollarization	343	0.312	0.464	0	1
Deposit dollarization	343	0.289	0.454	0	1
Dollarization	343	0.571	0.496	0	1
Full dollarization	343	0.187	0.390	0	1
Euroization	343	0.006	0.076	0	1
Equality test	343	0.041	0.198	0	1
Panel methods	343	0.058	0.235	0	1
IV methods	343	0.088	0.283	0	1
Treatment	343	0.018	0.131	0	1
Matching	343	0.067	0.251	0	1
Latin America	343	0.053	0.223	0	1
Africa	343	0.006	0.076	0	1
Eastern Europe	343	0.006	0.076	0	1
Currency crisis exp.	343	0.134	0.341	0	1
Publication year	343	0.0001	4.175	−4.653	11.347
Journal	343	0.367	0.483	0	1
Proceeding	343	0.032	0.176	0	1
Spanish	343	0.018	0.131	0	1
Global fin. crisis	343	0.257	0.437	0	1
Dollarization focus	343	0.706	0.456	0	1
Central Bank	343	0.627	0.484	0	1
IMF	343	0.006	0.076	0	1
BIS	343	0.047	0.211	0	1
World Bank	343	0.064	0.245	0	1
EU Institution	343	0.204	0.404	0	1
Government	343	0.035	0.184	0	1
5-year averages	343	0.012	0.108	0	1
Quarterly data	343	0.041	0.198	0	1
Time trend (data)	343	0.0001	8.972	8.971	−21.014
GDP volatility					
PCC	55	0.169	0.174	0.0088	0.818
Coefficient	58	0.971	2.507	0.0001	18.308
Deposit dollarization	58	0.310	0.467	0	1
Dollarization	58	0.983	0.131	0	1
Equality test	58	0.138	0.348	0	1
IV methods	58	0.207	0.409	0	1
Treatment	58	0.155	0.365	0	1
Matching	58	0.328	0.473	0	1
Latin	58	0.086	0.283	0	1
Publication year	58	0.0001	2.234	−3.086	4.914
Journal	58	0.414	0.497	0	1
Proceeding	58	0.138	0.348	0	1
Spanish	58	0.086	0.283	0	1
Global fin. crisis	58	0.086	0.283	0	1
Central Bank	58	0.569	0.500	0	1
IMF	58	0.035	0.184	0	1
5-year averages	58	0.103	0.307	0	1

Variable	Observations	Mean	St dev.	Min	Max
Inflation					
PCC	174	−0.060	0.571	−4.888	4.384
Coefficient	187	−1.263	3.123	−12.630	7.661
Credit dollarization	187	0.005	0.073	0	1
Deposit dollarization	187	0.353	0.479	0	1
Dollarization	187	0.615	0.488	0	1
Full dollarization	187	0.278	0.449	0	1
Euroization	187	0.021	0.145	0	1
Equality test	187	0.080	0.272	0	1
Panel methods	187	0.043	0.203	0	1
IV methods	187	0.037	0.190	0	1
Matching	187	0.150	0.358	0	1
Latin America	187	0.150	0.358	0	1
Africa	187	0.053	0.226	0	1
Eastern Europe	187	0.011	0.103	0	1
Currency crisis exp.	187	0.316	0.466	0	1

Table A3 (*continued*)

Variable	Observations	Mean	St dev.	Min	Max
Publication year	187	0.0001	4.220	−5.134	10.866
Journal	187	0.455	0.499	0	1
Proceeding	187	0.139	0.347	0	1
Spanish	187	0.032	0.177	0	1
Global fin. crisis	187	0.310	0.464	0	1
Dollarization focus	343	0.706	0.456	0	1
Central Bank	187	0.230	0.422	0	1
IMF	187	0.032	0.177	0	1
World Bank	187	0.080	0.272	0	1
Government	187	0.032	0.177	0	1
Quarterly data	187	0.096	0.296	0	1
Time trend (data)	187	0.0001	7.728	−20.514	19.487

Source: Own calculations.

results presented in this paper also point to a cost associated with limiting monetary discretion: reduced output growth and increases in output volatility. Hence, there is a trade-off between limiting monetary discretion and output growth and stability. In countries where price stability is not a pressing issue, policymakers may want to reconsider the costs of reduced growth and the increase in output volatility.

Moreover, with the limited lender of last resort, the country ought to have adequate international reserves to be able to provide liquidity. At a minimum, it requires that a country has adequate credit lines or loans from international creditors. On the other hand, government finances also ought to be in order, else the country would have to pay a high-risk premium, and the cost of borrowing can be substantially high. The danger of fiscal dominance has increased due to the Global Financial Crisis and, recently, due to the Covid-19 pandemic and the associated public spending to counter the effects of the pandemic. Coupled with the absence of seigniorage revenues, dollarization means the tax base should be adequate to sustain government spending. The covid-19 pandemic has likely resulted in high output volatility and increased financial vulnerability. Considering the results presented in this paper, it is important to look for suitable de-dollarization strategies, especially in financially dollarized economies.

The financial sector too should be able to cope with the absence of a lender of last resort which requires a sound and stable financial system. This requires strong solvency and liquidity requirements and a robust prudential framework particularly when the banking system holds a large fraction of foreign currency deposits. Financial sector stability is also essential for a dollarized country to meet its financial obligations and withstand temporary international financial flights (Cheung et al., 2020a, 2020b). Finally, highly dollarized economies should have a robust international trade base and a competitive economy as exports provide an important source of foreign exchange revenues.

Declaration of Competing Interest

Data availability

Data will be made available on request.

Appendix A. Further statistics

Tables A1-A3

Appendix B. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jimonfin.2023.102915.

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