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ARE ALTERNATIVE CURRENCIES A SUBSTITUTE OR A COMPLEMENT TO FIAT MONEY? EVIDENCE FROM CROSS-COUNTRY DATA

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ABSTRACT

This paper studies the determinants of the usage of alternative currencies (currencies which exists parallel to the national currency of a country) across countries. We find that monetary stability, financial sector development and a country's general level of economic development are all positively related to both the likelihood of a country hosting an alternative currency as well to the number of alternative currencies a country is hosting. This suggests that these currencies, in contrast to their historical function, mainly act as a complement to fiat money. We discuss the implications for the role of fiat money in the economy as well as for the welfare effects of alternative currencies.

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1. INTRODUCTION

A country's national currency (fiat money) is typically its dominating means of exchange. Standard monetary theory suggests that as such it has to fulfill three different important functions: it has to act as a means of payment, to serve as a unit of account, and to be a store of value.

Surprisingly, little is known about whether fiat money around the world fulfills these functions well. One may argue that the fact that it is the dominating form of money alone indicates that fiat money fulfills its role sufficiently well as otherwise (self-interested) economic agents would trade using alternative forms of money. However, there are problems with this argumentation. Economic agents may simply not switch to other currencies due to coordination problems (there are network effects from adopting a new form of money). In addition, government legislation favors fiat money over other forms of money, thus effectively inducing agents to accept it as a main means of exchange (even though better forms of money may exist). It might also be that economic agents indeed prefer fiat money overall but that actually one specific function is better served by an alternative form of money. For example, fiat money may be an efficient means of account and exchange due to its widespread prevalence but not a store of value as governments have incentives to inflate.

In recent years we have seen an increase in alternative currencies (ACs) around the world. For example, the number of organizations issuing ACs has increased from 20 in 1992 to 224 by mid 2011 according to the database of Complementary Currency Resource Center. Alternative currencies refer to unofficial currencies that exist parallel to the national currency and which can exist for a variety of stated purposes. A common element, however, is that they are often established on a local or regional level, backed by some form of local interest group, such as private nonprofit organizations, small businesses or local institutions. Representative examples for such currencies are the Ithacahours, the Toronto Dollar and the WIR-bank. Historically, the currencies spring whenever fiat money is not performing its functions. For example, during the German Hyperinflation of the 1920s many cities introduced so-called Notgeld (emergency money) which arguably helped to alleviate problems caused by inflation in the affected regions.[1] Another example is the emergence of trading coupons when circulation of national fiat money is restricted. The literature on alternative currencies has hence largely focused on a substituting role of these currencies.[2]

The increase in the number of alternative currencies may -- at first -- suggest that national currencies are somewhat less successful in fulfilling the three core functions of money, and that as a result agents are substituting them (partly) for alternative currencies.[3] This arguably was the case in the 1920s when alternative currencies gained in importance because inflation undermined the role of official currencies as a store of value and unit of account. Another potential explanation for the increasing popularity of alternative currencies is a perceived deterioration in institutional quality, or a reduction in the effectiveness of the financial system. For example, if agents believe there is a risk of a currency reform, they may be less likely to see fiat money as a reliable store of value. Likewise, reduced trust in the established financial system will equally reduce the appeal of storing money using this system, hence reducing its overall demand. In addition, if access to money is not widespread (for example due to a lack of an extensive bank branch network in rural areas and in developing countries), agents may start to accept alternative forms of payments.

The key competing explanation is that alternative currencies act as a complement to national currencies. For example, in developed countries alternative currencies may not serve to substitute for a less well functioning of fiat money but rather to pursue objectives beyond the core functions of money, such as promoting local business interests or furthering specific local causes (e.g., the promotion of certain activities and the promotion of a community spirit).

This paper attempts to shed some light on these questions by studying the determinants of alternative currencies. For this we use an international sample on the usage of alternative currencies across 76 countries. The main basis of this dataset is the database of Complementary Currency Resource Center, which documents alternative currency projects around the world. We use the information from this database to ask the question if (and which) factors related

[1] In the Miracle of Wörgl, a town in Austria introduced scrip money during the Great Depression. This resulted in growth and a reduction in unemployment in the region, defying the depression in the rest of the country. The experiment was later terminated by the Austrian Central Bank on the basis of being a threat to the bank's monopoly for printing money. A related, but not necessarily overlapping, concept is the one of Schwundgeld advocated by Gesell (1906). Gesell posited that interest on money is undesirable as it discourages spending and leads to money hoarding. He instead proposed to introduce demurrage money, i.e. money that depreciates automatically (for example because each month the face value is reduced by a certain fraction).

[2] Alternative currencies may also have a role to play in the current situation in Greece, see Sotiropoulou (2011) and Sotiropoulou (2102).

[3] Several papers have shown that there is a role for dual-currencies. Ales et al (2008) and Craig and Waller (2000, 2004) provide search-based models of second currencies. Cavalcanti and Wallace (2005) shows that a role for private money arises if there are commitment problems in the economy. Macroeconomic repercussions of dual currencies are discussed, among others, in Calvo and Vegh (1992).

to the functions of money on a country level determine the usage of alternative currencies.

From our empirical investigation a clear picture emerges: alternative currencies are a complement rather than substitute for fiat money. First, indicators of monetary stability (e.g., low inflation, low money growth, low prices volatility) all are associated with a higher usage of alternative currencies. These indicators are important proxies for potential inadequacies in money's role as a unit of account or store of value. Indicators of development of the financial system (e.g., number of bank branches, credit availability in the economy, share of non-performing loans) likewise increase usage of alternative currencies. In addition, proxies for overall development of a country (e.g., GDP per head, low business cycle volatility, internet usage) also go along with higher usage of alternative currencies. The results are robust to the econometric method used and hold both for the likelihood of a country hosting an alternative currency as well as the number of alternative currencies in a country.[4]

To some extent a complimentary role for alternative currencies constitutes a puzzle. It is difficult to conceive how they can provide a substantial value added over fiat money, especially with respect to the store of value and unit of account function. These currencies are pegged with a fixed-rate against the national currency and hence will be equally subject to devaluation arising from inflation. What then about the function as a means of payment? The usage of these alternative currencies is typically local, and often expressly so (e.g., the stated motive for setting up the currency may be promoting the local economy or a percentage of sales may be used to further local causes), hence their appeal as a means of exchange is restricted. Taken together, from the viewpoint of an individual there do not seem to be any direct benefits from using these currencies: everything which can be done with alternative currencies can equally well be done by national currencies.

However, alternative currencies potentially provide benefits to the local economy in the aggregate by creating an asymmetric system for means of exchanges: local agents who are endowed with the alternative currency face lower costs of spending their income in their region as opposed to other regions, which will serve to increase local demand. At the same time, alternative currencies do not deter demand from other regions, as local shops will still accept fiat money. Local currencies may thus serve as a commitment mechanism to overcome free-riding problems: each agent may individually find it optimal to spread her purchases across the country as she does not fully internalize the benefits for the local community when spending locally. The region as a whole may be better off if its inhabitants spend locally and community currencies may serve as a mechanism to do so.

This interpretation of local currencies has an interesting implication for welfare. Local currencies do not affect welfare (as one may have expected a priori) by undermining fiat currency, but because they impose externalities on other regions (i.e., by lowering demand there). Their emergence may thus be detrimental for the overall economy. For example, suppose that there are two regions in a country which both (independently) introduce their own alternative currency pegged to the legal tender money at a fixed exchange rate. Aggregate demand in this case should be unaffected because the effects in each region cancel out. Still the economy overall faces additional costs as there will be some deadweight losses from using the alternative currency.

The remainder of this paper is structured as follows. The next section describes the usage of alternative currencies from a historical perspective and their current usage and also discusses some recent research on ACs. The following section contains the empirical results, based on cross-country probit, ordered logit and poisson regressions. The final section concludes.

2. ALTERNATIVE CURRENCIES

2.1. Multiple Currency Regimes in History

Multiple currencies have throughout history arisen in circumstances where the legal tender was no longer providing its functions well. In these cases, the market mechanism led to the emergence of secondary currencies that allowed for some (or all) of the functions of money without imposing undue additional costs.

A well-known example in modern history is France in the aftermath of the Revolution. Starting in 1790 a series of paper money devaluations led to old silver and gold coins, along with some other foreign metal currencies, to be used in everyday's life. This was despite the fact that anyone refusing payments in the official bills could be prosecuted by French law. The so-called Louis d'Or, the French coin named after Louis XIII, was actively used in the market throughout the entire revolutionary period (see White, 1933). During 1795 and 1796 the paper Franc depreciated against the Louis d'Or by 87% in just six months and efforts of the authorities to enforce exchange with the legal tender was largely unsuccessful.

Alternative currencies also played a significant role during the German hyperinflation. Prior to the introduction of the Rentenmark in 1922, foreign exchange, old metallic coins and privately issued currencies had replaced the official currency in all of its functions. The most important industries started to express their prices in foreign currencies or gold marks. This led to the issuance of Notgeld ("emergency money"). Its amount grew so dramatically that regulations restricting its issuance were implemented. How-

[4] Alternative currencies are conceivably more likely to be a substitute for fiat money in developing countries as in these countries fiat money is fulfilling its role less well. We thus examine whether at least within the group of developing countries alternative currencies act as a substitute, which is not the case.

ever, in many cases the issuers continued operating outside the law. The popularity of secondary money caused the real supply of fiat money to decline – even though its nominal quantity steadily increased – as Germans were preferring alternative media of exchange. During that period fiat money was refused by consumers and businesses alike. When the Rentenmark was introduced, it effectively did not took the place of the hyper-inflated old paper mark, but substituted the various alternative currencies that had arisen (Bresciani-Turroni (1931)).

An important role for the advancement of alternative currencies was played by the German philosopher and economist Silvio Gesell. In his pamphlet The Natural Economic Order, Gesell (1929) suggests introducing currencies with so-called demurrage or negative interest. The idea was to impose a scheduled depreciation on paper money in order to discourage money hoarding by the savers.[5] Gesell's depreciating money proposal was later refined by Irving Fisher (1933). Fisher expressed the opinion that a key reason behind economic stagnation is the fact that consumers avoid spending. He suggests a mechanism similar to demurrage with the aim to boost the speed of circulation of the currency and ultimately to stimulate economic activity. Fisher suggests local scrip money, paper money redeemable in legal tender but with an expiration date after which it has to be converted into the official currency. A scrip bill would have a reverse side divided into cells. This allows the holding of money to be taxed by stamping cells at, say, and weekly frequency. Stamping would be required for the holder of the bill to be able to later exchange the bill.

2.2. Modern Alternative Currencies

ACs can nowadays be broadly distinguished into three groups: (i) backed currencies, (ii) un-backed currencies, and (iii) mutual credit system currencies (see Schraven (2004), Blanc (2011) and Martignoni (2012)). The first ones are backed by commodities, real goods or legal tender money, for which they can be exchanged at a fixed fee. In the great majority they are fully convertible to the official currency. The earlier examples of complementary or community currencies fell into this category. Unbacked currencies are typically tied to the provision of some services (e.g., baby sitting) or simply one hour of labour (e.g., the Ithaca Hours currency). Mutual credit systems are the most common category of ACs nowadays. A prevalent form of such systems is *Local Exchange Trading Systems* (LETS) networks. These networks essentially represent an alternative payment club; there is no initial stock of cash in the system. They incorporate a central (automatic) clearing mechanism which allows individual accounts to go in debt or credit. An individual account outstanding balance can then be traded inside the network. The general idea behind LETS is to transform working time (often of unskilled labour) into direct purchasing power.

2.3. Economic Implications of Alternative Currencies

ACs can be used as an alternative to fiat money when the latter is, for whatever reason, not fulfilling its functions properly. For example, the role of fiat money may be undermined in the presence of significant inflation or because of a currency shortage (which can arise when money is backed by a scarce commodity). ACs can also be used as a means to accommodate macroeconomic imbalances. When it tends to be adopted in situations of (fiat) money scarcity, it serves to (endogenously) modify the elasticity of money supply. It can also counter inflationary tendencies by inducing individuals to switch to (more stable) AC whenever fiat money is losing value. AC (in particular in the form of LETS) can also mitigate credit constraints for small and medium-size enterprises and utilize unskilled labor to a greater extent. On the downside, ACs are often used as a local policy instrument. As such AC have a potentially protectionist role in diverting trade to a network or region.

Economic research has so far paid little attention to the alternative currency phenomenon. One reason for this is surely that these moneys are often arranged by relatively small communities and with rather different purposes. The characteristics of these moneys also differ widely, making it difficult to draw general inferences. However, spurred by the rapid growth of organizations that offer such currencies in recent years, there has been an intensified interest in alternative currencies. Stodder (2009) analyzes the WIR credit network in Switzerland that was established in response to currency shortages after the 1929 stock market crash. It only exists as a bookkeeping system and its aim is to serve small and medium-sized businesses. Stodder (2009) provides evidence of the countercyclical effect of the WIR system: the network extends whenever individual are cash-short such as in recession (and vice versa). It thus appears to have smoothed the business cycle fluctuations in Switzerland. Stodder suggests that credit networks should hence be generally taken into account by monetary policy. Colacelli and Blackburn (2009) study the barter clubs of *crédito,* which played a significant role in Argentina during the financial meltdown in 2002. Using survey data they investigate the determinants of their acceptability as secondary currency. They find that the degree of acceptability increases when local money supply is low, when the relative transaction costs of the secondary currency decrease and when individual trading technologies are less effective. Colacelli and Blackburn also find that the usage of alternative currencies has a sizeable impact on economic activity: individuals who use these currencies gain about 15% of the average income in the country. Our study complements their research by looking at the cross-country variation of ACs; showing that beside micro-level determinants (which are considered in Colacelli and Blackburn) the spread of ACs is also heavily determined by macroeconomic factors. Rösl (2009) focuses on regional currencies in Germany and demonstrates that there are welfare losses associated with local systems of payments. He asserts that regional currencies perform worse than the legal tender under all functions of money. He concludes that such local media of exchange cannot be explained by currency substitution models and suggest they should be considered as luxury-goods. This is consistent with our cross-country findings in that the emergence of alternative currencies does not seem to be motivated by a desire to replace fiat money. Alternative currencies may also have social effects. In particular, Nakazato and Hiramoto (2012)

[5] A discussion of the impact of demurrage for alternative currencies can be found in Godschalk (2012).

find community currencies provide social benefits by increasing user awareness.

3. DETERMINANTS OF ALTERNATIVE CURRENCIES: EMPIRICAL ANALYSIS

3.1. Data

We gather information on alternative currencies from the online database of the Complementary Currency Resource Center (where necessary we also consulted additional web resources). This database provides information on AC organizations around the world. It includes various types of ACs, such as regional currencies, local exchange and trading system, barter clubs, commodity monies. For each currency in the database we retrieve the country in which it is based.

Our aim is to study whether economic characteristics can explain the prevalence of ACs. We do not differentiate among the various types of ACs and thus examine the importance of ACs in general. We use three alternative ways to measure ACs in a country. First, a simple dummy variable which takes the value one if there is at least one AC in a country, and zero otherwise. Second, a count variable that indicates the number of ACs in a country. Third, in order to address skewness in the distribution of the ACs (there are few countries that have a large number of ACs) we define an ordinal variable that measures the importance of alternative currencies. This variable takes the value of 5 if a country has more than 15 ACs, 4 if the number of ACs is between 11 between 15, 3 if the number of ACs is between 6 and 10, 2 if the number of ACs is between 3 and 5, 1 if the number of ACs is between 1 and 2, and 0 otherwise.

We consider a wide set of factors that may determine whether an environment is conducive to ACs. First, we consider some basic country characteristics, such as real GDP per capita, (log of) population and whether the country is a federal union. Second, we consider indicators of monetary stability and monetary policy in a country. For this we include an inflation measure (average CPI inflation over the last five years), money growth (five-year average of M2), inflation volatility (average five-year standard deviation of CPI inflation), money velocity (the ratio of GDP to M2) and a short-term interest rate (5-year average of 3-6 month interest rates). Third, we include measures of business cycle characteristics in the dataset. For this we take average GDP growth (5-year average of the growth rate of GDP) and business cycle volatility (defined as the average standard deviation of the GDP growth over the last 5 years). Fourth, we also consider various measures of financial development of a country. We include domestic credit (domestic credit to private sector excluding the government as percentage of GDP), bank branch intensity (number of branches of commercial banks per 100,000 inhabitants), stock market capitalization (defined as the total value traded on the stock exchange) and the fraction of non-performing loans at banks. Finally, we include the following other country characteristics: a dummy variable which takes the value of one if the national central bank is in charge of the monetary policy and the currency supply and of zero if instead the country is part of a monetary union or is bound to a currency board and similar (as a proxy for the activism of the monetary institutions), a measure of a country's openness (measured by the ratio of the sum of imports and exports to GDP) and the prevalence of internet usage (percentage of people with access to the net).

Most of the variables are collected from the World Development Indicators statistics of the World Bank. Monetary data and interest rates are taken from the IMF Data Statistics and the ECB Statistical Data Warehouse. The data on the domestic credit and the stock market are from the Financial Structure Dataset by the World Bank (See Beck et al., 1999). The source of the banking sector variables is the dataset on banking services by Beck et al. (2007).

All variables are taken from 2007 or the most recent information available before that date. Our final sample consists of 76 countries, of which 31 host at least one alternative currency. Furthermore, the regions with the most AC countries are Europe (15) and in America (8). In Asia, Oceania (Australia and New Zealand) and Africa there are 5, 2, and 1 country(s) that have an alternative currency, respectively. The frequency of countries that have AC is the highest in Oceania (100%) and America (53%), followed by Europe with 45% and Asia with 33%. Alternative currencies in Africa are quite rare: only one out of 11 African countries has an alternative currency.

Looking at the number of AC gives the following picture. Most ACs are in Europe (53) and America (42). The highest intensity of ACs per country is in Oceania (about 7.5 per country), the U.S. (2.8 per country) and Europe (1.6 per country). The relatively lower frequency of ACs in developing countries may reflect that seignorage is relatively more important for these countries -- ACs could potentially threaten this revenue -- thus the government might more actively fight to prevent their spring (see Calvo and Vegh, 1992).

3.2. HYPOTHESES

There are two broad set of hypotheses for how alternative currencies depend on macroeconomic factors, depending on whether such currencies are a substitute or complement to fiat money.

Alternative currencies are a substitute to fiat money

If alternative currencies substitute for fiat money, the benefits from introducing such currencies should be the highest when fiat money does not perform its function very well. This should first be the case when there is an inflationary environment and when monetary policy is generally unstable as in this case holding fiat money is less attractive. Second, the benefits from fiat money are generally low (and thus the relative benefits from ACCs high) when the country is less developed financially. In such cases, access to and usage of fiat money may be relatively costly (for example, in rural areas with no bank branches). Third, in countries

that are less stable economically, there is a higher perceived likelihood of breakdown of the political and monetary system, also increasing the benefits from alternative currencies. This leads to the following hypothesis:

Hypothesis 1: *If alternative currencies are a substitute to fiat money, we would expect the likelihood of ACC adoption to*

i) increase in indicators of inflationary pressure and instability of monetary policy,

ii) decrease in financial sector development,

iii) increase in economic stability.

Alternative currencies are a complement to fiat money

If, on the other hand, alternative currencies complement fiat money, its usage should be more widespread precisely when fiat money performs its functions well. This leads to exactly opposite predictions as in Hypothesis 1:

Hypothesis 2: *If alternative currencies are a complement to fiat money, we would expect the likelihood of ACC adoption to*

i) decrease in indicators of inflationary pressure and instability of monetary policy,

ii) increase in financial sector development,

iii) decrease in economic stability.

Other hypotheses

If there are some fixed costs to ACC adoption, we would expect the likelihood of their adoption to vary with the economic area they are able to serve. Thus, ACC adoption should increase with measure of population and GDP. Second, in countries with more political heterogeneity, there may be a higher need for local currencies that complement nationwide money. We would thus expect ACCs to be more widespread in decentralized countries. Finally, many of the alternative currencies in our database are internet-based. Access to them is such easier in countries with more prevalent internet usages. This leads to the following additional hypothesis:

Hypothesis 3: *We expect the likelihood of ACC adoption to*

i) increase in proxies of the size of the economic area they can serve,

ii) be higher in federal countries,

iii) *increase in the internet access.*

3.3. Results

For our baseline regressions we focus on explaining whether a country hosts an AC or not. Our dependent variable is thus a dummy that indicates that a country has at least one AC (in Section robustness we report the results for the number of ACs and the ordinal AC variable). Table 1 reports results from Probit regressions. All coefficients are expressed as marginal effects. They thus represent the impact of a marginal change in an independent variable on the predicted probability of hosting an AC, assuming that all other independent variables are at their respective means.

The standard controls in the regressions in Table 1 are GDP per capita, population and the federal dummy. The various regressions represent various subset of controls: columns 1 to 5 analyze monetary indicators, columns 6 to 7 business cycle measures, columns 8 to 11 financial development indicators and columns 12 to 14 various other controls.

The results for the main control variables turn out to be robust across all the specifications where they are included. GDP per capita is positively and significantly related to the likelihood of a country hosting an alternative currency. Alternative currencies are thus more prevalent in richer countries. This seems plausible since it takes resources and time to build up an alternative currency. The regressions also show that population is positively and significantly related to ACs. This is to be expected since there is a higher potential for an alternative currency in a country with more inhabitants. The third control variable, the dummy for whether the country is a federal one, is also positively and significantly related to the dependent variable. Federal countries are thus more likely to host alternative currencies. An explanation for this is that most of these currencies are of regional nature and there is less potential for starting up an independent regional currency in a country with a higher centralization.

We now turn to the controls that give information about monetary stability and monetary policy in a country. Due to multicollinearity concerns among the controls, we always include one control variable at a time. Column 1 considers the relationship between CPI inflation and the likelihood of hosting an alternative currency. Theoretically, this relationship is ambiguous. On the one hand, a high inflation rate undermines all the three functions of money (means of payment, unit of account and store of value). This should increase the attractiveness of an alternative currency. In fact, during various episodes in history alternative currencies were introduced in order to escape the devaluation of fiat money, such as in Germany and Austria during the time of the German hyperinflation. On the other hand, a high inflation rate may indicate instability in a country, making it less likely that economic agents find time to found alternative currencies. Column 1 shows that the relationship between the inflation rate and the dependent variable is negative and significant. Thus, AC are more likely in countries where fiat money probably fulfills its role well (i.e., due to a low inflation rate). This suggests that ACs are complementing fiat money.

Column 2 considers an alternative proxy for inflation: money growth. This regression confirms the previous results, showing that higher money growth is associated with a lower prevalence of ACs. Column 3 then examines the impact of inflation volatility. The rationale behind this is

that it is often argued that inflation by itself does not induce substantial costs -- as long as it is predictable. However, when inflation is volatile, relative prices in the economy are likely to be distorted when inflation expectations are not fulfilled. The regression shows that this proxy of monetary stability is negatively and significantly related to the dependent variable. Taken together, these results corroborate the finding that ACs are not substituting for a country's national currency as they are more likely to be set up in an environment where the national currency performs well.Column 4 considers the velocity of money. A high money velocity may be due to inflationary expectations as agents try to spend money as quickly as possible. It may also indicate a highly developed financial system in which the stock of money can be turned over more quickly. However, column 4 reports that there is no statistical evidence that the velocity of money circulation affects the likelihood of ACs. Column 5 then considers (nominal) interest rates. Again, high nominal rates may be indicative of inflation or inflation expectations. They also may proxy the stage of a country in the business cycle, as interest rates are typically procyclical. Yet, column 5 shows that interest rates are not significantly related to ACs.

We next examine indicators of the business cycle performance of a country. Column 6 shows that average GDP growth is significantly and negatively associated with the AC probability. This is consistent with the idea that a key function of alternative currencies is to promote local economic growth. Presumably, the scope for doing so is higher when output is below its potential, which is more likely to be the case following years of low growth. Column 7 shows that business cycle volatility is negatively and significantly related to ACs. This is consistent with the findings concerning monetary indicators that ACs are less attractive in volatile environments.

The next four columns include various indicators for the financial development of a country. We first consider the ratio of domestic credit (excluding credit to the general government) to GDP as a factor explaining alternative currencies. This variable is a proxy for the sophistication of a country's financial system. In addition, a high amount of credit suggests that domestic agents are less likely to be subject to borrowing constraints. Column 8 shows that the likelihood of ACs is significantly higher in countries with a higher volume of domestic credit. This indicates that ACs are more prevalent in well developed financial systems. Since fiat money is probably fulfilling its function in such countries better, this suggests again the ACs act as a complement rather than a substitute for the national currency. It also suggests that their primary motivation does not seem to be to alleviate financial constraints (as alternative currencies can be used to support lending). The next column looks at the impact of financial sector outreach, as measured by the bank branch intensity. A higher number of bank branches should make it easier for economic agents to use the national currency (for example, payment systems and the possibility of cash withdrawals provided by branches facilitate the usage of fiat money). This should make AC less attractive -- if they are a substitute to national money, but more attractive if they are a complement. Column 9 shows banking branches are positively and significantly related to ACs, thus suggesting a complementary role for ACs.

Column 10 considers an alternative proxy for financial sector development: the value of the stock market trading volume relative to the GDP. High stock market capitalization suggest that it is easy for firms to obtain financing through equity and indicates the absence of financing constraints in a similar way as a high domestic credit volume. Nonetheless, the results show that stock market capitalization is not significantly related to the likelihood of a country hosting ACs. The final variable on financial sector development we consider is a proxy for banking system quality: the share of non-performing loans in banks' loan portfolios. Everything else equal, a higher share of non-performing loans indicates that banks provide a lower level of their screening and monitoring function. The regression results show that non-performing loans are negatively and significantly related to the likelihood of hosting an AC. Again, this suggests that developed financial services increase the attractiveness of ACs, confirming the complementary role played by these currencies.

The last three columns of the table include indicators of central bank activism, country openness and a variable indicating internet usage in a country. As regards the first variable, when the domestic central bank is not bound by any external constraint as the case of monetary unions or dollarization systems it will most likely intervene in the market more proactively and possibly the degree of elasticity of the money supply to external shocks could be relatively higher. Thus, if ACs are a substitute, they should be more likely in countries where the supply of money adjust less readily to exogenous factors. Column 12 shows, however, that central bank activism is not significantly related to the supply of alternative currencies. Column 13 next considers the (trade) openness of a country. Openness is a general proxy for economic development and integration of a country. In addition, in more open countries economic agents should have more possibilities for bypassing fiat money when it does not function well (for example, due to high inflation). Under a substituting role we would thus expect openness to be negatively related to ACs. Column 13 then shows that openness is not related to ACs. Finally, column 14 looks at internet usage. Internet usage is an alternative measure of development of a country. The availability of internet also directly facilitates the spread of ACs as many of them are web-based systems. Not surprisingly we find that internet usage is significantly and positively related to ACs.

Table 1: Determinants of Alternative Currencies: Probit Regressions.

	Monetary indicators					*Business cycle indicators*		*Financial indicators*				*Other indicators*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
CPI	-0.051					-0.059	-0.054	-0.058	-0.038	-0.083	-0.062	-0.035	-0.079	-0.035
	(0.021)**					(0.021)***	(0.022)**	(0.023)**	(0.023)*	(0.023)***	(0.019)***	(0.020)*	(0.021)***	(0.022)
Money growth		-0.049												
		(0. 014)***												
Inflation volatility			-0.101											
			(0.051)*											
Money velocity				-0.059										
				(0.070)										
Interest rate					-0.016									
					(0.012)									
GDP growth						-0.115								
						(0.038)***								
GDP volatility							-0.193							
							(0.052)***							
Domestic credit								0.003						
								(0.001)**						
Banking branches									0.020					
									(0.007)***					
Stock market value										0.077				
										(0.068)				
Non-performing loans											-0.040			
											(0.018)**			
Central bank dummy												0.045		
												(0.132)		
Openness													0.172	
													(0.126)	
Internet users														0.010
														(0.004)***
GDP per capita	1.29e-05	1.01e-05	1.46e-05	1.87e-05	1.89e-05							1.69e-05		
	(6.10e-06)**	(6.84e-06)	(6.40e-06)**	(6.81e-06)***	(5.87e-06)***							(6.42e-06)***		
Population	0.117	0.122	0.112	0.115	0.136	0.121	0.071	0.114	0.116	0.095	0.126	0.130	0.122	0.144
	(0.046)***	(0.044)***	(0.044)***	(0.046)**	(0.050)***	(0.042)***	(0.041)*	(0.052)**	(0.054)**	(0.051)*	(0.052)**	(0.047)***	(0.056)**	(0.051)***
Federal dummy	0.396	0.670	0.359	0.333	0.273	0.494	0.568	0.456	0.306	0.499	0.411		0.519	0.329
	(0.129)***	(0.131)***	(0.149)**	(0.155)**	(0.154)*	(0.136)***	(0.163)***	(0.128)***	(0.147)*	(0.119)***	(0.133)***		(0.113)***	(0.140)**
N	76	76	76	71	74	76	76	74	63	70	74	76	73	76
Pseudo- R^2	0.28	0.39	0.29	0.27	0.26	0.35	0.39	0.29	0.32	0.29	0.30	0.24	0.27	0.32

Notes: The dependent variable is a dummy indicating whether a country hosts an alternative currency. Reported coefficients are the marginal effects. For dummy variables coefficients give the effect of a discrete change from 0 to 1. (Robust) standard errors are reported in brackets (*** p<0.01, ** p<0.05, * p<0.1).

Table 2: Determinants of Alternative Currencies: Poisson regressions.

	Monetary indicators					*Business cycle indicators*		*Financial indicators*				*Other indicators*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
CPI	-0.149					-0.108	-0.089	-0.151	-0.212	-0.235	-0.133	-0.076	-0.227	-0.033
	(0.055)***					(0.038)***	(0.034)***	(0.052)***	(0.068)***	(0.066)***	(0.040)***	(0.069)	(0.062)***	(0.047)
Money growth		-0.067												
		(0. 019)***												
Inflation volatility			-0.303											
			(0.126)**											
Money velocity				-0.208										
				(0.115)*										
Interest rate					0.018									
					(0.030)									
GDP growth						-0.238								
						(0.075)***								
GDP volatility							-0.305							
							(0.083)***							
Domestic credit								0.006						
								(0.003)**						
Banking branches									0.016					
									(0.006)**					
Stock market value										0.045				
										(0.128)				
Non-performing loans											-0.076			
											(0.038)**			
Central bank dummy												-0.323		
												(0.488)		
Openness													-0.169	
													(0.273)	
Internet users														0.026
														(0.008)***
GDP per capita	2.12e-05	1.71e-05	2.23e-05	4.30e-05	4.96e-05							4.58e-05		
	(1.00e-05)**	(1.00e-05)*	(1.00e-05)**	(1.00e-05)***	(1.00e-05)***							(1.00e-05)***		
Population	0.290	0.255	0.254	0.319	0.318	0.260	0.169	0.258	0.377	0.303	0.257	0.408	0.272	0.309
	(0.069)***	(0.060)***	(0.071)***	(0.076)***	(0.078)***	(0.059)***	(0.051)***	(0.075)***	(0.094)***	(0.084)***	(0.066)***	(0.098)***	(0.095)***	(0.064)***
Federal dummy	1.621	1.429	1.197	1.179	1.284	1.010	0.672	1.733	1.744	2.136	1.406		2.307	0.645
	(0.520)***	(0.497)***	(0.468)***	(0.504)**	(0.501)***	(0.307)***	(0.309)**	(0.594)***	(0.494)***	(0.570)***	(0.457)***		(0.544)***	(0.297)**
N	76	76	76	71	74	76	76	74	63	70	74	76	73	76
Pseudo- R^2	0.44	0.47	0.45	0.43	0.41	0.50	0.51	0.46	0.43	0.42	0.53	0.35	0.42	0.51

Notes: The dependent variable is the number of alternative currencies in a country. Reported coefficients are the marginal effects. For dummy variables coefficients give the effect of a discrete change from 0 to 1. (Robust) standard errors are reported in brackets (*** p<0.01, ** p<0.05, * p<0.1).

Table 3: Determinants of Alternative Currencies: Ordered Logit regressions.

	Monetary indicators					*Business cycle indicators*		*Financial indicators*				*Other indicators*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
CPI	[-] 0.779 (0.080)**					[-] 0.737 (0.072)***	[-] 0.744 (0.083)***	[-] 0.751 (0.082)***	[-] 0.746 (0.089)**	[-] 0.652 (0.070)***	[-] 0.698 (0.077)***	[-] 0.856 (0.078)*	[-] 0.681 (0.066)***	[-] 0.874 (0.099)
Money growth		[-] 0.829 (0. 037)***												
Inflation volatility			[-] 0.633 (0.130)**											
Money velocity				[-] 0.730 (0.201)										
Interest rate					[-] 0.949 (0.045)									
GDP growth						[-] 0.534 (0.940)***								
GDP volatility							[-] 0.349 (0.108)***							
Domestic credit								[+] 1.015 (0.004)***						
Banking branches									[+] 1.042 (0.024)*					
Stock market value										[+] 1.202 (0.308)				
Non-performing loans											[-] 0.810 (0.094)*			
Central bank dummy												[-] 0.925 (0.497)		
Openness													[+] 1.251 (0.510)	
Internet users														[+] 1.060 (0.022)***
GDP per capita	[+] 1.000 (2.30e-05)***	[+] 1.000 (2.45e-05)**	[+] 1.000 (2.23e-05)***	[+] 1.000 (2.44e-05)***	[+] 1.000 (2.05e-05)***							[+] 1.000 (2.32e-05)***		
Population	[+] 1.973 (0.503)***	[+] 1.922 (0.402)***	[+] 1.879 (0.418)***	[+] 1.948 (0.470)***	[+] 2.059 (0.490)***	[+] 2.099 (0.438)***	[+] 1.797 (0.498)**	[+] 2.028 (0.583)**	[+] 1.892 (0.567)**	[+] 1.934 (0.593)**	[+] 2.331 (0.809)**	[+] 2.040 (0.535)***	[+] 1.950 (0.618)**	[+] 2.385 (0.652)***
Federal dummy	[+] 6.766 (3.585)***	[+] 12.609 (8.879)***	[+] 5.944 (3.499)***	[+] 4.483 (2.420)***	[+] 4.464 (2.595)***	[+] 9.239 (5.490)***	[+] 8.289 (4.811)**	[+] 9.135 (5.753)***	[+] 5.647 (3.391)***	[+] 10.102 (6.102)***	[+] 8.554 (4.850)***		[+] 10.708 (6.159)***	[+] 4.136 (2.291)***
N	76	76	76	71	74	76	76	74	63	70	74	76	73	76
Pseudo- R^2	0.25	0.32	0.25	0.23	0.23	0.31	0.32	0.26	0.24	0.24	0.28	0.20	0.22	0.29

Notes: The dependent variable is an ordinal variable ranging from 0 to 5 that indicates the AC intensity of a country. Reported coefficients are the odds ratios. An odd ratio is de.ned as the odds of a country to fall in a higher [+] or lower [-] category (of AC intensity) following a one-unit change in the explanatory variable. (Robust) standard errors are reported in brackets (*** p<0.01, ** p<0.05, * p<0.1).

Overall, our results give a clear picture. Monetary stability, financial development and other indices of a countries development tend to be conducive to the emergence of an alternative currency, consistent with Hypothesis 2 (but inconsistent with Hypothesis 1). As discussed, this suggests that the role of AC is mainly complementary. In addition, we find evidence that support the various elements of Hypothesis 3.

3.4. Robustness

In this section we examine the robustness of our results regarding different specifications of the dependent variable. While in the previous section we studied the determinants of whether a country hosts an AC at all, in this section we focus on information on the number of ACs in a country.

Table 2 reports results for the same set of controls as in the previous section. However, the dependent variable is now the number of ACs in a country. The regression reports marginal coefficients from a Poisson regression.

The results in Table 2 are almost identical to the ones of the binary choice variables. In particular, GDP, population and the federal dummy are all positively and significantly related to the number of ACs. The indicators of monetary instability (inflation, money growth and inflation volatility) are all significantly and negatively related to the number of ACs. Furthermore, in the Poisson regression money velocity turns significant at a 10% level and with a negative sign: this result corroborates the inverse relationship between ACs and inflation indicators and it is in line with some theoretical arguments employed to justify the choice of establishing ACs. GDP growth and business cycle volatility are both negatively related to the number of ACs -- as in the baseline regressions. Indicators of financial sector development (high credit volume, high branching intensity and a low number of non-performing bank loans) are all positively and significantly related to a country's ACs, whereas the stock market value indicator has again no statistical effect on the numbers of ACs. The domestic central bank dummy and country openness have no effect on the propensity to hosts ACs, similar to the previous section. Finally, countries that have a higher internet usage have significantly more ACs.

Using the number of ACs as the dependent variable has the disadvantage those results may be affected by a few outliers, that is in our context countries with many ACs (Australia, Canada, Germany and the United States each have ten or more ACs). To address this concern, we also carry out regressions where the dependent variable is the ordinal ACs measure described in Section data. In these regressions, the four above mentioned countries are assigned to the category 4 or 5, where countries without ACs are in category 0. Table 3 reports the output of ordered Logit regressions. This table reports odds ratios (rather than standard coefficients) which have a more straightforward interpretation: these ratios represent the odds that a country falls into a higher (or lower) category following a one-unit change in an explanatory variable.

The results are similar to the ones of the previous two tables. The sign of the effects and their significance for the base control variables (GDP, population and federal dummy), the monetary control variables (inflation, money growth, inflation volatility, velocity and interest rate) and the business cycle indicators (growth and growth volatility) are identical. The financial development variables have the same sign as before; however, the significance of some variables declines. Branching intensity and the share of non-performing loans are now only significant at the 10% level and stock market capitalization remains insignificant. The results for the remainder of the covariates, namely the domestic central bank dummy, the indicator of the country openness and of internet usage are unchanged.

We thus conclude that our results do not only apply to whether a country hosts an AC or not, but also to the number of ACs hosted by a country. In addition, they seem robust to alternative specifications of the AC intensity in a country (number of ACs versus original AC ranking).

Another issue of robustness is whether the results also hold for the subset of developing countries. For example, the fact that in the overall sample ACs are a complement to fiat money may be driven by developed countries, for which issues of inadequate fiat money is not likely to be a significant issue. We thus have also examined whether AC act perhaps as a substitute in the subset of developing countries (for these countries inflationary issues are probably of a higher level concern). The regressions overall suggest that also in the sample of developing countries ACs do not act as a substitute for fiat money.

4. CONCLUSIONS

In this paper we have studied the determinants of the usage of alternative currencies on a cross-country basis. For this we have performed cross-country regressions relating the number of alternative currencies in a country to macroeconomic variables. We have, first, found that measures of monetary stability (such as inflation, money growth and inflation volatility) are negatively related to the likelihood of ACC adoption. Second, we have found that measures of financial sector development (such as domestic credit, number of bank branches and non-performing loans) are positively related to the number of ACCs hosted by a country. Our final key finding is that overall developments of economic development (GDP per head and GDP volatility) are positively related to ACCs. This suggests, contrary to what one may have expected, that alternative currencies do not act as a substitute for fiat money. They thus seem to fulfill a role very different from the ones they have fulfilled in history where they were mainly established in periods of high inflation and political instability.

Despite concerns about the viability of the worldwide monetary system, our results broadly suggest that national currencies are fulfilling their required roles sufficiently

well. This is because otherwise one would expect alternative currencies to spring up in a response to inadequacies of fiat money, rather than to complement it. In the absence of a substitution effect, the ensuing question is then why alternative currencies do act a complement. In this paper we can only speculate about this and our preferred explanation is its role as a stimulus of the local economy and in furthering local interests. Further research is warranted on the usage of alternative currencies in order to learn more about the functioning of fiat money.

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