What makes cash such a resistant king?

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Abstract

The study that follows aims to reveal and understand the drivers behind people's continuing, resolute use of cash, despite authorities all over the world imposing laws expressly aimed at limiting its use (see list of limitations by country, annex no. 1). Rather than limiting the use of cash by making it more expensive; restricting access; or subsidising digital payments; authorities have recently preferred promoting digital payments to directly limit the use of cash by quantity.

Authorities intermittently devise new obstacles to cash usage in the name of "fighting the underground economy". It seems they would go to almost any length to create an atmosphere where cash use is illegitimate. It should not be forgotten, however – in fact, it should be emphasised – that it has never been proven that cash payments, or their receipts, are the reasons for the development of the underground economy.

Our results show that just as the classic models prove a significant correlation between GDP (positive), interest rate (negative) and tax (positive) to the amount of money in the economy, so the influence of these classic variables exists in relation to cash. However, it should be noted that a positive correlation between tax and cash does not necessarily indicate that growth derives only from tax evasion or the underground economy. Moreover, Lepecq G. (2019), argues that even increasing card usage will not curb the shadow economy.

Further to the said classic variables, several other social demographic factors affect the use of cash, some of them, significantly. Income per capita – as a measure of wealth or its opposite, poverty – has a negative effect on cash usage; that is to say, as a country becomes poorer, cash usage rises. Regarding the influence of demographic variables, a positive correlation exists between age and cash use: younger people (under the age of 35), use significantly less cash. On education: with a higher proportion of educated people, a population's use of cash significantly declines. Regarding the influence of technology and demand for cash: when the use of technology in a country is highly developed, the use of cash declines. When the level of technology is low; the amount of cash in circulation increases.

We examined the relationship between two additional variables and cash behaviour – one being the level of corruption (public sector) in a country, measured by an International Corruption Index (CPI). We found that the level of corruption did not substantively affect the use of cash. The other was to measure the impact of rapid technology development over time and the effect of setting limits upon the use of cash in several countries since 2012.

In order to measure the impact of these two factors, a dummy variable, excluding demographic and technologic variables, was fixed and added into the model over the designated time frame.[1] Contrary to expectations, the results showed the amount of cash still growing (even significantly) and not yet showing any signs of weakness. In fact, growth continues. It seems premature to us, therefore, as of 2016, to draw any firm conclusions about the future of cash or seek to predict any would-be, flow-on effects.

One way or another cash remains, as it were, stubborn. Both cash in circulation and card payments (a proxy for e-payments) have increased since 2007, amounting to a clear, in-summary statement for cash: "I am still here and have no intention to disappear".

Introduction

Our aim was to investigate why the demand for cash has remained so robust, despite the obstacles, in the context of the rapid development and increasing use of electronic payments in countries around the world.

In fact, Jobst C. and Stix H. (2017), showed an increase in cash quantities in 72 economies in the period 2001-2014, with demand for cash rising faster in most advanced economies hit by the 2008 Great Financial Crisis. On the face of it, the accelerated technology that led to the rapid development of e-payments, pointed to a shift away from cash (i.e. notes and coins), to the vast supply of electronic payments. However, the data so far shows otherwise. This despite the limitations imposed (so far respected, as there is no evidence of systematic or large-scale violation within those countries), and the existence of plenty of alternative e-payments and their accelerated development. This has probably caused a slow-down in the growth of cash in recent years.

Literature Review

Money demand – Some studies have not found a significant correlation between technology development and demand for money. However, others have found that demand depends on inflation stability:

Gbadebo, Olusegun Odularu (2008), found that financial innovations introduced into the financial system did not significantly affect the demand for money in Nigeria.

Sahin A. (2013), found that the stability of money demand is related to the stability of inflation. The money demand function indicates a nonlinear behaviour between high and low inflation in periods of uncertainty. During high inflation (uncertainty period), precautionary motives around money mean that demand increases.

With regard to the demand for cash

Briglevics T., and Schuh S., deal with U.S. consumer demand for cash in the era of low interest rates and electronic payments, and find no evidence that interest rates affect the decision to adopt interest–bearing cheque accounts

[1] A dummy variable (also known as indicator or variable) is one that takes the value 0 or 1 to indicate the absence or presence of some categorical effect, that may be expected to shift the outcome.

(extensive margin) or credit cards. The finding is surprising in light of Mulligan and Sala-i-Martin (2000), who found that the extensive margin is important for the management of demand deposits at low interest rates. The novel result of this paper is that credit card borrowing seems to affect consumers' cash management practices, including the interest elasticity of cash demand. Another key finding is that beyond the control variables commonly used in the cash demand literature, the primary withdrawal method significantly influences cash management. This finding shows the importance of understanding why people use certain cash withdrawal locations.

Bech M., Faruqui U, Ougaard F., Picillo C. (2018), found that demand for cash has risen in most advanced economies since the start of the GFC, despite financial innovations. The continuing growth of cash appears to be driven by store-of-value motives (reflecting the lower opportunity cost of holding cash), rather than by payment needs. Flannigan G., Staib A. (2017), showed in a study conducted in Australia, that while survey data indicated that the share of Australian consumers' payments made with cash continues to fall, the number (and value) of banknotes in circulation continues to grow, at around its trend rate of 6 per cent a year.

Sisak B., (2011), found that transactional cash demand is strongly influenced by the level of improvement in payment systems. In most of the cases examined, interest rates negatively influenced non-transactional cash holding.

Studies on means of payments preferences

Edelman Intelligence and Cardtronics U.S. Health of Cash Study (2018), found that, with regard to freedom of choice, people do not like stores or restaurants to limit cash acceptance, and that they use cash regularly. This despite an increase in the number of digital payments. New digital payment options are not significantly shifting U.S. consumer behaviours.

A Latin American study on Direct Tax imposed on real cash holdings

Giraldo, M., Buckles B.W. (2011), found no evidence that taxing financial transactions involving the withdrawal of money from a bank account in Colombia, had any substitution effect impact toward cash holdings on any kind of bank account.

Methodology

A vast number of studies have already been undertaken on what factors affect the demand for money in its broader definition (M1+M2), which is critical in the conduct and determination of the effectiveness of monetary policy. As cash is an important component of the definition of money, it seems almost de rigueur to start with the classic approach of evaluating the dominance of the demand for cash and the factors that influence the demand for money as a whole: GDP; interest- rates; tax.

The next step, in our assessment, would be to not only elaborate the range of these factors, but to look for additional, unique factors that may also assuredly affect demand, such as population factors (age, income, and education); technology; density of residency; poverty, and modernisation proxies.

Data Collection

After scanning the data bases of the main international institutions' data suppliers – IMF, World Bank, OECD, BIS, ECB and other unique sources – it was found that the specific data required for our research could be provided by two main international database resources:

IMF Data Base - M1 and Currency in Circulation;
World Bank Data Base - all other variables.

Other specific resources include: Transparency International Corruption Index – a non-weighted average. A lack of data on Credit and Debit accounts was allowed for by calculating a moving average.

Sample Range

1. Australia
2. Brazil
3. Chile
4. China
5. Columbia
6. Croatia
7. Czech Republic
8. Denmark
9. Euro Area
10. Hong Kong
11. Hungary
12. Indonesia
13. Israel
14. Japan
15. South Korea
16. Mexico
17. New Zealand
18. Poland
19. Romania
20. Russia
21. Serbia
22. South Africa
23. Sweden
24. Switzerland
25. Turkey
26. Great Britain
27. United States

The collected sample is dated 2007-2016, with the availability of the data variables required, enabling the model to be applied to the following 27 countries:

Variable Groups Index

This covers demographics, interest rate, prices, tax, demographics, education, technology, and modernization proxies.

Data Steps and Analysis

The first step would be to elucidate graphic descriptions of the data in order to identify the linkage between the demand for cash and the variables explanatories.

A Fixed Effect Model[2]

In our model, the assumption is that the average of each group of countries is fixed. The model estimates the variance among countries but refers to the variance in each group of countries as fixed, as opposed to a simple random effects model, in which the group means a random sample from a population where each observation is referred to equally, irrespective of the group to which it belongs. In this case, the model estimates the variance within the group and among the groups in the same manner without drawing any difference. In panel data, where only a single observation exists for a whole period regarding each group, fixed effects represent the subject-specific means, neutralising the influence of specific characteristics in each group, which cannot be measured.

We collected observations over ten years for the 27 countries and estimated them according to the following model:

[2] In statistics, a fixed effects model is a statistical model in which the model parameters are fixed or non-random quantities, in contrast to random effects models and mixed models in which all or some of the model parameters are considered as random variables.

$Currency\ in\ Circulation_{it} = X_{it}\beta + \alpha_i + \epsilon_{it}$, $i \in \{1,\ldots,25\}, t \in \{1,\ldots,9\}$

While:

X_{it}- represents the regression in the indexes of variables of each country in every year;

β - represents the parameters observed in the model;
α_i - represents the fixed effect (which was not observed in each country);
ϵ_{it} - represents the range of statistical error.

Table 1: Variables Summary

	Currency/M1		Demand Deposit/M1		GDP per capita		Tax Revenue		Under 35 y/o	
	Average	SD	Average	SD	Average	SD	Average	SD	Average	SD
Australia	0.213	0.012	0.787	0.012	54998.762	9003.222	22.113	1.296	44.194	0.095
Brazil	0.574	0.071	0.426	0.071	10296.532	2085.207	13.899	1.079	58.896	2.103
Chile	0.299	0.014	0.701	0.014	13298.259	2106.305	17.792	1.546	53.504	1.421
China	0.175	0.020	0.825	0.020	5748.978	2012.677	9.891	0.397	49.076	1.711
Colombia	0.611	0.032	0.389	0.032	6441.955	1265.359	13.576	0.982	60.345	1.916
Croatia	0.385	0.031	0.615	0.031	13640.166	1128.459	19.257	0.466	40.625	0.915
Czech Republic	0.192	0.029	0.808	0.029	19792.950	1498.752	14.209	0.586	41.309	2.020
Denmark	0.075	0.007	0.925	0.007	58960.688	3661.240	33.864	1.146	42.010	0.418
Euro Area	0.179	0.009	0.821	0.009	50448.100	7326.320	18.481	0.497	39.211	0.998
Hong Kong	0.318	0.027	0.682	0.027	36211.559	4896.305	NA	NA	39.082	1.672
Hungary	0.351	0.028	0.649	0.028	13594.888	957.479	22.731	0.812	41.136	1.824
Indonesia	0.548	0.050	0.452	0.050	3072.287	704.873	11.286	0.880	63.202	1.510
Israel	0.377	0.084	0.623	0.084	8678.861	1374.181	23.208	1.169	57.221	0.658
Japan	0.163	0.007	0.837	0.007	40885.279	4842.585	9.960	1.116	35.348	1.543
Korea	0.110	0.014	0.890	0.014	244072.35	3174.673	14.515	0.522	43.834	2.499
Mexico	0.375	0.008	0.625	0.008	9457.21	862.759	10.779	1.35	64.195	2.015
New Zealand	0.148	0.026	0.852	0.026	37057.961	5357.74	27.766	1.939	47.768	0.448
Poland	0.245	0.020	0.755	0.020	12954.075	1060.285	16.428	0.987	44.789	1.837
Romania	0.365	0.033	0.635	0.033	9127.733	741.026	17.340	0.973	42.433	1.891
Russia	0.544	0.024	0.456	0.024	11799.869	2927.834	13.191	2.170	45.538	0.761
Serbia	0.399	0.049	0.601	0.049	5869.320	512.584	20.784	1.124	44.292	1.178
South Africa	0.102	0.008	0.898	0.008	6448.940	897.201	26.164	1.084	67.100	1.119
Sweden	0.058	0.020	0.942	0.020	54620.243	4549.985	26.928	0.720	42.475	0.152
Switzerland	0.123	0.012	0.877	0.012	78636.726	8139.606	9.644	0.178	40.329	0.289
Turkey	0.344	0.017	0.656	0.017	10984.771	1051.659	18.38	0.455	60.277	1.71
United Kingdom	0.041	0.003	0.959	0.003	43148.997	3815.676	25.429	0.646	43.664	0.283
United States	0.478	0.049	0.522	0.049	51459.580	3766.742	10.137	1.152	47.318	0.526

Description of Graphs

The following graphs show the average of cash in circulation in each country, 2007-2016.

The countries are displayed in descending order, where the colours are divided according to the explanatory variables that appear in the model. Each variable is divided into three categories according to its distribution, so each category is comprised of about one third of the number of countries.

In graph no. 1, the countries are divided according to Income Per Capita (IPC) in US Dollars. When IPC is lower than 9,500 USD, it is in pink; in green, from 9,500 USD to 30,000 USD; and blue, over 30,000 USD. In most countries, where IPC is lower, cash in circulation is higher – with the USA, South Africa and China as notable exceptions.

In graph no. 2, countries are divided according to population under the age of 35. In pink are the countries with a small percentage of the population under 35 (less that 43 percent). Countries in green are in the middle range (43 percent to 55 percent of the population) and in blue are the countries with the highest percentage of the population under the age of 35 (above 55 percent). Clearly, the larger the part of the population under 35, the lower the use of cash.

In graph no. 3, the division is based on the percentage of the population that is highly educated (with a tertiary degree). Countries in pink have a small population percentage with a tertiary education (less than 19 percent), while countries in green are in the middle range (19 to 39 percent) and countries in blue, have the highest percentage of tertiary education (above 39 percent of the population). In fact, the division is not quite so clear, but a trend can be identified thus: the higher the level of education, the lower the level of cash in circulation.

In graph no. 4, we measure technology by the number of subscribers to mobile telephones among 100,000 people. Pink denotes countries with less than 110 subscribers in 100,000 people; green, between 110 and 120 subscribers, and blue, above 120 subscribers per 100,000 population. In countries in the margins, the trend is less clear; ie, among pink countries where the number of subscribers is small, the use of cash is higher. In blue countries with the highest number of subscribers, cash usage declines. In the middle green tier, the trend is less clear.

Figure 1

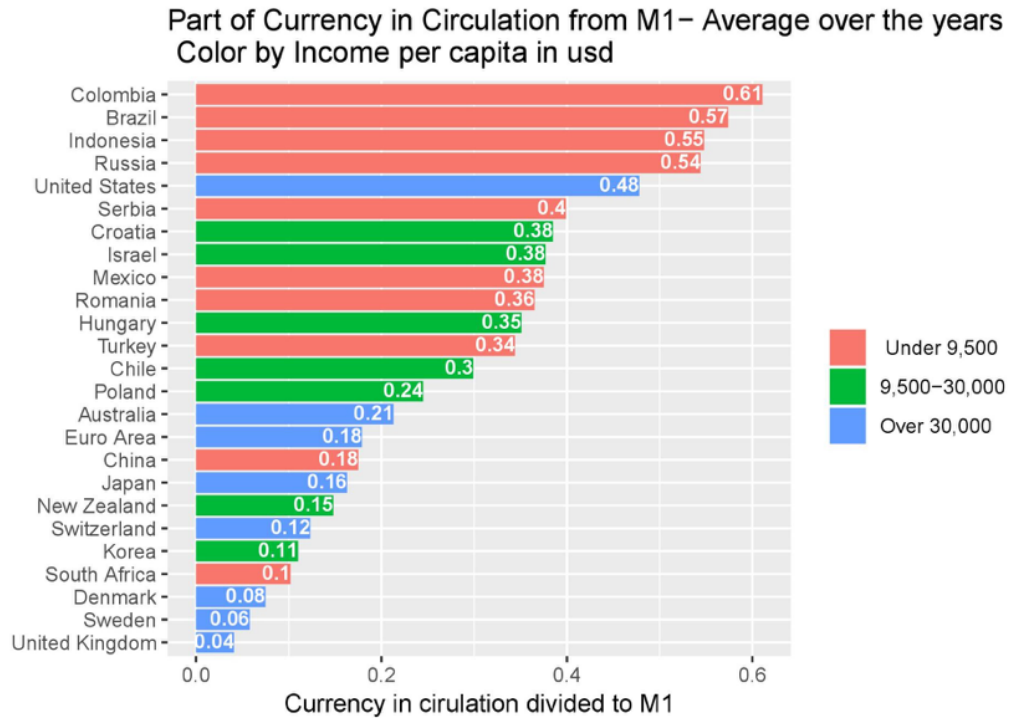


Figure 2

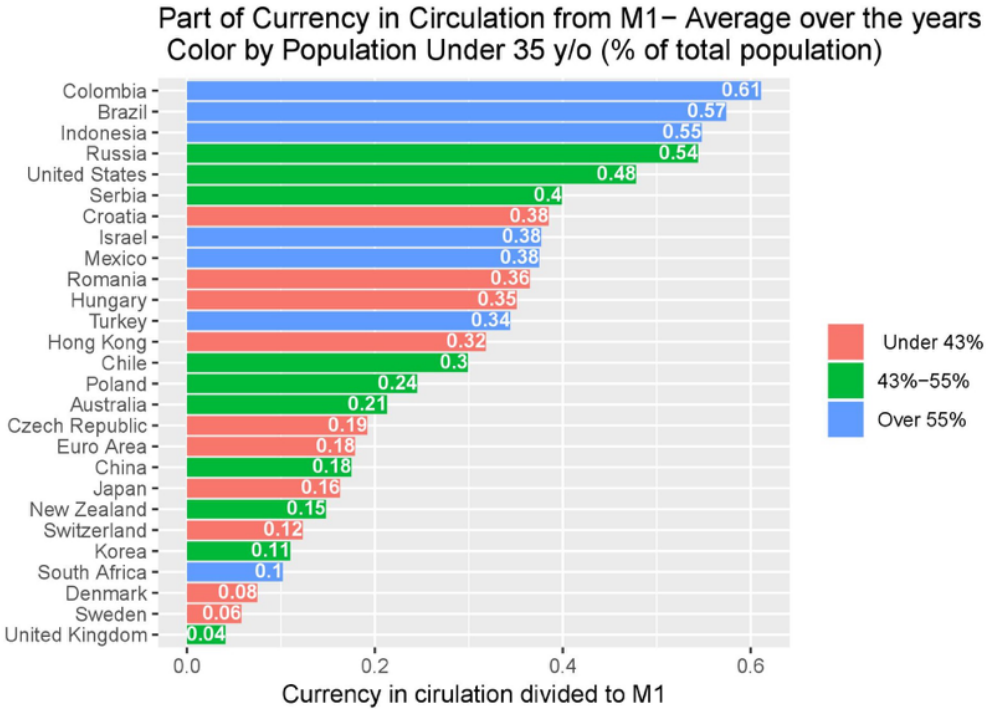


Figure 3

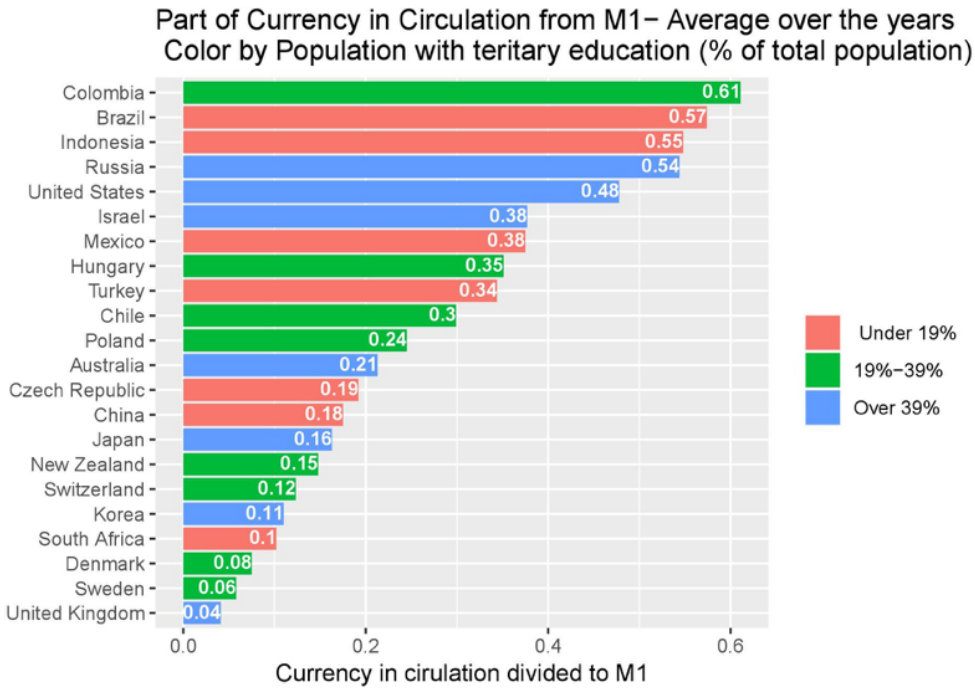
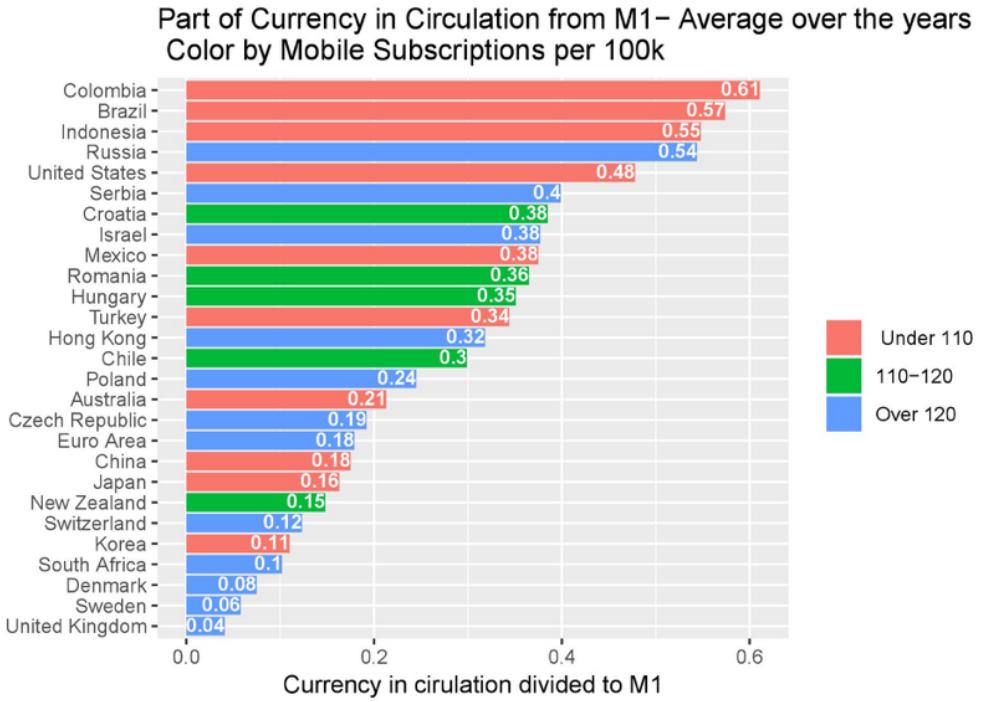


Figure 4



The Model

Model stages

We start with the basic model of money demand, where M is the money base, Y is gross domestic product and R is the interest rate:

$$ln(M)=\beta_0+\beta_1 \cdot ln(Y)+\beta_3 \cdot ln(R)+e$$

The money base (M1) is comprised of cash and cheque accounts. In this study, we are interested to estimate only those factors that affect cash. Estimates are made using two equations: the first uses cash instead of money base[3], and the second, logarithmic identities[4].

Therefore, we have disassembled the equation thus

$$ln(C)=\beta_0+\beta_1 \cdot ln(Y)+\beta^2 \cdot ln(r)+e$$
$$ln(1+C/DD)=\alpha_0+\alpha_1 \cdot ln(Y)+\alpha_2 \cdot ln(r)+\alpha_3 \cdot l\, n(DD)+u$$

While:

DD = Demand Deposits
C = Cash In Circulation
M = Money Base (=Cash in Circulation + Demand Deposits)
Y = GDP
r = Interest Rate
e, u = Error

For every country each year (2007-2016), the model (money demand equation), will be shown via various estimates for β.

In order to find one equation that enables estimates for all countries over the entire period, we use a fixed effects regression, so neutralising the differences among countries.

A fixed effects model refers to a regression model, in which the group means are fixed (non-random). In a fixed effects model, each group means a group-specific fixed quantity. A fixed effects estimator is used to refer to an estimator for the coefficients in the regression model, including those fixed effects (one time-invariant intercept for each subject). Such models assist in controlling for unobserved heterogeneity when this heterogeneity is constant over time.

Indeed, the first stage is to measure the influence on cash by the basic model for money demand. But as we aim to measure other variables that affect cash demand, we started, after the first stage, adding to the model variables that may also affect the use of cash: tax; demography (population); density; employment; poverty; technology and education – variables which are represented in the equation by X. Initially, we measured the absolute value of cash; secondly, we measured cash as a function of total demand deposits. Among other variables, we added a dummy variable in order to determine whether a difference exists in estimating the model before and after 2012, the date at which several countries started imposing limitations on the use of cash.

$$ln(C)=\beta_0+\beta_1 \cdot ln(Y)+\beta_2 \cdot ln(r)+\beta_3\, ln(Tax)+\beta_4 \cdot I_{\{Year \geq 2012\}} +\beta_5 \cdot X$$
$$ln(1+C/DD) =\alpha_0+\alpha_1 \cdot ln(Y)+\alpha_2 \cdot ln(r)+\alpha_3 \cdot ln(DD)+\alpha_4 ln(Tax)+\alpha_5 \cdot I_{\{Year \geq 2012\}}$$

[3] Cash in circulation (a stock measure) is obviously not equivalent to the use of cash for payments (a flow measure). However, comparable cross-country data on cash use, are not available and cash in circulation is often used as a proxy.

[4] $ln(DD+C)=l\, n[DD(1+C/DD)]=ln(DD)+ln(1+C/DD)$

Regression Analysis and Results

Equation 1

Table 2: Regression Table

	(1)Cash	(2)Cash	(3)Cash	(4)Cash
GDP	01.048***	1.380***	1.367***	1.310***
	(0.0628)	(0.252)	(0.250)	(0.254)
Interest	-0.0573***	-0.0362***	-0.0362***	-0.0357***
	(0.00856)	(0.0101)	(0.0100)	(0.0100)
Tax Revenue	0.382***	0.350***	0.353***	0.320***
	(0.0951)	(0.0997)	(0.0988)	(0.102)
Year > 2012	0.0672***	0.0133	0.0153	0.0187
	(0.0172)	(0.0219)	(0.0218)	(0.0219)
Income Per Capita		-0.379	-0.313	-0.238
		(0.243)	(0.243)	(0.251)
Population Under 35		-3.944***	-3.917***	-3.934
		(0.432)	(0.429)	(0.428)
Tertiary education		-0.448**	-0.363*	-0.352
		(0.146)	(0.151)	(0.151)
Mobile Subscriptions- per 100k			-0.123	-0.122
			(0.0648)	(0.0648)
Corruption Index				0.130
				(0.109)
Constant	-19.39***	-7.434	-7.708	-7.373
	(1.939)	(5.097)	(5.053)	(5.053)
Observations	249	170	170	170
R2	0.753	0.84	0.844	0.846
Adjusted R2	0.721	0.808	0.812	0.812

Standard errors in parentheses

*p < 0.05, **p < 0.01, ***p < 0.001

Equation 2

Table 3: Regression Table

	(1) 1 + Cash/DD	(2) 1 + Cash/DD	(3) 1 + Cash/DD	(4) 1 + Cash/DD
GDP	0.344*** (0.0258)	0.430*** (0.0947)	0.437*** (0.0947)	0.399*** (0.0961)
Interest	-0.0178** (0.00346)	-0.0125** (0.00394)	-0.0130** (0.00395)	0.0124** (0.00393)
Tax Revenue	0.0901** (0.0334)	0.0968** (0.0355)	0.0998** (0.0355)	0.0808* (0.0366)
Year > 2012	0.0247*** (0.00610)	0.000248 (0.00755)	0.000864 (0.00755)	0.00255 (0.00754)
Demand Deposit	-0.313*** (0.0142)	-0.345*** (0.0154)	-0.350*** (0.0157)	-0.347*** (0.0157)
Income Per Capita		-0.108 (0.0872)	-0.0985 (0.0872)	-0.0536 (0.0898)
Population Under 35		-1.003*** (0.152)	-1.005*** (0.152)	-1.009*** (0.150)
Tertiary education		0.00233 (0.0502)	0.0221 (0.0523)	0.0283 (0.0520)
Mobile Subscriptions- per 100k			-0.0301 (0.0230)	-0.0288 (0.0228)
Corruption Index				0.0697 (0.0375)
Constant	-5.766*** (0.710)	-2.529 (1.821)	-2.734 (1.824)	-2.453 (1.814)
Observations	249	170	170	170
R2	0.753	0.828	0.830	0.834
Adjusted R2	0.721	0.792	0.793	0.797

Standard errors in parentheses

*p < 0.05, **p < 0.01, ***p < 0.001

Definitions of Proxies:

1. GDP - Gross Domestic Product;

2. Interest rate - Fixed by the central bank of each country;

3. Tax - The extent of tax collection is used as a proxy, although it reflects only actual collection and not the tax rate as such, because of different kinds of taxes among countries.

In addition to the above-mentioned classic variables and in order to review other variables that may affect the use of cash, we have added to the basic variables, socio-economic; demographic; and technological variables. The following proxies were selected to measure them:

4. Dummy variable - (to distinguish between the period before and after 2012(. In order to measure the impact of two factors; rapid technology development over time, and the limitations imposed overall on cash usage, we fixed and inserted into the model a dummy variable since 2012[5];

5. DD - Demand Deposits of the public.

Demographics:

6. Income Per Capita (with value in USD for all countries). This variable measures the wealth of countries (not individuals) or its opposite, poverty. We use IPC in order to compare countries of different wealth levels, and not as a wealth index of individuals that affects household income.

7. Population weights by age – under 35 years.

8. Education – the weight, as it were, of the tertiary educated population among people aged 24-64, was selected as proxy for education.

9. Technology – mobile phone subscribers – per 100k, is used as the proxy for technology.

10. Corruption index – An international index which ranks 180 countries and territories by their perceived levels of public sector corruption – according to experts and business people – using a scale of 0 to 100, where 0 is highly corrupt and 100 is very 'clean'.

[5] A dummy variable (also known as an indicator or variable), is one that takes the value of 0 or 1 to indicate the absence, or presence, of some categorical effect that may be expected to shift the outcome.

Robustness Check[6]

The robustness check proves that the regressions are significantly valid and can therefore be used to confirm the findings.

After running regressions for selected models, the durability of the regressions must be examined. We started from the basic equation of the money and added different variables to test their impact on demand for cash. In order to ensure that the added variables did not hurt the punctuality of estimators, we ran a durability test using the basic equation. In the durability test, a set of regressions were used, making the explained variable the cash in circulation (or the weight of cash in circulation in demand deposits). The explanatory variables were divided into the core variables (GDP; interest rate; tax revenue and dummy variable; as well as demand deposits for the second explained variable), which were fixed and included in all the regressions, on the one hand, and the added variables, on the other. In each regression, a different combination of the added variables was selected.

We combined the average of estimators (Mean) and standard deviation (AVG STD) of the coefficients (β_i), over all regressions, as well as the percentage of regressions in which their coefficient was significant (PercSign). In table 4, the durability test of regression number 4 sits in accordance with the explained variable, which is the cash in circulation (table 2). In table 5, the durability test of regression number 4 accords with the explained variable.

[6] Barslund, M., Chiconela, J., Rand, J. & Tarp, F., 2007, 'Understanding Victimization: The Case of Mozambique'. World Development Vol. 35, No. 7 (July).

Table 4: Robustness Check 1

GVariable	Mean	Avg STD	PercSign
GDP	1.040	0.161	1
Interest	-0.043	0.010	1
Tax Revenue	0.362	0.102	1
Year > 2012	0.036	0.021	0.25
Income per capita	0.010	0.234	0.000
Population Under 35	-3.409	0.379	1.000
Tertiary education	-0.111	0.155	0.500
Mobile Subscription	-0.113	0.065	0.250
Corruption Index	0.137	0.109	0.250

Table 5: Robustness Check 2

GVariable	Mean	Avg STD	PercSign
GDP	0.309	0.059	1.000
Interest	-0.013	0.004	1.000
Tax Revenue	0.082	0.035	0.813
Year > 2012	0.010	0.007	0.25
Demand Deposit	-0.325	0.015	1.000
Income per capita	0.035	0.081	0.125
Population Under 35	1.002	0.132	1.000
Tertiary education	0.089	0.050	0.500
Mobile Subscription	-0.012	0.022	0.000
Corruption Index	0.084	0.036	0.500

It seems that in the first equation, besides the dummy variable, the core variables are significant in most of the regressions. Also, the standard deviation is relatively small and therefore the estimators are durable. Apart from the education and corruption index variables, the added variables are significant, while the equations are generally durable. In the second equation, the coefficients of the core variables are significant in a smaller percentage of the regressions, but the coefficients of the additional variables are significant in a larger percentage of the regressions.

After ensuring that there are no inter-

relations among the variables, the fullpicture of what affects the use of cash can be drawn.

Main findings:

1. GDP – As assumed, there is a significant positive correlation between GDP and cash growth.

2. Interest rate – Also as assumed, there is a significant negative correlation between cash in circulation and the interest rate: as it rises, the amount of cash declines.

3. Tax Revenue – This reflects the tax burden in a country. Although there is a significant positive correlation between tax revenue and cash holdings, its significance is less prominent than with the two other classic variables. Moreover, the robustness check of regression no. 2, clearly shows that tax results were only 80 percent significant, while the results from other classic variables (GDP and the interest rate), were significant in 100 percent of results. Proven herein is that after adding to the basic regression of the other factors that affect the use of cash, such as the significance of tax cuts, there is no less a significant correlation with the use of cash than tax.

4. Effects of restrictions on the use of cash - A Dummy variable that excludes demographic and technological variables was fixed and added into the model, in order to measure the impact of rapid technology development over time, and the impact of the limitations imposed on the use of cash in several countries since 2012 (see list in annex 1). Although results show cash is still growing (even significantly), the short time period between 2012 and 2016 prevents us from drawing any firm conclusions, especially as several countries started imposing limitations after 2012, while others are still in the midst of processing the impact of those limitations. As of 2016, therefore, the results of these impositions cannot be categorically determined; whether they would negatively impact the intensity of cash use or decrease the quantity in circulation. The only clarity exists around the fact that over the period since 2012, there was a decrease in the amount of cash in circulation.

5. Demand deposits of the public – as they grow, the use of cash significantly declines.

Demographics: Income, Age, Education

6. Income per capita – was selected as a feature of wealth or its opposite, poverty. It shows a negative correlation with the use of cash: as a country becomes richer, the use of cash declines; conversely, when a country is poorer the cash amount rises.

7. Age – There is a significant negative correlation between the use of cash and the number of people under the age of 35, whereas the correlation is positive (though not significantly), when people are above the age of 35. The younger people are, the significantly less they use cash; as they become older, their use of cash increases.

8. Education – A degree in tertiary education between the ages of 25 and 64, selected as a proxy for education, had a significant negative correlation

with the use of cash. A higher level of education indicated a decline in the use of cash; a lower level of education (less than a tertiary degree) pointed to an increase in the use of cash.

9. Technology – cellular phone subscribers – Two variables were examined as a proxy for technology: the rate of the use of the internet, which was not found to be significant in relation to the use of cash; and the number of cell phone subscribers per 100, 000 people. This was found to have a significant negative correlation with the use of cash; ie., as the technology level of a country increases, the use of cash declines. As the level of poverty increases, so too, does the use of cash.

10. Corruption Index (defined by an international index of corruption, CPI) – Findings indicate a very low positive correlation between the index value and the level of cash; meaning that the level of a country's corruption (public sector) does not really affect the use of cash.

11. Settlement Form – Density of Urban population. This measure showed no clear correlation between the settlement form and the use of cash.

Conclusions

Looking for drivers behind any negative effect on the use of cash, our study encompassed annual data from 26 countries and the Euro Area over a period of ten years (2007-2016). Regressions run on the basis of the data, reliably confirmed the findings, which were found by the robustness check to be significantly valid.

From the results of the model, the following conclusions can be drawn:

1. The classical drivers (GDP; interest rate and tax) that significantly influence the quantity of money in the economy, identically affect the amount of cash in circulation. However, the model shows that contrary to some authorities justifying limitations on the use of cash as an 'ultimate medication against tax evasion', tax revenue affects the use of cash, though significantly, in a lower volume by all means than GDP and the interest rate. Moreover, studies conducted in South America confirm that tax on financial transactions withdrawing money from a bank account, do not show any transfer towards cash holdings.

Aside from the classical variables, the model shows several additional prominent factors driving the use of cash:

2. Younger people (under 35 years of age) use significantly less cash than older people, who prefer to use cash as they grow older.

3. More highly educated people (tertiary degree) use significantly less cash. The lower the level of education, the more cash is used.

4. The same tendency applies regarding the technological level of a country: widespread use of highly developed technologies, and the use of cash declines, while poor technology equates to a higher use of cash.

So, in contrast to those who claim that holding cash derives mainly from the intention to avoid paying tax, our model shows that cash plays an important role

for various societal groups, depending on the level of development in a given of country.

5. These additional factors were examined. The implications of limiting the use of cash in several countries since 2012. Although the model still shows a significant increase in the amount of cash in circulation, it is probably too early to draw conclusions for future cash in circulation behaviour, principally because of the obstacles authorities are continuing to use to seek to thwart the use of cash. Determinant will be their administrative success in blocking its use.

6. The model did not find any real reliance between the level of public sector corruption and the use of cash.

7. Also, no correlation was found between the forms of settlement, which were tested according to the density of urban residence and the use of cash.

The study results provide us with tools of analysis to review the cash sector in each country, while serving central banks, cash centers and suppliers, to predict the level of cash in different economies and in crisis situations.

Despite substantial efforts to limit cash, even to eliminate it in some countries, its use continues to increase, albeit retarded by the accelerated growth of various means of electronic payment.

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Annex No. 1:

Cash usage limitations by country 2011-2019

Restrictions on Cash Usage

Cash Essentials
www.cashessentials.org

Belgium	€3,000	1 January 2014
Bulgaria	BGN 10,000 (€5,112)	1 July 2011
Czech Republic	CZK 350,000 (€12,673)	1 January 2013
Denmark	DKK 10,000 (€1,340)	1 July 2012
France	"€1,000 Residents €15,000 Non residents"	1 January 2001 revised in 2015
Greece	€1,500	1 January 2012
Hungary	HUF 1.5 million (€5,000)	1 January 2012
Israel	"€3,500 for merchants €12,000 for individuals"	1 January 2019
Italy	€1,000	6 December 2012
Portuga	€1,000	14 May 2012
Slovakia	€5,000	1 January 2012
Spain	"€2,500 Residents €15,000 Non residents"	19 November 2012

Source: The Irreplaceability of Cash and recent Limitations on its Use: Why Europe is off the Track, Edoardo Beretta, Università della Svizzera Italiana. Updated by AGIS Consulting