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Informal Economy Rate and Largest Banknote Denomination

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Abstract

The rapidly growing literature on informality has demonstrated its effects on various aspects of countries' economies. This paper aims to build upon the existing literature on banknote denominations and informality by examining the relation between the value of the largest banknote denominations in countries (expressed in US dollars) and their GDP per capita, inflation rate, percentage of people using credit cards, and central bank independence index using cross-country data from 104 countries. This paper uses different methodologies such as plain correlation and least squares regression in order to find the correlation between the aforementioned variables. The results indicate a negative correlation between informal sector size and the value of the largest banknote denomination, suggesting that countries with larger informal sectors tend to have lower-value banknotes. In conclusion, this paper suggests that the informal sector is one of the underlying factors that explain why governments are averse to new larger banknote denominations and how this is related to the correlation between the informal sector percentage and the value of the largest banknote denomination in USD. Adding onto this, the paper also compares and contrasts the results of the observations obtained with the current literature on informality and banknote denominations.

Keywords: informality; banknote denominations; credit card usage; GDP Per Capita; Inflation Rate

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Introduction

An informal economy is the portion of the economy of a country that is not monitored or taxed by the government. The focus on informal economy started in the 1950s and 1960s especially with W. Arthur Lewis's Nobel-Winner 1954 essay regarding the concerns raised about informal economy.

Although it makes up a significant portion of the economy of many developing countries, it has been labeled as unmanageable. However, the research Elgin (2020) sponsored by MasterCard, "*found that eliminating Turkey's informal sector (approximately 30% of GDP in 2012) would increase the formal sector by a mere 1.67%*" This suggests that informal economy significantly contributes to the GDP of countries and allow many workers who are unable to be employed in the formal industry to create income. This phenomenon is not limited to Türkiye, informal sector "*represents more than half of nonagricultural employment in most developed regions and as much as 82 percent of nonagricultural employment in South Asia*", indicating that informality contributes to the overall economy and may work as alternative solutions for poverty and inequality (Chen et al. 2012). History also backed these findings as the informal sector increased after the Asian economic crisis. The informal sector had allowed workers who couldn't find jobs in the formal sector to earn income. Furthermore, the researchers were "*largely positive*" regarding the informal sector in Kenya in research mounted by the International Labour Office Organization in 1972 (Chen et al. 2012).

Although the informal economy may have significant contributions to the economy and provides opportunities for many entrepreneurs to start their businesses, there are social and economic shortcomings that create conflicting views regarding informal economy. In the informal sector, since there isn't a constant monitoring of the government, the safety of the workers can not be ensured. The workers are hired without any social protection, which results in "*lower maternal, prenatal, and infant health, lower life expectancy, less human capital, less growth, and greater income inequality*" (Chen et al. 2016 ; Elgin 2020)

Not only does the nature of informal economy creates conflicts but also there are many different views on how informality is measured. Furthermore, according to "Towards a Better Understanding of the Informal Economy", there has not been an optimal way to measure the informal economy of a country without missing crucial aspects. This is caused by the fact that the informal economy has many differing definitions, and the indicators used for measurement greatly vary according to the definition. Many of the many variables used for measuring informality, such as the share of self-employed in the labor force, may greatly represent formal activities as well (Andrews et al. 5 2011).

Moving on to banknote denominations, although various online payment methods have emerged and banknotes were anticipated to be the old payment method, there is still a great demand for banknotes in many regions of the world (Assenmacher et al. 2019). This was also investigated by Bagnall et al. (2014) and cash is observed to be a prominent payment method, especially in low-value transactions in all countries investigated in the research. Two proposed reasons for the

increase in cash demand in Jobst et al. are the decreasing interest rates in 2007/8 and increase in shadow economy activities (Jobst et al. 2017). However, the same research states that the shadow economy was not proven to be an important factor for the 2001-2014 period (Jobst et al. 2017). On the other hand according to Sands elimination of high denomination currencies can help reduce underground economic activity.(Sands 2016) Moreover, the COVID-19 pandemic has accelerated the trend towards digital payments, potentially affecting both the informal economy and the demand for cash. This study's examination of the relationship between banknote denominations and informal economic activity is particularly timely, as it may shed light on how these trends interact in the post-pandemic economy.

There is a significant amount of research done focusing on both aforementioned fields. In addition to the previously done research, this paper will work to establish an intersection between two broad brands of literature by specifically discussing the relationship between the value of the largest banknote denomination of a country in USD with the country's informality rate, percentage of people using credit cards, inflation rate, and GDP Per capita. The question that this research paper focuses on emerged from the current discussion regarding new banknote denominations of 500 and 1000 Turkish Liras in Türkiye, where the largest denomination (as of August 2024) is 200 TL and this has not changed since 2009, even though there has been significant inflation in the last 10 years.

This study aims to investigate the relationship between the value of a country's largest banknote denomination and various economic factors, with a particular focus on the informal sector. I hypothesize that countries with larger informal sectors will tend to have lower-value banknotes

The rest of the paper is organized as follows In the next section, I describe my data sources and present the methodology I use. Then in section three, I present the results of the empirical analysis. Finally, in the last section, I provide some concluding remarks.

2. Data and Methods

2.1 Data

Data were obtained for five different variables: percentage of people above 15 years of age having credit cards, average of the inflation rate from 2020 to 2024, GDP per capita in 2023, informality rate of 2024, value of the largest banknote denomination in USD in 2024, and central bank independence-extended index in 2023 for 104 countries. These variables were chosen based on their potential influence on currency use and informal economic activity, as suggested by previous literature

Table 1. Descriptive Summary Statistics

Variable	Mean	Median	Standard Deviation	Minimum	Maximum
Percentage of People with credit cards (% Population)	22.58	13.23	22.60	0.22	82.74
Average Inflation Rate 2020-2024 (%)	18.08	4.74	82.18	0.44	913.52
GDP per capita 2023 (constant USD)	18060.76	7519.84	23824.85	199.58	128259.4
Informal Sector (% GDP)	27.28	26.72	10.79	7.15	59.35
Largest Banknote Denomination Value in USD	231.53	36.26	868.29	0.38	7404.64
Central Bank Independence Index 2023	0.71	0.72	0.15	0.30	0.91

Table 1 presents descriptive summary statistics of all variables I use in my empirical analysis. The data for “Percentage of people with credit cards 2021” were obtained from the World Bank Global Financial Inclusion survey, and the data was only available for years 2011 to 2021.

GDP per capita for 2023 data was collected from the World Bank Group which was determined by the World Bank national accounts data, and OECD National Accounts data files. For data on central bank independence, the central bank independence extended (CBIE) index in Romelli (2022, 2024) was used and the year 2023 was selected to match with other variables. For the average inflation rate, the inflation rate information was obtained from the International Monetary Fund's database and the average for the last 5 years was calculated. Last but not least, the banknote value in USD of each country's largest banknote denominator was calculated with the help of Google Finance according to the exchange rates on July 7th, 2024. Finally, the data for the informal sector is taken from the database that the World Bank's Prospect Group has created. (2024)

The data for this research is more current than most research done on similar questions, thus providing more relevant evidence, however, because some of the desired data are not available for more recent years this paper uses data from different times and relatively shorter periods.

2.2.

Methods

First, I report the pairwise correlation of banknote value in USD, one by one with all the explanatory variables of interest. Then, I also go beyond the simple correlation analysis and using ordinary least squares regressions with robust errors, I estimate the following regression equation:

$$\text{Banknote Value in USD} = a + b * \text{Informal sector rate} + c * \text{Percentage of People with credit cards} + d * \text{GDP Per Capita} + e * \text{Average Inflation Rate} + f * \text{CBIE Index} + \text{Error Term}$$

A priori, I expect the estimated values of the coefficient b to be negative, as the purchasing power of the local currency will decrease when the value of the banknote in USD is lower. Lower purchasing power might push people who are unemployed in the formal sector to look for more jobs in the informal sector to provide for themselves. Hence, according to my hypothesis, the informal sector will be negatively correlated with the largest banknote denomination value in USD.

I expect the correlation between the percentage of people with credit cards and banknote value to be negative as well, as people will be more inclined to use credit cards when the largest denomination cash has less value. However, there is also the technology factor that comes into play as the countries need to be technologically developed enough to provide the necessary equipment for the use of credit cards. The usage of credit cards might be higher in many countries with higher banknote value simply because of the increased convenience of using credit cards in those more technologically advanced countries.

For the d coefficient, however, I expect the value to be positive as in economies with higher GDP per capita, inflation might be moderate or well-managed, preserving the purchasing power of money. Thus, the value of the banknote value will remain high as long as the economic stability and high GDP remain.

Inflation decreases the purchasing power of money, meaning more currency is needed to purchase the same goods and services over time. As a result, larger denomination banknotes

become less practical for everyday transactions because they would need to be issued in even higher denominations to keep pace with rising prices. With continuous high inflation rates, the purchasing power of the largest local currency will constantly be dropping thus, resulting in more valuable denominations to be introduced. Hence, initially, I expect the correlation between inflation and banknote value to be positive.

Finally, for the f coefficient, the coefficient for central bank independence, I expect the correlation to be positive although I am not expecting a very significant plain correlation. Central bank independence might indirectly support confidence in the currency through effective inflation control and economic stability. Thus, a higher central bank independence index may lead a currency to have a greater value in USD.

3. Results

Before looking at the result of the regression for

Table 2 Plain Correlation Data for Each Variable

	Informal Sector (% GDP)	Percentage of people with credit cards 2021	GDP per capita 2023	Average Inflation Rate 2020-2024	CBI Index 2023
Banknote Value in USD	-0.1011	0.1772	0.2959	0.0549	0.0044

Table 2 presents the plain correlation for each of the 5 independent variables with banknote value in USD. Looking at the table, the correlation coefficient of the informal sector, average inflation rate, and the central bank independence index seem to be insignificant considering that their absolute values are all less than 0.15. However, there is a correlation between GDP per capita and banknote value in USD. A correlation coefficient of 0.2959 between GDP per capita and the largest banknote denomination value in USD suggests a moderate positive relationship between these two variables. Economies with higher GDP per capita often have better control over inflation, which helps maintain the purchasing power of larger denominations, making them more practical and useful. However, this trend may not hold for countries that have recently undergone currency redenomination.

One other factor that is slightly correlated with banknote value in USD according to Table 2 is the percentage of people with credit cards. A plain correlation of 0.1772 between the percentage of people using credit cards and the largest banknote denomination value in USD suggests a weak positive relationship between these two variables. Countries with higher credit card usage often have more developed financial systems, which might also support the circulation of higher denomination banknotes for significant transactions. The infrastructure supporting credit card usage could also reflect an economy where larger banknote denominations are used effectively. Furthermore, another reason for both payment methods (cash and credit card) to be high at the same time could be because consumers may use credit cards for convenience or rewards but opt for cash, when they want to avoid transaction fees or maintain anonymity. Last but not least, according to Assenmacher et al. (2019), distrust in the banking system - especially after the global financial crisis- and the lower nominal interest rates and desire for privacy and be some of the reasons for the demand for cash.

Table 3. Results of Least Squares Regression

Banknote Value in USD	Coefficient	Standard Error	t value	P> t 	[95% Confidence Interval]	
Informal Sector (% GDP)	-2.64028	1.219300	-2.17	0.039	-4.62127	8.90182
Percentage of people with credit cards 2021	-14.72207	5.663186	-2.60	0.011	-25.96048	-3.483661
GDP per capita 2023	0.025182	0.0054185	4.65	0.000	0.0144293	0.0359348
Average Inflation Rate 2020-2024	5.281445	1.671467	3.16	0.002	1.964473	8.598417
CBI Index 2023	-27.85534	486.5505	-0.06	0.954	-993.3989	937.6882
Constant	-64.22968	404.104	-0.16	0.874	-866.1608	737.7015

Banknote Value in USD = -64.22968 + -2.64028*Informal Sector Rate + -14.72207 *Percentage of people with credit cards + 0.025182 *GDP Per Capita + 5.281445*Average Inflation Rate + -27.85534*CBIE Index + Error

Table 3 presents the results of the regression described in the methods section. The result of the regression analysis will be used for exploring the correlation between variables in the table. Informal Sector, credit card usage, GDP per capita, and inflation rate are significant predictors of banknote value, with varying degrees of impact and directions (positive or negative). On the other hand, the CBI index does not seem to have a significant correlation with the value of the largest banknote denomination values in USD.

First of all, according to the constant value of the informal sector variable in the second row of Table 3, -2.64028, there is a negative correlation between a country's largest banknote denomination's value in USD and the informal economy rate. Looking at the p-value of 0.039, one

can say that this correlation is valid and not due to chance. The confidence interval is [-4.62, 8.90], indicating uncertainty in the exact impact but consistent with a negative trend.

Although one might expect the informal sector’s growth to be thriving with more valuable cash and the anonymity that comes with the cash, according to the regression with the cross country data, there is a negative correlation between the two variables. The negative correlation may be related to the purchasing power of the local cash currencies in every country. This is because these informal sector exports and imports don’t use the local currencies of the hosting country. Especially in countries that import most of their goods, the prices are based on the value of the currency that the exchange is made on. According to Eurostat, most of the international trade was done using USD or EUR (2023).

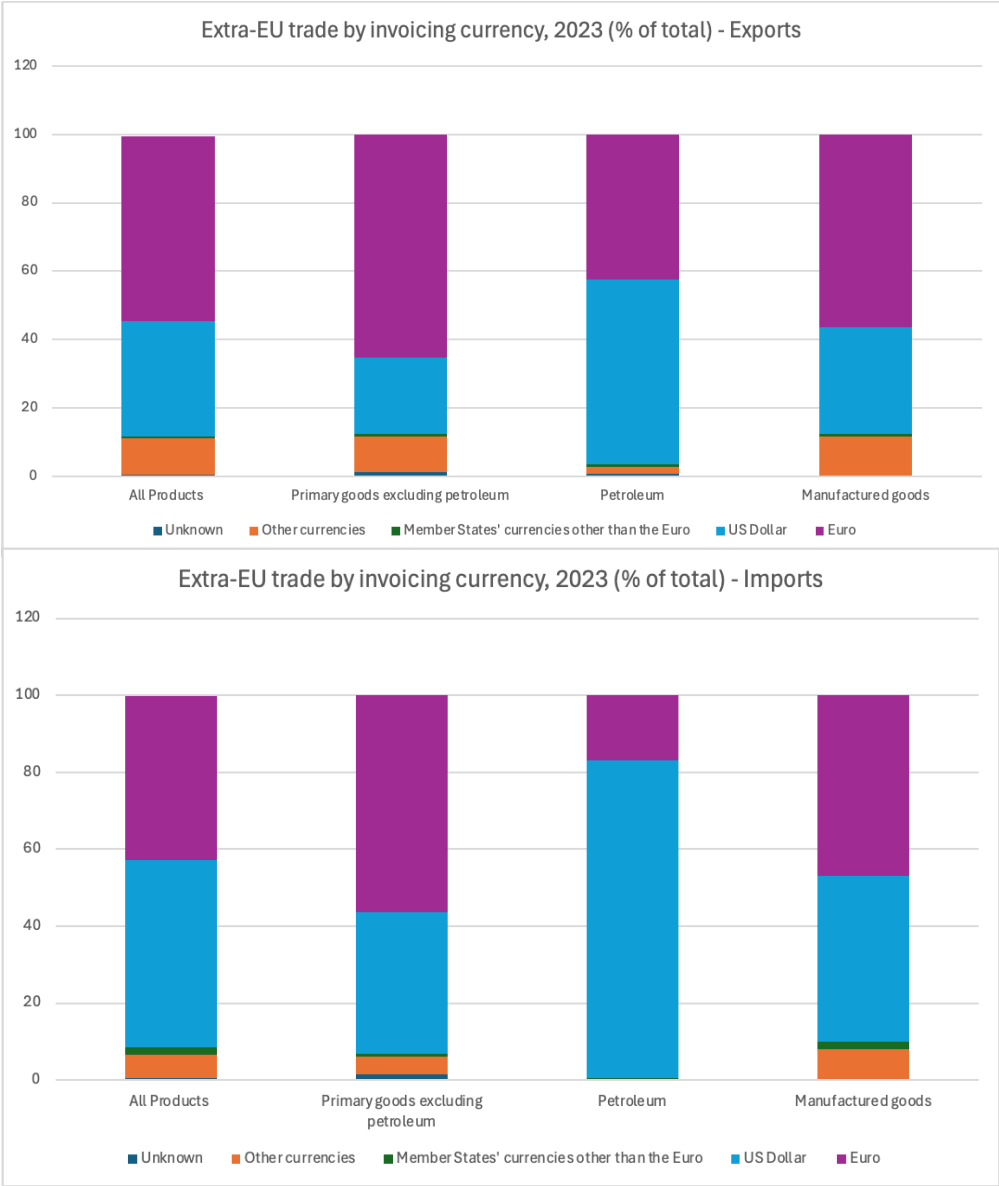


Figure 1. Extra EU trade by invoicing currency

Source: Eurostat ([ext_It_invcur](#))

Figure 1 presents the currencies used in extra EU trade in percentages. This paper doesn't directly object the claim that was made by Peter Sands in a previous study regarding the necessity of eliminating the high denomination currencies to “*make it harder*” for criminals to initiate illegal trade using cash (Sands 2016). This is because the relationship established in this study is regarding the high denomination banknotes for local currencies, not the currencies that are most commonly used for aforementioned transactions. According to his research, the currencies that were used the most for illegal and informal transactions were Euro and US dollars. In fact, figure 1 supports this claim by demonstrating that the euro and US dollars were the most commonly used cash currencies for import and export. Although eliminating such currencies might help to eliminate the grounds for illegal transactions, this research works with the values of local currencies, thus there are other factors influencing the informal sector.

With this study, the results suggest a negative relationship between the value of the largest local banknote denomination and the informal sector percentage. When the value of the largest banknote denomination is low and the goods are imported from other countries causing the prices of the goods to be relatively higher, people need more money to purchase their basic needs. Hence, needing to work more to earn more. However, when more people need to work multiple jobs, there will be a deficit of jobs in the formal sector due to the high demand for employment. People who are unable to be employed in the formal sector will attempt to find jobs in the informal sector or even create their jobs easily in the informal sector without the obstacles they will face in the formal sector. Hence, yielding a higher percentage of the informal sector contributing to the country's GDP.

Furthermore, another conclusion that can be drawn from this correlation might be regarding the government's policies towards banknote denominations. Larger banknote denominations, as stated by Sands (2016), can be an easy transaction medium for people in the informal sector. Hence, some governments might think that by eliminating higher denominations and larger value banknotes, they can hinder already high ratios of informal sector transactions. As a result, maintaining the of informal sector in the country. For instance, in countries in which largest value banknote denominations are dominating the cash circulation, the most anticipated response from the authorities would be to introduce a higher denomination banknote. However, looking at the negative relationship between the informal sector percentage and the largest banknote denomination value, the countries that need new denominations for everyday transactions already have high informal sector ratios. As a result, to prevent the growth of the informal sector such countries even more, the governments prefer not to issue larger value banknote denominations.

Another factor that is influencing the value of the largest denomination banknote in USD is the percentage of people using credit cards in that country. According to Table 2, the coefficient for the percentage of people using credit cards in a country has a coefficient of -14.72207, which indicates a negative correlation between the variable and the largest denomination banknote value in USD of a country. Interestingly, this negative correlation contradicts our initial expectation of

a positive relationship according to the plain correlations, suggesting that the dynamics between credit card usage and cash denomination are more complex than initially thought. The p-value of 0.011 indicates significance at the 5% level, implying a strong negative relationship between credit card usage and banknote value. Although the plain correlation between the two variables showed a positive correlation, when other variables are added a more realistic and significant negative correlation is obtained. This negative correlation may be due to technology becoming more accessible in the world. As credit cards become more prevalent for large transactions, cash is often reserved for smaller, everyday purchases, decreasing the necessity for large-denomination banknotes. Although there is still demand for cash due to economic instability, the ease of carrying less physical cash for large transactions make larger values of banknotes less needed for daily life. Furthermore, another reason for choosing credit cards over cash in everyday transactions may be the risk of carrying large amounts of cash in case of a robbery. Payment with credit cards is overall more secure and physically conventional.

One of the many factors that have a significant correlation with the largest denomination banknote value in USD is the GDP of the country. A \$1 increase in GDP per capita is associated with an increase of approximately 0.025 USD in banknote value. With a p-value of 0.000, this variable is highly significant, suggesting a positive relationship between GDP per capita and banknote value. Higher GDP per capita typically indicates a more developed economy with higher average income levels. In such economies, larger transactions are more common, and higher denomination banknotes can facilitate these transactions without the need for carrying large quantities of lower denomination notes. In economies with higher GDP per capita, inflation might be moderate or well-managed, preserving the purchasing power of money. Larger banknote denominations can serve as a convenient means of handling large sums without frequent cash replenishment, particularly if the purchasing power supports such denominations. Furthermore, many developed countries with high GDP per capita engage in extensive international trade. This also raises the need for a more conventional way of money transactions, which is using larger banknote denominations.

The last variable with a significant correlation with the largest banknote denominator is the country's average inflation rate in the last 5 years. Inflation leads to a decline in the purchasing power of money, meaning that over time, more money is required to purchase the same goods and services. To accommodate this, central banks may issue higher-denomination banknotes to facilitate transactions that would otherwise require an impractically large number of smaller notes. Central banks might proactively issue higher denominations in anticipation of continued inflation to stabilize the economy and maintain confidence in the currency. This ensures that people can continue to use cash efficiently even as inflation rises.

Although it is one of the variables in the equation, the central bank independence index does not have a significant correlation with the largest banknote value of a country. This is indicated with a p value of 0.954. The lack of a significant relationship between the central bank independence and banknote value may seem somewhat surprising. This could suggest that central bank policies regarding banknote denominations are influenced more by practical economic

factors, such as inflation and GDP, than by the institutional independence of the central bank. Alternatively, the effect of central bank independence might be indirect, operating through its influence on other economic variables like inflation rates.

4. Conclusion

The fast-expanding body of research on informality has shown how it affects many facets of national economies. By analyzing the relationship between a country's GDP per capita, inflation rate, percentage of credit card usage, and central bank independence-extended index and the value of its largest banknote denominations using cross-country data from 104 countries, this paper expands on the body of research already available on banknote denominations and informality. Furthermore, the study compares the findings of the observations made with the existing research on informality and banknote denominations.

According to the findings in the results section, informal sector size can be one of the variables that dissuade central banks from introducing new banknote denominations. The regression from Table 3 in the result section demonstrate a negative correlation between the USD value of the largest banknote denomination in each country and the informal sector size. This suggests that there are countries with high informal sector percentages and low largest cash denomination values. The already high percentages of informal sector causes the governments to not introduce new banknotes resulting in these countries not remaining with largest banknote denominations with low values in USD. This can be caused by the fear that larger banknote denominations may make it easier for people to make monetary transactions without the supervision of the government. With lower value banknote denominations, it is harder to make monetary transactions in large numbers due to its physical inconvenience. Hence, with larger banknotes, the governments of the countries with already high rates of informal sector might struggle even more with maintaining a low rate of informal sector.

These findings have important implications for monetary policy, particularly in countries with large informal sectors. Policymakers should consider the potential impact on informal economic activity when making decisions about introducing new banknote denominations. Furthermore, as digital payment methods become more prevalent, central banks may need to balance the demand for cash in the informal sector against the push for greater financial inclusion and transparency through digital transactions.

This study is limited by the availability and recency of data, particularly for credit card usage. These limitations should be considered when interpreting the results. Another limitation of this research is the lack of recent and complete data available on some of the variables such as percentage of people with credit cards. Furthermore, the data on informality is, although not incomplete, but inherently hard to measure and variable by definition. This research can be further enhanced and broadened by additional variables that might have a significant impact on the equation mentioned in the previous section. In addition to this, additional current and complete data for the variables mentioned above can provide a better understanding of the correlation between the variables. Future studies could also explore the causal mechanisms behind these correlations, perhaps using longitudinal data or case studies of countries that have introduced new banknote denominations.

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