Examining Predictors of Currency Strength in Developing and Transition Economies

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Abstract

In the globalized world, the strength of a country's currency is paramount, especially for developing and transition economies. This research endeavors to identify the key predictors for currency strength in such countries, with a spotlight on Ukraine, particularly in the aftermath of Russia's invasion. Leveraging cross-country regression analysis, the study examines the factors influencing exchange rates. The findings highlight the role of economic prosperity, import dynamics, and government spending as vital determinants of currency strength, while interest rates, exports, and inflation were found to have less significance. For policymakers, this implies a need to bolster economic growth, manage imports, and ensure prudent fiscal policies. This study not only augments the academic discourse on international finance but also offers actionable insights for economies like Ukraine striving for currency stability.

Keywords: Exchange Rates, Developing Countries, Transition Economies.

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Introduction

In the global economy, the strength of a country's currency is a crucial factor that affects economic stability and growth. This issue is particularly important for developing and transition countries. Specifically, their economies often face numerous challenges in maintaining a stable currency value due to a wide range of internal and external factors. Throughout this analysis, we seek to analyze the primary sources of exchange rate formation and provide valuable insights into the specificity of their effects in unstable economic conditions.

The objective of this research study is to identify the key predictors for currency strength in developing and transition countries. Specifically, their economies often face numerous challenges in maintaining a stable currency value due to a wide range of internal and external factors. By conducting a cross-country regression analysis, we aim to investigate the factors that significantly influence the exchange rates of developing nation The results are expected to be used to define the key factors of national currency strength in Ukraine and formulate policy recommendations aimed to reinforce the stability of hryvna's value during and after Russia's invasion.

Therefore, the study's findings can provide valuable implications for three main reasons. First, policymakers can leverage these insights to devise targeted strategies aimed at enhancing currency stability and fostering economic recovery in developing countries, including Ukraine. Second, understanding the main predictors for currency strength can inform decisions regarding monetary and fiscal measures, foreign exchange market interventions, and attracting foreign investments. Third, our research findings can contribute to the existing body of knowledge in the realm of international finance and economics by stimulating the discourse regarding the interplay between economic indicators and currency fluctuations in developing or transition economies. The

results are expected to be used to define the key factors of national currency strength in Ukraine and formulate policy recommendations aimed to reinforce the stability of hryvna's value during and after Russia's invasion of Ukraine.

Data and Methods Description

Data sources and variables

The data for this research study was obtained from the World Bank. Specifically, we used the DataBank tool due to its wide collection of databases with economic indicators, and its credibility. In order for the research to account for economic instability, the time period of 2015-2019 was taken to measure the average value for all observations during the selected period. This way the most precise and general data was obtained, minimizing cyclical fluctuations in the selected measures.

The dependent variable in this study is the local currency real exchange rate of each country with respect to the US dollar calculated as the product of the nominal exchange rate and the ratio of prices between the two countries, measured by the IMF.

The independent variables considered in this study are (1) inflation, (2) real interest rate, (3) import, (4) export, (5) GDP per capita, and (6) government consumption. They are measured as follows:

(1) *Inflation* is measured by the consumer price index which reflects the annual percentage change in the cost to the average consumer of acquiring a predefined basket of goods and services by using a Laspeyres formula;

(2) *Real interest rate* is the lending interest rate (in %) adjusted for inflation as measured by the GDP deflator.

(3) *Import* is represent the value of all goods and other market services received from the rest of the world, measured as percentage of GDP;

(4) *Export* is represent the value of all goods and other market services provided to the rest of the world, measured as percentage of GDP;

(5) *GDP per capita* is gross domestic product divided by midyear population;

(6) *Government consumption,* represented as percentage of GDP, includes all government current expenditures for purchases of goods and service, expenditures on national defense and security, but excludes government military expenditures that are part of government capital formation.

Regression model

The model used to analyze the relationship between the dependent variable and the set of independent variables is specified as follows:

Exchange rate = f(Inflation, Real interest rate, Import, Export, GDP per capita, Government consumption).

To be more precise, the regression model can be written accordingly:

$Exchange\_rate = a + b_1 Inflation + b_2 Interest\_rate + b_3 Import + b_4 Export + b_5 GDP\_per\_capita + b_6 Gov\_consumtion + e$

The aforementioned variables have been selected based on several studies, conducted by credible financial media and research institutions, namely, *Investopedia*, *AvaTrade*, and *Business Research Methodology*.

Considering the existing theories of exchange rate determination, the expectations regarding the influence of each predictor on the exchange rate can be formulated as follows:

Hypothesis 1: Inflation is expected to have a positive effect on the exchange rate since higher inflation rates tend to lead to a depreciation of the local currency.

Hypothesis 2: Real interest rate is anticipated to have a positive effect on the exchange rate. This is because higher real interest rates may attract foreign investment, leading to a higher exchange rate.

Hypothesis 3: Export is expected to have a negative effect on the exchange rate. Higher levels of exports indicate a stronger economy, which can lead to increased demand for the local currency and result in an appreciation of the exchange rate.

Hypothesis 4: Import is anticipated to have a positive effect on the exchange rate. Increased imports may indicate a higher demand for foreign currencies to purchase goods from other countries, potentially leading to a depreciation of the local currency.

Hypothesis 5: GDP per capita is expected to have a negative effect on the exchange rate. Higher GDP per capita signifies a stronger economy, attracting foreign investment and increasing the demand for the local currency, potentially resulting in a depreciation of the exchange rate.

Hypothesis 6: Government consumption is expected to have a positive effect on the exchange rate. Higher levels of government consumption may lead to budget deficits and potentially inflationary pressures, which can result in a depreciation of the local currency.

The proposed model will be estimated using ordinary least squares (OLS) regression analysis. Any required data transformations or variable adjustments will be applied prior to estimation. The OLS estimation procedure will calculate the coefficient values and provide measures of their statistical significance. The significance of the coefficients will be assessed using t-tests, and the overall fit of the model will be evaluated using the coefficient of determination (R^2) and adjusted R^2. Moreover, the F-statistic will be used to identify the utility of each independent

variable in order to provide the best explanatory model. Finally, the model will be used to make predictions and determine the ultimate factors affecting the dependent variable.

Empirical Analysis and Results

Data transformation

To begin with, we proceed to transformations of our variables. Since many of our measures display a substantial cross-country variation, a log transformation is commonly used to prepare the data for the analysis. The failure to do so may lead to the violation of basic assumptions of the regression analysis.

To demonstrate the correctness of our choice, we fit a regression model to the initial data and plot fitted values against residuals from this model:

```
model1 = lm(ex_rate ~ inflation + gdp_p_c + export + interest + import + gov_cons, data = ex_r)
```

The distribution of residuals (see Annex 1) is evident not to be linear. Moreover, the variance in residuals appears to be non-constant. This can be concluded from the residuals being not symmetric around the zero-line and their density in the right bottom corner. Therefore, it is necessary to transform the data in order to meet the aforementioned assumptions.

In achieving this objective, we first apply the logarithmic transformation to the dependent variable and re-plot the fitted values against residuals. The figure in *Annex 2* exhibits that this action positively affected the distribution of residuals resulting in the significant improvement of the variance, making it close to constant. To achieve even better performance, the logarithmic transformation is also applied to GDP per capita due to the fact that the observations for this variable are widely spread, having large standard deviation (see Table 1).

```
ex_r$log_ex_rate <- log(ex_r$ex_rate)
```

```
ex_r$log_gdp_pc <- log(ex_r$gdp_p_c)

model2 = lm(log_ex_rate ~ inflation + gdp_p_c + export + interest + import + gov_cons, data =
ex_r)
model3 = lm(log_ex_rate ~ inflation + log_gdp_pc + export + interest + import + gov_cons, data
= ex_r)
```

Eventually, the fitted values against residuals plot for Model 3 (*Annex 3*) looks close to linear with the residuals holding approximately constant variance and located symmetrically around the zero-line. This provides additional evidence, supporting our decision for the transformation of the initial variables. Thus, Model 3 will be further considered as the full model during the backward selection process. The testing of the remaining assumptions will be conducted after the main analysis in greater detail.

Empirical Analysis

After completing the required data transformations, we proceed with exploring the relationships between the variables visually. Scatterplots provided in *Annex 4* demonstrate that there are negative correlations between the ln(Exchange rate) and ln(GDP per capita), percentage of export in GDP, and percentage of import in GDP. However, there is a strong positive correlation between the latter independent variables - export and import. This correlation is expected and will be eliminated further in the analysis.

When exploring the correlation coefficients (*Annex 6*), statistics show that there is a relatively strong negative relationship between the dependent variable and export, import, and government consumption, with the strongest correlation existing between the exchange rate and ln(GDP per capita) (-0.47). The correlation coefficients also support the preliminary claim that

there is a strong correlation between export and import as percentage of GDP (0.79). Moreover, a positive correlation exists between export and ln(GDP per capita) (0.55), along with the correlation between import and government spending (0.4). This implies that the multicollinearity problem may arise, which will be addressed later in the analysis.

We initiate the back-ward selection process in order to determine our final regression model, which will subsequently be utilized to assess the impact of the selected predictors on the exchange rate. In this process, variables exhibiting non-significant coefficients are systematically eliminated from the model, one at a time. Backward elimination leads to only 3 predictors being significant in terms of their effect on the exchange rate at the 10% significance level, which are ln(GDP per capita), import and government consumption (s*ee Model 3, Annex 7*).

```
model_full = lm(log_ex_rate ~ inflation + log_gdp_pc + export + interest + import + gov_cons,
data = ex_r)
model_reduced = lm(log_ex_rate ~ log_gdp_pc + import + gov_cons, data = ex_r)
```

After reducing the model, the R-squared value remains unchanged signaling that the quality of the model was not influenced. The anova() test confirms our findings by demonstrating that the reduced model outperformes the full model, with the p-value being $0.37 > 0.05$ proving that export, interest rate and inflation are not influential predictors of the log of exchange rate for our selection of countries. In addition, introducing interaction terms between several predictors has not been successful. Furthermore, when exploring the presence of multicollinearity by using the vif() test, no values above 5 were received, hence, this problem is absent. As a result, the reduced model is considered the most relative and optimal for the analysis.

In order to proceed with the interpretation of the results, it is imperative to verify the remaining assumptions of linear regression. Previously, we assumed the fulfillment of the linearity

assumption through data transformation. The visual assessment of constant variance in residuals was also confirmed, supplemented by conducting the Breusch-Pagan test, which yielded a p-value exceeding the 5% significance level. However, the assumption of normal distribution of residuals was not satisfied based on the Shapiro-Wilk test. Therefore, it becomes necessary to address outliers and influential points by employing Cook's distance (*see Model 5, Annex 7*). By doing so, not only the normality in the distribution of residuals is achieved, as evidenced by a p-value exceeding the 0.05 level of significance, but also observe a substantial increase in the R-squared value from 0.37 to 0.46. Thus, all assumptions are met and the final model can be written as follows:

```
model_final = lm(log_ex_rate ~ log_gdp_pc + import + gov_cons, data = ex_r, subset = dist <= 4 / length(dist))
```

We present a fitted versus residuals plot in *Annex 8*. The distribution of residuals appears to satisfy all the assumptions of regression analysis.

Results interpretation and discussion

Based on the final model summary, the fitted regression equation is written accordingly:

ln(Exchange_rate) = 16.92 - 0.05Import - 1.2ln(GDP_per_capita) - 0.09Gov_consumtion + e

For every 1% increase in the independent variable, our dependent variable increases by about 0.20%.

The coefficients can be interpreted as follows: For a one-percentage increase in import share in GDP, the estimated mean exchange rate decreases by 5%, holding other predictors constant. This suggests that a higher import share in GDP is associated with a lower exchange rate, which contradicts our expectations formulated in *Hypothesis 4*.

For a one-percent increase in GDP per capita, holding all other variables constant, the estimated average exchange rate is expected to decrease by 1.2 percent. This implies that higher levels of economic prosperity, as captured by GDP per capita, are associated with a lower exchange rate, which supports *Hypothesis 5*.

An increase by 1 percent in government consumption is associated with 9% decrease in the estimated mean exchange rate, holding other predictors constant. This suggests that higher government spending leads to a lower exchange rate, which is contrary to *Hypothesis 6*.

After standardizing the coefficients, it becomes evident that log(GDP per capita) has the strongest effect on the exchange rate, holding the value of -0.48, followed by import (-0.3) and government consumption (-0.22) (*Annex 7*). These results highlight the importance of achieving economic prosperity.

To summarize, according to the results of the regression analysis exploring the relationships between several predictors and the exchange rate in the developing countries, only three independent variables are found to be influential. These variables are import as percentage of GDP, ln(GDP per capita) and government consumption as percentage of GDP, which express a negative relationship with the ln(exchange rate). Contrary to our expectations, inflation, interest rate and export tend to have no significant effect on the exchange rate in developing countries. This may be due to the fact that the hypotheses are based on data, accounting for all countries, contrary to our sample consisting of countries with developing and transition economies only.

Conclusion

In summary, the regression analysis conducted in this research provides valuable insights into the predictors of currency strength in developing and transition economies. The model highlights the importance of import, ln(GDP per capita), and government consumption as

significant factors influencing the exchange rate. Contrary to existing theories, no significant evidence of the influence of interest rate, export, and inflation were found. Consequently, these results emphasize the significance of economic prosperity, import dynamics, and government spending in determining currency strength.

Based on the results, several policy recommendations can be formulated. Firstly, policymakers should focus on fostering economic growth and raising GDP per capita, as it has the strongest negative effect on the exchange rate. This can be achieved through measures that promote economic strength, attract foreign investment, and enhance productivity. Moreover, the results indicate that import dependency in developing countries strengthens the exchange rate, which can be explained by capital inflows into the country and retrieving additional resources from abroad in addition to domestic production, which is common in developing and transition economies. However, it is debatable whether this strategy is efficient as it commonly does not contribute to economic prosperity. Furthermore, controlling government consumption and ensuring responsible fiscal management can help maintain currency stability. The analysis suggests that increasing government expenditures lowers the exchange rate. Nevertheless, it is important to note that most probably this indicates that government spending is aimed at improving the standard of living.

For Ukraine, specifically, the findings of this research can be applied to formulate policy recommendations to reinforce the stability of the hryvnia's value during and after Russia's invasion. The Ukrainian government should prioritize measures to boost economic prosperity, attract foreign investments, and direct the government spending at establishing high living quality. Implementing structural reforms, promoting a favorable business environment, and diversifying the economy can aid in achieving these goals will be crucial for maintaining currency stability.

Further research can be aimed to explore additional factors that may influence currency strength in developing and transition economies. Moreover, conducting a comparative analysis across different countries and time periods can shed light on the generalizability and stability of the identified predictors. In addition, the next analysis may focus on the developing countries in the post-war period, discovering the main predictors of the exchange rate after the war.

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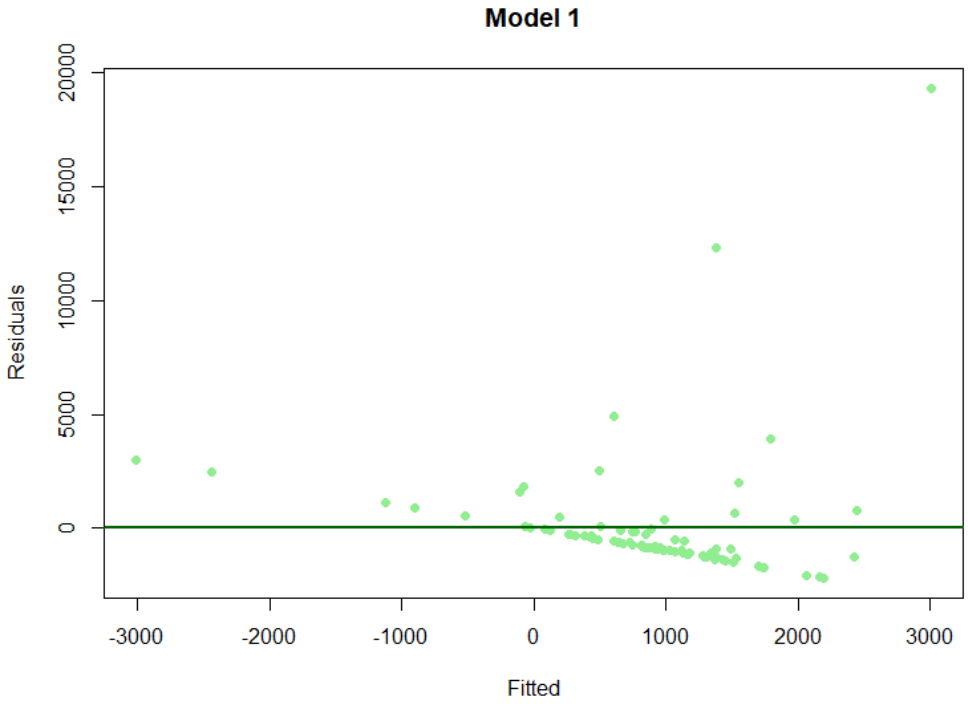
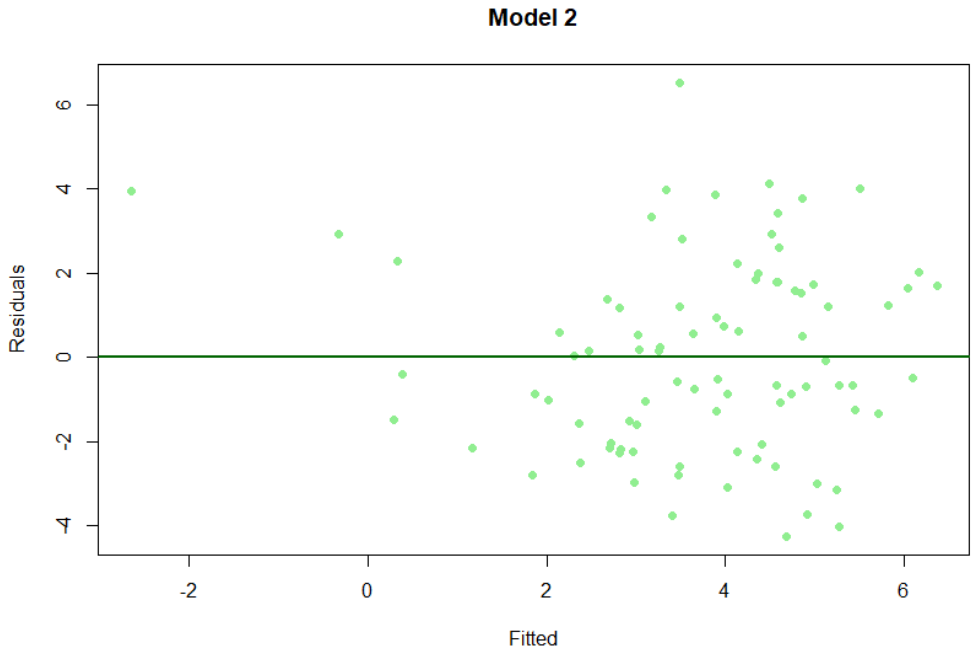
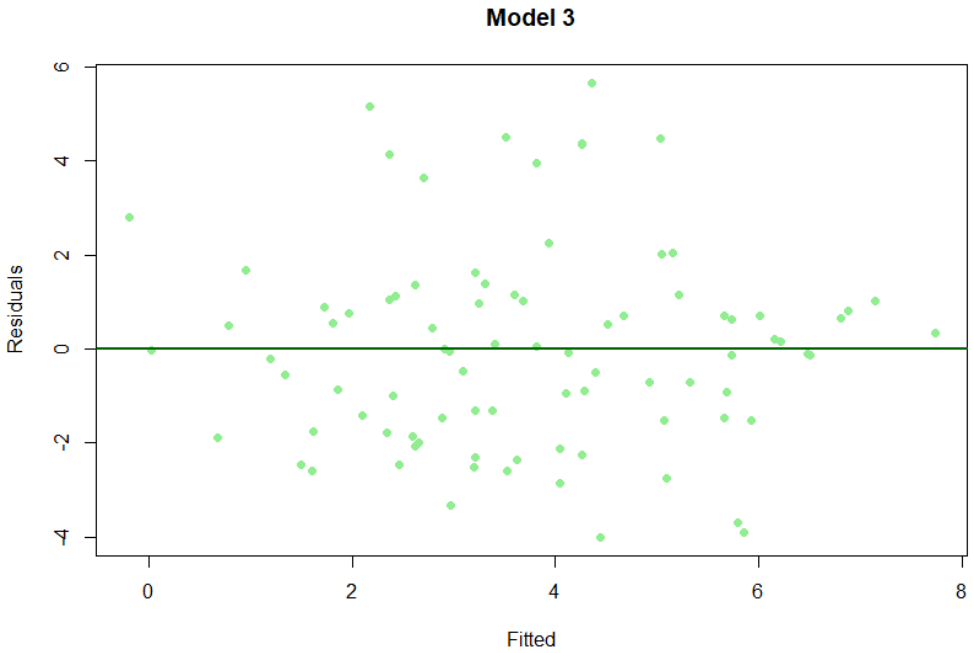
Annex I. A fitted against residuals plot from Model 1.



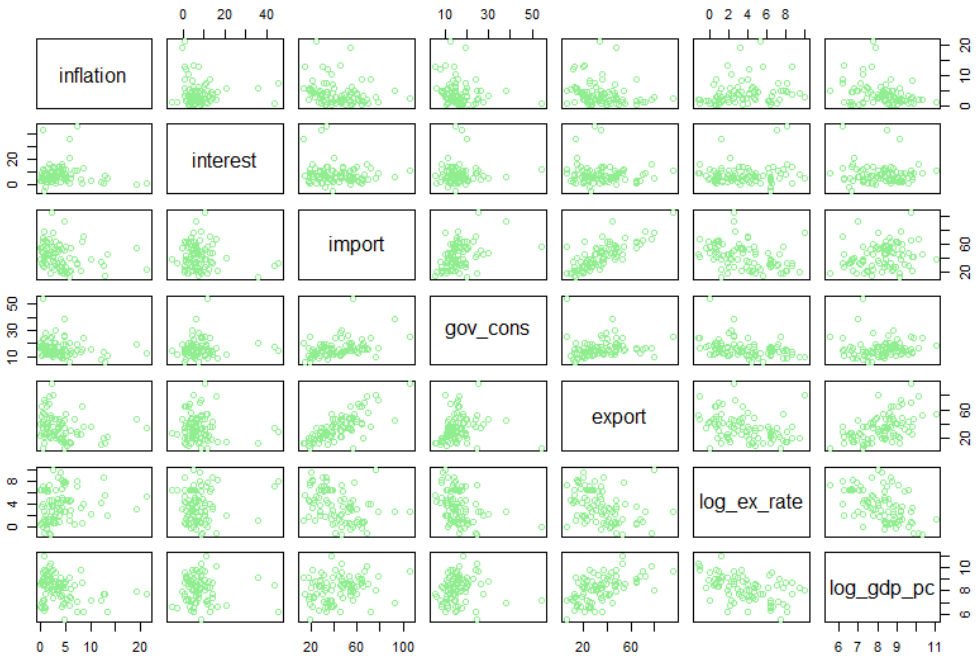
Annex 2. A fitted against residuals from Model 2.



Annex 3. A fitted against residuals plot from Model 3.



Annex 4. Relationships between the variables used in the analysis.



Annex 5. Descriptive statistics for the main variables used in the analysis

Variable	N	Mean	Std. Dev.	Min	Max
inflation	87	3.9	3.9	0.01	21
interest	87	7.9	7.9	-5.3	46
import	87	43	18	13	106
gov_cons	87	16	6.8	5.4	54
gdp_p_c	87	6319	8274	245	62752
export	87	35	18	5.9	96
ex_rate	87	875	2928	0.3	22331

Annex 6. Correlations between the selected variables.

	inflation	**interest**	**import**	**gov_cons**	**export**	**log_gdp_pc**
inflation	1	-0.054	-0.211	-0.182	-0.213	-0.286
interest	-0.054	1	-0.121	0.061	-0.065	-0.057
import	-0.211	-0.121	1	0.405	0.776	0.233
gov_cons	-0.182	0.061	0.405	1	0.135	0.038
export	-0.213	-0.065	0.776	0.135	1	0.534
log_gdp_pc	-0.286	-0.057	0.233	0.038	0.534	1

Annex 7. The main results from the regression analysis.

	Dependent variable:				
	ex_rate		log_ex_rate		
	(1)	(2)	(3)	(4)	(5)
inflation	-12.253	-0.008	-0.043		
	(84.136)	(0.069)	(0.065)		
gdp_p_c	-0.080*	-0.0001***			
	(0.046)	(0.00004)			
log_gdp_pc			-1.351***	-1.330***	-1.209***
			(0.289)	(0.278)	(0.208)
export	58.945*	0.008	0.035	0.038	
	(34.658)	(0.028)	(0.028)	(0.027)	
interest	28.305	0.040	0.027		
	(40.357)	(0.033)	(0.031)		
import	-32.332	-0.042	-0.053**	-0.055**	-0.047***
	(34.884)	(0.028)	(0.026)	(0.026)	(0.015)
gov_cons	-61.060	-0.087*	-0.094**	-0.085**	-0.085**
	(55.222)	(0.045)	(0.042)	(0.041)	(0.035)
Constant	1,531.111	7.158***	17.326***	17.097***	16.920***
	(1,180.707)	(0.962)	(2.418)	(2.158)	(1.752)
Observations	87	87	87	87	83
R^2	0.092	0.313	0.394	0.384	0.480
Adjusted R^2	0.024	0.262	0.349	0.354	0.460
Residual Std. Error	2,893.332 (df = 80)	2.357 (df = 80)	2.214 (df = 80)	2.204 (df = 82)	1.970 (df = 79)
F Statistic	1.345 (df = 6; 80)	6.081*** (df = 6; 80)	8.669*** (df = 6; 80)	12.798*** (df = 4; 82)	24.324*** (df = 3; 79)
Note:					*p<0.1; **p<0.05; ***p<0.01

Standardized Coefficients::

log_gdp_pc import gov_cons

-0.4843241 -0.2933352 -0.2170197

Annex 8. A fitted against residuals plot from the final model (Model 5).