The Relationship between Economic Growth and Money Laundering – a Linear Regression Model

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Abstract. *This study provides an overview of the relationship between economic growth and money laundering modeled by a least squares function. The report analyzes statistically data collected from USA, Russia, Romania and other eleven European countries, rendering a linear regression model. The study illustrates that 23.7% of the total variance in the regressand (level of money laundering) is "explained" by the linear regression model. In our opinion, this model will provide critical auxiliary judgment and decision support for anti-money laundering service systems.*

Keywords: money laundering; economic growth; GDP; money laundering estimates; microeconomic approach.

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JEL Codes: G18, H28, O17.
REL Codes: 8E, 8K.

Survey methodology

To determine the impact of money laundering on economic growth we have rendered a linear regression model. The model provides an estimation through technical fitting-quantitative approximation of the relationship between money laundering, expressed as percentage of GDP, and economic growth, expressed as real GDP growth rate.

Economic growth of a country was expressed by the rate of real GDP growth. Gross Domestic Product (GDP) is a measure of economic activity, defined as the total value of goods and services produced within an economy, less the value of goods used in the creation. Calculation of annual growth rate of GDP volume is designed to allow comparisons of the dynamics of economic development, both in time and between countries of different sizes. To measure the GDP rate of growth in terms of volume, GDP in current prices is valued in the prices of the previous year, achieving a chain series which is influenced by price movement. Changes in the population and birth rate/mortality are not taken into account. Eurostat, The Statistical Office of the European Communities, data were used(1), the reference year being 2008.

The real GDP growth rate

Table 1

Country	Real GDP growth rate (%)
UK	0.70
Russia	6.00
Romania	7.10
Greece	2.90
Swiss Confederation	1.60
Cyprus	3.70
Bulgaria	6.00
Austria	1.80
Luxembourg	0.90
Germany	1.30
Netherlands	2.10
France	0.40
Spain	1.20
US	1.10

This range of data represents the independent variable of the econometric model presented in the second part of this article.

To determine the correlation between economic growth and money laundering, we proposed a model that assess the level of money laundering before the initial placement. The model quantifies, in a microeconomic approach, the volume of dirty money generated by an economy having the following data entries:

- nature and level of crime in a given country (expressed as total number of crimes reported per type of criminal action);
- estimated average of dirty money generated by each type of crime;
- national wealth.

As a starting point we used the AUSTRAC report, estimating the profit generated by each type of crime in Australia. Using estimates from this report and the comprehensive database of the *United Nations Center for International Crime Prevention,* including records of annual crime levels in more than 100 countries, we went on to extend these results to the US, Bulgaria, Russia, Romania, Switzerland, Cyprus, Greece, Slovakia, UK, Austria, Luxembourg, Germany, Holland, France and Spain. By taking into account the most profitable 11 *money laundering predicate* offenses and multiplying the average profit of each of these(2) with the number of crimes recorded for each country(3), we obtained a set of preliminary estimates of the level of dirty money generated by criminal activities for each of the countries above. Estimates were then adjusted based on GDP per capita. By this we assume that the benefits of criminal activities in a country are proportionate to GDP per capita of that country. GDP per capita of Australia is considered as 1.00, the results being adjusted to it.

Results obtained using this model are presented in the following table.

Laundered money/GDP

Table 2

Country	Laundered Money/GDP
UK	1.60
Russia	3.40
Romania	3.10
Greece	1.90
Swiss Confederation	2.10
Cyprus	2.20
Bulgaria	2.90
Austria	1.70
Luxembourg	1.20
Germany	2.20
Netherlands	1.70
France	2.10
Spain	2.80
US	3.90

This set of data represents the dependent variable of the econometric model presented below.

The degree of correlation between economic growth and money laundering – a linear regression model

Using the technique of fitting-approximation, we processed the experimental data obtained to estimate the quantitative relationships between:

- Real GDP growth rate as a measure of economic growth (dependent variable Y)
- Money laundering (explanatory variable X)

The link between the two variables could be predicted with a linear function that takes the form Y = a + b × X[4]:

Y = 0.014051 X -0.00663

Apparently surprising, the two variables are positively correlated: an increased level of money laundering leads to a raise in the real GDP growth rate. The intensity of this relationship, as we can isolate it from the model testing, is equally surprising.[5]

Regression Statistics

Table 3

Regression Statistics	
Multiple R	0.487353
R Square	0.237513
Adjusted R Square	0.173972
Standard Error	0.020132
Observations	14

The general regression statistics confirm the quality of the model and regression estimates.

Multiple R[6] = 0.487353: the correlation exists and is of average intensity.

23.7% of the variation of the real GDP growth rate is explained by the variation of laundered money in an economy.[7] This result is significant and may seem surprising given the diversity of factors that influence economic growth: rate of employment, natural resources, capital, innovation, labor productivity, foreign trade, information, educational system, social insurance system, other socio-demographic and cultural factors, access to education, legal policies, religious and psycho-sociological factors, etc. It should be borne in mind, however, that the restricted range of data for which could be calculated the level of money laundering can artificially influence the correlation, as a factor in the increase.

Variance analysis

Table 4

ANOVA					
	df	SS	MS	F	Significance F
Regression	1	0.001515	0.001515	3.737967	0.077126756
Residual	12	0.004864	0.000405		
Total	13	0.006379			

Table 4 includes a panel analysis of associated regression estimates.

The value (Significance F[8] = 0.0771) is smaller than 0.08, therefore it invalidates the null hypothesis, independent variable coefficient can not be 0. This means that the regression model that has been chosen is valid (significant up to 8%).

Based on these data an estimation is given by the method of least squares[9]:

Estimated coefficients

Table 5

	Coefficients	Standard Error	t Stat	P-value
Intercept	-0.00663	0.017856	-0.37146	0.716772
Laundred Money/GDP	0.014051	0.007267	1.933382	0.077127

The Standard Error[10] is 0.017856 for the estimated a coefficient and 0.007267 for b.[11] Testing of the significant model parameters was performed using the t test[12].

P-value[13] = 0.077127. For the threshold of ignificance $\alpha = 0.08$ we can reject the hypothesis of nullity (P-value is very close to 0.08 which is enough to rule out the null hypothesis for the significance threshold of 8%). The null hypothesis can not be ruled out for the b coefficient.

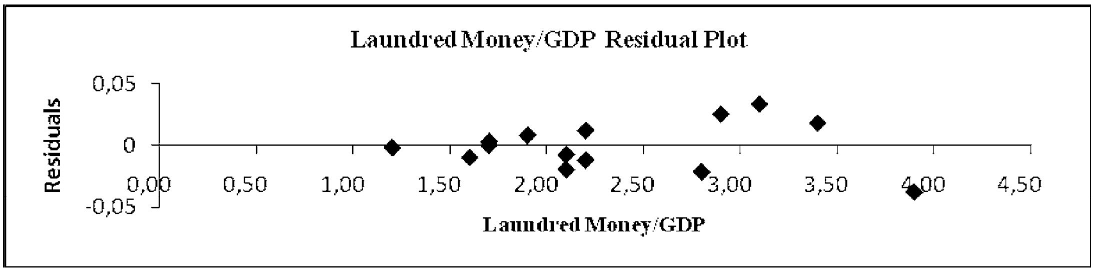

Figure 1. *Residual plot*

The residual plot[14] confirmed that this model is appropriate to estimate the level of money laundering in an economy. The Line Fit Plot also provides a positive answer that verifies the hypothesis of the model quality: Y estimated values do not differ significantly from the real values.

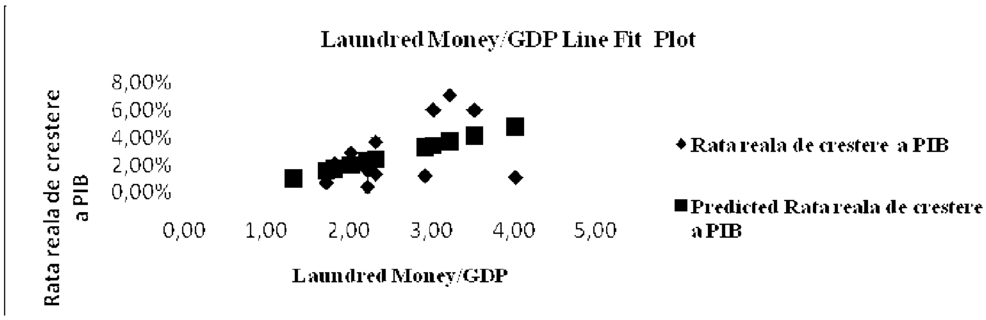

Figure 2. *Line Fit Plot*

On the adjusted values of the model (Table 6) we take in that we attain the best estimates for Austria (item 8 from table 6) and the weakest for the US (14^{th} position in the table).

The Adjusted Model

Table 6

RESIDUAL OUTPUT

Observation	Predicted Real GDP growth rate	Residuals	Standard Residuals
1	0.015848	-0.00885	-0.45744
2	0.041139	0.018861	0.975086
3	0.036924	0.034076	1.7617
4	0.020063	0.008937	0.462021
5	0.022873	-0.00687	-0.35535
6	0.024278	0.012722	0.657693
7	0.034114	0.025886	1.33829
8	0.017253	0.000747	0.038611
9	0.010228	-0.00123	-0.06348
10	0.024278	-0.01128	-0.58309
11	0.017253	0.003747	0.193708
12	0.022873	-0.01887	-0.97574
13	0.032709	-0.02071	-1.07063
14	0.048165	-0.03716	-1.92138

In conclusion, by analyzing the data series we could ascertain, for a significance threshold of 8%, that the volume of laundered money in an economy influences economic growth (measured as real GDP growth rate). Between the two variables there is a positive relationship. Increased volume of laundered money generates short term economic growth.

It is customary to expect that once the money laundering has completed, money is ready to return in the economy, providing funds for investment and consumption and consequently economic growth (Araujo, Moreira, 2005, Masciandaro, 1999). However, most theories state that by not fighting against money laundering we leave more funds available for criminals to be reinvested in illegal activities. Some of these theories have not yet considered the fact that in order to "invest" in criminal activity money laundering is not necessarily required. The dirty money can very well be used for this purpose. Forcing this reasoning we can consider that money laundering, up to a point, even represents funds that are redrawn from the criminal activity.

The fight against money laundering can even have perverse effects (Cavalcante, Andrade, 2006). Even if we find fully effective measures to combat money laundering is not difficult to presume that criminal activity will continue to exist. Theories of etiology of modern criminal psychology confirm this (Masciandaro, 1999, 2001). Opting to battle money laundering instead of combating the criminal activity that generated the dirty money can have as a result that offenders can not wash the dirty money and therefore can not use them for legal purposes and are practically compelled to reinvest in the criminal activity.

The econometric model and the reasoning above seem to present the idea that the funds used to fight against money laundering should be reallocated in combating the predicate offences, otherwise we are just preventing the return of money from the underground economy into the real economy. Although short-term logic and data analysis support the conclusion above, long-term effects are different. There is to consider the inhibitory effect of a criminal activity without a profit that can be used lawfully, and a number of other effects that discourage criminal activity.

The model presented may suffer improvements by increasing the quality of the data series by the use of a larger number of predicate offences used in calculating the dependent variable.

Notes

(1) Eurostat is located in Luxembourg. Its task is to provide the European Union with statistics at European level to enable comparisons between countries and regions.

(2) Identified in Australia's case by the AUSTRAC report.

(3) According to the database of the *United Nations Center for International Crime Prevention*.

(4) Model parameters were obtained using the Excel software.

(5) Testing model quality was carried out using dispersion analysis.

(6) Correlation coefficient.

(7) The coefficient of determination R Square 0.23.

(8) Significance F - If value is less than the significance threshold set, then the null hypothesis is rejected in favor of alternative hypothesis.

(9) In the distribution assumptions of the linear model, the calculated values of the coefficients are derived from normal distributions, making possible the statistical tests of the coefficients.

(10) Standard error of the coefficient (standard deviation of the distribution coefficient).

(11) Which means (if errors have a normal distribution) that in 95 cases of one hundred the real factor will be less than 0.017856 away from the estimated one and the actual coefficient for the independent variable in the range 0.014051 plus minus 0.007267 and in two of three cases in a halved interval.

(12) If there had been more variables using t test we could determine which variable had the greatest influence.

(13) The probability of critical bilateral t test with t Stat specified hypotheses.

(14) The band reflects the uniform dispersion of the residue.

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