

AUTOREGRESSIVE MODELS FOR ANALYSIS OF FOREIGN INVESTMENT IN ROMANIA

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On the base of significant fluctuations of the international financial markets, the international investment position of Romania has an increasing importance in assuring the financial stability. The Romanian National Bank reserves are increasing as a result of exchanging the minimum reserves into foreign currencies made by banks and of the privatization revenues. The international reserve has been negatively influenced by the payments made in the foreign debt service account and by the foreign payment forms redeemed by the Public Finance Ministry. This paper offers to analyze the evolution and impact of the foreign investments in any form whatsoever, on the Romanian economy with the help of autoregressive econometrical models. These models shall refer to all foreign investments elements: direct investments of non-residents, portfolio investment and other categories of foreign investments as well as bank deposits or external short-term, medium and long-term credits.

Keywords: econometric analysis, foreign investment, autoregressive models

Introduction

The international investment position of Romania is given by foreign currency inflow and outflow caused by governmental operations or private economic agents. An important piece of this external position represent the foreign investments in Romania. These are performed on some more elements that include direct investments of non-residents in Romania, portfolio investment and other foreign investments relating to deposits or foreign currency loans.

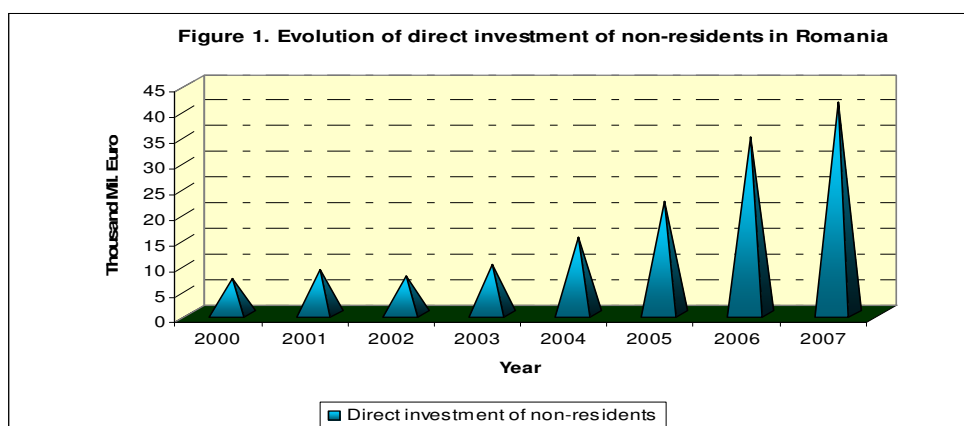
Direct investments of non-residents in Romania represent the fundamental element of foreign investments, materializing in establishments of firms with state or private capital of integral or partial external origin, in different participating interests and other foreign liabilities. The evolution of these investment categories is vital for maintaining the Romanian external financial equilibrium. The second element of foreign investments represents the portfolio investment of equity securities, of debt securities and of money market instruments. These investment categories are materialized on the stock market or on the financial-banking one. It represents volatile elements of foreign investments since they can be easily changed into liquidities and repatriated by external operators. Foreign investments can be accomplished based on other investments like foreign loans and credits on short or long terms, on the foreign currency and deposits or on other liabilities on short, medium or long term. All these elements provide the equilibrium to the Romanian cash and currency market.

Autoregressive models will be used in order to study the behavior of each element of foreign investments in Romania and to predict their future evolution, up to a degree of certainty. From an econometrical point of view, the term 'autoregressive' defines the measure in which an economical variable presents the property of self-correlation [1], meaning that its current level is significantly determined by its previous levels, corresponding to one or more periods of time behind.

Autoregressive model for analysis of foreign direct investments of non-residents in Romania

The analysis of the first component of foreign investments in Romania is accomplished based on a data sample pattern which refers to the evolution of foreign direct investments of non-residents in Romania during 2000-2007 ([5], [6]). These investments showed an increase in the period of analysis, having a significant share from the value of the current account default. Even without the sums of money obtained

from privatization, the financing based on foreign direct investments is on a slow rise than in previous years. The evolution of foreign direct investments of non-residents in Romania during 2000-2007 is presented in Figure 1:



Source of data: National Bank of Romania & Romanian National Institute of Statistics

In Figure 1 one can notice the emphasis of the rise tend starting with 2004, while in the last two years, 2006 and 2007, the rise is almost exponential. It can be uttered for certain that the Romania's EU integration has given an important boost to foreign investments, with no precedent case in the last half of century.

The autoregressive model assumes that the effect of the accelerated rise of foreign investments is not significantly caused by direct influence of some factorial variables but it is a retroactive one, induced by informational load of the studied variable. Basically, the autoregressive effect is materialized in a more or less striking way in which its registered levels of foreign investments in the previous periods of times influence the actual level, the deviation of influences in time having different values. Generally, the bigger the deviation, that is the displacing behind is now more emphasized, the weaker the influences. The problem that occurs is that of determining the moment in which these become insignificant in order to be left out of the model [2].

The increased volatility, and sometimes unpredictable, of the economic anticipations make these a significant, pseudo-adaptive category which means that the formation principle can be of snowball type, the propagation speed being very high and the direction of evolution contrary to the theory [3]. An important issue is that between different foreign investors category there is an important informational asymmetry, which equivalates with different forms of the functions that formally describe their anticipation mechanisms. Estimating on distinct periods of time can attenuate this asymmetry. Yet, two great categories of investors can be distinguished, namely: those who want to invest and get profit on long-term and speculative investors who go for advantages for a short period of time. Depending on the number of periods with which the analysis is deviated behind, there are more types of model, starting with the autoregressive model of first order – in which case the effect in time is analyzed on one past period of time – and models of superior order – two, three, etc. – in which case the effect in time is studied on k periods of time behind [4]. The autoregressive model of first order takes into consideration the linear influences of the previous level of direct foreign investments FDI_{t-1} on their current level FDI_t . Based on the analyzed data sample, the results of the autoregressive model of first order applied on direct foreign investments in Romania are shown in Table 1:

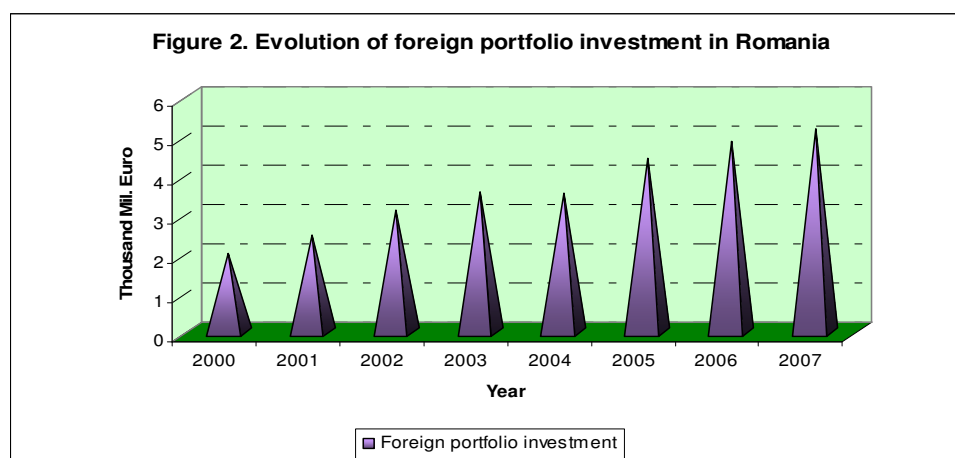
Table 1.

Dependent Variable: <i>Foreign Direct Investment</i>				
Method: <i>Least Squares</i>				
Model Equation: $FDI_t = \beta_1 \cdot FDI_{t-1}$				
<i>Estimated Coefficient</i>	<i>Value</i>	<i>Std. Error</i>	<i>t-Statistic</i>	<i>Probability</i>
β_1	1,314389627	0,076063618	17,28013549	2,406E-06
<i>Multiple R</i>	0,990102134	<i>Mean dependent variable</i>		18184,625
<i>R-Square</i>	0,980302235	<i>S.D. dependent variable</i>		13234,813
<i>S.E. of regression</i>	3542,620943	<i>F-statistic</i>		298,60308
<i>t critical</i>	2,446911846	<i>F critical</i>		3,7870435

The statistical parameters of the model show a strong autoregressive character of direct foreign investments because *Multiple R* and *R-Square* have values very close to 1. *t-Statistic* value is much above *t critical*, the same with *F-statistic* in report to *F critical*, which shows a model with a high degree of statistic significance. In such conditions, the estimated greater than one value of β_1 (*Estimated Coefficient Value*) shows a strong rising trend of direct foreign investments in Romania (an average rise of 1,314 times from one year to another).

Autoregressive model for analysis of foreign portfolio investments in Romania

The second element of foreign investments in Romania is analyzed using the same data sample from 2000-2007 ([5], [6]). This category of investments had a rising trend during the analyzed period, too. Unlike the first category of foreign investments, the portfolio investments had a more linear trend, less abrupt. The evolution of foreign portfolio investments in Romania during 2000-2007 is shown in Figure 2:



Source of data: National Bank of Romania & Romanian National Institute of Statistics

The foreign portfolio investments are the result of various categories of transactions, such as: purchase by the residents of a part of the shares in “lei” released by the World Bank on the Romanian Market; the purchase of shares of foreign banks by a part of the Romanian employees of the banks’ branches; issuing bonds by the Romanian banks onto the foreign capital markets; the redeem of the bonds issued in a foreign currency by various companies; other transactions with financial instruments expressed in foreign currency on the internal capital market. The autoregressive model of first order takes into consideration the linear influences the precedent level of foreign portfolio investments FPI_{t-1} undertake over the present level of these FPI_t . On the base of the data pattern analyzed, the results of the autoregressive model of first order, applied to the foreign portfolio investments in Romania, are shown in Table 2:

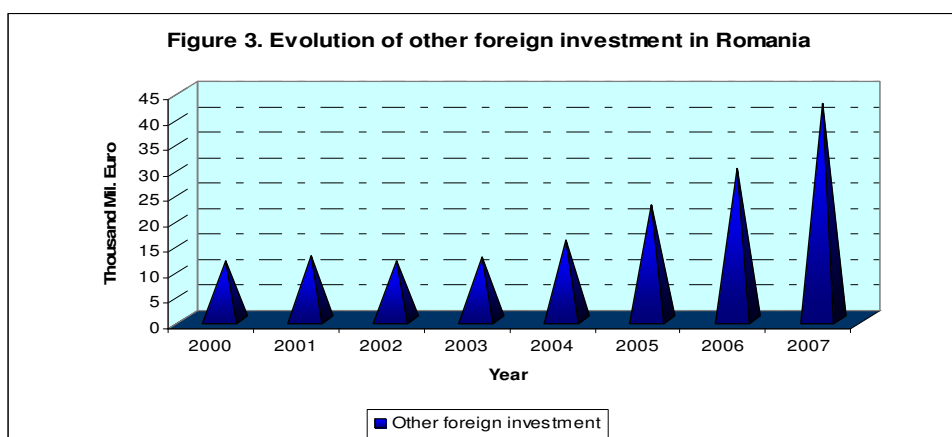
Table 2.

Dependent Variable: <i>Foreign Portfolio Investment</i>				
Method: <i>Least Squares</i>				
Model Equation: $FPI_t = \beta_1 \cdot FPI_{t-1}$				
<i>Estimated Coefficient</i>	<i>Value</i>	<i>Std. Error</i>	<i>t-Statistic</i>	<i>Probability</i>
β_2	1,1191819	0,0361730	30,939621	7,569E-08
<i>Multiple R</i>	0,9968807	<i>Mean dependent variable</i>		3647,375
<i>R-Square</i>	0,9937712	<i>S.D. dependent variable</i>		1129,374
<i>S.E. of regression</i>	340,10079	<i>F-statistic</i>		957,260
<i>t critical</i>	2,44691184	<i>F critical</i>		3,787043

As in the case of direct foreign investments, the statistic parameters of the model show a strong autoregressive condition of the portfolio investments, that is because *Multiple R* and *R-square* have values very close to 1, and the value of *t-Statistic* is much over the *t critical*. Also, *F-statistic* is much higher than *F-critical*, which shows us a model of great statistic significance. We notice that the supra-unitary estimated coefficient value of β_2 (*Estimated Coefficient Value* is of 1,119) is a little bit lower than the value of β_1 , situation that shows us a trend to rise, a little bit milder than in the case of direct foreign investments. Anyways, the market of portfolio investments is fully developing, especially after the integration in the European Union.

Autoregressive model for analysis of other foreign investments in Romania

The third element of foreign investments is being analyzed based on the same data sample pattern during 2000 – 2007 ([5], [6]). It is made up of assets of the type of foreign loans and credits on short or long term, of cash and foreign currency deposits, or of other short, medium or long-term liabilities. This category of foreign investments also had a rising tendency during the period of time analyzed, with a significant acceleration in the last two years. The evolution of other foreign investments in Romania during 2000 – 2007 is shown in Figure 3:



Source of data: National Bank of Romania & Romanian National Institute of Statistics

The net foreign financing obtained from medium and long-term loans and credits has increased due to the increase of the volume of the credits undertaken by the bank sector, the public administration, and by other sectors. The net cash inflow from credits and loans on short term has also increased in a sustained pace. The foreign short-term debt had a strong increasing development, too. Its development needs attention from the perspective of financial stability for at least two reasons. The first reason is given by the fact that

the foreign debts' on short term dynamism is considerably superior to the cash flows that can be used in case of need, by the exports or the official fund of the Romanian National Bank; and the second reason is given by the very high degree of concentration of the foreign short term debt within the non-banking domain.

The autoregressive model of first order takes in consideration the linear influences the precedent level of other foreign investments OFI_{t-1} undergoes over the present level of these OFI_t . On the grounds of the analyzed data sample, the results of the autoregressive model of first order applied to other foreign investments in Romania are represented in Table 3:

Table 3.

Dependent Variable: <i>Other Foreign Investment</i>				
Method: <i>Least Squares</i>				
Model Equation: $OFI_t = \beta_3 \cdot OFI_{t-1}$				
<i>Estimated Coefficient</i>	<i>Value</i>	<i>Std. Error</i>	<i>t-Statistic</i>	<i>Probability</i>
β_3	1,316009905	0,065905415	19,96816056	1,02387E-06
<i>Multiple R</i>	0,992559927	<i>Mean dependent variable</i>		19773,750
<i>R-Square</i>	0,985175208	<i>S.D. dependent variable</i>		11220,907
<i>S.E. of regression</i>	3094,205365	<i>F-statistic</i>		398,72743
<i>t critical</i>	2,446911846	<i>F critical</i>		3,7870435

The statistical parameters of the model show a strong autoregressive character of other foreign investments, as it is in the case of the other two components of the foreign investments in Romania. *Multiple R* and *R-Square* have values very close to 1, and the value of *t-Statistic* is a lot over *t-critical*; the same is *F-statistic*, if compared to *F-critical*. All these elements show us an autoregressive model with a high level of statistical significance. The supra-unitary estimated coefficient value β_3 shows a strong rising tendency for other foreign investments in Romania, similar to those noticed with the direct foreign investments (a medium rise of 1,316 times from one year to another, the most noticeable of all three components).

Conclusions

The autoregressive model which studies the development of the foreign investments in Romania on the grounds of the three fundamental components – direct investments, portfolio investments, and other investments – have shown a few essential characteristics of these macro-economical indicators. Firstly, the increase of all components, and so, of the whole system, was strictly increasing during the period of time of the research, the portfolio investments with a linear tendency, and the direct investments, and other foreign investments with accelerated rise in the past two years. Secondly, there is a autoregressive character, extremely powerful demonstrated by all the components, which shows the importance of the rational anticipations of the market operators.

One should take into account the fact that the activities the direct foreign investments aimed at in the past few years have been: industry, commerce, financial intermediation and insurance, telecommunication, company servicing, transport, and construction. The main investing countries were: Holland, Austria, Germany, France, Italy, United Kingdom of Great Britain and Northern Ireland, Greece, Cyprus, and United States of America. Compared to the total official fund, the size of foreign debts on short term has reached almost 60 per cent [5]. In the situation in which the export is relatively dependent on the imports, and an important part of the official reserve fund is made-up of the minimum compulsory fund of banks and of the country's income from privatizations, the growth pace of the foreign debts on short term experiences a significant attention. The degree of concentration of the exposure of the foreign debts on short term within non-financial companies has increased; but the number of the firms that generated such net cash flow debts is decreasing.

The perspective of a continuation of capital inflow is relatively favorable, that if the American market crisis does not expand. But the excess of cash flow on the international markets is still going, and the companies' performances in Romania, who were the beneficiaries of the infusion of foreign capital, are

substantial. These companies are more profitable and more productive than the rest of economy. The profitableness of the capitals also records a sustained and increased dynamism. The wage efficiency of the companies with foreign capital is in a continuous rising, over the national average of economy. On the other hand, it is necessary to undertake some coherent politics on a macro-economical level in order to maintain the favorable results mentioned above.

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ECONOMETRIC MODEL WITH CROSS-SECTIONAL, TIME SERIES, AND PANEL DATA

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In this paper is performed the ways to estimate parameters of a linear regression model for that models which use different type of data sets: cross-sectional data, time series data, and panel data.

Keywords: regression model, intercept, slope, marginal effect.

Estimation with straightforward OLS

Data sets may be of three types: cross-sectional data, time series data, and panel data.

Cross-sectional data sets are generated at one moment in time and the observations generally relate to households, individuals, enterprises, or geographical areas. It is usually very desirable that the sample should be drawn from a well-defined population using a statistically respectable sampling scheme, so that one may generalize from the results.

Time series data sets consist of repeated observations on a set of variables over an interval of time. Generally the interval between the observations is fixed, often being a year, a quarter, or a month, but in some cases, such as analysis using stock market prices, the frequency may be much greater.

Panel data sets have both cross-sectional and time series dimensions, being repeated observations over an interval of time on the same cross-section sample.

Consider the model :

$$Y = \beta_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_2 X_3 + u \quad (1)$$

This is linear model in parameters and it may be fitted using straightforward OLS, provided that the regression model assumptions are satisfied. However, the fact that it is nonlinear in variables has implications for the interpretation of the parameters. In the multiple regressions the slope coefficients may represent the separate, individual marginal effects of the variables on Y , holding the other variables constant. In this model, such an interpretation is not possible. In particular, it is not possible to interpret β_2 as the effect of X_2 on Y , holding X_3 and $X_2 X_3$ constant, because it is not possible to hold both X_3 and $X_2 X_3$ constant if X_2 changes.

To give a proper interpretation to the coefficients, we can rewrite the model as:

$$Y = \beta_1 + (\beta_2 + \beta_4 X_3) X_2 + \beta_3 X_3 + u \quad (2)$$

The coefficient of X_2 , $(\beta_2 + \beta_4 X_3)$, can now be interpreted as the marginal effect of X_2 on Y , holding X_3 constant. This representation makes explicit the fact that the marginal effect of X_2 depends on the value of X_3 . The interpretation of β_2 now becomes the marginal effect of X_2 on Y , when X_3 is equal to zero.

One may equally well rewrite the model as:

$$Y = \beta_1 + \beta_2 X_2 + X_3 (\beta_3 + \beta_4 X_2) + u \quad (3)$$

From this it may be seen that the marginal effect of X_3 on Y , holding X_2 constant, is $(\beta_3 + \beta_4 X_2)$ and that β_3 may be interpreted as the marginal effect of X_3 on Y , when X_2 is equal to zero.

If $X_3 = 0$ is a long way outside its range in the sample, the interpretation of the estimate of β_2 as an estimate of the marginal effect of X_2 when $X_3 = 0$ should be treated with caution. Sometimes the estimate will be completely implausible, in the same way as the estimate of the intercept in a regression is often implausible if given a literal interpretation. This can make it difficult to compare the estimates of the effects of X_2 and