10. POSSIBLE EVOLUTIONS OF INVESTMENT RATE – ERROR CORRECTION MODELS SCENARIOS[1]

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Abstract

Starting from the basic relationship among investment, GDP and the active interest rate estimated as long-term tendency, several short-term dynamics equation are built for revealing the impact of different factors: cost of capital, foreign direct investments, labor (unemployment rate, real net wage, tax burden). The impact of the economic crisis is analyzed in relation to the changes that occur on long term in the elasticities of different factors. Scenarios are built, which allow for previsions on the possible macroeconomic evolutions. Some required economic policy measures are suggested, with the view to diminish the negative impacts of certain factors in times of economic crisis.

Keywords: investment, simulation

JEL Classification: E22, C51, C53

Introduction

As previously presented in other papers (Scutaru, 2010), the error correction models (ECMs) consider both the long-term relationships among the variables (equilibrium relationships) and the short/medium-term dynamics around such equilibrium relationships. The ECMs are usually used in short-term forecasts because the long-term adjustment to equilibrium is relatively slow, but they also allow for discussing long-term evolutions.

The theory was developed considering that many macroeconomic series are non-stationary (they have unit-root) [Carnot *et al.*, 2005] and, consequently, the modeling of phenomena described by such series raises serious problems. Engle and Granger demonstrated in 1987 that a linear combination of non-stationary series can be

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stationary. If such a linear combination is found, the series are called *cointegrated*, and the respective linear combination is called a *cointegration equation*. The Engle-Granger representation theorem shows that when a group of variables integrated of *d* order admits a single cointegration equation each of them has an error-correction representation. When several cointegration relationships are found, each error-correction term may influence the evolution of all the other variables. The purpose of a cointegration test is to determine whether a cointegration equation for a group of non-stationary series exists or not (namely a linear combination of the analyzed series that is stationary). The test is applied only to the series known as non-stationary. In order to test the cointegration of some non-stationary series we used the Johansen cointegration test.

The presence of a cointegration relationship among the analyzed variables is the indication of a long-term economic equilibrium. However, when certain variables are cointegrated, the cointegration relationship is not identically preserved over time; certain exogenous shocks or disturbances with short-term impact occurring in the dynamics of certain factors may influence the long-term relationship [Carnot *et al*., 2005]. In such cases, the economic forces tend to push the relevant variables back to equilibrium.

The main factor that influences economic growth is investment. In times of economic crisis, phenomena such as shrinking of global economic activity due to credit limitations, loss of the main export markets and diminution of domestic demand appear, accompanied by increase in unemployment and decline in population incomes. Such evolutions influence both the direct foreign investment rate and the total investment rate, which falls back upon the economic evolutions through negative impacts cumulated over time.

Starting from the basic relationship among investment, GDP and the active interest rate estimated as long-term tendency, several short-term dynamics equations are built, which reveal the impact of different factors: cost of capital, foreign direct investments, labor (unemployment rate, real net wage, tax burden). On such a basis, scenarios that allow for short-term forecasts of the possible macroeconomic evolutions are built. On long term, the impact of the economic crisis is analyzed starting from the changes occurred in the elasticities of different factors. Some economic policy measures are suggested in order to diminish the negative impacts of certain factors in times of economic crisis.

1. The model

1.1. The data base

The data base includes monthly series for the January 2000-June 2010 interval. The data are taken from the statistics published by the National Institute of Statistics (NIS) and the National Bank of Romania (NBR). The data on 2010 are provisional. The data series on GDP and its components (final consumption, gross capital formation, import and export) were elaborated according to the methodology presented in the 2008 phase of the project[3]. As starting basis, the quarterly data series published by the NIS are used; the monthly evolutions of “proxy” variables are used for demand and gross fixed capital formation[4]; the GDP is interpolated on the basis of the monthly demand equal to the sum of gross fixed capital formation and private consumption. The fact that the current account deficit increased over the last years caused that also the GDP departed from the private domestic demand.

1.2. The work phases

1. Data series processing [Hertveldt, B., Lebrun, I., 2003, Allard-Prigent *et al*., 2002, Estrada *et al*., 2004, Scutaru *et al*., 2006]:

- Real terms series, in logarithm, were used. In order to eliminate the influence of inflation, specific deflators were used;
- In order to eliminate seasonality influences, the “Tramo/Seats” procedure was used to adjust seasonally the data series;
- The stationarity of series was checked up with the help of the ADF test; the stationarity of the series used to build the model was eliminated either by building the differences of order equal to their order of integration, or by using indices or rhythms of the basic series;
- The possible statistically causal structures/relationships were identified with the help of the Granger test in order to find the most probable correlations to specify the model;
- The cointegration relationships for the identification of the long-term relationships were built by using the Johansen test.

2. Building the long-term equations, taking into account the consistency with the economic theory;

3. Building the short-term dynamics equations, by including an error-correction mechanism. The respective coefficient measures the speed of adjustment to equilibrium.

The tests used to build the model:

The Augmented Dickey-Fuller stationarity test;

The Granger causality test;

The Johansen cointegration test;

R^2; DW; t-statistics; regression SE;

The “informational” Akaike and Schwartz tests to choose the number of lags.

1.3. Model description

There are certain causality structures in the investment process determined by the specific evolutions of the Romanian economy. The analyses up to date (Scutaru,

[3] “PIB lunar şi investiţii lunare. Metodologie de construire a bazei de date”, author: Cristian Stanica, elaborated for the program: “Modelarea şi evaluarea impactului investiţiilor directe naţionale şi internaţionale asupra pieţei muncii şi evoluţiilor macroeconomice din România”, Contract MEC 91-052/10 September 2007.

[4] *Industrial output, retail trade, constructions, machinery output, etc.*

2010) revealed the presence of strong Granger causality relationships between the economic growth and the foreign direct investment rate; between the GDP and the total investment rate and between the GDP and the indicators that characterize labor. Although without a significant share, such causality structures are well defined in the investment process over the analyzed period. The economic crisis influences all the aspects of economic and social life, but the causality structures statistically determined with the help of the Granger test are preserved over time due to the structural inertia of the economy, which maintains some of the former trends.

The model identifies the long-term evolution tendency of the macroeconomic dependences in investment, the short-term dynamics and the speed of adapting to the long-term tendency.

We used the same theoretical model as in Scutaru (2010); the model coefficients have changed due to the updating of the series with the June 2008-June 2010 interval. The changes in the equation coefficients are influenced by the crisis specific phenomena; so that it is interesting to find out to what extent the crisis impacts are felt.

The theoretical model is a ECMs equation for investment:

$$\Delta i_t = \alpha - \beta(i_{t-1} - x_{t-1}) + \Sigma_j \gamma_j \Delta x_{t-j} + \Sigma_j \mu_i \Delta i_{t-j} + \eta_i \Delta z_t^i$$

where: i_t is the real investment series, in logarithm;

i_{t-j} are the j order lags of the variable representing investment;

x_t is the real aggregate demand series, in logarithm;

x_{t-j} are the j order lags of the variable representing aggregate demand;

z_t^i are other variables with impacts on investment, either on short or on long term;

β measures the speed of investment short-term dynamics adjustment to the long-term equilibrium;

$\Sigma_j \mu_i \Delta i_{t-j}$ introduces not only the "process history", but allows for taking into account the delays specific to the investment process;

$\Sigma_j \gamma_j \Delta x_{t-j}$ takes into account the eventual delays in the impact of the macroeconomic variables that characterize demand on the investment dynamics;

$\eta_i \Delta z_t^i$ allows for introducing into the model certain variables with long or short term impact on investment dynamics.

The dynamics equations built this way allow for taking into account both the time required to make the investment decisions and the time to implement the investment per se. Practically, when the model is specified, a clear distinction between the two types of lags cannot be drawn.

We used the GDP for the variable regarding the aggregate demand. A significant factor of investment is the cost of capital, which was replaced with the active interest rate for the non-banking clients in real terms, thus allowing for the analysis of the short-term impacts of the monetary policies.

Other variables were:

RINVPIB, the rate of total investment to GDP;

IISD, the foreign direct investments;

IER, the exchange rate index;

GXM, the degree of import covering by export;

RSOM, the unemployment rate;

ISALNETR, the real net wage index;

FISC, the tax burden

1.4. Indicators and statistical tests

Real data series were used, which reveal annual seasonality that was eliminated with the Tramo/Seats procedure. The series thus obtained are stationary of order 1; their first degree differences are non-stationary. In order to check up the stationarity of series, the Augmented Dickey-Fuller (ADF) was used; the results are presented in the Appendix.

The series used to build the long-term equilibrium equation have to be (and are) stationary of order 1. The Johansen cointegration test shows the presence of a cointegration equation (see Appendix).

The data series used to build the short-term dynamics are first order differences of the equilibrium equation series and are non-stationary. In order to estimate the equations, we searched for the best values of R^2, DW, t-statistics and regression SE tests. The “informational” Akaike and Schwartz tests were used to choose the number of lags.

Figure 1

Investment rate dynamics

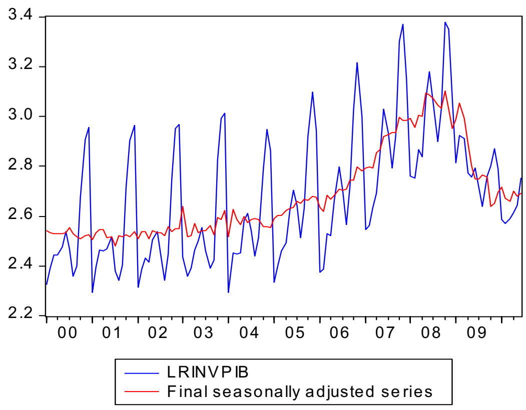
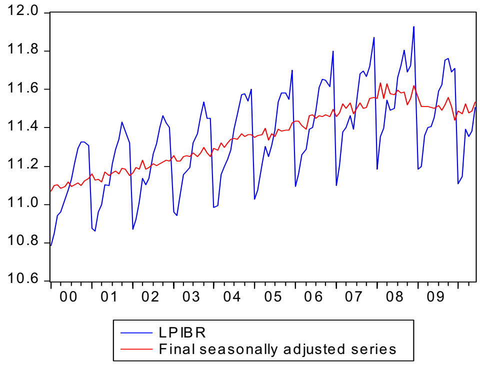


Figure 1 shows the investment rate dynamics (series in logarithm) and the series de-seasoned with the help of the Tramo/Seats procedure. Two important aspects may be revealed: the strong seasonality of the investment process and the decline in investment occurred since the half of 2008.

Figure 2

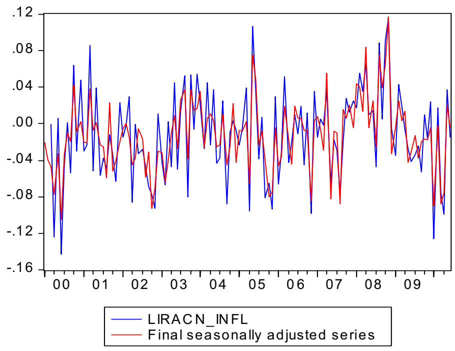
Gross domestic product dynamics



Also, the gross domestic product dynamics reveals seasonality of the basic series; the series was de-seasoned with the help of the Tramo/Seats procedure; the economic growth revealed decline since the last months of 2008.

Figure 3

Real active interest rate for the non-banking clients



We used the real active interest rate for the non-banking clients, which takes into account the inflation dynamics. The seasonality adjustment does not reveal significant changes in the two data series, but due to the fact that inflation was moderate over the period when the crisis started we witness, at least apparently, a decline in the interest rates, which also explains the behavior of long-term elasticities.

1.5. The empirical model

The long-term relationship and the short-term dynamics of the total investment

The Johansen test (see Appendix) for the variable total investment rate to GDP, real GDP and average active interest rate for the non-banking clients reveals the presence of a cointegration equation. The three variables are stationary of order 1 (checked with the ADF test). The long-term elasticity of the investment rate in relation to GDP is +0.91, and the long-term elasticity of the investment rate in relation to the active interest rate is +0.48. The equation was estimated for the interval January 2000-June 2010, and the interest rate elasticity reveals a behavior anomaly in investment.

LRINVPIB_SA = -7.651026536 + 0.9103709093*LPIBR_SA + 0.4773035516*LIRACN_INFL_SA(-1)

We re-evaluated the same equation, searching for the moment when the change in the sign of the interest rate elasticity occurred; we consider that moment as the one when the impacts of the economic crisis have begun to be felt within the economy. In fact, the economic crisis began to have hidden impacts since June 2008; when the equation estimated for the interval January 2000-May 2008 is:

LRINVPIB_SA = -7.258757713 + 0.8746345947*LPIBR_SA - 0.06957369279*LIRACN_INFL_SA(-1)

where the long-term elasticity of GDP is +0.87 and the long-term elasticity of active interest rate is -0.07.

The same equation estimated for the interval January 2000-June 2008 is:

LRINVPIB_SA = -7.758042558 + 0.9193336301*LPIBR_SA + 0.07434500433*LIRACN_INFL_SA(-1)

where the long-term elasticity of GDP is +0.92 and the long-term elasticity of active interest rate is +0.07. Such an impact of the economic occurred in May 2008 and continued over the following interval. However, on short term the evolutions are different. Table 1 shows the evolution of the long-term elasticities since 2003.

Table 1

Evolution of the long-term elasticities of investment rate over in the interval 2003-2010

Year*	Long-term elasticity in relation to GDP	Long-term elasticity in relation to the active interest rate for the non-banking clients
2003	+0.17	-0.19
2004	+0.21	-0.09
2005	+0.24	-0.03
2006	+0.39	-0.11
2007	+0.54	-0.12
2008	+0.83	-0.17
2009	+0.87	-0.07
2010**	+0.91	+0.48

**.Estimate using the long-term equilibrium relationship for the data series over the interval January 2000-January of the respective year.*

*** For 2010, the estimation was made with the available data, including June 2010.*

For the short-term dynamics we built the equation:

DLRINVPIB_SA = - 0.008930595066 - 0.03001494045*(LRINVPIB_SA(-1) – (-7.651026536 + 0.9103709093*LPIBR_SA(-1) + 0.4773035516*LIRACN_INFL_SA(-2))) - 0.1372760891*DLRINVPIB_SA(-1) + 0.146176508*DLRINVPIB_SA(-6) -

0.4749539392*DLRINVPIB_SA(-12) + 0.3560949073*DLPIBR_SA(-1) + 0.5247579468*DLPIBR_SA(-2) + 0.7043012814*DLPIBR_SA(-3) + 0.3538509738*DLPIBR_SA(-4)+0.395451069*DLPIBR_SA(-5) + 0.481925577*DLPIBR_SA(-6)+0.3549046821*DLPIBR_SA(-7) + 0.2743603087*DLPIBR_SA(-8)+0.3286870157*DLPIBR_SA(-9) - 0.1673992856*DLPIBR_SA(-11) - 0.2814187706*DLPIBR_SA(-12)- 0.05652928012*DLIRACN_INFL_SA(-1)

This equation reveals the speed of short-term adjustment to the long-term equilibrium (-0.03), which is quite low. The history of the investment process was taken into account through the evolution of the total investment rate over the last semester and the evolution of GDP over the last year; the interest rate negatively impacted the short-term investment dynamics (-0.057 elasticity). We speak about the active interest rate for the non-banking clients, considered as a proxy for the cost of capital.

2. Previsions and simulations (scenarios)

The economy is a complex system which in times of economic crisis responds to shocks through unpredictable behavior changes. The complexity of an economic system can be comprehended only in large scale models, which function under circumstances of relative stability of the exogenous variables. It is difficult to build forecasts under circumstances of domestic and foreign instability. Below, we present different scenarios that allow for evaluating certain short-term forecasts. They are based on the impacts on the short-term dynamics of certain factors considered as exogenous to the analyzed system. On such a basis, we may signal some measures of adaptation of the Romanian economy to the crisis.

The scenarios for previsions start from the short-term dynamics equation into which the variables considered as exogenous for the next period are introduced.

2.1. The short-term dynamics in relation to the foreign direct investments

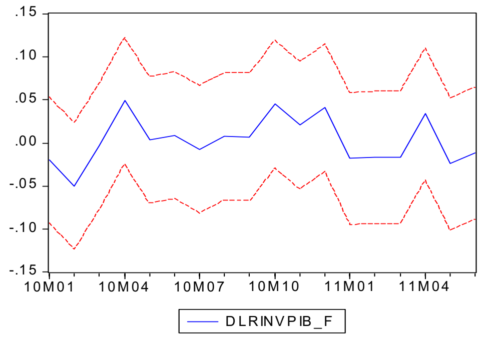
The foreign direct investments are a significant part of the investment process; due to business environment instability generated by the ongoing economic crisis the foreign direct investments elasticity is negative and very low (-0.00037). Consequently, the impact of the foreign direct investments is shown through the decline in the speed of adjustment to the long-term equilibrium (from –0.0300 to –0.0306) and the increase in the short-term elasticity of the interest rate (from –0.0565 to –0.0525).

DLRINVPIB_SA = -0.008971445961 - 0.03063983525*(LRINVPIB_SA(-1) – (-7.651026536 + 0.9103709093*LPIBR_SA(-1) + 0.4773035516*LIRACN_INFL_SA(-2))) - 0.1368656513*DLRINVPIB_SA(-1) + 0.1507599548*DLRINVPIB_SA(-6) - 0.4758882162*DLRINVPIB_SA(-12) + 0.3609465535*DLPIBR_SA(-1) + 0.5197499563*DLPIBR_SA(-2) + 0.7022049254*DLPIBR_SA(-1) + 0.3615260915*DLPIBR_SA(-4) + 0.4047872261*DLPIBR_SA(-5) + 0.5032163887*DLPIBR_SA(-6) + 0.3859650484*DLPIBR_SA(-7) + 0.2987429678*DLPIBR_SA(-8) + 0.3264597697*DLPIBR_SA(-9) - 0.1563780135*DLPIBR_SA(-11) - 0.2786790887*DLPIBR_SA(-12) - 0.05247498704*DLIRACN_INFL_SA(-1) - 0.0003677349838*IISD

The basic hypothesis of this scenario is that the exogenous variables have the same evolution over the forecasting interval as in the last statistical interval. Even under such circumstances, an increase in the investment rate is forecasted for the last period of 2010, followed by a declining fluctuation in the first semester of 2011 (Figure 4).

Figure 4

Evolution of investment rate in relation to foreign direct investments



2.2. The short-term dynamics in relation to the unemployment rate

The problems raised by the labor market in times of economic crisis are determined by the shrinking of activity, which leads to decline in employment (and, implicitly, increase in unemployment), as well as by the level of wages. To reflect these, we introduced a variable referring to the unemployment rate into the short-term dynamics equation.

DLRINVPIB_SA = -0.008945295171-0.0262270921*(LRINVPIB_SA(-1) – (-7.651026536 + 0.9103709093*LPIBR_SA(-1) + 0.4773035516*LIRACN_INFL_SA(-2))) - 0.1268241206*DLRINVPIB_SA(-1) + 0.142903125*DLRINVPIB_SA(-6) - 0.4841224928*DLRINVPIB_SA(-12) + 0.3547266261*DLPIBR_SA(-1) + 0.5295318303*DLPIBR_SA(-2) +0.7208348307*DLPIBR_SA(-3) + 0.3530889261*DLPIBR_SA(-4) +0.4171868291*DLPIBR_SA(-5) + 0.4883617225*DLPIBR_SA(-6) +0.3543762723*DLPIBR_SA(-7) + 0.2763882532*DLPIBR_SA(-8) +0.2990320548*DLPIBR_SA(-9) - 0.1812902052*DLPIBR_SA(-11) -0.2626734144*DLPIBR_SA(-12) - 0.07290629436*DLIRACN_INFL_SA(-1) -0.0757120065*DLIRSOM_SA

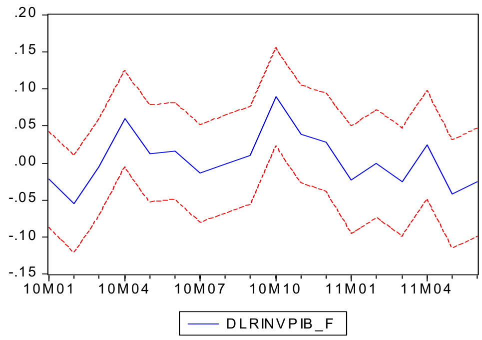
The increase in the unemployment rate has negative short-term impact on the total investment rate (-0.076 elasticity). However, the unemployment impact shows through a slight increase in the speed of adjustment to the long-term equilibrium (from –0.030 to –0.026) and through the decline in the interest rate elasticity (from –0.05653 to –0.0729).

Scenario 1

The basic hypothesis of this scenario is that the exogenous variables have the same evolution over the forecasting interval as in the last statistical interval. Even under such circumstances, an increase in the investment rate is forecasted for the last period of 2010, followed by a declining fluctuation in the first semester of 2011 (Figure 5).

Figure 5

Evolution of investment rate in relation to unemployment rate (Scenario 1)

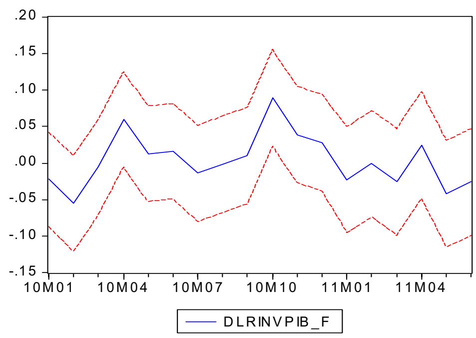


Scenario 2

Under the current circumstances, when the economic crisis induces a shrinking of activity, one may assume that unemployment will rise also in the next period. We consider as possible a monthly increase by 0.1% in the unemployment rate. In such a case, the prevision regarding the investment rate indicates a faster decline in the first semester of 2011 as compared to Scenario 1 (Figure 6).

Figure 6

Evolution of investment rate in relation to unemployment rate (Scenario 2)



2.3. The short-term dynamics in relation to the real net wage

The short-term elasticity of the real net wage is positive and significant (+0.05); if a decline in the real net wage occurs a proportional decline in the interest rate also occurs (see the two scenarios). The impact of the real net wage slightly increases the speed of adjustment to the long-term equilibrium (from -0.0300 to –0.0298). Also, one may notice an increase in the short-term elasticity of the interest rate (from –0.0565 to –0.0510).

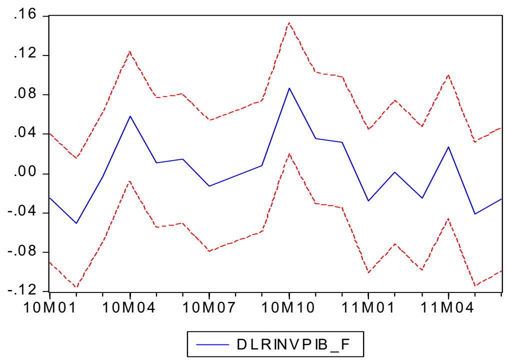
DLRINVPIB_SA = -0.008984021691 - 0.02984288823*(LRINVPIB_SA(-1) - (-7.651026536 + 0.9103709093*LPIBR_SA(-1) + 0.4773035516*LIRACN_INFL_SA(-2))) - 0.1372172486*DLRINVPIB_SA(-1) + 0.1430916678*DLRINVPIB_SA(-6) - 0.4695465354*DLRINVPIB_SA(-12) + 0.3733333308*DLPIBR_SA(-1) + 0.5190877447*DLPIBR_SA(-2) + 0.7038000711*DLPIBR_SA(-3) + 0.3517315217*DLPIBR_SA(-4) + 0.3894664206*DLPIBR_SA(-5) + 0.4776997516*DLPIBR_SA(-6) + 0.3557924305*DLPIBR_SA(-7) + 0.2796023318*DLPIBR_SA(-8) + 0.328245092*DLPIBR_SA(-9) - 0.1610537465*DLPIBR_SA(-11)-0.2819970256*DLPIBR_SA(-12) - 0.05102545557*DLIRACN_INFL_SA(-1) + 0.04885423821*DLISALNETR_SA

Scenario 1

We consider that the exogenous variables have the same evolution in the forecasting period as in the last statistical period, namely a decline in the real net wage. According to such a hypothesis, the investment rate follows on a downward trend over the entire forecast period, with a positive fluctuation in April 2011 (Figure 7).

Figure 7

Evolution of investment rate in relation to real net wage (Scenario 1)

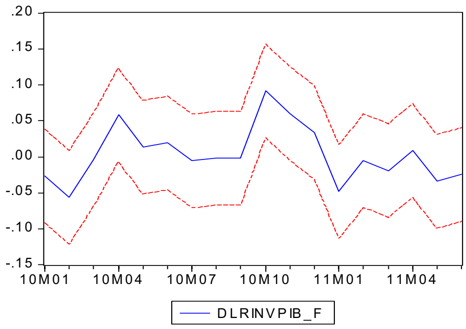


Scenario 2

It is built on the hypothesis of a 25% decline in the net nominal wage and perpetuation of such a decline over the entire forecasting period. For deflation, we used an inflation rate with an evolution similar to that of the previous period. One may notice a sharp decline in the investment rate over the entire first semester of 2011 (Figure 8).

Figure 8

Evolution of investment rate in relation to real net wage (Scenario 2)



Conclusions

The conclusions refer to the economic policy measures the forecasted evolutions may suggest. Since the foreign direct investments play a part in engaging the economic growth, the increase in the legal stability of the economic environment is required. The increase in tax burden has negative long-term impact upon investment; however, also the fiscal instability has the same impact. The increase in the active interest rate leads on short-term to the decline in the total investment rate; as a consequence, the NBR's monetary policy is directed towards reducing the interest rate. The unemployment rate has negative impact upon the total investment rate, so that measures aimed at increasing employment are vital in the current period. The use of structural funds for investment works and the augmentation of public investments may support the increase in the investment rate not only directly, but also indirectly, through the decline in unemployment and rise in the wage level, whose decline induces negative impacts.

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Appendix

1. Stationarity tests

Investment rate

Null Hypothesis: LRINVPIB_SA has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.507027	0.8223
Test critical values:	1% level	-4.033108	
	5% level	-3.446168	
	10% level	-3.148049	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LRINVPIB_SA)
Method: Least Squares
Sample (adjusted): 2000M02 2010M06
Included observations: 125 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LRINVPIB_SA(-1)	-0.047097	0.031251	-1.507027	0.1344
C	0.119516	0.076715	1.557930	0.1218
@TREND(2000M01)	0.000127	0.000151	0.837742	0.4038
R-squared	0.020466	Mean dependent var		0.001214
Adjusted R-squared	0.004408	S.D. dependent var		0.038481
S.E. of regression	0.038396	Akaike info criterion		-3.658034
Sum squared resid	0.179856	Schwarz criterion		-3.590154
Log likelihood	231.6271	F-statistic		1.274503
Durbin-Watson stat	2.322607	Prob(F-statistic)		0.283265

Null Hypothesis: D(LRINVPIB_SA) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.42398	0.0000
Test critical values:	1% level	-4.033727	
	5% level	-3.446464	
	10% level	-3.148223	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LRINVPIB_SA,2)
Method: Least Squares
Sample (adjusted): 2000M03 2010M06
Included observations: 124 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LRINVPIB_SA(-1))	-1.196507	0.089132	-13.42398	0.0000

C	0.005750	0.006986	0.823123	0.4121
@TREND(2000M01)	-6.66E-05	9.58E-05	-0.694745	0.4885
R-squared	0.598278	Mean dependent var		0.000170
Adjusted R-squared	0.591638	S.D. dependent var		0.059671
S.E. of regression	0.038132	Akaike info criterion		-3.671653
Sum squared resid	0.175936	Schwarz criterion		-3.603421
Log likelihood	230.6425	F-statistic		90.10167
Durbin-Watson stat	2.026221	Prob(F-statistic)		0.000000

Gross domestic product

Null Hypothesis: LPIBR_SA has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 2 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.978587	0.9423
Test critical values:	1% level	-4.034356	
	5% level	-3.446765	
	10% level	-3.148399	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LPIBR_SA)
Method: Least Squares
Sample (adjusted): 2000M04 2010M06
Included observations: 123 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LPIBR_SA(-1)	-0.058548	0.059830	-0.978587	0.3298
D(LPIBR_SA(-1))	-0.550561	0.100284	-5.489994	0.0000
D(LPIBR_SA(-2))	-0.281172	0.092876	-3.027397	0.0030
C	0.660416	0.663041	0.996042	0.3213
@TREND(2000M01)	0.000168	0.000263	0.636265	0.5258
R-squared	0.284913	Mean dependent var		0.003486
Adjusted R-squared	0.260673	S.D. dependent var		0.031098
S.E. of regression	0.026740	Akaike info criterion		-4.365546
Sum squared resid	0.084370	Schwarz criterion		-4.251230
Log likelihood	273.4811	F-statistic		11.75372
Durbin-Watson stat	2.074972	Prob(F-statistic)		0.000000

Null Hypothesis: D(LPIBR_SA) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.64217	0.0000
Test critical values:	1% level	-4.034356	
	5% level	-3.446765	
	10% level	-3.148399	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LPIBR_SA,2)
Method: Least Squares
Sample (adjusted): 2000M04 2010M06
Included observations: 123 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LPIBR_SA(-1))	-1.906476	0.150803	-12.64217	0.0000
D(LPIBR_SA(-1),2)	0.309549	0.088217	3.508939	0.0006
C	0.011593	0.005074	2.284768	0.0241
@TREND(2000M01)	-8.13E-05	6.84E-05	-1.188289	0.2371
R-squared	0.749225	Mean dependent var		0.000336
Adjusted R-squared	0.742903	S.D. dependent var		0.052726
S.E. of regression	0.026735	Akaike info criterion		-4.373724
Sum squared resid	0.085055	Schwarz criterion		-4.282271
Log likelihood	272.9840	F-statistic		118.5097
Durbin-Watson stat	2.093014	Prob(F-statistic)		0.000000

Interest rate

Null Hypothesis: LIRACN_SA has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.672194	0.2500
Test critical values:	1% level	-4.033727	
	5% level	-3.446464	
	10% level	-3.148223	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LIRACN_SA)
Method: Least Squares
Sample (adjusted): 2000M03 2010M06
Included observations: 124 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LIRACN_SA(-1)	-0.176921	0.066208	-2.672194	0.0086
D(LIRACN_SA(-1))	-0.437664	0.082427	-5.309711	0.0000
C	-0.003448	0.003078	-1.120149	0.2649
@TREND(2000M01)	2.12E-05	3.82E-05	0.553568	0.5809
R-squared	0.317357	Mean dependent var		-4.30E-05
Adjusted R-squared	0.300291	S.D. dependent var		0.017262
S.E. of regression	0.014439	Akaike info criterion		-5.605978
Sum squared resid	0.025020	Schwarz criterion		-5.515001
Log likelihood	351.5706	F-statistic		18.59577
Durbin-Watson stat	2.053085	Prob(F-statistic)		0.000000

Null Hypothesis: D(LIRACN_SA) has a unit root
Exogenous: Constant, Linear Trend

Lag Length: 0 (Automatic based on SIC, MAXLAG=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-19.72612	0.0000
Test critical values:	1% level	-4.033727	
	5% level	-3.446464	
	10% level	-3.148223	

*MacKinnon (1996) one-sided p-values.
Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LIRACN_SA,2)
Method: Least Squares
Sample (adjusted): 2000M03 2010M06
Included observations: 124 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LIRACN_SA(-1))	-1.526187	0.077369	-19.72612	0.0000
C	0.000776	0.002707	0.286499	0.7750
@TREND(2000M01)	-1.15E-05	3.71E-05	-0.308523	0.7582
R-squared	0.762801	Mean dependent var		-0.000216
Adjusted R-squared	0.758880	S.D. dependent var		0.030143
S.E. of regression	0.014801	Akaike info criterion		-5.564305
Sum squared resid	0.026509	Schwarz criterion		-5.496072
Log likelihood	347.9869	F-statistic		194.5600
Durbin-Watson stat	2.125430	Prob(F-statistic)		0.000000

2. The Johansen test for investment rate, real GDP, and active interest rate for the non-banking clients

Sample (adjusted): 2000M06 2010M06
Included observations: 121 after adjustments
Trend assumption: Quadratic deterministic trend
Series: RINVPIB PIBR RACN
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.315669	62.97794	35.01090	0.0000
At most 1	0.098940	17.08106	18.39771	0.0757
At most 2 *	0.036307	4.474858	3.841466	0.0344

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.315669	45.89688	24.25202	0.0000

At most 1	0.098940	12.60620	17.14769	0.2032
At most 2 *	0.036307	4.474858	3.841466	0.0344

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

RINVPIB	PIBR	RACN
0.177681	-0.000132	-0.013777
-0.564644	5.36E-05	0.125222
0.263521	-2.21E-05	0.152615

Unrestricted Adjustment Coefficients (alpha):

D(RINVPIB)	-0.108720	0.250377	-0.318066
D(PIBR)	7097.666	-496.6137	-1044.206
D(RACN)	-0.115332	-0.228677	-0.023613

1 Cointegrating Equation(s): Log likelihood -1682.615

Normalized cointegrating coefficients (standard error in parentheses)

RINVPIB	PIBR	RACN
1.000000	-0.000745	-0.077537
	(9.0E-05)	(0.15393)

Adjustment coefficients (standard error in parentheses)

D(RINVPIB)	-0.019317
	(0.03203)
D(PIBR)	1261.122
	(205.460)
D(RACN)	-0.020492
	(0.01306)

2 Cointegrating Equation(s): Log likelihood -1676.312

Normalized cointegrating coefficients (standard error in parentheses)

RINVPIB	PIBR	RACN
1.000000	0.000000	-0.242830
		(0.11594)
0.000000	1.000000	-221.8857
		(281.711)

Adjustment coefficients (standard error in parentheses)

D(RINVPIB)	-0.160692	2.78E-05
	(0.10575)	(2.6E-05)
D(PIBR)	1541.532	-0.966079
	(683.890)	(0.16498)
D(RACN)	0.108629	3.01E-06
	(0.04148)	(1.0E-05)

Long-term equilibrium equation **(eq_11)**

Dependent Variable: LRINVPIB_SA
Method: Least Squares
Sample (adjusted): 2000M02 2010M06

Included observations: 125 after adjustments
LRINVPIB_SA=C(1)+C(2)*LPIBR_SA+C(3)*LIRACN_INFL_SA(-1)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-7.651027	0.615819	-12.42414	0.0000
C(2)	0.910371	0.054151	16.81164	0.0000
C(3)	0.477304	0.218560	2.183852	0.0309
R-squared	0.731349	Mean dependent var		2.682320
Adjusted R-squared	0.726945	S.D. dependent var		0.174592
S.E. of regression	0.091233	Akaike info criterion		-1.927100
Sum squared resid	1.015455	Schwarz criterion		-1.859221
Log likelihood	123.4438	Durbin-Watson stat		0.481218

Short-term equilibrium equation (eq20_opt3)

Dependent Variable: DLRINVPIB_SA
Method: Least Squares
Sample (adjusted): 2001M02 2010M06
Included observations: 113 after adjustments
DLRINVPIB_SA=C(1)+C(2)*(LRINVPIB_SA(-1)-(-7.651026536
+0.9103709093*LPIBR_SA(-1)+0.4773035516
*LIRACN_INFL_SA(-2)))+C(3)*DLRINVPIB_SA(-1)+C(4)
*DLRINVPIB_SA(-6)+C(5)*DLRINVPIB_SA(-12)+C(6)
*DLPIBR_SA(-1)+C(7)*DLPIBR_SA(-2)+C(8)*DLPIBR_SA(-3)
+C(9)*DLPIBR_SA(-4)+C(10)*DLPIBR_SA(-5)+C(11)
*DLPIBR_SA(-6)+C(12)*DLPIBR_SA(-7)+C(13)*DLPIBR_SA(-8)
+C(14)*DLPIBR_SA(-9)+C(16)*DLPIBR_SA(-11)+C(17)
*DLPIBR_SA(-12)+C(18)*DLIRACN_INFL_SA(-1)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.008931	0.003864	-2.311150	0.0230
C(2)	-0.030015	0.041256	-0.727530	0.4687
C(3)	-0.137276	0.092990	-1.476245	0.1432
C(4)	0.146177	0.090581	1.613771	0.1099
C(5)	-0.474954	0.100534	-4.724312	0.0000
C(6)	0.356095	0.136252	2.613506	0.0104
C(7)	0.524758	0.154084	3.405667	0.0010
C(8)	0.704301	0.159812	4.407055	0.0000
C(9)	0.353851	0.158071	2.238552	0.0275
C(10)	0.395451	0.154526	2.559127	0.0121
C(11)	0.481926	0.159680	3.018069	0.0033
C(12)	0.354905	0.161674	2.195190	0.0306
C(13)	0.274360	0.160199	1.712624	0.0900
C(14)	0.328687	0.133820	2.456192	0.0158
C(16)	-0.167399	0.126967	-1.318448	0.1905
C(17)	-0.281419	0.134915	-2.085898	0.0396
C(18)	-0.056529	0.071018	-0.795980	0.4280
R-squared	0.444583	Mean dependent var		0.001665

Adjusted R-squared	0.352014	S.D. dependent var	0.040239
S.E. of regression	0.032391	Akaike info criterion	-3.883998
Sum squared resid	0.100724	Schwarz criterion	-3.473683
Log likelihood	236.4459	Durbin-Watson stat	2.086805

Foreign direct investments

Dependent Variable: DLRINVPIB_SA
Method: Least Squares
Sample (adjusted): 2001M02 2010M06
Included observations: 113 after adjustments
DLRINVPIB_SA=C(1)+C(2)*(LRINVPIB_SA(-1)-(-7.651026536
+0.9103709093*LPIBR_SA(-1)+0.4773035516
*LIRACN_INFL_SA(-2)))+C(3)*DLRINVPIB_SA(-1)+C(4)
*DLRINVPIB_SA(-6)+C(5)*DLRINVPIB_SA(-12)+C(6)
*DLPIBR_SA(-1)+C(7)*DLPIBR_SA(-2)+C(8)*DLPIBR_SA(-3)
+C(9)*DLPIBR_SA(-4)+C(10)*DLPIBR_SA(-5)+C(11)
*DLPIBR_SA(-6)+C(12)*DLPIBR_SA(-7)+C(13)*DLPIBR_SA(-8)
+C(14)*DLPIBR_SA(-9)+C(16)*DLPIBR_SA(-11)+C(17)
*DLPIBR_SA(-12)+C(18)*DLIRACN_INFL_SA(-1)+C(19)*IISD

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.008971	0.003881	-2.311610	0.0230
C(2)	-0.030640	0.041448	-0.739242	0.4616
C(3)	-0.136866	0.093377	-1.465733	0.1460
C(4)	0.150760	0.091490	1.647836	0.1027
C(5)	-0.475888	0.100968	-4.713266	0.0000
C(6)	0.360947	0.137213	2.630566	0.0099
C(7)	0.519750	0.155095	3.351175	0.0012
C(8)	0.702205	0.160534	4.374192	0.0000
C(9)	0.361526	0.159584	2.265433	0.0258
C(10)	0.404787	0.156464	2.587091	0.0112
C(11)	0.503216	0.166790	3.017060	0.0033
C(12)	0.385965	0.175632	2.197573	0.0304
C(13)	0.298743	0.169245	1.765150	0.0808
C(14)	0.326460	0.134456	2.427998	0.0171
C(16)	-0.156378	0.129689	-1.205793	0.2309
C(17)	-0.278679	0.135599	-2.055170	0.0426
C(18)	-0.052475	0.071845	-0.730388	0.4670
C(19)	-0.000368	0.000794	-0.463393	0.6441

R-squared	0.445836	Mean dependent var	0.001665
Adjusted R-squared	0.346669	S.D. dependent var	0.040239
S.E. of regression	0.032525	Akaike info criterion	-3.868557
Sum squared resid	0.100497	Schwarz criterion	-3.434106
Log likelihood	236.5735	Durbin-Watson stat	2.074418

Unemployment rate

Dependent Variable: DLRINVPIB_SA
Method: Least Squares
Sample (adjusted): 2001M02 2010M06
Included observations: 113 after adjustments
DLRINVPIB_SA=C(1)+C(2)*(LRINVPIB_SA(-1)-(-7.651026536
+0.9103709093*LPIBR_SA(-1)+0.4773035516
*LIRACN_INFL_SA(-2)))+C(3)*DLRINVPIB_SA(-1)+C(4)
*DLRINVPIB_SA(-6)+C(5)*DLRINVPIB_SA(-12)+C(6)
*DLPIBR_SA(-1)+C(7)*DLPIBR_SA(-2)+C(8)*DLPIBR_SA(-3)
+C(9)*DLPIBR_SA(-4)+C(10)*DLPIBR_SA(-5)+C(11)
*DLPIBR_SA(-6)+C(12)*DLPIBR_SA(-7)+C(13)*DLPIBR_SA(-8)
+C(14)*DLPIBR_SA(-9)+C(16)*DLPIBR_SA(-11)+C(17)
*DLPIBR_SA(-12)+C(18)*DLIRACN_INFL_SA(-1)+C(19)
*DLIRSOM_SA

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.008945	0.003867	-2.313074	0.0229
C(2)	-0.026227	0.041494	-0.632068	0.5289
C(3)	-0.126824	0.093756	-1.352700	0.1794
C(4)	0.142903	0.090723	1.575151	0.1185
C(5)	-0.484122	0.101108	-4.788190	0.0000
C(6)	0.354727	0.136370	2.601216	0.0108
C(7)	0.529532	0.154295	3.431942	0.0009
C(8)	0.720835	0.160948	4.478679	0.0000
C(9)	0.353089	0.158201	2.231905	0.0280
C(10)	0.417187	0.156446	2.666654	0.0090
C(11)	0.488362	0.159962	3.052991	0.0029
C(12)	0.354376	0.161805	2.190146	0.0310
C(13)	0.276388	0.160343	1.723733	0.0880
C(14)	0.299032	0.137755	2.170754	0.0324
C(16)	-0.181290	0.127964	-1.416731	0.1598
C(17)	-0.262673	0.136553	-1.923595	0.0574
C(18)	-0.072906	0.073273	-0.995001	0.3223
C(19)	-0.075712	0.082330	-0.919622	0.3601

R-squared	0.449484	Mean dependent var	0.001665
Adjusted R-squared	0.350970	S.D. dependent var	0.040239
S.E. of regression	0.032418	Akaike info criterion	-3.875162
Sum squared resid	0.099835	Schwarz criterion	-3.440711
Log likelihood	236.9467	Durbin-Watson stat	2.045025

Real net wage

Dependent Variable: DLRINVPIB_SA
Method: Least Squares
Sample (adjusted): 2001M02 2010M06
Included observations: 113 after adjustments
DLRINVPIB_SA=C(1)+C(2)*(LRINVPIB_SA(-1)-(-7.651026536
+0.9103709093*LPIBR_SA(-1)+0.4773035516
*LIRACN_INFL_SA(-2)))+C(3)*DLRINVPIB_SA(-1)+C(4)
*DLRINVPIB_SA(-6)+C(5)*DLRINVPIB_SA(-12)+C(6)
*DLPIBR_SA(-1)+C(7)*DLPIBR_SA(-2)+C(8)*DLPIBR_SA(-3)
+C(9)*DLPIBR_SA(-4)+C(10)*DLPIBR_SA(-5)+C(11)
*DLPIBR_SA(-6)+C(12)*DLPIBR_SA(-7)+C(13)*DLPIBR_SA(-8)
+C(14)*DLPIBR_SA(-9)+C(16)*DLPIBR_SA(-11)+C(17)
*DLPIBR_SA(-12)+C(18)*DLIRACN_INFL_SA(-1)+C(19)
*DLISALNETR_SA

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.008984	0.003884	-2.312973	0.0229
C(2)	-0.029843	0.041445	-0.720068	0.4733
C(3)	-0.137217	0.093410	-1.468985	0.1451
C(4)	0.143092	0.091362	1.566204	0.1206
C(5)	-0.469547	0.102017	-4.602647	0.0000
C(6)	0.373333	0.144416	2.585132	0.0113
C(7)	0.519088	0.155519	3.337775	0.0012
C(8)	0.703800	0.160539	4.383995	0.0000
C(9)	0.351732	0.158885	2.213746	0.0292
C(10)	0.389466	0.156045	2.495862	0.0143
C(11)	0.477700	0.160798	2.970816	0.0038
C(12)	0.355792	0.162420	2.190567	0.0309
C(13)	0.279602	0.161530	1.730960	0.0867
C(14)	0.328245	0.134428	2.441783	0.0165
C(16)	-0.161054	0.128663	-1.251753	0.2137
C(17)	-0.281997	0.135532	-2.080665	0.0402
C(18)	-0.051025	0.072840	-0.700514	0.4853
C(19)	0.048854	0.130596	0.374087	0.7092
R-squared	0.445400	Mean dependent var		0.001665
Adjusted R-squared	0.346156	S.D. dependent var		0.040239
S.E. of regression	0.032538	Akaike info criterion		-3.867771
Sum squared resid	0.100576	Schwarz criterion		-3.433320
Log likelihood	236.5291	Durbin-Watson stat		2.087068