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Two Exercises of Inflation Modelling and Forecasting for Azerbaijan

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Contents

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Abstract

The paper proposes two econometric models of inflation for Azerbaijan: one based on monthly data and eclectic, another based on quarterly data and takes into account disequilibrium at the money market. Inflation regression based on monthly data showed that consumer prices dynamics is explained by money growth (the more money, the higher the inflation), exchange rate behaviour (appreciation drives disinflation), commodities price dynamics ("imported" inflation) and administrative changes in regulated prices. For the quarterly model, nominal money demand equation (with inflation, real non-oil GDP and nominal interest rate on foreign currency deposits as predictors) and money supply equation were estimated, and error-correction mechanism from money demand equation was included into inflation equation. It is shown that disequilibrium at the money market (supply higher than demand) drives inflation together with money supply growth and nominal exchange rate depreciation and administrative changes in prices. No cost-push variables appeared to be significant in this equation specification. Both models give similar inflation projections, but sudden changes in money demand (2012) lead to significant differences between the projections. It is shown that money is the most important inflation determinant that explains up to 97.8% of CPI growth between 2012 and 2015, and that in order to keep inflation under control the Central Bank of Azerbaijan should link money supply to real non-oil GDP growth.

1. Introduction

In this paper, two exercises of inflation modelling and forecasting are elaborated: one is represented by an "eclectic" model based on monthly data (that include both cost-push inflation and demand-pull factors) and another (based on quarterly data) – by modelling money demand and supply and taking into account disequilibrium at the money market. The purpose of these exercises was to propose analytical tools for inflation modelling and forecasting and to prepare medium-term (5 years) forecast of inflation in Azerbaijan.

The paper is structured as follows. In the next two sections both models are presented (underlying data, econometric modelling results). Fourth section provides explanatory variables forecast, comparison of the inflation forecasts based on both models and discusses importance of monetary and exchange rate policy as inflation determinants. Fifth section contains brief conclusions and selected policy recommendations.

2. Monthly model

The model of Azerbaijani inflation was estimated with monthly data spanning 5 years and 57 observations (2007m1-2011m9). The advantage of using monthly data (as opposed to using quarterly) to estimate determinants of inflation in Azerbaijan is that the comfortable number of degrees of freedom can be achieved with the considerably shorter sample (in terms of years of data). This is an important benefit given the likely instability of econometric relationship between inflation and its determinants and its evolution over time.

To eliminate the problem with seasonality and the impact of index bases on obtained coefficients, the model was estimated in 12-month percentage changes of original indices.

2.1. Selection of explanatory variables

The set of explanatory variables is eclectic and comprises both demand-pull and cost-push variables. Demand pressures are represented by the M3 money supply, while cost factors – by the index of world commodity prices and nominal effective exchange rate.

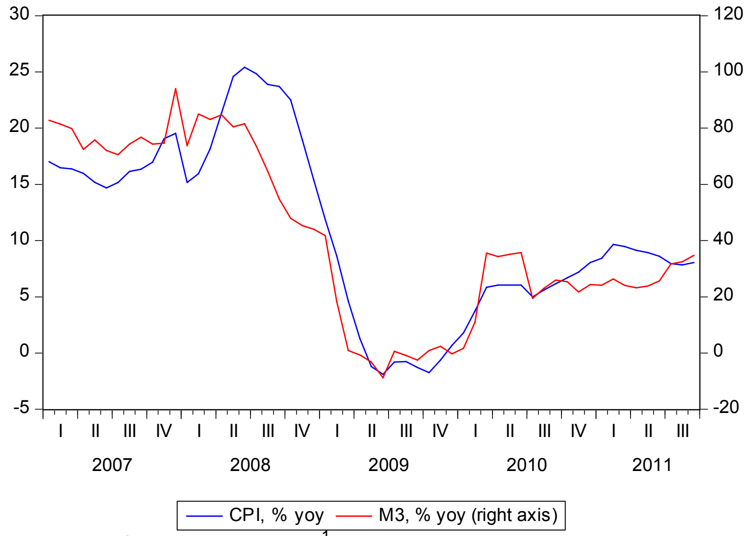
Monetary aggregates: *M*3 money supply is a natural candidate for the set of explanatory variables in an inflation model as it is the broadest money aggregate and is also most closely correlated with the *CPI*:

Sample: 2007m1-2011m9*	Reserve Money	*M*1	*M*2	*M*3
Correlation coefficient with *CPI*	0.82	0.71	0.76	0.89

* m stands for month.

As the Figure 1 shows, both variables move in the same direction with the range of *M*3 changes several times bigger than that of *CPI*.

Figure 1: CPI and M3 growth rates

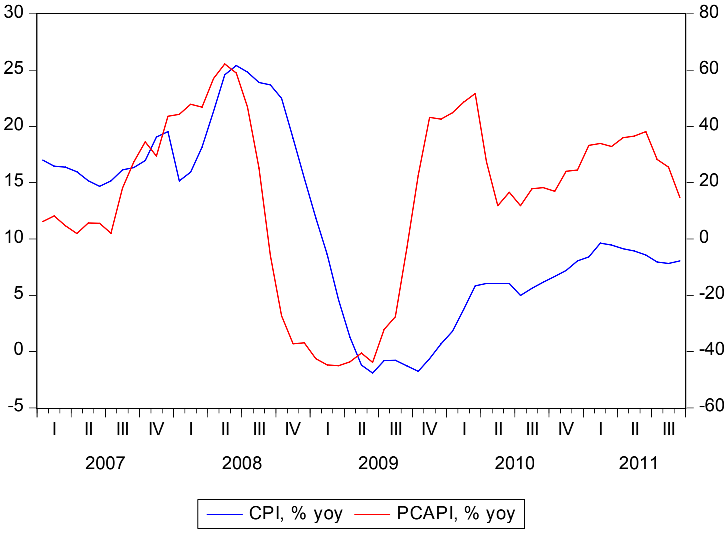


Source: IFS database, Azstat[1].

Commodity Prices: The key cost-push variable is the IFS All Primary Commodities Price Index (*PCAPI*, see Figure 2). It is comprised of food (17%[2]), agricultural commodities (11%), metals (11%) and energy (61%). Therefore it reflects a whole range of different price pressures on domestic price indices. The advantage of using the single all-commodity price index over several specific commodity price indices is that they are all highly correlated with one another causing a potential multicollinearity problem.

[1] IFS – International Financial Statistics, see http://elibrary-data.imf.org/; Azstat – State Statistical Committee of Azerbaijan, see http://azstat.org.
[2] Average weights over the sample.

Figure 2: CPI and PCAPI growth rates



Source: IFS database, Azstat.

Nominal effective exchange rate: Nominal effective exchange rate was added to the set of explanatory variables to reflect the key factor in shaping the price level of imports. The series was calculated as the weighted average of year on year changes in the exchange rates of Azerbaijan's key trading partners:

$$NEER = \sum_{i=1}^{n} w_i \cdot ER_i , \qquad (1)$$

where $w_i = \dfrac{\text{merchandise imports from country } i \text{ during 2005-2010}}{\text{total merchandise imports during 2005-2010}}$ and ER_i is the year on year percentage change in the nominal exchange rate of the *manat* vis-a-vis the currency of a country *i*.

Imports data for the calculation of weights were sourced from the COMTRADE database and the selection of countries was based on the sample of 6 years 2005–2010.

Table 1: Main trading partners of Azerbaijan (merchandise imports), 2005–2010

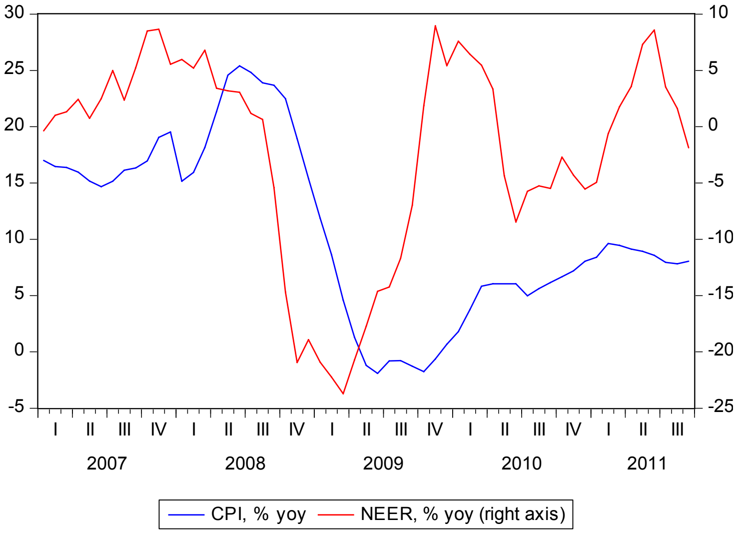
Country	Average shares in imports, % of total	Country	Average shares in imports, % of total
1. Russian Federation	18.46	8. Japan	3.06
2. Turkey	10.58	9. Kazakhstan	2.81
3. Germany	8.10	10. Italy	2.27
4. Ukraine	7.15	11. Singapore	2.10
5. United Kingdom	6.57	12. France	2.00
6. China	6.12	13. Finland	1.96
7. USA	3.83	14. Rep. of Korea	1.70
Sum			**76.70**

Source: own estimates based on COMTRADE data[3].

[3] See http://comtrade.un.org/db/.

Seven different *NEER* indices were calculated for all 14 top import partners with average weights from Table 1 used in the calculations. The resulting *NEER* series formulated as the annual percentage change is presented at Figure 3, where positive numbers point to depreciation while negative – to appreciation on an annual basis. The figure clearly shows that *NEER* series during most of the sample period moved in line with the *CPI*.

Figure 3: CPI and NEER (14 trading partners) growth rates



Source: own estimates based on the COMTRADE and IFS databases data; Azstat.

2.2. Estimation results

In order to achieve better modelling results while saving degrees of freedom some explanatory variables were transformed by taking moving averages. In this way explanatory series gain a smoother shape but at the same time retain all the necessary information about the past developments of indicators in question. The modelling strategy assumed experimenting with various widths of the moving average windows and various lags of the variables. The final version of the specification was chosen based on the set of information criteria (Akaike, Schwartz, Hannan-Quinn).

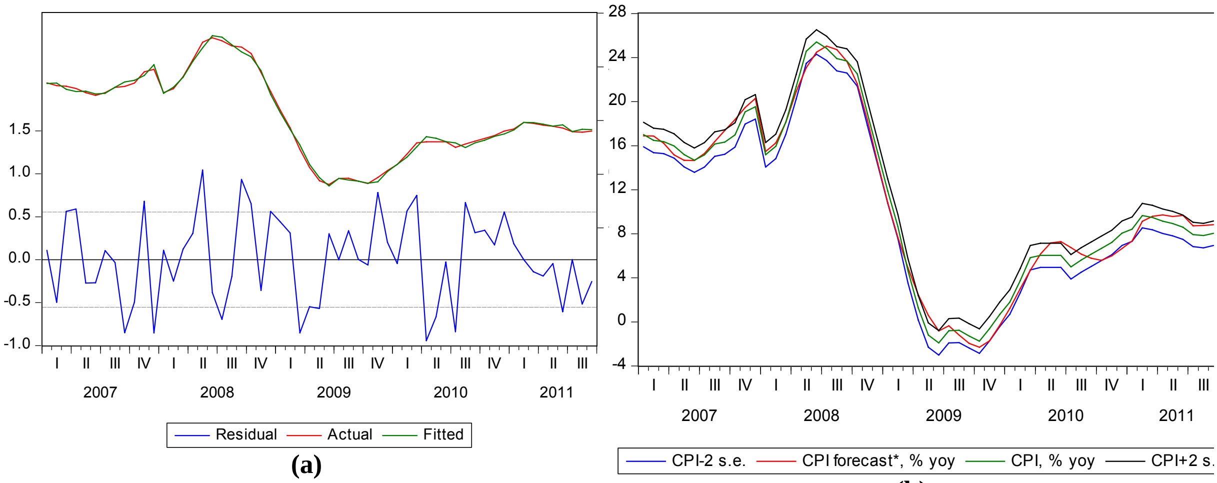
In addition to *M*3, *PCAPI* and *NEER* the specification was augmented by the lagged explained variable and four dummy variables that reflect important changes of administratively regulated prices. The final version of the model is presented below:

$$CPI_t = \underset{(0.00)}{0.94} \cdot CPI_{t-1} - \underset{(0.03)}{0.20} \cdot CPI_{t-2} - \underset{(0.01)}{0.17} \cdot CPI_{t-3} + \underset{(0.00)}{0.095} \cdot movav(M3_{t-1}, 10) + \underset{(0.00)}{0.059} \cdot NEER_{t-1} +$$
$$+ \underset{(0.00)}{0.022} \cdot movav(PCAPI_t, 4) + \underset{(0.00)}{0.025} \cdot movav(PCAPI_{t-3}, 4) + \sum_{i=1}^{n} \beta_i \cdot D_t^i + \varepsilon_t, \tag{2}$$

where probabilities (significance levels) are presented in brackets, D^i is set of dummy variables including 2007m1 minus 2008m1, 2009m7, 2011m2, 2011m7.

Equation residuals, actual and fitted values of inflation are presented at Figure 4a. Residuals are well-behaved: normality, serial correlation and heteroscedasticity tests reveal no deviations. The model performs fairly well in in-sample dynamic forecasting with the highest errors (more or equal to the 2 standard errors of regression) recorded in October 2007, May 2008, April-May 2009, and March, May, July, November and December of 2010 (see Figure 4b).

Figure 4: *CPI* modelling results: actual and fitted values, logarithmic scale (a) and in-sample dynamic forecast (b)



(a) (b)

* in-sample dynamic forecast, 2007m1–2011m9.
Source: own estimates.

Several messages emerge from the estimation:

– Inflation has high inertia: in sum, 1% of lagged inflation gives 0.57% of current inflation;

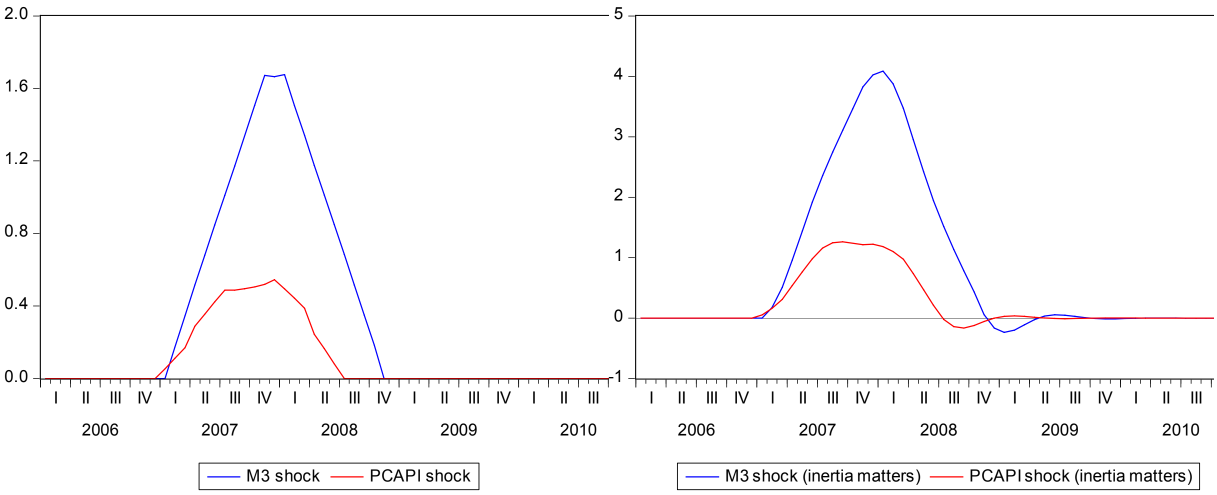
– Money growth leads to inflation: 1% of *M*3 increase (measured as 10 months moving average of growth rate) brings 0.1% of inflation (long-lasted effect – 10-month moving average);

– Nominal depreciation drives inflation: 1% of *NEER* increase brings 0.06% of inflation;

– Imported inflation present, but small: in sum, 1% of increase of commodities price gives 0.05 of inflation (quite long effect – 4 months moving average);

– The dummy introduced for electricity price adjustment in January 2007 is highly significant and points to a 5.4% of extra inflation in this month. Due to the high-base-effect the symmetrical dummy in January 2008 is negative and points to a the same decline in inflation. Other dummies reflect increase in prices for gas (July 2009), water, post and railway services (February 2011), and (probably) the effect of high base for food prices in mid-2010 (July 2011).

Figure 5: Extra inflation coming from 10% shock to *M*3 and *PCAPI* in January 2007



(a) (b)

Source: own estimates.

Due to the fact that both money and commodity price variables are transformed by taking moving averages the interpretation of their impact is somewhat complicated. The schematic impact of a one-time 10% rise in *M*3 and *PCAPI* is presented in the Figure 5a and Figure 5b. In the case of money a one-time 10% shock to growth of *M*3 in month 1 produces higher inflation from month 2 to month 22 (lagged inflation taken as given) or from 1 to 23 months (lagged values are estimated taking into account the shock)[4] with the extra inflation growing from 0 to peak at 1.67% during months 11–13 or 3.81–4.09% in months 11–14 (if inertia matters). In the case of world commodity prices the shock of the same magnitude (10%) raises inflation from month 1 to month 18 with the maximum impact of 0.49–0.54% from month 7 to month 13 (or for the same periods, but with maximum of 1.16 – 1.25 in case when inertia is taken into account).

[4] Labeled as “inertia matters”.

3. Quarterly model

One of the disadvantages of monthly model is that it does not take into account changes in money demand. Although behaviour of residuals of equation (2) is satisfactory, absence of some variable characterising money market imbalances may improve specification of this model. However, no good monthly data for income is available for Azerbaijan; even quarterly data should be constructed based on the available information. Thus, we are switching to the quarterly model that will take into account such imbalances. First, money demand function is estimated, and then inflation equation is built based on error-correction model, where error correction mechanism (*ECM*) is residuals from long-term money demand equation.

3.1. Data

Estimates in this section are based on the quarterly data with sample size of 39 quarters (2002q1–2011q3). The list of analyzed indicators5 is presented in Table 2.

Table 2: Variables list

Name	Description	Source of the actual data
Quarterly model: money demand and inflation		
CPI	Inflation, consumer price index (2010=1)	IFS[6] (re-based to 2010)
DRC	Nominal interest rate on deposits in foreign currency (9-12 month maturity), % per annum	Own estimates based on the CBA monthly data (simple average by 4 months' eop data)
*M*3	Monetary aggregate M3, AZN mln, period average	Own estimates based on the IFS monthly data (simple average by 4 months' eop data)
NEER	Nominal effective exchange rate of manat, index, 2010=1 (weighted average of CPIs for 9 major trading partners for imports)	Own estimates based on the IFS and COMTRADE data
RGDPNO	Non-oil GDP in constant prices of 2010	Own estimates based on the Azstat data
Variables used for money supply equation:		
CPIM	Imported inflation (weighted average of CPIs for 9 major trading partners for imports)	Own estimates based on the IFS and COMTRADE data
MB	Monetary base, AZN mln, period average	Own estimates based on the IFS monthly data (simple average by 4 months' eop data)
REER	Real effective exchange rate of manat, index, 2010=1; *REER = NEER*CPI_SA/CPIM_SA**	Own estimates

* Hereafter seasonally adjusted time series are denoted with *_sa* symbol.

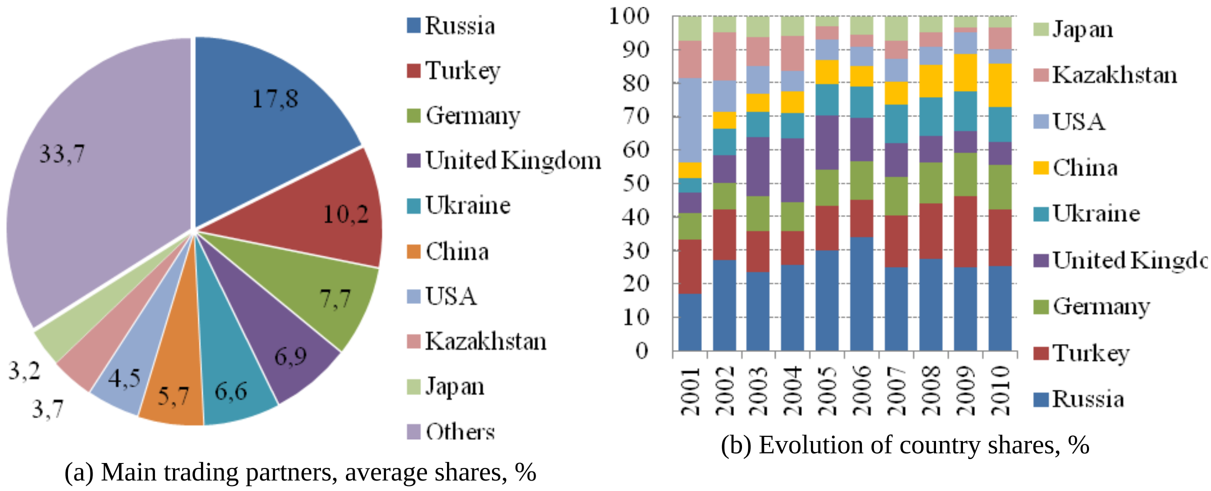
Monetary and interest rates data in Azerbaijan is available only as of the end of period (eop). That is why quarterly averages were estimated on the basis of 4 months data[7]. All index

[5] Few other indicators (oil and food prices) were analyzed, but they appeared insignificant and therefore they are not included in Table 2.
[6] See http://imfstatistics.org/.

indicators were re-based to 2010 average. For *NEER*, weights of main trading partners (for imports of goods) were estimated. The following approach was applied:

- Based on the *average* share of a country in Azeri imports for 2000–2010, main trading partners of Azerbaijan were selected (9 countries were selected, about 2/3 of total imports, see Figure 6a);
- Country weights in total imports on main trading partners were calculated (see Figure 6b);
- Weighted average *growth rate* of exchange rate was calculated (country weights for a year *t*-1 were applied to estimate weighted average in a year *t*);
- Index (2010=1) *NEER* was built.

Figure 6: Main trading partners of Azerbaijan (merchandise imports), 2000–2010



Source: own estimates based on COMTRADE data.

For further analysis, time series were tested on presence of seasonality. If seasonality present, seasonally adjusted time series were used. Also, all time series were tested for presence of unit root, and all of them appeared to be I(1) variables (see Annex 1 for graphic presentation).

3.2. Estimation of money demand function

The idea behind money demand estimation is as follows: if money supply (actual value of a monetary aggregate) is higher than money demand (fitted values of a monetary aggregate), than inflation goes up. Based on the theoretical considerations, real income, inflation and

[7] For example, for a 1st quarter average eop data for the following months was included: December, January, February and March. The logic behind this is as follows: quarterly average is average of 3 monthly averages; monthly average for January is simple average of end-December and end-January and so on.

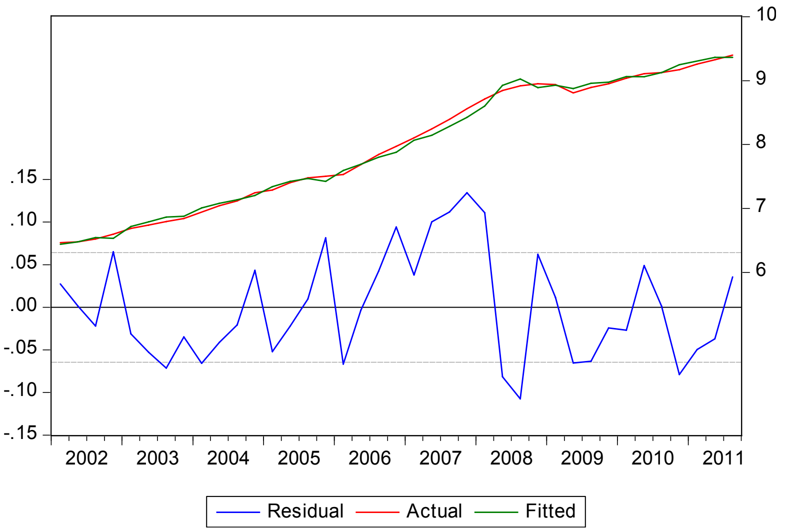
interest rate were included to the right-hand side of equation. The following long-term equation was estimated:

$$m3\_sa_t = \underset{(0.00)}{2.361} \cdot cpi\_sa_t + \underset{(0.00)}{1.064} \cdot rgdpno\_sa_t + \underset{(0.00)}{0.013} \cdot DRC_t^{t>2002q4} + \varepsilon_t, \qquad (3)$$

where small letters mean natural logarithms, $D_{t \geq 2003q1}$ is dummy equals to 1 since the 2003q1 and 0 otherwise, probabilities (significance levels) are presented in brackets. Equation residuals (gap between money demand and supply) are presented on the Figure 7.

Engle-Granger cointegration test shows reject hypothesis about absence of cointegration at 5% level, so (i) there is long-run relationship between money demand and right-hand side variables and (ii) residuals from the equation (3) can be used for inflation equation as a measure of money market imbalances. If the gap between actual and fitted *M*3 is positive (negative), it should lead to acceleration (deceleration) of inflation. Thus, in a short-term inflation equation this gap should influence inflation positively.

Figure 7: Demand for nominal money balances (M3): Actual and fitted values (logarithmic scale)



Source: own estimates.

3.3. Estimation of money demand function

Full specification included 2 lags of all variables[8] and set of dummies reflected important administrative price changes and other structural breaks. Final specification (after reduction procedure) is as follows:

[8] Initial specification of inflation equation included few variables that should reflect external pressures on Azeri inflation: imported inflation, price index for food primary commodities and crude oil price index. However, in the final specification after elimination of insignificant none of these variables remained.

$$d(cpi\_sa_t) = \underset{(0.00)}{0.342} \cdot d(cpi\_sa_{t-1}) + \underset{(0.00)}{0.101} \cdot d(m3\_sa_t) + \underset{(0.00)}{0.066} \cdot d(m3\_sa_{t-2}) - \underset{(0.00)}{0.138} \cdot d(neer_t) +$$
$$- \underset{(0.00)}{0.128} \cdot d(neer_{t-1}) + \underset{(0.00)}{0.154} \cdot d(neer_{t-2}) + \underset{(0.02)}{0.045} \cdot ECM_{t-1} + \sum_{i=1}^{n} \beta_i \cdot D_t^i + \varepsilon_t, \tag{4}$$

where ECM_t is residuals from equation (3), D^i is set of dummy variables, probabilities (significance levels) are presented in brackets. Actual and fitted values of inflation are presented on the Figure 8. Equation residuals are well-behaved: no problems with normality, serial correlation or heteroscedasticity were found.

Figure 8: Inflation estimation (CPI, first logarithmic differences): Actual and fitted values

Source: own estimates.

The following conclusions about inflation determinants could be made based on this equation:

– Coefficient at the error correction mechanism is statistically significant and has expected (positive) sign, which means that imbalances at the money market influence inflation: 1% gap between supply and demand gives about 0.05% of *CPI* increase;

– Equation (4) provides an evidence of direct impact of money supply increase on inflation (in sum, 1% of *M*3 increase leads to 0.167% of additional inflation);

– Inflation has inertia: 1% of lagged inflation brings 0.34 percentage points of additional increase in *CPI*;

– Nominal depreciation of *manat*[9] brings inflation: in sum, 1% of *NEER* decrease brings 0.11% of inflation.

3.4. Money supply

In order to switch to inflation forecast, one should estimate the second half of the money market – money supply. Here the following approach is implemented. First, money multiplier $d(M3)/d(MB)$, where *MB* is monetary base, is estimated based on the following equation:

$$d(M3_t)/d(MB_t) = \alpha + \sum_{i=1}^{n} \beta_i \cdot D_t^i + \varepsilon_t, \qquad (5)$$

where α is revealed money multiplier, D^i is set of dummy variables that eliminate outliers. For the analyzing period, the revealed multiplier amounted to 1.72, i.e. increase of monetary by 1 manat base brings 1.72 manat increase of broad money supply.

Next, monetary base equation was estimated. However, taking into account the fact that monetary base is policy variable and its behavior in a big extent depends on decisions of the Central Bank or the government policy, we did not expect to build comprehensive model. Instead, we used the only variable that definitely matters: behavior of real exchange rate that reflect reaction of the Central Bank on exogenous pressures on manat such as export/import changes or fluctuations of prices in main trading partners. The following short-term equation was estimated:

$$d(mb\_sa_t) = \underset{(0.00)}{0.565} \cdot d(mb\_sa_{t-1}) - \underset{(0.01)}{0.5436} \cdot d(reer_{t-1}) + \underset{(0.00)}{0.030} + \underset{(0.00)}{0.115} \cdot D_t + \varepsilon_t, \qquad (6)$$

where *D* is dummy that reflect shock in money supply in the 2nd and 3rd quarters of 2006, probabilities (significance levels) are presented in brackets. The results bring the following conclusions:

– As it was expected, real exchange rate dynamics influence monetary base growth: 1% of real appreciation brings 0.54% of monetary base reduction. In other words, 1% of *NEER* appreciation or 1% of increase of relative prices (domestic comparing to foreign) leads to this effect. Hence, indirectly there is a phenomenon of imported inflation, as increase of inflation in countries – main import partners leads *ceteris paribus* to real depreciation of manat then to monetary base growth then to *M*3 and as a result to domestic inflation increase;

– Monetary base has strong inertia: 1% of lagged *MB* growth brings 0.57% of its current increase;

[9] *NEER* definition is different from those in the section 2.

– “Autonomous” growth of monetary base is approximately 3% per quarter (in other words, this unexplained part of its dynamics is explained by monetary policy decisions).

4. Inflation forecasts

4.1. Explanatory variables projections

For the monthly model, all right-hand side variables are exogenous: *M*3 forecast is taken from the quarterly model as given[10], while *PCAPI* and *NEER* forecasts are made on the basis of the IMF annual forecasts[11] and partially MoED[12] forecasts. For the quarterly model, exogenous variables are *NEER*, *CPIM* (both are derived from the IMF annual forecasts), as well as *DRC* (assumed) and *RGDPNO*[13] (derived from the MoED annual forecast). Endogenous variables are monetary base (depend on *REER* and, hence, on domestic inflation, see equation (6)) and *M*3 (depend on *MB*). Approaches to explanatory variables forecasting are presented in the Table 3.

Table 3: Sources of and approaches to the explanatory variables forecast

Name	Description	Source of the forecast
Monthly model:		
*M*3	Monthly values are estimated based on the seasonal factor and annual dynamics	Own forecast based on the quarterly model
NEER	Monthly values are estimated based on annual dynamics of the exchange rates in the 14 main trading partners to the US dollar (implicitly calculated on the basis of data on GDP in current prices measured in the US dollars and national currencies) and manat exchange rate to the US dollar	WEO database, September 2011, except manat exchange rate – MoED forecast*
PCAPI	Monthly values are estimated based on annual dynamics of PCAPI (2011 – 2012) / average annual growth rate for 1992–2012 (2013–2015)	WEO database, September 2011 / assumption
Quarterly model:		
CPIM	Quarterly values are estimated based on annual dynamics of CPI in 9 main trading partners	Own estimates based on the IFS and COMTRADE data
DRC	Fixed at the level of 10.5% per annum since 2012q1	Assumption
MB	Estimated based on the system of equations (4) and (6)	Own forecast
*M*3	Estimated based on *MB* dynamics and multiplier obtained from equation (5)	Own forecast

[10] Taking into account close inflation forecast provided by both models (see Figure 9) this is acceptable; however, one should take into account that from equation (6) *CPI* influences money supply through *REER*, so in fact it is not purely exogenous.
[11] World Economic Outlook (WEO) database, see http://www.imf.org/external/pubs/ft/weo/2011/02/weodata/download.aspx.
[12] MoED stands for Ministry of Economic Development of the Republic of Azerbaijan.
[13] In the MoED forecasting framework, inflation influence real non-oil GDP through several channels, so there it should be an iteration process to set the equilibrium between these two indicators. However, at the predicted levels of inflation this influence is quite negligible, so gradual fluctuations of *CPI* (1–2 percentage points) do not affect non-oil GDP growth and it can be taken as exogenous.

Name	Description	Source of the forecast
Monthly model:		
NEER	Quarterly values are estimated based on annual dynamics of the exchange rates in the 9 main trading partners to the US dollar (implicitly calculated on the basis of data on GDP in current prices measured in the US dollars and national currencies) and manat exchange rate to the US dollar	WEO database, September 2011, except manat exchange rate – MoED forecast
RGDPNO	Quarterly values are estimated based on annual dynamics	MoED forecast

* Forecast version as of December 2011.

Table 4: Explanatory variables forecast, growth rates, % yoy

	2011	2012	2013	2014	2015
Monthly model:					
*M*3	28.4	27.7	28.4	22.8	18.2
PCAPI	26.2	-4.0	6.2	6.2	6.2
NEER	1.3	-1.1	-0.5	-0.5	-0.4
Quarterly model:					
CPIM	6.5	3.8	4.0	3.7	3.6
*DRC**	10.9	10.5	10.5	10.5	10.5
*M*3**	28.4	27.5	28.8	22.7	18.1
NEER	0.2	-1.4	-0.7	-0.6	-0.7
RGDPNO	10.0	10.1	6.3	6.5	4.8

* % per annum.
** Small differences between annual *M*3 growth rates for monthly and quarterly models are due to the procedure of distribution of annual money growth rates between months for monthly model.
Source: own estimates.

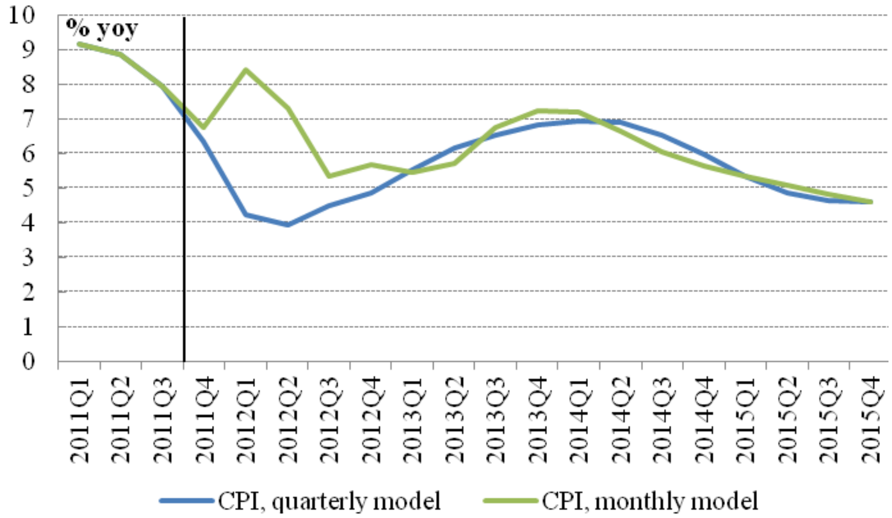
In case of monetary base forecast, the only interference was made: for 2014–2015 constant from equation (6) was reduced by 0.01 to 0.02 per quarter[14]. It was made because of the declared intention of the Azeri Central Bank to keep inflation within one-digit values, while taking into expected non-oil GDP slowdown keeping "autonomous" money supply growth at the previous levels would lead to inflation acceleration. No dummy variables were introduced to the forecast, as at the moment of its preparation (December 2011) no future administrative price increases were expected. Annual growth rates of the explanatory variables for both models are presented in Table 4.

4.2. Inflation forecast

Both models give surprisingly close results: for 2013–2015 difference between annual average inflation does not exceed 0.2 percentage points. The only exception is 2012 when faster-than-average non-oil GDP growth is expected, i.e. money demand is high relative to money supply. As a result, quarterly model that takes into account money market imbalances forecast lower inflation rate for that year, see Figure 9. For some quarters the gap is really high and comparable with inflation rate predicted by the quarterly model (4.2 and 3.4 percentage points for the first and the second quarters of 2012); on average, the monthly model gives 2.3 percentage points higher inflation than the quarterly one.

[14] This manipulation gave 4.4 and 8.2 percentage points lower *M*3 growth rates in 204 and 2015, respectively.

Figure 9: Inflation forecasts comparison



	2011	2012	2013	2014	2015
CPI, % yoy (monthly model)	8.2	6.7	6.3	6.4	4.9
CPI, % yoy (quarterly model)	8.1	4.4	6.3	6.6	4.9

Source: own estimates.

Overall, both models give quite moderate one-digit inflation. It appears that annual inflation rate on average amounted to 1/3 of the difference between nominal growth rates of M3 and real growth rate of non-oil GDP, i.e. in order to keep inflation under control money supply should follow real non-oil GDP dynamics.

Inflation determinants: The role of policies and exogenous factors

Similar results of the forecast produced by both models are largely determined by the same money growth rates, as money plays crucial role in both models. Nominal effective exchange rates also follow same path, but magnitude of their fluctuations is rather small (see Table 4) due to the assumed policy of fixed exchange rate towards the US dollar. Other explanatory variables are different, but their influence is also not as significant as those of money supply.

Contributions of inflation determinants to overall CPI increase are presented on the Figure 10. As both equations (2) and (4) contain lagged inflation, its contribution was proportionally distributed between other determinants. The results are as follows:

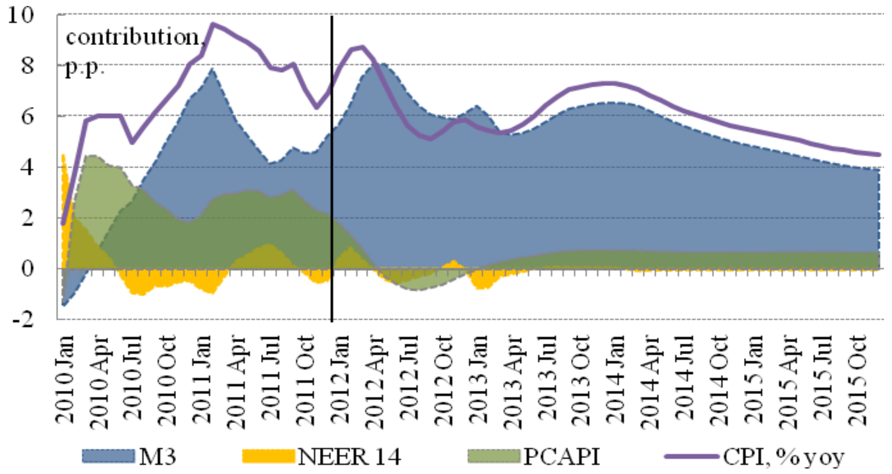
– First, it is clear that money matters the most: in 2012–2015 this factor explains about 94% of inflation dynamics in the monthly model and almost 98% in the quarterly one;

- Second, as NEER is slightly appreciating on average, it leads to some disinflation and explains from -1% of inflation in the monthly model and -2.3% in the quarterly one;

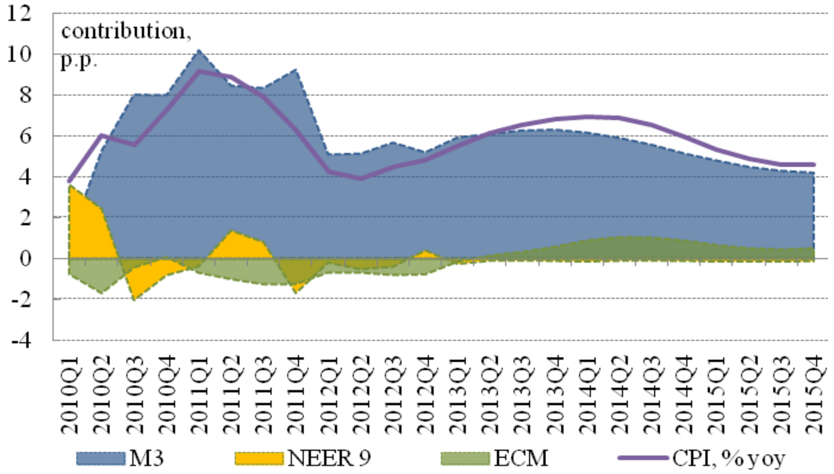
- Third, as we expect moderate (slightly more that 6% a year) growth of commodities prices in 2013–2015 and even price decrease in 2012, their impact on inflation is also moderate and on average amounts to 8% of inflation predicted with the monthly model. Different dynamics of commodities prices would lead to larger difference between the models projections, as for instance in 2010 or 2011 their contribution to inflation was comparable or even bigger than those of money;

- Fourth, money market imbalances impact is also limited (4.5% of inflation predicted with the quarterly model). One reason behind this is small coefficient at the ECM in the equation (4). Another reason is relatively balanced money market: between 2012 and 2015, the gap between money supply and money demand amounted on average to 1.15% of broad money, ranging from -5.75 to 6.02%. Evidently, less balanced monetary policy would result in higher inflation.

Figure 10: Sources to inflation growth, monthly (a) and quarterly (b) models



(a)



(b)

Source: own estimates.

5. Conclusions and policy recommendations

The following conclusions and related policy recommendations can be drawn from the analysis implemented in the paper:

First, despite specification of the model, inflation in Azerbaijan is “monetary phenomenon”: according to our projections, between 2012 and 2015 money supply increase explains about 94% of inflation dynamics in the monthly model and almost 98% in the quarterly one. Hence, controlling money supply growth is one of the main measures of anti-inflationary policy in Azerbaijan.

Second, the exchange rate is a very important transmission channel to prices, although due to relatively small volatility of the nominal exchange rate its impact on inflation is not so sizable. In both models inflationary pressures rise whenever the currency depreciates and decline in times of appreciation, making appreciation one of the most conducive phenomena supporting disinflationary policies. Apart from direct influence on prices of tradables and costs of non-tradables, exchange rate influence money supply, as buying currency is one of the main emission channels in Azerbaijan, and nominal appreciation of manat *ceteris paribus* means lower emission.

Third, phenomenon of imported inflation was revealed only in the monthly model (and its effect on inflation is much lower than those of money supply, see Figure 5). Another channel of impact of external inflation is its influence on real effective exchange rate dynamics: faster CPI growth in main trading partners leads to real depreciation of manat (*ceteris paribus*) and pushes money supply up, as net buying of currency by the Central Bank increases. Hence, in order to reduce influence of the external factors on inflation in Azerbaijan the Central Bank may restrict money supply in case of commodities price hikes or inflation acceleration in main trading partners.

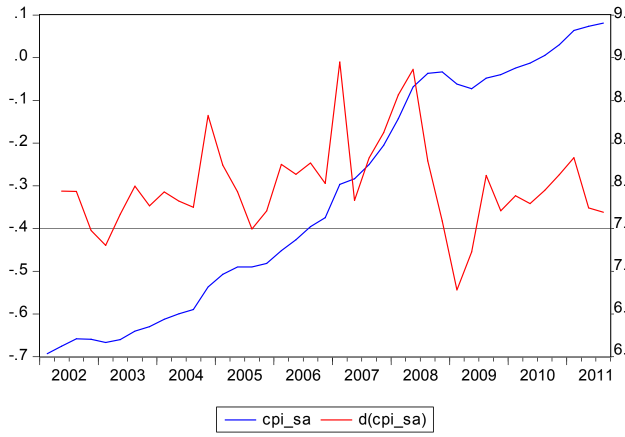
Fourth, influence of imbalances at the money market on inflation shown by the quarterly model justifies following a monetary policy rule like linking money supply to real non-oil GDP growth. This is especially important taking into account likely real non-oil GDP slowdown. Following such a rule is assumed by the forecast: in 2014 and 2015 *M*3 growth rate is lowered by 4.4 and 8.2 percentage points respectively[15], which gives 0.6 and 2.4 percentage points lower inflation than without this assumption.

Last but not least, in order to have more control over inflation Azerbaijani authorities should consider implementing measures that would foster financial deepening and contribute to expanding the share of credit in GDP. An important part of these measures would be policies to reduce the prevalence of cash transactions in the economy. On a more general level the financial deepening could benefit from reducing the grey economy (which is largely outside the control of the Central Bank) that avoids official financial intermediation channels and relies on cash operations instead. The central bank should also think of developing more sophisticated open market operations that would support the two basic policy instruments[16].

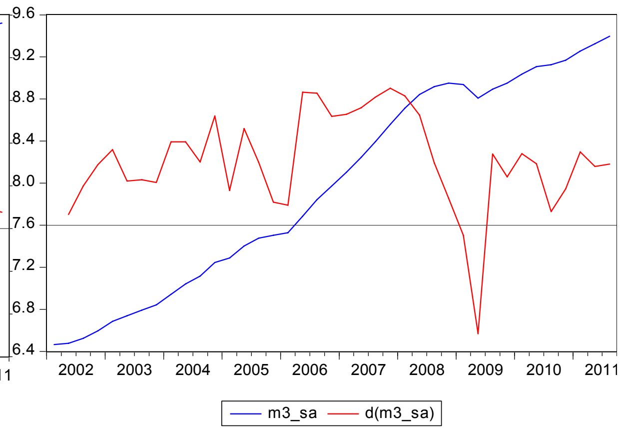
[15] See section 4.1 for details.
[16] Monetary policy instruments used in Azerbaijan (interest rates and reserve requirements) have so far had a very weak effect on inflation due to the low monetisation of the economy, prevalence of cash transactions (*M*0 constitutes about half of *M*3) and the ensuing relative low importance of financial intermediation. The money market rate is not influenced by the two policy instruments – the refinancing rate and the reserve ratio – and

Annex

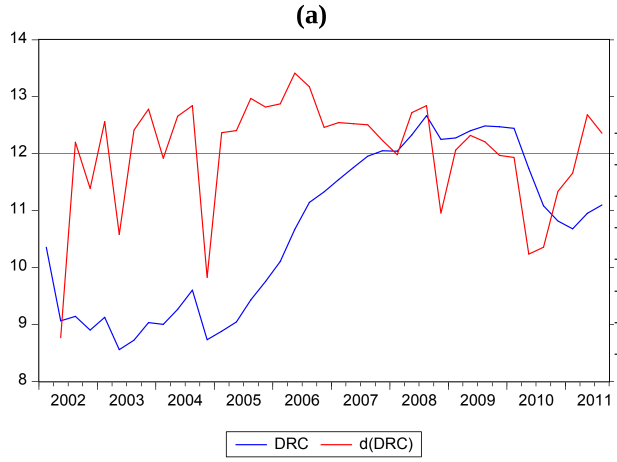
Annex 1. Time series used for the quarterly model



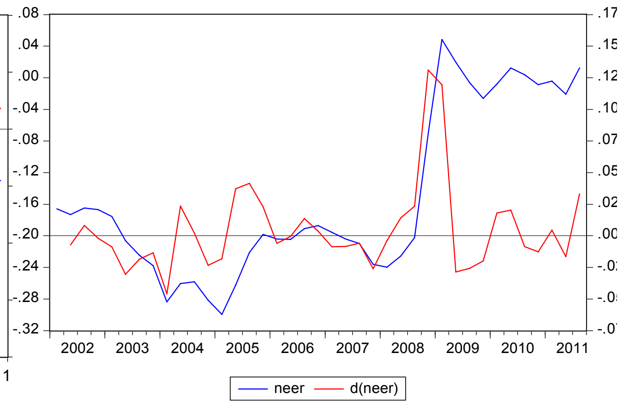
(a)



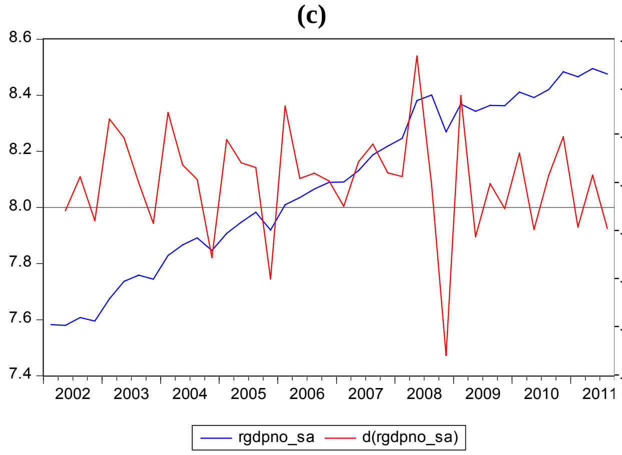
(b)



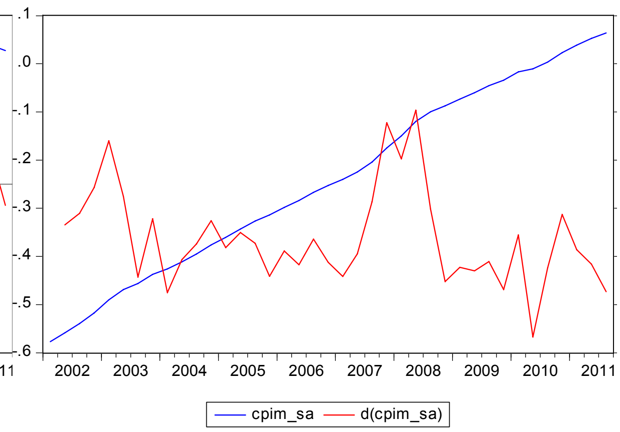
(c)



(d)*



(e)



(f)

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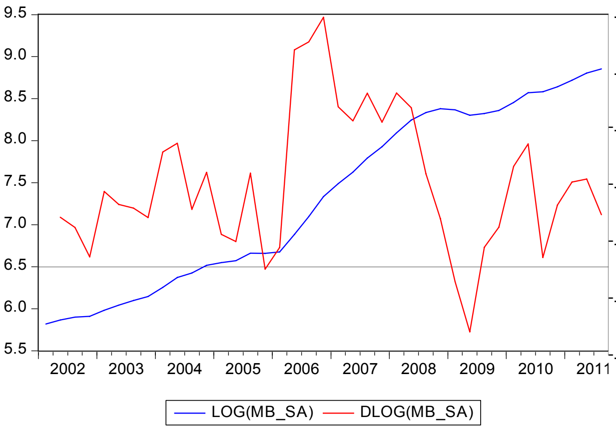
hence has little (if any) influence on inflation. The co-movement between the instruments and inflation exists but the causality runs clearly from inflation to policy changes and not the other way around.



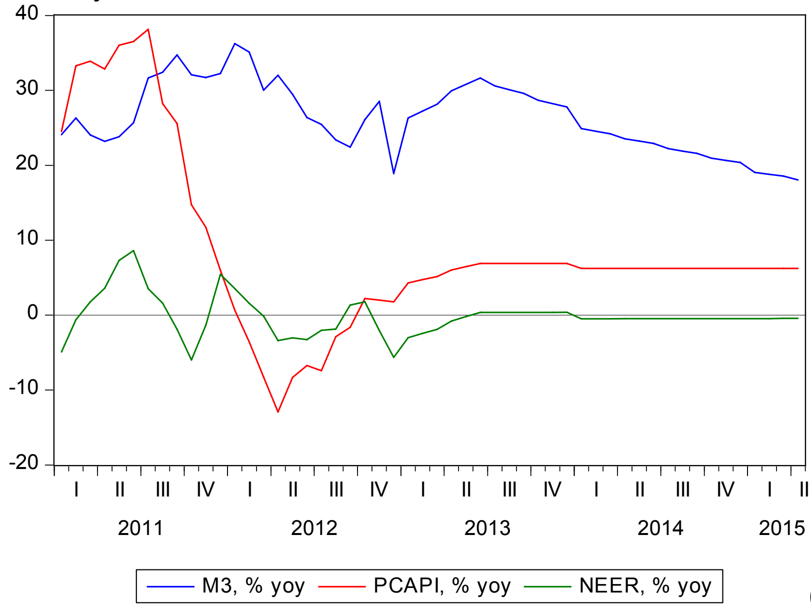
(g)

(h)

* *NEER* for 9 trading partners, see Table 2.
Source: own estimates based on Azstat, IFS and COMTRADE data.

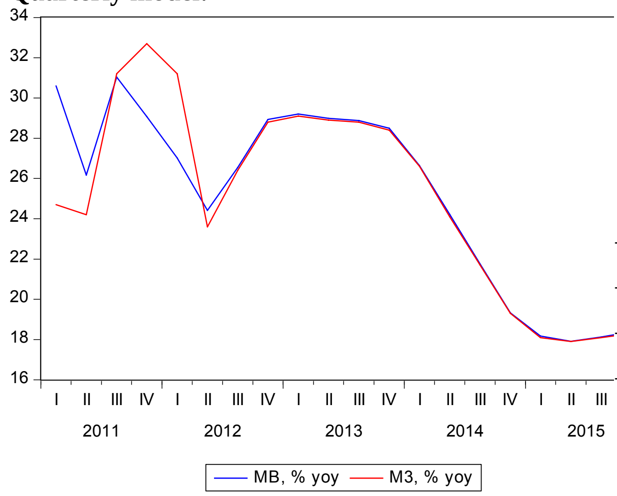
Annex 2. Explanatory variables forecast

Monthly model:

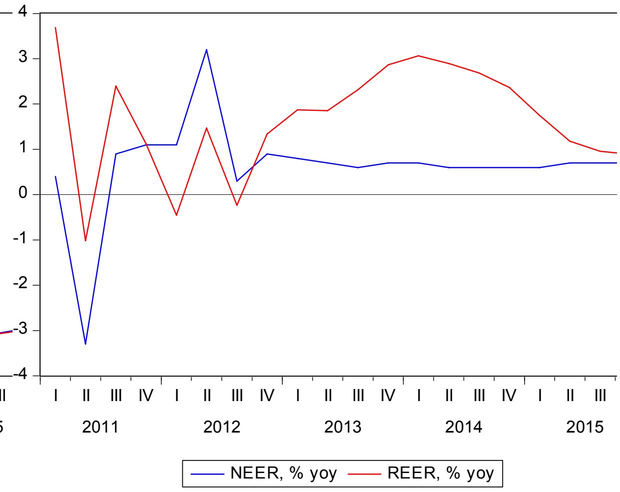


(a)

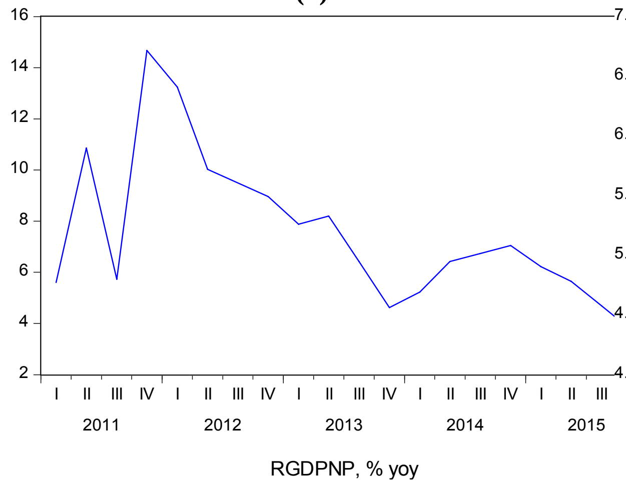
Quarterly model:



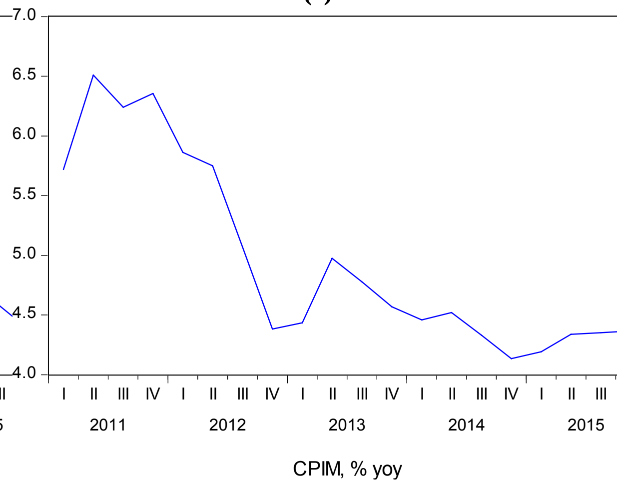
(b)



(c)



(d)



(e)

Source: own estimates.