HUNGARIAN MACROECONOMIC
VARIABLES – REFLECTIONS ON CAUSAL RELATIONSHIPS

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Abstract

This paper investigates the relationship among macroeconomic variables for a transition country of European Union as Hungary. The purpose of this paper is to measure the dynamic interrelation among macroeconomic variables as money supply, output, interest rates, inflation and exchange rates. For the empirical analysis of this investigation quarterly data have been used for the period from 1980:I to 2000:IV and the Johansen multivariate cointegration technique and the Granger causality tests have been applied. The results of this paper provide evidence for the existence of important causal relationships of the variables that describe the macroeconomic activity in Hungary.

keywords: macroeconomic variables, cointegration, Granger causality, Hungary
1. Introduction

The transformation of the Central European economies over the past decade has been radical. The private sector’s share of GDP has increased to 60% or more. Two-thirds of these countries exports are sold in EU markets. The external debt is declining continually. The goal of these successful countries is macroeconomic and structural adjustment through imposing hard budget constraints on firms, freeing prices, opening trade and the reforming of the financial sector, Feldman and Watson, (2000).

Hungary is one of the most advanced transition economies. After joining NATO in March, 1999, Hungary continues its intensive efforts in the accession process of European Union. Accession to the Union means accepting common values on the one hand and guarantee of the country’s security in economic and social terms on the other. Diplomatic relations among Hungary and the countries of the European Union were established in August 1988, followed by the Europe Agreement signed in Brussels on December 16, 1991, defining an associated status for Hungary to EC. The Communities programs (PHARE, SHAPARD, ISPA) provided an important financial assistance for economic growth, R&D, environmental investments, agricultural and rural development of Hungary. The Europe Agreement, by its content, defines some necessary obligations and tasks that every country must implement in the accession process of EU. The Hungarian government considers this process as a part of the framework of adopted national strategies and programs. The Europe Agreement provided legal foundations for First Pillar close co-operation between Hungary and EU. The agreed scheduled facilitating market access, has resulted in an increasing volume of bilateral trade and EU investments.
As a result of consistent economic strategies followed in the recent years, the Hungarian economy has been stabilised and conditions for a sustainable economic development has been created.\(^1\) Macroeconomic indicators such as inflation, unemployment, interest rates, exchange rate, money supply, exports, specified the frameworks of appropriate economic policy that had to be adopted. The annual growth of GDP has been over 4% since 2001, unemployment is now below 8%, both figures are better than EU average. Competitiveness of domestic production grew by 20%, inflation dropped under 11%, budget deficit remained under acceptance limits, while exports grew more rapidly than imports and exceeded world trade average growth for the period 1997-2001. By the end of 1990s, the share of the EU in Hungary’s external trade relations reached 75\(^2\)\(^2\).

The “emerging” economy of Hungary converted to a “converging” economy. The harmonization of legislation between the EU and its associated countries, marks an important stage on the road to a united Europe. The Hungarian government adopted a program of legal harmonization that covers all fields of both traditional legislation (customs law, company law) and the ensuring of the conditions of their implementation. The harmonization, in fact, has become a mean of modernizing the country’s legal system. The goal of this program was the preparation of the country in order to become a member of EU.

By the introduction of the Economic and Monetary Union, the EU entered in a qualitatively new phase of its history. In the second stage of EMU the political dimension of integration of European Union countries developed. The European Union broadened the role of a new Common Foreign Security and Defence Policy for associated members. Since December 1994 the heads of state and government of the

\(^{1,2}\) Relations between Hungary and European Union, [http://www.kum.hu/euint/huneu_rel.html](http://www.kum.hu/euint/huneu_rel.html), 2001
associated Central and Eastern European countries, foreign ministers and European correspondents, were invited to attend summit meetings marking the starting point for participating of their countries in the mechanisms of the Union.

Hungary has joined with the most common positions and presidency’s declarations of EU until now. Also, Hungary has welcomed the important decisions has taken by the Helsinki European Council of December 1999 on the further development of Common Foreign and Security Policy and the formation of a new Common European Security and Defence Policy (CESDP) will cover military operations serving crisis management and peacekeeping. As a candidate country to EU, member of NATO and associated member of Western European Union as well as on the basis of its geopolitical location, Hungary is interested to participate as an active and proportionate member in the implementation of goals of Common Foreign and Security and Defence Policy. As European integration develops in reference to related issues to the security policy in the world economy, the Third Pillar of the Maastricht Treaty obtained an increasing importance. Since the beginning of the process of its accession to EU, Hungary has been striving for a full membership in all three pillars of the Maastricht Treaty. The country has already been harmonized with the international commitments, the domestic legislation and the administrative procedures in relation to the respective EU objectives, and has enacted the institutions providing the proper functioning of a legal state in a democratic and constitutional way. The purpose of state policy is to combat the international crime, the corruption and the illegal migration. Upon accession, Hungary will guarantee to apply the rules that are related to the control of the external frontiers of the Union.
The European Commission published its opinion about the associated countries in December 1997. The conclusions stated that Hungary, Czech Republic, Estonia, Poland, Slovenia, could be in the position to satisfy all the demanded conditions of full membership in the medium term in the accession process to the EU. The accession negotiations started in March 1998 and Hungary was admitted to the first circle of candidates countries-members. The Berlin and Helsinki meetings of the European Council in 1999 adopted major decisions to prepare the Union for the next round of admitting new members. Berlin approved the financial provisions facilitating the EU enlargement, while Helsinki undertook the political commitment to reform the EU institutions and the decision making process intended to keep up with the international commitments for EU enlargement. Up to the Nice European Council decisions Hungary is obliged to accelerate and complete its preparation in order to become a full member of EU since 2002 and is expected to join the EU among the first new members.

The ultimate goal of the Hungarian monetary policy is the sustainable reduction of inflation. The exchange rate and interest rate policies are the instruments of the National Bank to achieve this goal. In an open economy monetary policy, through the interest rate channel, an increase in interest rates can reduce inflation by reducing aggregate demand, and by influencing inflation expectations, which in turn affect the wage and price-setting mechanism. Through the credit channel, two effects are generally distinguished: the impact of a tighter monetary policy on the supply of loans by banks (the lending channel) and the impact on the liquidity of borrowers (the balance sheet channel). The direct exchange rate channel entails the pass-through of exchange rate changes (an appreciation in the case of a tighter monetary policy) on to

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tradable goods prices, as well as indirect effects on the prices of domestically produced goods via the price of imported intermediate inputs.⁴

The exchange rate is the dominant channel for monetary policy transmission, but the NBH’s ability to influence the exchange rate is limited. Benczur (2002) highlight the importance of the direct exchange rate channel in the disinflation process in Hungary. An appreciating nominal exchange rate is not only the central, but also the fastest channel of monetary policy transmission in this regard.⁵ However, the main instrument of the NBH to influence the exchange rate is limited to its policy interest rate,⁶ and many other factors, which cannot be foreseen and involve expectations in financial markets over a range of domestic and external variables, also play a critical role. The interest rate policy will also have to ensure that capital inflows can be contained within reasonable limits.

The crawling peg system that introduced in March 1995 provided a degree of predictability in the development of fluctuation the exchange rate and at the same time maintained the necessary flexibility against external shocks. It also helped to consolidate its external economic equilibrium and improved competitiveness. This was reflected in the dynamic growth of export and a favourable movement in the real effective exchange rate indices. Reflecting the high degree of economic integration with the EU (76.5% of total Hungarian exports, import to the EU), the composition of the currency basket used for the establishment of the exchange rate has been changed, since 1 January 2000 it is comprised only of euro. The government and the National Bank of Hungary will continue to reduce the monthly devaluation of the HUF, as has

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⁴ For a detailed discussion of these channels useful references are: Bernanke and Gertler (1995); Bondt (1998); Meltzer (1995); Mishkin (1995); Svensson (1998).
⁵ NBH’s ‘‘Quarterly Report in Inflation,’’ August 2001, p.35.
been the practice over recent years. In the long run the reduction of inflation is a fundamental pre-condition for rapid and balanced economic growth.

Hungary in order to enter to EMU of EU and to ERM-2 (Exchange Rate Mechanism) must implement the convergence criteria of Maastricht Treaty. The fundamental convergence criteria of the EMU are the curbing inflation in constant levels, the limitation of fiscal deficit, the lowering public debt as percentage of GDP, the reduction of intervening government role to private sector. The goal of Hungarian government is the adoption of the single currency in the medium term after a transition period of convergence to EU, so as the initial aim of economic integration with EU be achieved. In order to draw the national currency and to substitute it with euro, Hungary was forced to adopt a new economic system based on a fixed exchange rate in relation to euro with a relatively wide deviation (±15%). According to statistical data of National Bank of Hungary the inflation rate while fluctuated in 1995 to 28.2%, marked a downward trend to 11% in 2000, the public debt from 84.3% in 1995 reduced to 60% in 2000, the fiscal deficit while in 1995 was 6.4% reached at 3.5% in 2000, the long run interest rates reduced to 8.1% and final the average devaluation of national currency in relation to euro from 26.8% in 1995 reached at a very large recession of 4% in 2000.7

Hungary’s output growth performance has been relatively modest compared to neighboring transition economies in last years. By 1997, official data indicate that real GDP in Hungary was still around 9% below its level in 1988. This contrasts with the Czech Republic and Poland where real GDP in 1997 were equal to or exceeded the 1988 levels by 12%, respectively, Beaumont, C, Doyle, P, Hviding, K, and Ligthart, J,

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6 While foreign exchange rate intervention cannot be ruled out, the NBH has restrained from intervening since the band widening and it has signaled that it would resort to intervention only in emergency situations.
Although economic growth slowed in 2001, the economy showed considerable resilience to the weaker external environment. GDP growth was a still respectable 3.8% down from 5.2% in 2000, but higher than most other countries in the region. Meanwhile, the unemployment rate edged down to 5.6% by the start of 2002, International Monetary Fund, (2002).

The Hungarian government successfully introduced a new monetary regime widening the exchange rate band in May 2001 to ±15% against the euro adopting inflation targeting in June 2001. Notwithstanding a string of interest rate cuts since the band widening, this led to a tightening of monetary conditions. With inflation expectations falling faster than nominal interest rates, real short-term interest rates have increased modestly and the national currency and forint has strengthened against the euro by some 10% points since the band widening. Inflation has come down markedly. After peaking at 10.8% in May 2001, year-on-year consumer price inflation declined steadily to 5.9% in March 2002, International Monetary Fund, (2002).

The government hopes economic growth will be accelerated in the next years. The real GDP growth of 4% by 2003 due to the exports growth, the reduction of inflation to 3.5% and the limitation of fiscal deficit to 2-3% of GDP by 2004 and the adoption of the common European currency consist medium-term goals, which the government ought to implement in the accession process of EU. The government have announced end-year targets (with tolerance of band ±1%) for headline inflation of 4.5% and 3.5% for 2002 and 2003 respectively and narrowing the deficit of the general government to 2-3% of GDP by 2004 (ESA-95 basis, consistent with the Maastricht fiscal criterion).

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It is common sense that curbing of disinflation rate should be the primary objective of monetary policy. The achievement of a strong currency in relation to the reduction policy of price level and the decline of inflationary expectations contributed to the credibility of disinflation strategy that National Bank of Hungary adopted. The aim of National Bank is the continuation of rapid disinflation rate recession. Regarding more possible the upside inflationary risks, the National Bank of Hungary had lowered the assumed exchange rate, despite its general forecast, so this measure leaded to lower-than-expected inflation. Upside inflationary risks in relation to initial projections of National Bank stem from uncertainty over regulated prices especially in 2003 and wages behavior. Nevertheless, the government is hopeful that labour market flexibility will mitigate its impact and other wages pressures on inflation.\textsuperscript{11}

The aim of the new monetary regime is the limitation of inflationary expectations through restraining of the future wage growth level, the cautious decrement of interest rates and the stabilization of a strong currency according to the inflationary predictions. The restrictive interest rates policy is regarded as a necessary measure in case of intensive inflationary pressures. The adoption of a tightening monetary policy can’t contribute to the inflation recession alone. The practice of a relatively strict fiscal policy is essential presupposition for credibility of the economic system of Hungary.

\textsuperscript{9} Effective the day of the Board meeting the National Bank of Hungary also raised its policy interest rate by 50 basis points to 9%.

\textsuperscript{11} Although too soon to form firm judgements, technical discussions at the NBH suggested that December 2001 data on private sector wages may be indicative of labor markets responding flexibly to the slowdown in growth and the appreciation of the forint.
2. Theoretical and empirical approaches

In the study of empirical macroeconomics the dynamic interrelations among economic variables is crucial and controversial one. The central question has been the study of the causal relationship among output and other macroeconomic variables such as money supply, interests, inflation and exchange rates. Different schools of thought, such as the Classicals, the Keynesians, the Monetarists, the New Classicals, the New Keynesians, the New Growth Theorists have provided different explanations for the relationship among variables.

The emphasis of the Keynesian theory was that the effective demand determines output. Even if output eventually returns to its natural level in the long run, this process is very slow. In the 60s debates between Keynesians and Monetarists concerned three issues: the effectiveness of monetary versus fiscal policy, the Phillips curve and the role of policy. The Keynesian school of thought emphasized fiscal rather than monetary policy as more important to the economy.

Friedman and Schwartz (1963) studied the evidence on monetary policy and the relationship between money supply and output in the U.S.A over a century. Their conclusion was that the monetary policy was very powerful and could explain most of the fluctuations in output. Monetarists agreed with the Classicals about the long-run neutrality of money supply and that in the long run there was no trade-off between inflation and unemployment. An important development during the 80s was the emergence of the Real Business Cycle Theory. As opposed to Keynesians and Monetarists who conclude that business cycles result in changes in Aggregate Demand (AD), RBC theorists ruled out any demand changes as a likely cause of long-lasting changes in real output. Some new classical economists have hypothesized that
business cycles are caused by factors that disturb the long-run growth trend of aggregate supply. According to this view, real factors as technology, resource availability and productivity are the main causes of business cycles.

Since the mid-1980s the New Growth Theorists have been discussing the determinants of technological progress and the role of the increasing returns to scale in explaining economic growth. A vast empirical literature has studied the predictions on the theories. Kamas and Joyce (1993) investigated the impacts of changes in monetary variables in domestic and foreign sections for Mexico and India under fixed exchange rates in two economies. The results of their investigation proved that the domestic monetary policy didn’t affect output in the two economies. Bryant et al (1988) contrasted and compared simulations by more than 10 empirical macroeconomic models. Karras (1994,1999) using a simple model studied the ability of monetary policy to affect output for a panel of 38 countries and concluded that money supply affects output, while money supply increases its influence to inflation. In the same framework Gordon and King (1982), Masih and Masih (1995, 1996), Hondroyannis (2000) have examined the causal relationships among money supply and other variables of macroeconomic environment for various countries and time periods. The different results of all these studies make it difficult for policymakers to draw firm conclusions on the relationship among macroeconomic variables. Furthermore, the new advances in the time series models help to shed light on the question of the interrelations among the macroeconomic variables.

The purpose of this paper is to evaluate empirically the dynamic interaction among macroeconomic variables for Hungary such as output, money supply, inflation, interests and exchange rates.
The testing of existence statistical relationship among 5 variables carries out as follows: Initially we confirm the integration order of related variables. Then we proceed with cointegration test using the Johansen maximum likelihood approach, and finally Granger causality test deploys, since firstly the vector error correction model has preceded.

3. Unit root tests

In Table 1 are presented the ADF tests for the 5 variables that have been used in this paper. The tests for the existence of unit root are based on Dickey-Fuller papers (1979,1981) and are used to measure the integration order of variables that used in this empirical analysis. For the best structure of ADF equations we used the Akaike (1973) and Schwarz (1978) information criteria, while the Lagrange Multiplier LM(4) test has been used for the autocorrelation test of disturbance terms.

INSERT TABLE 1 APPROXIMATELY HERE

The results of Table 1 indicate that the variables in their second differences become stationary, therefore they can be characterized as integrated order 2 I(2). Moreover, for all the variables the LM(4) test second differences shows that there is no serial correlation in the disturbance terms.
4. Cointegration analysis

Since it has been determined that the variables under examination are integrated order 2 \text I(2), we then proceed by defining the number of cointegrating vectors among variables, using the Johansen (1988) maximum likelihood procedure approach, Johansen and Juselious (1990,1992). This approach tests for the number of cointegrating vectors among all variables. It also treats all variables as endogenous, avoiding thus the arbitrary choice of a dependent variable. Finally, it provides a unified frame for the estimation and testing of cointegration relations, in the framework of the vector error correction model. The Johansen and Juselious estimation method presupposes the estimation of the following relationship:

\[
\Delta Y_t = \mu + \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \ldots + \Gamma_{p-1} \Delta Y_{t-p+1} + \Pi Y_{t-p} + u_t
\]

where:

- \( Y_t \) is a 5×1 vector containing the variables
- \( \mu \) is the 5×1 vector of constant terms
- \( \Gamma_i \) (i=1,2…p-1) is the 5×5 matrix of coefficients
- \( u_t \) is the 5×1 vector of the disturbance terms coefficients

Given the fact that in order to apply the Johansen technique a sufficient number of time lags is required, we have followed the relative procedure which is based on the calculation LR (Likelihood Ratio) test statistics (Sims 1980). The results showed that the value \( \rho = 4 \) is the appropriate specification for the abovementioned relationship. Further on we determine the cointegration vectors of the model under the
condition that matrix $\Pi$ has an order $r<n$ ($n=5$). The procedure of calculating order $r$ is related to the estimation of the characteristic roots (eigenvalues), which are the following:

\[
\hat{\lambda}_1 = 0.82316 \quad \hat{\lambda}_2 = 0.54951 \quad \hat{\lambda}_3 = 0.17724
\]
\[
\hat{\lambda}_4 = 0.030481 \quad \hat{\lambda}_5 = 0.016308
\]

The results that appear in Table 2 suggest that the number of statistically significant cointegration vectors is equal to two. The results are the following:

\[
\text{LGDP} = -26.5823\text{LM} + 37.1066\text{LCPI} - 41.9653\text{LINTER} + 24.4358\text{LEXCH} \quad (1)
\]
\[
\text{LGDP} = 0.20181\text{LM} + 0.89243\text{LCPI} - 0.090092\text{LINTER} + 0.56317\text{LEXCH} \quad (2)
\]

According to the signs of the vector cointegration coefficients that are based on the basis of the economic theory, relationship (1) can be used as error correction model in the VAR model.

5. The VAR model with an error correction model

After determining that the logarithms of the model variables are cointegrated, we must estimate a VAR model with an error correction model (EC). The error correction model is based on the long-term cointegration relationship and has the following form:
\[ \text{DLX}_t = \mu + \Gamma_1 \text{DLX}_{t-1} + \Gamma_2 \text{DLX}_{t-2} + \Gamma_3 \text{DLX}_{t-3} + \text{EC}_{t-4} + u_t \]

where:

DLX\(_t\) are the first logarithmic differences of all variables.

EC is the error correction term estimated from the long-term relationship.

Table 3 presents the estimations of error correction terms for all variables. The negative signs of the coefficients of the EC are consistent to the hypothesis that this term corrects the deviations from the long-term equilibrium relationship. Also, in Table 3 we can see that there is significance of the coefficients of error correction model in all variables.

\[ \text{INSERT TABLE 3 APPROXIMATELY HERE} \]

From Table 3 we can infer that all coefficients of the error correction have the expected signs and are statistically significant at a 5\% level in the functions of output and inflation.

6. Granger causality tests

The model that was estimated in the previous part was used in order to examine the Granger causal relationships among the variables under examination. As a testing criterion the \(F\) statistic was used. With the \(F\) statistic the hypothesis of statistic significance of specific groups of explanatory variables was tested for each separate
function. The results relating to the existence of Granger causal relationships among the variables appear in Table 4.

**INSERT TABLE 4 APPROXIMATELY HERE**

The results of Table 4 suggest the following for the changes in output:

- There is a unidirectional causal relationship between output and money supply with direction from money supply to output.
- There is a unidirectional causal relationship between output and inflation with direction from output to inflation.
- There is a unidirectional causal relationship between output and interests with direction from interests to output.
- There is a unidirectional causal relationship between output and exchange rates with direction from exchange rates to output.

For money supply we can infer:

- There is bilateral causal relationship between money supply and inflation.
- There is a unidirectional causal relationship between money supply and interests with direction from interests to money supply.
- There is a unidirectional causal relationship between money supply and exchange rates with direction from exchange rates to money supply.

For inflation we can infer:

- There is a unidirectional causal relationship between inflation and interests with direction from inflation to interests.
- There is a unidirectional causal relationship between inflation and exchange rates with direction from exchange rates to inflation.
Finally for interests we can infer:

There is a unidirectional causal relationship between interest and exchange rates with direction from interests to exchange rates.

7. Conclusions

The main purpose of this paper was to examine the dynamic interrelations among output, money supply, inflation, interests and exchange rates using quarterly data for Hungary. In the framework of this empirical analysis we have applied the co integration technique, then we have specified an error correction model and finally we have examined the existence of causal relationships of the variables in use. The evidence of cointegration existence among these variables suggest that there is a long-term equilibrium relationship. This implies that although these variables may have occasional short-term or transiently deviations from their long-term equilibrium, finally because of pressures they direct to equilibrium. Moreover, the cointegration existence excludes the possibility that the estimated relationship is spurious, this means that there must be Granger causal relationship among variables. The results showed that there is unidirectional causal relationship between money supply and output with direction from money supply to output (is more consistent with Keynesian and monetaristic theory) such as interests and exchange rates, while there is opposite causal relationship between output and inflation with direction from output to inflation. Also, there is a bilateral causal relationship between inflation and money supply, while interests and exchange rates direct money supply. Finally, interests are directed by inflation, while exchange rates direct inflation and are directed by interests.
Conclusively, the goal of monetary policy of the National Bank of Hungary, according to the results of econometric analysis that have deployed above, will be the sustainable reduction of inflation. Consequently, the reduction of inflation (or the curbing of inflation in low levels) will affect decrement of interest rates, which will ensure the capital inflows that in turn will cause output growth. As well the devaluation of HUF against euro (for the application of exchange rate) will lead to exports growth and competitiveness growth too. Therefore, the long-run reduction of inflation consists the main and substantial presupposition for the balanced economic development of Hungary and for its accession to European Union as a full member.
References


### Table 1 - DF/ADF for a unit root test

<table>
<thead>
<tr>
<th>Variables</th>
<th>In levels</th>
<th>1st differences</th>
<th>2nd differences</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lag</td>
<td>Test statistic (DF/ADF)*</td>
<td>LM(4)**</td>
</tr>
<tr>
<td>LCPI</td>
<td>4</td>
<td>-1.9304 [0.126]</td>
<td>7.0028 [0.126]</td>
</tr>
<tr>
<td>LEXCH</td>
<td>0</td>
<td>1.3188 [0.500]</td>
<td>3.3538 [0.500]</td>
</tr>
<tr>
<td>LM</td>
<td>4</td>
<td>1.4167 [0.069]</td>
<td>8.7065 [0.069]</td>
</tr>
<tr>
<td>LINTER</td>
<td>3</td>
<td>-1.8055 [0.369]</td>
<td>4.2812 [0.369]</td>
</tr>
<tr>
<td>LGDP</td>
<td>2</td>
<td>-0.86219 [0.082]</td>
<td>8.2885 [0.082]</td>
</tr>
</tbody>
</table>

*Critical value: -3.4387

** The numbers in parentheses show the levels significance

### Table 2 - Johansen and Juselious Cointegration Tests

<table>
<thead>
<tr>
<th>Variables</th>
<th>LGDP, LM, LCPI, LINTER, LEXCH</th>
</tr>
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<tr>
<td>Eigenvalues</td>
<td>Critical Values</td>
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<td>r = 1</td>
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<tr>
<td>r = 1</td>
<td>r = 2</td>
</tr>
<tr>
<td>r = 2</td>
<td>r = 3</td>
</tr>
<tr>
<td>r = 3</td>
<td>r = 4</td>
</tr>
<tr>
<td>r = 4</td>
<td>r = 5</td>
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<table>
<thead>
<tr>
<th>Trace Statistic</th>
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<td>r &gt; 1</td>
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<tr>
<td>r ≤ 2</td>
<td>r &gt; 2</td>
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<tr>
<td>r ≤ 3</td>
<td>r &gt; 3</td>
</tr>
<tr>
<td>r ≤ 4</td>
<td>r &gt; 4</td>
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</table>
### Table 3
**Estimation of error correction model coefficients**

<table>
<thead>
<tr>
<th>Endogenous variables</th>
<th>Estimates of EC Coefficient terms</th>
<th>t-statistic</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLGDP</td>
<td>-0.00450</td>
<td>-82.8109</td>
<td>[0.000]</td>
</tr>
<tr>
<td>DLM</td>
<td>-0.041468</td>
<td>-0.83701</td>
<td>[0.405]</td>
</tr>
<tr>
<td>DLCPI</td>
<td>-0.081710</td>
<td>-3.4336</td>
<td>[0.001]</td>
</tr>
<tr>
<td>DLINTER</td>
<td>-0.059765</td>
<td>-1.0067</td>
<td>[0.317]</td>
</tr>
<tr>
<td>DLEXCH</td>
<td>-0.048360</td>
<td>-1.6944</td>
<td>[0.095]</td>
</tr>
</tbody>
</table>

### Table 4
**Granger causality tests**

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Hypothesis tested</th>
<th>F1</th>
<th>F2</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLGDP</td>
<td>DLM there is a unidirectional relationship (DLGDP ⇐ DLM)</td>
<td>9.574</td>
<td>1.515</td>
</tr>
<tr>
<td></td>
<td>DLCPI there is a unidirectional relationship (DLGDP ⇒ DLCPI)</td>
<td>0.287</td>
<td>7.279</td>
</tr>
<tr>
<td></td>
<td>DLINTER there is a unidirectional relationship (DLGDP ⇐ DLINTER)</td>
<td>4.239</td>
<td>0.067</td>
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<tr>
<td></td>
<td>DLEXCH there is a unidirectional relationship (DLGDP ⇐ DLEXCH)</td>
<td>5.028</td>
<td>0.140</td>
</tr>
<tr>
<td>DLM</td>
<td>DLCPI there is a bilateral relationship (DLM ⇔ DLCPI)</td>
<td>10.97</td>
<td>4.289</td>
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<td>DLINTER there is a unidirectional relationship (DLM ⇐ DLINTER)</td>
<td>3.881</td>
<td>0.254</td>
</tr>
<tr>
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<td>DLEXCH there is a unidirectional relationship (DLM ⇐ DLEXCH)</td>
<td>3.308</td>
<td>0.756</td>
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<tr>
<td>DLCPI</td>
<td>DLCPI there is a unidirectional relationship (DLCPI ⇒ DLINTER)</td>
<td>1.205</td>
<td>4.840</td>
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<tr>
<td></td>
<td>DLCPI there is a unidirectional relationship (DLCPI ⇐ DLEXCH)</td>
<td>4.570</td>
<td>1.094</td>
</tr>
<tr>
<td>DLINTER</td>
<td>DLINTER there is a unidirectional relationship (DLINTER ⇒ DLEXCH)</td>
<td>1.069</td>
<td>3.052</td>
</tr>
</tbody>
</table>

Critical value: 3.04