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An Investigation into the Dynamics of Inflation in Latvia: The P-star approach

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The remaining errors are those of the authors.

Abstract

The paper aims to evaluate the version of the P-star model of inflation dynamics in Latvia. There is no evidence that the model was applied to any of the Baltic countries prior to the research made by the authors. However, the approach has been widely employed for testing the influence of big anchor economies on the inflation development of smaller open economies. Originally, the model derives from the Quantity equation. The main idea behind the model states that inflation is driven by a positive gap between equilibrium and actual price level. This paper tests the influence of both domestic and foreign price gaps. The research covers quarterly macroeconomic data for the period starting from the first quarter of 1999 till the third quarter of 2004. The Euro Zone was selected as the anchor economy and even though the Lat was pegged to the Euro only on January 1, 2005, the Euro-based price gap turned out to be prominent in explaining inflation dynamics in Latvia. It is important to note that the model regards inflation as a monetary phenomenon and therefore does not encounter short-term inflationary factors. Rather, it estimates how short-term inflation dynamics adjust in the price level in the long term.

Keywords: The P-Star model, Inflation dynamics, Equilibrium price, GDP deflator, Domestic price gap, Foreign Price gap.

1 Introduction

After the official entry of the Republic of Latvia into the European Union (EU) on May 1, 2004, the country now proceeds with further fulfilment of numerous political and economic conditions. Among many EU regulations that the new member states have agreed to comply with, one of the most known is the chapter on Economic and Monetary Union (EMU) in the Maastricht Treaty, which obliges the new member states to enter EMU and adopt the Euro. For Latvian policy makers this process will involve not only implementation of formal requirements, but also handling the pivotal challenge of bringing back price stability in the economy.

The preparation process for the enlargement of EMU, outlined in Article 121 of the Maastricht Treaty, requires the European Commission to conduct supervision of the new member states and report on their progress by publishing the Convergence Report. The recent spurt of inflation in Latvia, marked as one of the problems in the latest Report, still persists and thus increases the challenge for the Bank of Latvia as well as providing interesting questions for scholars.

There have been several attempts in the field of academic research to test for the possible determinants behind the dynamics of inflation in Latvia. This paper aims to investigate the issue from the perspective of the P-star approach, a method that has not been previously applied for the country.

1.1 Relevance of the study

The Convergence Report, mentioned above, gives a continuous assessment on the new EU member states' performance in complying with the five Convergence Criteria. Firstly, the report examines the compatibility of each country's national legislation with the Maastricht Treaty as well as the Statute of the European Central Bank and that of the European System of Central Banks. Secondly, Convergence Criteria apply to several economic indicators and establish precise reference values for price stability, government budgetary position, exchange rate stability, and long-term interest rate convergence.

Table 1.1 summarizes the latest report, published on October 20, 2004, on the convergence of Latvia (see Appendix 1 for the fragment of the Convergence Report on Latvia). The "Convergence Report 2004 indicates that Latvia does not fulfil three of the above listed five criteria**.** Even though the Latvian Lat is now pegged to the Euro, the Treaty requires a country to participate in the fixed exchange regime for at least two years before the

assessment. Successful fiscal and monetary policy means have led to a satisfactory government budgetary position. In addition, Latvia meets the requirement for long-term interest rate convergence. However, efforts will have to be made to establish legal compatibility and address the problem of inflation.

Table 1.1 Latvia's position in the fulfillment of the Convergence Criteria

No.	Convergence Criteria	Latvia's fulfilment
1	Legal compatibility	No
2	Price stability	No
3	Government budgetary position	Yes
4	Exchange rates	No
5	Long-term interest rate convergence	Yes

***Notes*: Latvia's position had not changed at the completion date of the paper with regard to any of the five criteria. Source: European Commission, "The Convergence Report 2004", published on October 20, 2004**

Despite the presence of several issues that have to be handled by the Latvian authorities in order to fulfil the convergence criteria, this paper focuses specifically on the question of price stability. There are several reasons for making this delimitation, the most important being the simple fact that too high inflation is not only an obstacle for successful convergence, but also a serious problem for a country's economy. This is also acknowledged by the Bank of Latvia, which has set a low and stable long-term inflation rate as its key objective for ensuring favourable macroeconomic environment for growth of the national economy (Highlights of Resolutions and Regulations Adopted in Pursuit of the Bank of Latvia's Main Tasks, 2005). Moreover, the dynamics of inflation appear to be the most interesting issue for investigation due to the fact that the Latvian economy is currently experiencing a spurt of inflation after a five-year period of price stability. The Bank of Latvia has been trying to address the problem by increasing short-term interest rates in Latvian financial markets (Highlights of Resolutions and Regulations Adopted in Pursuit of the Bank of Latvia's Main Tasks, 2005). However, high inflation levels persist, and the reason behind that is still under question..

According to Friedman, inflation is a purely monetary phenomenon in the long run, because changing money supply affects only nominal income, but not real income, as prices eventually adjust to initial changes in production. However, if an economy does not have the equilibrium money supply and money velocity is not optimal, then inflation becomes not only a monetary issue (Kool and Tatom, 1994). This paper is dedicated to an analysis of inflation dynamics in Latvia by employing the P-star model, originally derived from the Quantity theory equation of exchange. Indirectly, the idea behind the model states that monetary disequilibrium results in greater spending and increased demand pressures. More generally,

the P-star model can be seen as a reduced form representing a narrative view of monetary transmission with a long pedigree, namely one that places imperfections in the financial system, monetary expansions and the resulting credit booms and busts at the heart of explanations of macroeconomic developments (Gerdesmeier, Motto, and Pill, 2002). Implicitly testing if and how the P-star model fits the situation in the Latvian economy allows determination of the influence of monetary aggregates change on the dynamics of inflation.

There are two main reasons why the authors of the paper chose the P-star approach for the intended analysis. Firstly, this approach has been used in numerous researches to explore the influence of monetary disequilibria on the dynamics of inflation. Secondly, there is no historical evidence that the model has been applied for Latvia; therefore, academic inquisitiveness is even more stimulated.

1.2 Research Questions

The primary purpose of this paper is to investigate the relation between price disequilibria and inflation dynamics by fitting the P-Star model to the country's economy. To be more specific, the paper has the following objectives.

Firstly, the research will explore the extent to which the P-star model is applicable for the case of Latvia and how precisely inflation dynamics can be explained using the techniques proposed by the developers of the model.

Secondly, the study aims to find a version of the model that best fits the Latvian economy. Thus, the authors intend to come across with implications about possible time lags between inflation determinants and their transmission into inflation figures as well as about the comparative significance of domestic and foreign causes of inflation.

Finally, the research will investigate if short run dynamics of inflation in Latvia can be described as moving towards long run equilibrium. This will then provide implications on whether inflation can be validly predicted by the P-star approach and if the country's ability to achieve set inflation targets can be evaluated.

1.3 Methodology

The chosen methodology of the P-Star approach is based on the simple assumption that a positive difference between equilibrium and current price level causes inflationary pressures, while negative difference evokes disinflation or even deflationary pressures. The model explores both domestic and foreign price gap dynamics and their influence on the short run dynamics of inflation.

For the purpose of the research, the study scrutinizes quarterly data series of the period Q1 1999 till Q3 2004. In order to attain the objectives of the paper presented above, the following tools are applied:

- Firstly, the methodological background for the research is established based on the historical development of the model and previous researches published.
- Secondly, the implicit variables, i.e. index of Latvian GDP deflator, index of domestic and Euro Zone money velocity, index of money supply as well as nominal and real exchange rate indexes are constructed. The equilibrium values of the outlined economic indicators are obtained using the Hodrick - Prescott filtering technique.
- Thirdly, the time series are tested for stationarity by applying unit root tests.
- Lastly, the best fitting version of the P-star model is evaluated by using OLS regressions. All regressions are run twice, i.e. using narrow money M1 as well as broad money M3[1] as a proxy for money supply.

1.4 Structure

The rest of the paper is organized in the following manner. Section 2 colligates the historical development and applications of the P-Star displaying a systematized literature review. A detailed theoretical framework and mathematical derivation of the model is delivered in section 3. Section 4 is devoted to evaluation of data collected and construction of data series variables. Section 5 reports the results of regressions run and presents the econometric analysis of the results. Section 6 presents the analysis and economic intuition behind the results. Section 7 concludes and presents propositions for further research.

2 Review of Literature

Aims of the section:

- *To present historical development of the P-Star model*
- *To perform a comparison of the results of the previous researches*

The P-star approach has been developed relatively recently and its general idea relies on the quantity theory of money and its equation of exchange. The original P-star model was firstly proposed in 1991 by Hallman, Porter and Small as a dynamic inflation model for the US economy. The model explicitly linked the determinants of long-run equilibrium prices to

[1] M3 for Latvia is obtained from the Eurostat data base so that data employed would be comparable among the Euro Zone and Latvia.

the short-run dynamics of inflation. Thus, the deviations of current prices from equilibrium were said to drive inflation and price level to equilibrium (Kool, Tatom, 1994).

As the basic P-star model relates to a closed economy, it has generally worked better for large than for small economies, particularly this being the case when small economies have had a fixed exchange rate. Hence, a modified version of the model has been developed to account for the influence of foreign price level on a small economy's dynamics of inflation (Wesche, 1998). In particular, large economies are not greatly influenced by economic events in a small country. On the contrary, some small economy views the monetary policy of the anchor country as given and strictly sticks to the obligation to peg the exchange rate. Thus, the exchange rate peg to a large extent determines the equilibrium price level and, consequently, the inflation rate of the small economy (Matuszek, 2000).

Despite the relatively short time span since the model's development in 1991, P-star has been used in a large number of studies to test the link between money and inflation. It is possible to distinguish four basic categories with respect to the ways the P-star approach has been applied in different research papers:

- Testing the link between money and inflation using a closed economy model, which includes only domestic price gap (usually applied for large economies, e.g. USA, Germany, Euro area);
- Testing the influence of a large country's monetary policy on the inflation of an open economy that is closely tight to the former one (usually applied for small economies with fixed exchange rate system);
- Finding the best fit version of the P-star model for a specific economy by adding additional explanatory variables to the "core" model, e.g. cost of raw materials, unit labor cost, short term and long term interest rate differential;
- Determining the inflation forecasting power of the P-star model and comparing it with that of alternative models, e.g. socio-political models based on cost push factors, interest rate term structure model.

Even though a substantial part of the papers cover the features of more than one category listed above, the authors of the paper focused specifically on the second type of research due to the objectives of the study described in the introduction. Appendix 2 summarizes the main papers in which the link between a large economy's money supply and a smaller economy's inflation has been investigated.

The P-star model has been used to test an anchor economy's influence on the inflation of open economies which have either fixed (The Czech Republic) or floating (Switzerland) exchange rate regimes, and can be described as either small (Belgium) or large (Spain) in the context of the EU. The results thus far suggest that the model has proven to work well for explaining inflation dynamics in various countries in Europe, particularly those having pegged exchange rates and closely tied economy to the anchor country.

The model has been extensively used to test for the influence of an exchange rate peg on a small economy's level of inflation. Clemens J.M. Kool and John A. Tatom (1994) explicitly focused in examining the influence of cross-country price gaps on the dynamics of inflation in five different countries, Austria, Belgium, Denmark, the Netherlands and Switzerland. Again, the importance of the German mark on the development of price level in these countries was investigated, while domestic factors were accounted for as well. In addition, the authors also investigated the influence of US price developments on inflation patterns in the five countries as well as in Germany. The authors concluded that the effect of German prices on each of the countries has been proportional to the tightness of the exchange rate peg of each particular country to the Deutschmark. At the same time, cross-country price gaps have proven to be insignificant in the determination of the price level in either Germany or the USA, the countries having floating exchange rates.

The P-star model has also been used to investigate inflation dynamics in the Central European countries. Jan Frait, Lubos Komarek and Lumir Kulhanek (2000) applied the model to the Czech Republic to analyze inflation for the period 1991-1999. Positive support was found for the model, and the foreign price gap turned out to be more significant than the domestic one. Thus, Czech prices are largely determined by monetary policy in the EU, by the peg of the Czech currency exchange rate to the DEM and later to the EUR.

Finally, the P-star approach has been widely used to study monetary integration in Europe in the context of the European Monetary System. Katrin Wesche (1998) tested the P-star model for the influence of German price movements on single countries, France, the Netherlands, Belgium and Austria, as well as for the aggregate of these countries. While the dominant influence of German prices on the EMS as a whole is rejected, positive evidence is found for the effect of German price level on separate countries, namely, the Netherlands, Austria and France.

To summarize, the P-star approach has been used in numerous researches to test for the influence of foreign price gaps on the inflation of a small economy. However, so far there

has been no research that would explicitly focus on Latvia and investigate if Latvian inflation has been determined by the monetary policy of some larger economy. This is a space in the field of academic literature that the following paper aims to cover. The P-star model, like other alternative models, is useful because it gives another perspective on the likely evolution of a critical macroeconomic variable, namely inflation, and thus provides a check on other methods that might be in use.

3 Theoretical Framework

Aims of the section

- *To introduce the concept of domestic and foreign price gaps*
- *To demonstrate the development of the P-Star model for a closed economy*
- *To gradually launch the mathematical framework.*

This section is devoted to developing the P-star model that will be used in the investigation of Latvian inflation dynamics in the proceeding parts of the paper. First, the authors present the model for a closed economy in order to test the significance of the domestic price gap on inflation. Then, the model for a small open economy will be introduced for evaluating the importance of the foreign price gap on price level changes in Latvia. In the ultimate P-star model for the Latvian economy, the authors intend to test the significance of both gaps together.

Even though at the first glance it might seem superfluous to develop a closed economy model for Latvia; there is sufficient theoretical reasoning to do so. Under a fixed exchange rate regime, purchasing power parity between two countries is only established in the long-run, while in the short run domestic prices can move within some unspecified band around purchasing power parity. Thus, domestic inflation is not entirely determined by foreign prices, and this requires additional explanation (Smant, 1997).

3.1 P-star Model for Closed Economy

The P-star model is based on the neo-classical quantitative theory of money and its main notion is the identification of long run equilibrium price level as a variable determined by current money supply, potential income and the equilibrium rate of money circulation. Porter's analysis begins with the basic equation of the Quantity theory of exchange:

$$(3.1)\quad M_t \cdot V_t = P_t \cdot Y_t,$$

where M is money supply, V denotes money velocity, P is price level and Y equals output. If all the variables are expressed as logs, the equation can be rewritten as

$$(3.2)\quad m_t + v_t = p_t + y_t$$

In their analysis of inflation, Hallman, Porter and Small (1991) assumed that there is long run equilibrium, in which according to quantity theory

$$(3.3)\quad p_t^* = m_t + v_t^* - y_t^*$$

where p* indicates long run equilibrium price level, v* is the equilibrium level of money velocity and y* is potential output, with all the variables taken as log values. Thus, according to the quantity theory of money the long run equilibrium price level is a purely monetary phenomenon, because v* and y* are constant, and p* is only dependent on money supply. However, the short run dynamics of price level also depend on the short run deviations of velocity and output from their long run equilibrium values. In particular, these are referred to as velocity and output gaps. The relationship between velocity gap, output gap and price gap, which is the short run price level deviation from its long run equilibrium, can be found by combining the equations (3.2) and (3.3). The relation obtained is

$$(3.4)\quad \left(p_t^* - p_t\right) = \left(v_t^* - v_t\right) - \left(y_t^* - y_t\right)$$

Thus, the price gap stands for the combination of velocity gap and output gap, which can also be interpreted as capacity utilization gap. If production utilization is too high (short run economic output is higher than long run equilibrium) and/or the velocity of money is below its long run equilibrium level, the price gap is positive, which indicates a presence of inflationary pressures in the economy. On the contrary, a lower than equilibrium production utilization rate and/or higher than equilibrium rate of money velocity would indicate a negative price gap, which implies a likely deceleration of the price level in order to return to the long run equilibrium. Hence, in estimating inflationary pressures the P-star model accounts for both real as well as monetary factors.

Further, Hallman, Porter and Small (1991) develop their model by stating that p and p* are co-integrated and in the long run equilibrium p = p*. Thus, current price level moves to adjust the equilibrium price level. The relationship obtained for the P-star model is then the following:

$$(3.5)\quad \Delta\pi_t = \alpha_0 + \sum_{i=1}^{4} \alpha_i \left(p_t^* - p_t\right)_{t-i} + \sum_{j=1}^{4} \delta_j \Delta\pi_{t-j} + \varepsilon_t \ ,$$

where π_t stands for inflation, (p* - p) is the price gap and ε denotes an error term. The $\Delta\pi$ is used in the equation (3.5) in order to deal with possible nonstationarity in the data set of inflation. An autoregressive distributed lag (ADL) scheme is used in the equation (3.5), as it features lagged values of explanatory variable, domestic price gap, as well as of the dependent variable. The lagged inflation π_{t-j} is added to the equation to account for short run inflation

dynamics that influence the current level of inflation, while lagged domestic price gap values are included to account for possible time lags before changes in inflation determinants are transmitted into actual inflation changes. The obtained relationship can be tested to find the significance of the domestic price gap on changes in inflation, and, in particular, the extent to which inflation is influenced by deviations of domestic velocity and output from their equilibrium levels.

3.2 P-star Model for a Small Open Economy

As indicated earlier in the paper, the initial version of the P-star model has been generally rejected when tested for small open economies, thus giving rise to the issue that inflation is to a great extent determined by foreign price changes, particularly in cases of fixed exchange rate regimes. The major idea of the adjusted model hence becomes the fact that short-term changes of inflation are a function of the price gap between a small open economy with a fixed exchange rate and a big economy. The big economy acts like an anchor and the effects of its monetary policy are transmitted to the small economy through the exchange rate. In particular, the equilibrium foreign price level determines the equilibrium domestic price level through the exchange rate as can be observed in the following equation

$$(3.6)\quad P^{d*} = \frac{E \cdot P^{f*}}{ER^*}\ ,$$

where P^{d*} is domestic long run equilibrium price level, P^{f*} is foreign long run equilibrium price level, E is nominal exchange rate and ER^* is long run equilibrium real exchange rate. Once all variables are expressed as logs, the equation can be rewritten as

$$(3.7)\quad p_t^{d*} = p_t^{f*} + e_t - er_t^*$$

This exchange rate constraint then implies that the price gap in the small open economy is determined in the anchor country and is sustained by the fixed exchange rate regime. The foreign price gap that determines the inflation rate in the domestic country can be expressed as:

$$(3.8)\quad \left(p_t^{d*} - p_t^{d}\right) = \left(p_t^{f*} + e_t - er_t^*\right) - p_t^{d}\ ,$$

where p^{d*} is the domestic equilibrium price level, p^d is current domestic price level, p^{f*} denotes foreign equilibrium price level, e stands for current nominal exchange rate and er^* is the real equilibrium exchange rate. In the equation all the variables are expressed as logs.

Kool and Tatom (1994) present another implication following the introduction of the foreign price gap in the P-star model. In particular, the domestic price should lose its significance as a determinant of inflation in the small economy, whose exchange rate has been

fixed. Still, the extent to which domestic inflation is determined by the foreign price level will depend on the degree to which the exchange rate is fixed as well as on the level of integration between the big and the small economy. The larger the mobility of goods and capital between the two countries, the faster will be the speed at which domestic prices will adjust to long run equilibrium determined through the exchange rate regime.

Hence, the relationship derived from the P-star approach that will be tested for a small open economy is the following:

$$(3.9)\quad \Delta\pi_t = \alpha_0 + \sum_{i=1}^{4} \alpha_i \left(p_t^{d*} - p_t^{d}\right)_{t-1} + \sum_{j=1}^{4} \delta_j \Delta\pi_{t-j} + \varepsilon_t$$

In the equation (3.9), $(p^{d*} - p^{d})$ represents the foreign price gap. The ADL scheme and, particularly, the lags of the foreign price gap are included to account for the possibility that inflation responds slowly to the differences between the current domestic price level and the foreign determined long run equilibrium price level.

Even though previous researches in the field have shown that the domestic gap generally loses its significance when the foreign gap is measured, the ultimate P-star model in this paper will include both gaps. The authors of the paper still want to account for the domestic gap because the exchange rate regime between Latvia and the Euro zone has not been strictly fixed, therefore, domestic influences might play a role in the determination of inflation. Thus, the fundamental P-star model to be tested can be represented as:

$$(3.10)\quad \Delta\pi_t = f\left(GAP_{t-1}^{d}, GAP_{t-1}^{f}\right),$$

where π stands for inflation, GAP^{d} designates domestic price gap and GAP^{f} is the foreign price gap. In this model, change in inflation is a function of both price gaps that were presented previously in the paper.

Finally, the econometric form of the P-star model that will be tested can be represented as:

$$(3.11)\quad \Delta\pi_t = \alpha_0 + \sum_{i=1}^{4} \alpha_i \left(p_t^{*} - p_t\right)_{t-1} + \sum_{j=1}^{4} \alpha_j \left(p_t^{d*} - p_t^{d}\right)_{j-1} + \sum_{k=1}^{4} \delta_k \Delta\pi_{t-k} + \varepsilon_t \ .$$

The authors would also like to note their expectations about the results that will be taken into account when evaluating the best fit version of the model. Firstly, as stated above, positive price gaps should imply inflationary pressures in the economy; therefore, the authors expect the coefficients α_i and α_j to be positive. Secondly, Latvia is a small open economy having a fixed exchange rate; thus, it is expected that the magnitude of the coefficient α_j will

be larger than that of α_i. Finally, the authors expect that the presence of long-term inflation equilibrium will be proven; therefore, the coefficient δ_k is expected to be negative.

4 Data Description

Aims of the section:

- *To define the sample size*
- *To specify the data gathered*
- *To perform stationarity tests*
- *To introduce detrending techniques*
- *To estimate the equilibrium values of the variables*

To begin with, the Euro zone including hereupon the current twelve EMU members was chosen as the anchor economy for the P-star model developed for Latvia. The initial representations of the model suggested that the large economy represents a country with which the small economy has established a fixed exchange rate regime. However, there are several reasons for selecting the Euro Zone as a proxy for the anchor economy in spite of the fact that the Latvian national currency Lat (LVL) was pegged to the Special Drawing Rights basket (SDR) over the period considered in the research.

At the outset, during examination of the academic literature, the authors spotted several working papers (see Kool and Tatom, 1994), which showed that the P-star model can be successfully fitted to economies that have not explicitly adopted a fixed exchange rate regime. In addition, since 1999 the weight of the Euro currency in the SDR basket has been 32%, thus, the Lat has been partially pegged to the Euro over this period.

Secondly, taking into account the importance of macroeconomic forecasting, the authors believe it is highly reasonable to test the relationship between Latvian and Euro zone price levels, since the Lat was pegged to the Euro on January 1st, 2005. Detecting strong previous monetary links between the two economies will allow implications about possible future inflation developments in Latvia.

Thirdly, the geographic and trade proximity between Latvia and the Euro zone was considered. The option that the economy of the United States directly affects inflationary trends in Latvia was rejected due to two reasons. The Euro zone and, particularly, Germany, is strongly related to the US economy and the internal relationship among them is assumed to be fully reflected in Euro zone performance. Moreover, the Latvian foreign trade account relies on trade with the EU much more than on trade with the USA.

Finally, the largest part of Latvian imports comes from Euro Zone countries, such as Germany and Finland. In particular, the largest export markets such as the United Kingdom

and Sweden are not the most active import partners of Latvia. Thus, the largest import partner having a unanimous currency turns out to be the Euro zone (around 30% annually) with Germany being ahead (consult Appendix 3 for Latvian import statistics).

4.1 Data Series

For the purpose of the research, quarterly data series for the period Q1 1999 to Q3 2004 were employed. There are two main reasons for choosing the specified period. Firstly, the euro was introduced on January 1st, 1999. Secondly, the authors consider the dynamics of inflation of earlier periods to be of little relevance in explaining today's inflation behavior. The price level increase slowed down in the middle of 1998 and even decreased to considerably low levels in the consecutive periods, during which the quarterly CPI moved up by 1-3% compared to the respective period of the previous year (see Appendix 4 for more detail). Only in 2004 inflation accelerated again and reached 7.4%.

The third quarter of 2004 became the upper boundary for the data series employed due to the latest data availability at the time of the research. All the data on monetary aggregates, national output as well as the historical development of nominal exchange rate was collected from The Eurostat on-line database, and compared to respective data provided by the Bank of Latvia and the Central Statistical Bureau of Latvia when possible.

Even though the official Latvian authorities publish data on the M2X monetary aggregate, the authors employed the M3 monetary aggregate provided by the Eurostat data base. Both figures slightly differ, since the structure of M2X is the same as that of M3 added to deposits in foreign currencies. The reason for this choice is the necessity for consistency since data on the M2X monetary aggregate was not available for the Euro zone.

All the indexes (GDP deflator index, Narrow and Broad money velocity index, M1 and M3 index, Real GDP index, Nominal and real exchange rate index) except for the GDP deflator index were calculated for both, Latvia and the Euro zone. The research uses the index values of the data because of two main underlying reasons. Firstly, the economic potential of Latvia and the Euro Zone cannot be compared in absolute terms, because the immense difference between the absolute values of their monetary aggregates and national output would disturb the results of the regressions even if log values are employed. Secondly, the research is expected to be more conclusive if the development speed and/or volume of change of an indicator rather than their nominal values are compared.

4.2 Construction of variables

The derivation of variables from the collected data is presented in the following section. Firstly, the change of the implicit GDP deflator (calculated as current GDP divided by real GDP) is used as a proxy for the inflation indicator in Latvia. GDP deflator change was selected as a measure of inflation for the research because it comprises the whole economy and reflects the true increase of the national price level. In addition, several previous academic researches (for example, see Smant, 1997) employed the same proxy for inflation.

Secondly, the implicit quarterly money velocity is calculated using the methodology employed by the Bank of Latvia, which is shown in the following equation:

$$(4.1)\quad V_t = \frac{4 \cdot GDP_t}{MS_t},$$

where V indicates money velocity, GDP is nominal gross domestic product, and MS stands for money supply. The money velocity figures obtained were then used to calculate money velocity index. Narrow and broad money velocity indexes were derived using M1 and M3 monetary aggregates as measures of money supply.

Thirdly, current domestic and foreign price levels were calculated according to the equation (3.2), while the domestic price gap was obtained from the equation (3.4). The required equilibrium values for money velocity, national output and real exchange rates were obtained using a suitable detrending technique, which was selected after testing for stationarity.

Finally, the foreign price gap was estimated using equation (3.8).

4.3 Equilibrium value estimation

In order to determine both, domestic and foreign price gaps, the equilibrium values of certain data variables are to be estimated. It is obvious that macroeconomic aggregates are influenced by numerous external and domestic factors; therefore, they do not follow a smooth pattern, but have cyclical trends, are affected, e.g., by shocks, changes in monetary, structural and fiscal policy.

Because of the cyclical behaviour of macroeconomic indicators the detrending procedure becomes pivotal for equilibrium output and money velocity estimation. However, the selection of detrending techniques is not a straightforward process. Different research papers question the appropriateness of available techniques, because there is no common opinion about the properties of the trend (deterministic or uncorrelated) and the relationship between the trend and the cyclical component (correlated or uncorrelated). The second issue

of concern is whether the method should be economic or econometric. Moreover, the selection of equilibrium value calculation technique depends on data properties as well, because some techniques cannot be applied to nonstationary data series. Hence, the stationarity of the data to be employed was tested (see Appendix 5 for a more detailed description of stationarity testing). Consult Appendix 6 to examine other possible detrending techniques (Peeters Anneleen, 1998).

The authors employed the Hodrick-Prescott (HP) filtering method to estimate the optimal output and money velocity rates. Selection of this technique was based on the fact that the method combines econometric and economic properties and both output and velocity gaps become stationary, as the trend follows the stochastic process. Moreover, the model is a relatively simple and widely used tool among other researches for detecting the equilibrium values of economic variables. See Appendix 7 to compare the advantages and disadvantages of the most commonly used detrending methods.

Equilibrium values are obtained through minimizing the data fluctuations around the trend, which basically requires minimizing the following function:

$$(4.5)\quad \sum\left(\ln y_t - \ln y_t^*\right)^2 + \lambda \sum\left[\left(\ln y_{t+1}^* - \ln y_t^*\right) - \left(\ln y_t^* - \ln y_{t-1}^*\right)\right]^2$$

where y^* stands for the trend value and the λ is a smoothing coefficient which regulates how smoothly the variable develops. A low λ produces optimal values very close to the observed variables. On the other hand, if the λ value is very high, the result will be very similar to the linear trend. The model is mostly criticized because of the freedom in selection of the smoothing value. Hodrick and Prescott, the developers of the model, suggested that for quarterly data the λ value should be 1600.

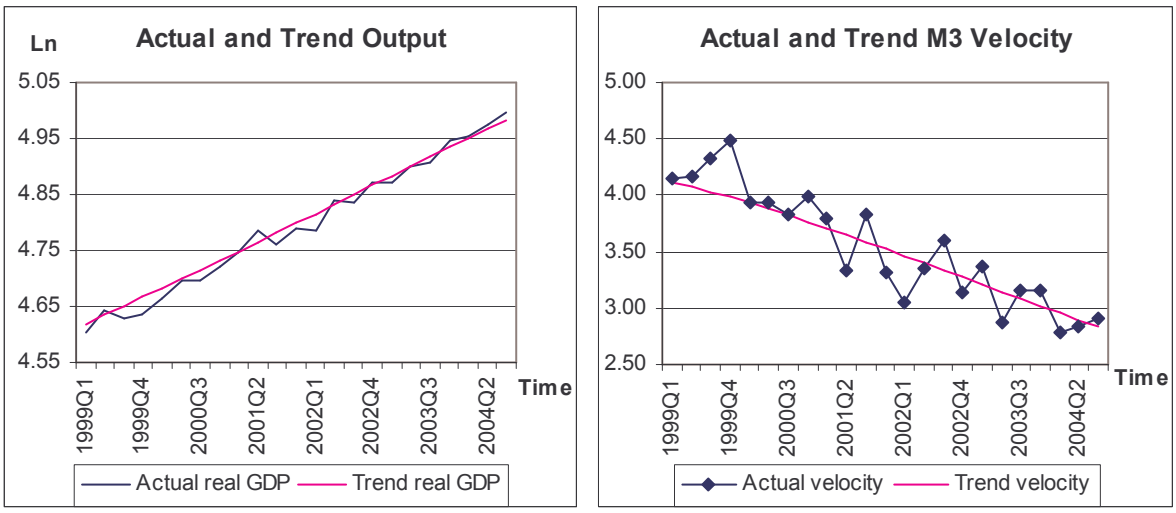

Figure 4.1 Actual and Potential Output and M3 Velocity for Latvia

The results obtained after applying HP filtering to output and broad money velocity series are depicted in Figure 4.1. As could be expected, output and velocity exhibit rather clear patterns – a general growth and decline, respectively. Thus, both of these variables are non-stationary. However, their actual values move closely around the trend, which makes output gap and velocity gap (the essential components of domestic price gap) stationary.

5 Results of Econometric Modelling

Aims of the section:

- *To analyse the regressions' results obtained employing narrow money aggregates*
- *To analyse the regressions' results obtained employing broad money aggregates*
- *To estimate the most suitable version of the P-Star model for Latvia*

The following section features the results of the fieldwork, which involved collection of the necessary data, calculation of the variables and treatment of the variables according to the P-star approach. In order to come up with the P-star model that best fits the Latvian economy several versions of the equations (3.5), (3.9), and (3.11) with different ADL schemes were tested. The following section presents both, the results for regressions conducted using narrow money (M1) data as the money supply variable as well as results for regressions that feature broad money (M3) data as the money supply variable.

It is important to note here that all the initial regressions were tested twice – firstly, using M1 as a proxy for money supply and secondly, using M3 instead of M1 in the same regressions. The rationale behind this choice was the evidence present in some previous studies that despite the fact that M3 turned out to be a better measure of the money supply in most cases, in some countries, e.g. Denmark, the same was true for M1 (Kool and Tatom, 1994). Thus, another objective of the research was to find out which proxy of the money supply has the largest influence on inflation in Latvia.

The OLS estimates and results of all preliminary regressions that were run with the objective of testing the expectations of the authors and find the best fit P-star model for Latvia are presented in Appendix 8. There are several observations that can be noted after examining these findings. Firstly, the regressions that were run using M3 as a proxy for money supply show a higher explanatory power than the same regressions where M1 was used. Even though the R^2 values for comparable regressions differ by approximately only .05 units, this pattern is consistent, which makes it possible to claim that the P-star model for Latvia will most likely feature M3 as a measure of money supply. Secondly, surprisingly enough, the second lag of all price gaps was the only explanatory variable besides dependent variable lags that had a significant explanatory power and featured a coefficient with the expected (positive) sign.

This was true for both, domestic and foreign price gaps across all regressions. Thus, the preliminary results suggested that adjustments in inflation in Latvia appear half a year (two quarters) after a change in price gaps have occurred. Finally, the lags of the dependent variable, namely, change of implicit GDP deflator, had significant explanatory power as well as the coefficients with the expected (negative) sign. This finding made it reasonable to include these variables in the adjusted P-star models for Latvia.

After evaluation of the preliminary findings, corrected specifications of the P-star model for Latvia were tested. This time, only those independent variables that turned out to be significant were included in the estimations. Overall, six corrected versions of the model were tested, the first three of which involved the use of M1 as an input for money supply, whereas M3 was used for the other three. Both sets of regressions were the same with respect to the combinations of price gap variables included. The results of these estimations are presented in table 5.1.

Table 5.1 OLS Estimates for the P-star Model for Latvia, 1999Q1-2004Q3

	M1			**M3**		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Constant	.052 (4.057)	.047 (2.910)	.022 (1.301)	.022 (1.573)	.023 (1.784)	.021 (1.893)
$\left(p_t^* - p_t\right)_{t-2}$	1.097 (3.695)	-	.991 (2.437)	.371 (1.943)	-	.417 (2.767)
$\left(p_t^{d*} - p_t^d\right)_{t-2}$	-	. 188 (1.680)	.007 (.047)	-	.467 (2.673)	.504 (3.390)
$\Delta\pi_{t-1}$	-1.131 (8.046	- 1.163 (5.512)	- .810 (4.309)	-.910 (4.893)	-.874 (5.064)	-.887 (6.060)
$\Delta\pi_{t-2}$	-1.131 (4.330)	-.980 (3.772)	-	-.517 (-2.749)	-.492 (2.797)	-.413 (2.722)
$\Delta\pi_{t-3}$	-.726 (2.773)	-.487 (2.261)	-	-	-	-
$\Delta\pi_{t-4}$	-.267 (1.471)	-	-	-	-	-
Regr. stat.						
Adjusted R^2	.794	.611	.469	.548	.611	.720
F	14.866	8.451	6.895	9.069	11.458	13.873

Notes: **The top entry represents a coefficient; absolute t-values are given in parenthesis. The dependent variable is the change of the implicit GDP deflator. Source: authors' calculations on data from the Eurostat and Central Statistical Bureau of Latvia.**

There are several observations that can be noted after examination of the results. One of the first things to notice, however, is the fact that the trends differ if the results for both sets of regressions (M1 and M3) are compared. For the estimations where M1 was used, model (1) exhibits the highest adjusted R^2, and domestic price gap has a much larger explanatory power

than the foreign price gap when tested in separate regressions. Moreover, when both price gaps are added into one equation, the explanatory power of the variables greatly decreases (adjusted R^2 equals .469) and the foreign price gap variable becomes insignificant. Thus, the results contradict the expectations of the authors that the foreign price gap should be a more important determinant of inflation than the domestic price gap.

Nevertheless, the results for the estimations, where M3 was used, show a different pattern. In particular, when both gaps are tested in separate equations, the foreign price gap exhibits a higher explanatory power than the domestic price gap. Moreover, when both gaps are added into one equation, the overall explanatory power of the model increases and the foreign price gap is still more significant than the domestic price gap. Thus, the results correspond to the expectations of the authors.

Finally, a closer examination of the estimations allows determination of the best fit P-star model for Latvia as well as the most appropriate proxy for the money supply. Even though model (1) shows the largest adjusted R^2, there is sufficient econometric ground to argue that model (6) is, in fact, more appropriate for explaining inflation dynamics in Latvia. In particular, the larger adjusted R^2 might well be explained by more lags of the dependent variable included in the model (1) specification.

6 Interpretation and Discussion of Results

An economist is an expert who will know tomorrow why the things he predicted yesterday didn't happen today.
Dr Laurence J. Peter (qtd in Economist, 2004)

Aims of the section:

- *To demonstrate the link between the results of econometric modelling and economic intuition*
- *To perform the model fit analysis*
- *To analyse the influence of the exchange rate dynamics*
- *To evaluate the forecasting power of the model*
- *To discuss the rational expectations' influence on recent inflation dynamics*

This section aims to link the results of the econometric modeling with relevant economic theory and provide the economic intuition behind the results. Firstly, the fit of the model. Secondly, the arguments against the P-star model considering the use of alternative methods in the context of Latvia will be presented and evaluated.

6.1 Monetary Analysis of Inflation in Latvia

Monetary aggregates can be considered as information variables that perform an indicator role for other economic variables that are relevant in explaining inflation. In

particular, the close correlation between the money supply and factors that affect prices allow use of money as an indirect indicator of price developments (Deutsche Bundesbank, 2005). This idea can also be traced behind the P-star model.

During evaluation of inflation dynamics in Latvia from the monetary perspective the objectives of the paper will be revisited and the extent to which the P-star model can be successfully applied in Latvia will be assessed.

One of the research aims, presented at the beginning of the paper, was to find a version of the P-star model that best fits the Latvian economy. As was discovered in the process of econometric modeling, this version is the following:

$$(6.1)\quad \Delta\pi_t = \alpha_0 + \alpha_1\left(p_t^* - p_t\right)_{t-2} + \alpha_2\left(p_t^{d*} - p_t^{d}\right)_{t-2} + \sum_{k=1}^{2}\delta_k \Delta\pi_{t-k} + \varepsilon_t$$

where $\Delta\pi_t$ stands for the quarterly change in GDP deflator, $\left(p_t^* - p_t\right)_{t-2}$ defines the second lag of domestic price gap, $\left(p_t^{d*} - p_t^{d}\right)_{t-2}$ is the notation for the second lag of the foreign price gap, and ε_t defines noise.

First of all, the results showed that both, Euro-based foreign as well as domestic price gaps, are significant in the context of inflation dynamics in Latvia. Thus, the expectation that domestic prices in Latvia are not entirely determined by those in the Euro zone but also by domestic factors turned out to be correct. More specifically, the results showed that a 1% change in the domestic price gap would affect the GDP deflator change by .417%, while the same magnitude change in the foreign price gap would cause a .504% change in inflation. Moreover, these results discard the concern that there might only be a weak relationship between Latvian inflation and the Euro-based price gap due to the fact that the Latvian Lat has been pegged to the SDR currency basket not the Euro over the period analyzed. Further, the significance of the domestic price gap might imply that other SDR countries (i.e. USA, Japan, and the United Kingdom) actually have had a very marginal impact on inflation dynamics in Latvia. Thus, pegging the Lat to the Euro after January 1, 2005 would most probably increase the impact of Euro-based price gaps on Latvian inflation.

To explore further the explanatory variables, the authors looked at the development of the two price gaps over the sample period. Domestic and Euro-based foreign price gaps are depicted in Figure 6.1.

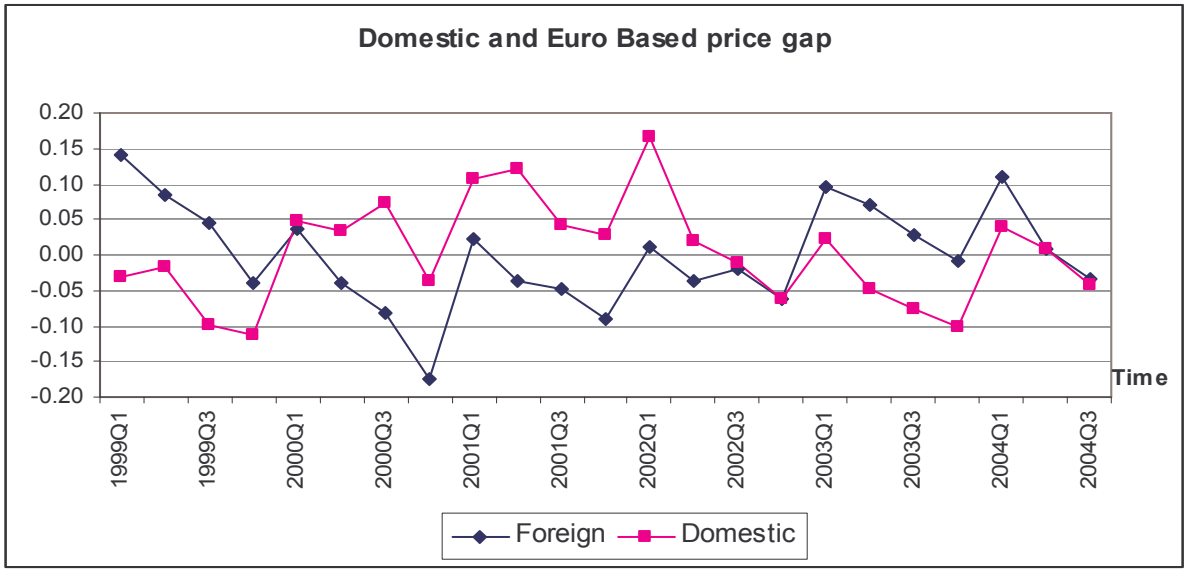

Figure 6.1 Domestic and Euro-based foreign M3 price gaps for Latvia

The most important pattern to be noted after comparing the development of the two gaps is the fact that they exhibit reverse trends. In particular, over most of the periods when the domestic price gap has been negative the foreign price gap was positive and vice versa. This implies that the development of foreign and domestic price equilibrium is contradictory, which can be attributed either to different economy development patterns in Latvia and the Euro zone or to changes in exchange rate. To proceed with the analysis, the authors decided to pay particular attention to exchange rate developments as the shifts of both nominal and real LVL/EUR rate are important in the context of the P-star model. The development of the exchange rate component of the equilibrium foreign determined price level, namely nominal exchange rate less equilibrium real exchange rate, $e_t - er_t^*$, is shown in Figure 6.2.

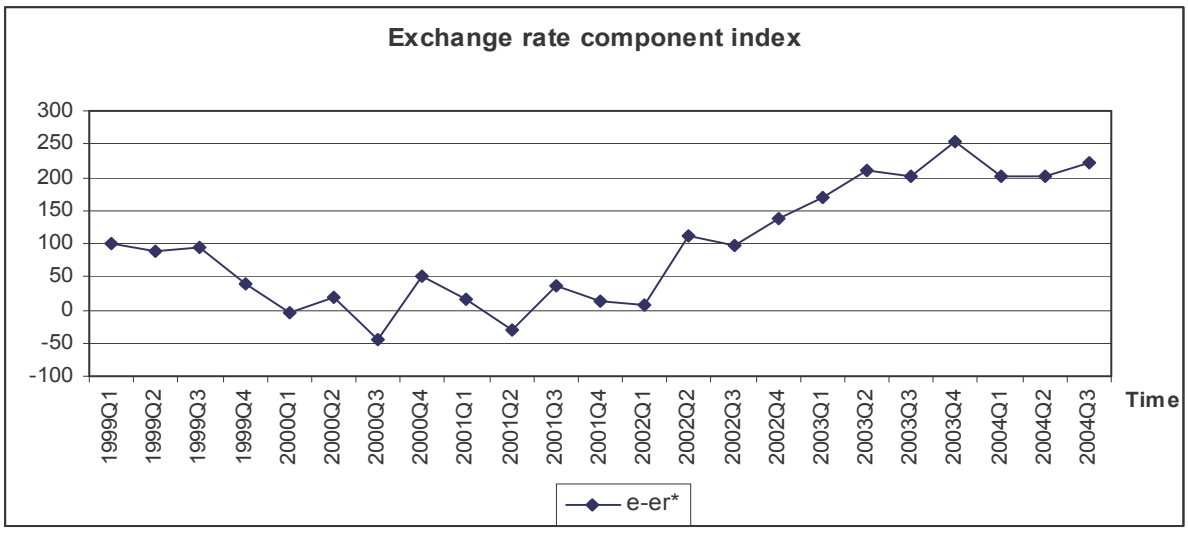

Figure 6.2 Index of the exchange rate component of foreign determined price level equilibrium

The graph clearly shows deterioration and a consecutive appreciation of this component over the sample period. If compared to Figure 6.1 and the foreign price gap, in particular, it is possible to distinguish similarities between the patterns of development of the two series. Thus, short run fluctuations in the Euro-based foreign price gap are to a large extent determined by shifts in real and nominal exchange rates.

Furthermore, in order to explore the factors behind the development of the domestic price gap, output and velocity gaps were depicted in Figure 6.3 and Figure 6.4, respectively.

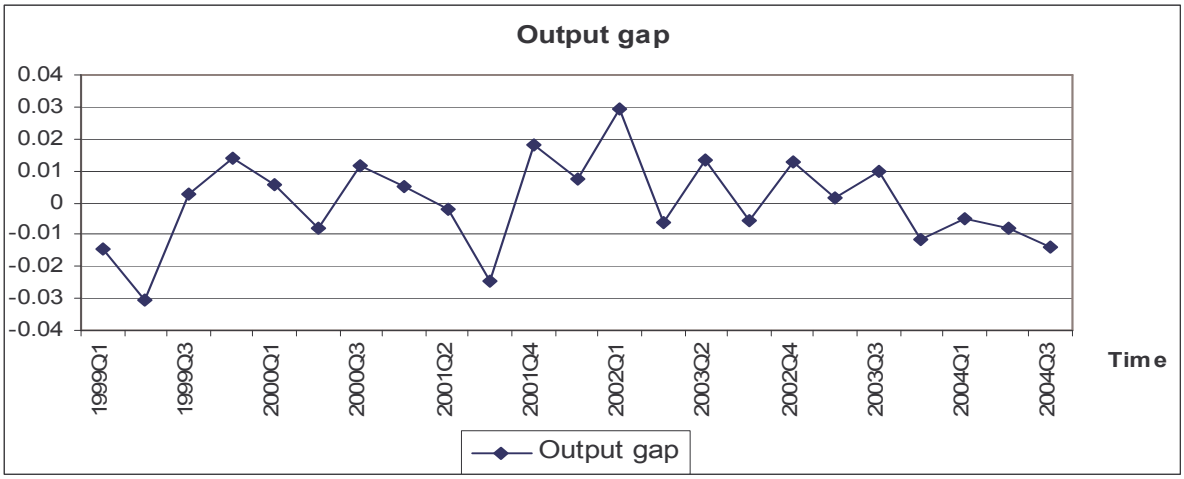

Figure 6.3 Output Gap for Latvia

In this case, the similarity between the development pattern of the velocity gap and the domestic price gap (see Figure 6.1) appears to be larger than that between output gap and domestic price gap.

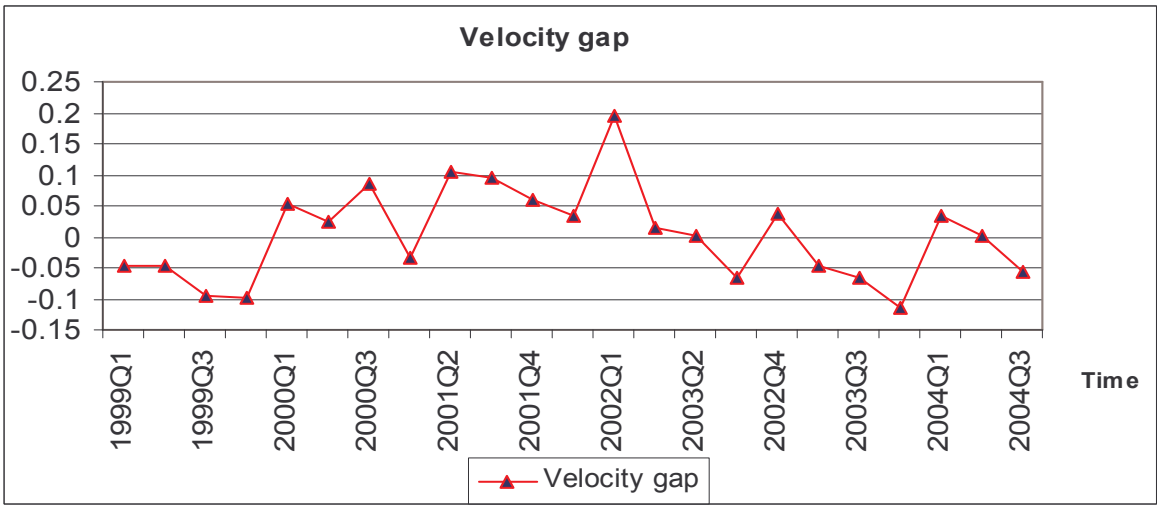

Figure 6.4 Velocity Gap for Latvia

Thus, it can be deduced that the observed trends in the domestic price gap have been more affected by velocity deviations from equilibrium than by that of output.

To revisit the final research aim of the paper, the authors tried to evaluate if inflation dynamics in Latvia can be described as moving towards long run equilibrium. The results of econometric modelling showed that the first two lags of the GDP deflator change variable are significant, and have coefficients of the correct negative sign. Thus, large inflation deviations from long-run equilibrium in some periods are offset by reverse changes in consecutive periods.

Finally, to evaluate the overall fit of the model, the actual changes in GDP deflator were compared to those predicted by the P-star model developed for the Latvian economy. It was observed that the actual value of inflation rather well correlates with that predicted by the P-star model. In fact, there have been very few cases where a significant difference between the values can be observed. Still, in all of these cases the actual inflation was larger than that predicted by the model, thus it can be expected that the error term in the equation 6.1 would have a small positive value.

6.2 The Significance of Inflation Expectations

Even though the P-star model estimation proved to be legitimate and inflation dynamics in Latvia appeared to be explainable by the price level second difference, the non-monetary aspects, namely short term inflation determinants, should be taken into account as well.

The International Monetary Fund report (2004) indicates that signals of overheating in the Latvian economy are not concrete and still mixed. There is no sufficient ground to claim that the substantial increase in inflation occurred because of an overly high level of capacity utilization. The spurt was mainly caused by growing domestic demand, to which producers and importers responded by raising prices while resources were used to optimal capacity. However, the authors would like to stress that the growth of domestic demand might indicate a concern of consumers that prices are on the rise or are about to start rising faster than income, which then explains why people try to purchase more at the present time. Characteristics of such behaviour usually can be distinguished in markets for durables and real estate, which, in fact, are currently experiencing a large growth rate in Latvia and are closely linked to the boom in consumer and mortgage lending. Supply side reaction corresponds to that expected, and, as a consequence, the increase in real estate prices contributes to the acceleration of the inflation rate noteworthy enough.

Expectations theories disagree with Friedman's idea of market self-adjustment and argue that economic outcome, and, thus, inflation dynamics as well, depends partially upon

what the public anticipate will happen. If people believe that goods and services will cost more in the future, they tend to consume and buy more today.

The Nobel Prize winners 2004 in Economics, Edward Prescott and Finn Kydland, present the idea that inflation arises due to the inability of policy makers to set clear future policy guidelines. As a result, businesses tend to increase the prices of goods and services in order to protect themselves from adverse movements in economic policy. In short, expectations are the main drive behind increasing rates of inflation (The Royal Swedish Academy of Sciences, 2004). The authors of the paper consider this idea as highly applicable to the case of Latvia.

The task of monetary policy-making authorities is even more complicated due to persistent political turbulence. Despite the fact that the growth of the economy and its structural development have shown outstanding results, Latvia is still not able to form a stable government that would last longer than a year. This makes businesses and consumers somewhat suspicious and cautious about future developments. Society does not trust the authorities completely and expectations are hard to manage. Therefore, the IMF report on Latvia suggests that the psychological effects of accession to the EU contributed positively to growing rates of inflation. People simply expect Latvia's price level convergence to the price level of the EU to occur faster than income elevation.

Another factor that contributed to the acceleration of inflation in the short run was one-time increase in administrative prices. Changes in taxation, such as changes in fuel excise duties related to EU accession, caused faster growth in the price level, particularly in the transportation and food industries. To illustrate, in 2004 transportation prices in Latvia grew from a 3.5% increase to 9.4% (Lauri Maris et al, 2004).

In the meantime, it appears that inflation will persist at least in the short term. To some extent, EU accession is to blame. However, this paper did not aim to test short-term non-monetary inflation determinants.

7 Conclusions

Aims of the Section:

- *To recapitulate the outcomes of the research aims presented in the introductory part of the paper*
- *To present the future implications of monetary policy*
- *To discuss in brief the possible effects of the currency peg on future inflation development*
- *To launch suggestions for further research*

The first aim of the paper was to test if the P-Star model could be applied for the Latvian economy in order to explain and project inflation dynamics. The authors have performed numerous calculations to construct the implicit variables in order to estimate both domestic and foreign price gaps. Econometric modeling showed that both domestic and foreign price gaps are significant in the context of the development of inflation dynamics in Latvia. This result goes in line with the authors' expectation that price development in Latvia is dependent not only on local output and velocity gaps but also on economic activity in the Euro zone. The fitted and actual GDP deflator change development exhibited almost identical paths, which led to the conclusion that the P-star model can be applied for the Latvian economy and let the authors proceed with the subsequent objectives of the paper.

The second aim of the research was to originate a version of the P-Star and discover possible time lags between inflation determinants and their transmission in inflation figures. The inflation dynamics model discovered defines that change in the GDP deflator comes with a two quarters' lag. For both, foreign and domestic price gap, changes are transmitted to inflation figures during a six-month period. Moreover, the result provided sufficient proof that choice of the Euro Zone as an anchor economy was not misleading. Moreover, the authors came to the conclusion that the Latvian currency peg to the Euro will result in a more influential foreign price gap role in future inflation development.

The third objective of the paper was to identify whether the short-run dynamics of Latvian inflation development possess the features of moving towards long-term equilibrium. As was observed, the results of the research showed that inflation is fluctuating around a long-run trend.

The P-Star model is derived from the Fisher equation, with a strong notion that inflation is a monetary phenomenon in the long run. The authors of the paper do not discuss the validity of the monetarists and their theory. However, non-monetary aspects were also considered in order to provide a more prosperous analysis. More precisely, the role of rational expectations as well as recent economic agents' behavior was assessed. The authors acknowledge the argument that the inflation spurt in 2004 was somewhat related to EU accession and the consecutive expectations of several economic agents of a sudden price increase. However, these effects are more likely to be a short-term phenomenon and would not have a significant influence on inflation movements to long run equilibrium without a corresponding increase in the money supply. Moreover, the correlation between money stock and price determining factors makes it possible to use monetary aggregates for describing and predicting inflation dynamics.

The authors suggest treating practical policy implication proposals with extreme caution. Firstly, it should be noted once again that the P-Star model equation focuses on adjustment towards long-run equilibrium. The model does not encounter short-term inflationary factors. Rather, it provides a measurement, a trend, where and when market conditions' changes will adjust in the price level in the longer term. Secondly, the decisions of central banks are subject to high uncertainty about the transmission mechanism of monetary policy to price level as multiple factors are involved and the results might be twisted in the short term.

Maintenance of a low and stable inflation rate is the primary aim of the majority of central banks, including the bank of Latvia. In order to draw any policy implications from the research done, one should look behind the monetary policy strategy employed by the Bank of Latvia.

Sustaining the recently established fixed exchange rate with the Euro can be considered an intermediate target[2] of the Latvian monetary authorities, since, indirectly, it involves supporting the same interest rates as those in the Euro zone. This intermediate target is tightly connected to the prime aim of the bank of Latvia, which means that it is also addressed to retain price stability. However, the target might be questioned, since accession to the EU obliges Latvia to keep the peg with the Euro and participate in ERM II for no less than two years. Moreover, the fixed exchange rate regime is a common and well performing strategy for small open economies (Monetary Policy of the Bank of Latvia, 2004). The research showed that short-run fluctuations in the Euro-based foreign price gap are to a large extent determined by shifts in real and nominal exchange rates. Thus, the implication follows to allow some flexibility in exchange rate policy. Currently, the Bank of Latvia is devoted to set exchange rate fluctuation margins against the Euro lower than the maximum (+/-15%) imposed by the Convergence criteria (Monetary Policy of the Bank of Latvia, 2004). The results suggest seeking a lower differential between the nominal and real exchange rate ($e_t - er_t^*$) in the short term.

Secondly, with regard to real exchange rate dynamics, the authors should turn to the fiscal policy implications; however, effective current account management solutions are beyond the scope of the paper.

[2] "Intermediate target - any of a number of variables, such as monetary aggregates or interest rates that have a direct effect on employment and the price level and that the central bank seeks to influence" (Mishkin, 2004)

Employing monetary instruments in case of external disorders can be regarded as a way of sustaining the operational target[3] of the Bank of Latvia, which is highly related to the intermediate target of ensuring the fixed exchange rate regime. Monetary analysis of the results showed that the velocity gap contributes more to domestic price gap fluctuations than the output gap. Although control of monetary aggregates is somewhat limited by the fixed exchange rate regime, certain adjustments in monetary base changes could contribute positively to inflation development in the long run. The P-Star approach suggests that the real money gap (the velocity gap) is of higher importance in explaining the dynamics of inflation than the output gap in Latvia. In addition, the link between monetary policy and the output gap is not straightforwardly drawn. Thus, the authors would like to provide a word of caution about money growth. Velocity disequilibrium could be lessened through tighter debt portfolio supervision, since the lending boom for households has a positive effect on the money multiplier, and consequently on larger velocity fluctuations. More concise monitoring of private lending and higher standard setting is an option the monetary policy authorities could influence and smooth the development of inflation figures.

In order to address monetary strategy in more detail and present more precise aspects of monetary policy, the authors turn to the possible implications on monetary policy tools implementation. The bank of Latvia uses three main tools for monetary policy conduct, namely, reserve requirement, open market operations, and standing facilities of lending and deposit of funds.

Even though Latvia must adopt the Basel Accord, which implies 2% of reserve requirements, on July 15, 2004 the reserve requirement was increased from 3% to 4% (On Resolutions Passed by the Bank of Latvia's Council, 2004). However, possible effects still are not detected by the P-Star approach. Thus, the implication can be drawn that a further short-term increase of reserve requirements would result in slower money creation.

The original P-Star model does not deal with interest rates directly, so there are no direct implications for interest rate control. Moreover, in an extreme case, money supply control through extensive purchase operations could lead to such capital inflows that are unsustainable for the currently-established fixed exchange regime as Latvia has established one of the most liberal international practices. In general, the standing facilities of lending are

[3] "Operating target - any of a set of variables such as reserve aggregates or interest rates that the central bank seeks to influence and that are responsive to its policy tools" (Frederick S. Mishkin, 2004)

not of high importance for the study, because only drastic changes could provoke some effects on the price level, which is neither wise, nor desirable.

The authors would like to stress once again that the proposed implications merely identify actions, a positive outcome of which are supported by the model evaluated. It should be stressed that after pegging the Lat to the Euro, fiscal policy is the key instrument for providing macroeconomic stability. Comprehensibly, no drastic monetary measures are to be implemented, but the adjustments made in the short term could be promising in the long run in order to slow down the acceleration of inflation.

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8 Appendices

8.1 Appendix 1

A fragment on progress of Latvia from the Convergence report by European Commission [4]

As regards to the central bank integration into the ESCB at the time of euro adoption, legislation in Latvia, in particular the Law on the Bank of Latvia, is not fully compatible with Article 109 of the Treaty and the ESCB/ECB Statute.

The average inflation rate in Latvia during the 12 months to August 2004 was 4.9%. Latvia does not fulfil the criterion on price stability.

Latvia is not the subject of a decision on the existence of an excessive deficit. The general government deficit was 1.5% of GDP in 2003 and government debt was 14.4% of GDP. Latvia fulfils the criterion on the government budgetary position.

The Latvian lat is not participating in ERM II and is pegged to the SDR basket of currencies with a normal fluctuation margin of 1%. Latvia does not fulfil the exchange rate criterion.

The average long-term interest rate in Latvia in the year to August 2004 was 5.0% and Latvia fulfils the criterion on the convergence of long-term interest rates. Long- term interest rate differentials with the euro area have increased slightly in Latvia since mid-2002 to ½-1 percentage points.

In the light of this assessment the Commission concludes that there should be no change in the status of Latvia as a "Member State with a derogation".

Convergence criteria, four numerical requirements:[5]

1. Price developments

Treaty provisions

- The first indent of Article 121 (1) of the Treaty requires:
  "the achievement of a high degree of price stability; this will be apparent from a rate of inflation which is close to that of, at most, the three best-performing Member States in terms of price stability";

[4] This section is entirely adopted from the European Commission web page (2004)
[5] This section is entirely adopted from the European Central Bank web page (2004)

- Article 1 of the Protocol on the convergence criteria referred to in Article 121 of the Treaty:
  "The criterion on price stability referred to in the first indent of Article 121 (1) of this Treaty shall mean that a Member State has a price performance that is sustainable and an average rate of inflation, observed over a period of one year before the examination, that does not exceed by more than 1½ percentage points that of, at most, the three best-performing Member States in terms of price stability. Inflation shall be measured by means of the consumer price index on a comparable basis, taking into account differences in national definitions."

Application of Treaty provisions

- With regard to "an average rate of inflation, observed over a period of one year before the examination", the inflation rate is calculated using the increase in the latest available 12-month average of the Harmonised Index of Consumer Prices (HICP) over the previous 12-month average.
- The notion of "at most, the three best-performing Member States in terms of price stability", which is used for the definition of the reference value, is applied by using the unweighted arithmetic average of the rate of inflation in the three countries with the lowest inflation rates, given that these rates are compatible with price stability.

2. Fiscal developments

Treaty provisions

1. The second indent of Article 121 (1) of the Treaty requires:
   "the sustainability of the government financial position; this will be apparent from having achieved a government budgetary position without a deficit that is excessive, as determined in accordance with Article 104 (6)".
2. Article 2 of the Protocol on the convergence criteria referred to in Article 121 of the Treaty stipulates that this criterion
   "shall mean that at the time of the examination the Member State is not the subject of a Council decision under Article 104 (6) of this Treaty that an excessive deficit exists".

Excessive deficit procedure

Article 104 sets out the excessive deficit procedure. According to Article 104 (2) and (3), the European Commission shall prepare a report if an EU Member State does not fulfil the requirements for fiscal discipline, in particular if:

1. the ratio of the planned or actual government deficit to GDP exceeds a reference value (defined in the Protocol on the excessive deficit procedure as 3% of GDP), unless:
    - either the ratio has declined substantially and continuously and reached a level that comes close to the reference value; or, alternatively,
    - the excess over the reference value is only exceptional and temporary and the ratio remains close to the reference value;
2. the ratio of government debt to GDP exceeds a reference value (defined in the Protocol on the excessive deficit procedure as 60% of GDP), unless the ratio is sufficiently diminishing and approaching the reference value at a satisfactory pace.

Additional provisions

- The report prepared by the European Commission shall take into account whether the government deficit exceeds government investment expenditure and all other relevant factors, including the medium-term economic and budgetary position of the Member State.
- The Commission may also prepare a report if, notwithstanding the fulfilment of the requirements under the criteria, it is of the opinion that there is a risk of an excessive deficit in a Member State. The Economic and Financial Committee shall formulate an opinion on the report of the Commission.
- Finally, in accordance with Article 104 (6), the EU Council, on the basis of a recommendation from the Commission and having considered any observations which the Member State concerned may wish to make, shall, acting by qualified majority, decide, after an overall assessment, whether an excessive deficit exists in a Member State.

Procedural issues and the application of Treaty provisions

For the purpose of examining convergence, the ECB expresses its view on fiscal developments. With regard to sustainability, the ECB examines key indicators of fiscal

developments in the relevant period, considers the outlook and challenges for public finances and focuses on the links between deficit and debt developments.

3. Exchange rate developments

Treaty provisions

- The third indent of Article 121 (1) of the Treaty requires:
  "the observance of the normal fluctuation margins provided for by the exchange-rate mechanism of the European Monetary System, for at least two years, without devaluing against the currency of any other Member State".
- Article 3 of the Protocol on the convergence criteria referred to in Article 121 (1) of the Treaty stipulates that:
  "the criterion on participation in the exchange-rate mechanism of the European Monetary System referred to in the third indent of Article 121 (1) of this Treaty shall mean that a Member State has respected the normal fluctuation margins provided for by the exchange-rate mechanism of the European Monetary System without severe tensions for at least the last two years before the examination. In particular, the Member State shall not have devalued its currency's bilateral central rate against any other Member State's currency on its own initiative for the same period."

Application of Treaty provisions

The Treaty refers to the criterion of participation in the European exchange rate mechanism (ERM until December 1998; superseded by ERM II as of January 1999).

- First, the ECB assesses whether the country has participated in ERM II "for at least the last two years before the examination", as stated in the Treaty.
- Second, with regard to the definition of "normal fluctuation margins", the ECB recalls the formal opinion that was put forward by the EMI Council in October 1994 and its statements in the November 1995 report entitled "Progress towards convergence":

  The EMI Council's opinion of October 1994 stated that "the wider band has helped to achieve a sustainable degree of exchange rate stability in the ERM", that "the EMI Council considers it advisable to maintain the present arrangements", and that

"member countries should continue to aim at avoiding significant exchange rate fluctuations by gearing their policies to the achievement of price stability and the reduction of fiscal deficits, thereby contributing to the fulfillment of the requirements set out in Article 121 (1) of the Treaty and the relevant Protocol".

In the November 1995 report entitled "Progress towards convergence" it was recognized by the EMI that "when the Treaty was conceived, the 'normal fluctuation margins' were ±2.25% around bilateral central parities, whereas a ±6% band was a derogation from the rule. In August 1993 the decision was taken to widen the fluctuation margins to ±15%, and the interpretation of the criterion, in particular of the concept of 'normal fluctuation margins', became less straightforward". It was then also proposed that account would need to be taken of "the particular evolution of exchange rates in the European Monetary System (EMS) since 1993 in forming an ex post judgement".

Against this background, in the assessment of exchange rate developments the emphasis is placed on exchange rates being close to the ERM II central rates.

- Third, the issue of "severe tensions" is generally addressed by examining the degree of deviation of exchange rates from the ERM II central rates against the euro. This is done by using such indicators as short-term interest rate differentials vis-à-vis the euro area and their evolution and also by considering the role played by foreign exchange interventions.

4. Long-term interest rate developments

Treaty provisions

- The fourth indent of Article 121 (1) of the Treaty requires:
  "the durability of convergence achieved by the Member State and of its participation in the exchange-rate mechanism of the European Monetary System being reflected in the long-term interest-rate levels".
- Article 4 of the Protocol on the convergence criteria referred to in Article 121 of the Treaty stipulates that:
  "the criterion on the convergence of interest rates referred to in the fourth indent of

> Article 121 (1) of this Treaty shall mean that, observed over a period of one year before the examination, a Member State has had an average nominal long-term interest rate that does not exceed by more than 2 percentage points that of, at most, the three best performing Member States in terms of price stability. Interest rates shall be measured on the basis of long-term government bonds or comparable securities, taking into account differences in national definitions."

Application of Treaty provisions

- First, with regard to "an average nominal long-term interest rate" observed over "a period of one year before the examination", the long-term interest rate has been calculated as an arithmetic average over the latest 12 months for which HICP data were available.
- Second, the notion of "at most, the three best performing Member States in terms of price stability" which is used for the definition of the reference value has been applied by using the unweighted arithmetic average of the long-term interest rates of the three countries with the lowest inflation rates. Interest rates have been measured on the basis of harmonized long-term interest rates, which were developed for the purpose of assessing convergence.

8.2 Appendix 2

1eSummary of the main researches testing the open economy version of the P-star model

Author	Country	Time period	Results and Comments
Frait, Jan, Lubos Komarek, and Lumir Kulhanek (2000)	The Czech Republic; Anchor economy: Germany	1991-1999	Equilibrium price level in the Czech Republic has been largely determined by the German and EU monetary policy via implicit or explicit exchange rate peg.
Garcia-Herrero, Alicia and Manoj Vasant Paradhan (1998)	Spain; Anchor economy: Germany	1970-1996	The domestic price gap is more explanatory than the German-based foreign price gap in the Spanish economy. Still, after joining ERM foreign price gap's explanatory power has increased.
Kool, Clemens J.M. and John A. Tatom (1994)	Austria, Belgium, Denmark, Netherlands, Switzerland; Anchor economy: Germany and USA	1960-1992	German-based foreign price gaps outperform domestically determined gaps in P-star model for small open economies. USA-based foreign price gaps are not significant
Matuszek, Stanislav (2000)	The Czech Republic; Anchor economy: Germany	1995-2000	The developed P-star model (featuring domestic and foreign price gaps) is proven to be valid for predicting short run inflation changes in the Czech Republic
Smant, David Jan Cornelis (1997)	The Netherlands; Anchor economy: Germany	1953-1994	Develops a P-star model and proves that it cannot be discarded in favor of a socio-economic inflation model
Tatom, John A. (1992)	Austria; Anchor economy: Germany	1962-1990	P-star model (featuring domestic and foreign price gaps and relative price of energy) for Austria is rejected; But, a significant long run relationship between Austrian and German inflation is found
Wesche, Katrin (1998)	Austria, Belgium, France, The Netherlands, European aggregate of these countries; Anchor economy: Germany	1979-1996	The research tests the presence of monetary integration in Europe through the influence of German price movements on single countries' inflation. Germany influences the prices in the Netherlands, France and Austria. The hypothesis that Germany determines the inflation rate in the whole system is rejected.

Source: authors' summary on the papers listed above.

8.3 Appendix 3

Import Partners of Latvia

Country	1999	2000	2001	2002	2003	2004
Germany	15,2 (1)	15,7 (1)	17.0 (1)	17.2 (1)	16.1 (1)	14.5 (1)
Lithuania	7,3 (4)	7,6 (4)	8.5 (3)	9.8 (2)	9.7 (2)	12.4 (2)
Russia	10,5 (2)	11,6 (2)	9.2 (2)	8.8 (3)	8.7 (3)	8.9 (3)
Finland	9,1 (3)	8,6 (3)	8.0 (4)	8.0 (4)	7.4 (4)	6.5 (5)
Sweden	7,2 (5)	6,7 (5)	6.5 (5)	6.4 (5)	6.3 (6)	6.3 (6)
Estonia				6.2 (6)	6.4 (5)	7.1 (4)

***Notes*: Proportions of each trading partner in imports are presented in percentage; the number in parenthesis indicates the ranking of value of imports. Source: Central Statistic Bureau of Latvia, trade statistics 1999-2004.**

8.4 Appendix 4

Consumer Price Changes, % of corresponding period of previous year

	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
I-XII	25.0	17.6	8.4	4.7	2.4	2.6	2.5	1.9	2.9	6.2
I-III	26.0	21.6	9.9	6.2	2.5	3.2	1.1	3.3	1.9	4.3
IV-VI	26.5	17.8	8.5	5.8	1.8	3.1	2.4	1.9	2.9	5.8
VII-IX	23.9	17.1	8.1	3.9	2.1	2.5	3.3	1.0	3.5	7.4
X-XII	23.7	14.4	7.3	2.8	3.1	1.8	3.2	1.5	3.5	7.3

Source: Central Statistical Bureau of Latvia

8.5 Appendix 5

Testing for Stationarity

Standard econometric techniques presume that regression variables have to be stationary to prevent spurious regressions and fake results. Moreover, the selection of equilibrium value calculation technique depends on data properties as well, because some techniques cannot be applied to nonstationary data series. In order to work with time series and get legitimate results, the stationarity of the data to be employed was tested.

According to Gujarati (1995), stationary data must posses the properties of stable mean, variance and autocorrelation structure. The Augmented Dickey Fuller (ADF) method is a widely used test for data stationarity. This research employs the ADF test in the following two forms. Firstly, with a constant but without a time trend (x,y). Secondly, since the time trend can usually be detected in macroeconomic data, the other regression includes both, a constant and a time trend (x,y). Both of them can be reflected in the following equations:

$$(4.2)\quad \Delta \ln Z_t = \beta_1 + \delta \ln Z_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta \ln Z_{t-i} + \varepsilon_t$$

$$(4.3)\quad \Delta \ln Z_t = \beta_1 + \beta_2 t + \delta \ln Z_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta \ln Z_{t-i} + \varepsilon_t$$

Both regressions are tested for the same null hypothesis, H_0 that $\delta = 0$, which implies that unit root is present; thus, data is nonstationary. The alternative hypothesis, H_1 states that $\delta \neq 0$, meaning that the nonstationarity is rejected. To proceed with a test, τ (tau) statistics was employed. The SPSS 13.0 software package does not produce the observed values of τ, therefore they were additionally computed according to the formula:

$$(4.4)\quad \tau_t(\delta_t) = \frac{\delta_t - 0}{SE(\delta_t)},$$

where $SE(\delta_t)$ is the standard error of δ_t (Cromwell, 1994). The critical values of the ADF were computed using the Monte Carlo simulations (Gujarati, 1995). If the absolute value of τ observed is greater then the critical τ, the null hypothesis is rejected.

The ADF test is run on the logarithmic values of the time series, and the table 4.1 summarizes the results. The information in parentheses specifies the properties of the test, C stands for test with constant only, T indicates the use of both, trend and constant, and the number of the lags included follows. At five percent significance level, τ critical value equals -3.60 and -3.00 with and without the trend, respectively. As can be observed, for most of the indexes the null hypothesis cannot be rejected.

Table 8.2 The Observed τ values

	Y	M1	M3	VM1	VM3	E	ER
Latvia	-1,10 (T,1)	2,57 (T,1)	1,11 (T, 1)	1.055 (C, 1)	2,05 (C, 1)	1,00 (C, 1)	2,79 (C,1)
Euro zone	-	-1,5 (T, 1)	2,12 (T, 1)	-	-	-	-

Source: Authors' calculations on the data from the Eurostat and Cental Statistical Bureau of Latvia.

For this specific research, the stationarity test, first of all, is a tool to facilitate selection of the calculation techniques of the equilibrium values. In case data proves to be nonstationary, a simple linear detrending method might reveal inadequate results and a more complex technique has to be employed.

8.6 Appendix 6
Detrending Techniques

Detrending method	Assumptions on features of T_1	Correlation between T_1 and C_1	Method: statist. or econ.
Linear detrending (LT)	Tt is a deterministic (can be approx. by polynomial functions of time) -structural break in Tt at a known time	Uncorrelated	statistical
Segmented detrending (SEGM)	-Tt is a deterministic process (can be approx. by polynomial functions of time) -structural break in Tt at a known time	Uncorrelated	statistical
First-order differencing (FOD)	- Tt is a random walk with no drift - Ct is stationary	Uncorrelated	statistical
Beveridge and Nelson (BN)	- Xt has a unit root and Tt accounts for its perfectly nonstationary behaviour (Ct is stationary) - Tt is the long-run forecast of Xt adjusted for its mean rate of change - decomposition is based on a fitted ARIMA-model for each individual seriesa	perfectly correlated (driven by same shocks)	statistical
Unobservable Components (UC)b	- Tt follows a random walk with drift - Ct is a stationary finite order AR process	may be correlated (but can be uncorrelated)	statistical
Frequency Domain (FREQ)c	- Tt has most of its power concentrated in a low frequency band of the spectrum - away from zero, the power of the trend component decays very fast - Tt can be deterministic or stochastic (as long as changes are not too frequent)	Uncorrelated	statistical
Multivariate Frequency (MFREQ) (one dimensional index)	In the low frequencies of the spectrum of Xt there exists a one dimensional process Tt which is common to all series - Tt has most of its power concentrated in a low frequency band of the spectrum and away from zero it decays very fast		statistical
Multivariate linear trend (MLT) (Common Deterministic Trend)	- all variables have a common deterministic trend - fluctuations around trend are transitory	Uncorrelated	economic
Cointegrating (COIN) (Common Stochastic Trend)	- all variables have a common nonstationary trend - estimate a vector error correction model (VECM) to produce estimates of Ct (incl. cointegration vectors)d	perfectly correlated (driven by same shocks)	economic
Blanchard and Quah (BQ)	- Tt has a unit root - Ct is stationary	Uncorrelated	economic
Hodrick and Prescott (HP)	- Tt is stochastic, but moves smoothly over time (sum of squares of second differences of Tt must be small) - λt regulates the extent of the penalty imposed for large fluctuations in T	Uncorrelated	statistical + economic

Source: The table is adopted from Peeters Anneleen (1998)

8.7 Appendix 7

Advantages and disadvantages of 5 widely used detrending techniques

Detrending method	Advantages	Disadvantages
First-order differencing (FOD)	- able to remove unit root components	- filter not symmetric (causes phase-shift)a - dramatic re-weighting of frequenciesb (re-weighting strongly toward higher frequencies, down-weighting lower frequencies)
Linear detrending (LT)		- failure to remove unit root components
Moving averages (MA) (two-sided or centered)	- symmetric filter (no phase shift)	- fixed order MA can be problematic if length of cycles changes over time - loss of observations (large number of observations are required)
Phase Average Trend (PAT)d	- straight forward and flexible procedure - able to deal with business cycles of varying length - excellent descriptions historical behaviour	- choice of preliminary peak and trough dates - requires large number of observations - method of extrapolation is problematic (estimation at end of sample less reliable) - not suitable for forecasting
Hodrick-Prescott (HP)	- symmetric filter (no phase shift) - removes unit root components - very flexible technique - can be applied to all observations - can extract same trend from set of variables - yields satisfactory results (Berk and Bikker (1995), Canova (1994))	– alters moments of the series (i.e. measures of persistence, variability and comovement) - may create spurious behaviour (Harvey and Jaeger (1993) and Jaeger (1994)) - choice of□ - estimation at end of sample less reliable

Source: the table is adopted from Peeters Anneleen (1998).

8.8 Appendix 8

Preliminary OLS Estimates of the P-star Model for Latvia using M1 as a proxy for money supply

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Constant	.015 (1.970)	.036 (2.144)	.043 (2.558)	.015 (.767)	.044 (2.163)	.042 (1.854)	.022 (1.228)	.047 (2.489)	.058 (2.511)
$\left(p_t^* - p_t\right)_t$	-.656 (1.940)	-.510 (1.383)	-.273 (.852)	-	-	-	-.818 (2.063)	-.745 (1.808)	-.409 (.896)
$\left(p_t^* - p_t\right)_{t-1}$	-	-	.148 (.460)	-	-	-	-	-	.481 (.807)
$\left(p_t^* - p_t\right)_{t-2}$	-	-	.976 (2.804)	-	-	-	-	-	1.111 (1.352)
$\left(p_t^* - p_t\right)_{t-3}$	-	-	-.195 (.488)	-	-	-	-	-	-.494 (1.001)
$\left(p_t^{d*} - p_t^d\right)_t$	-	-	-	-.038 (.267)	.043 (.361)	-.008 (.042)	.123 (.802)	.151 (1.201)	.185 (.694)
$\left(p_t^{d*} - p_t^d\right)_{t-1}$	-	-	-	-	-	-.219 (.991)	-	-	-.259 (.686)
$\left(p_t^{d*} - p_t^d\right)_{t-2}$	-	-	-	-	-	.459 (2.053)	-	-	-.186 (.476)
$\left(p_t^{d*} - p_t^d\right)_{t-3}$	-	-	-	-	-	-.163 (.732)	-	-	.396 (1.338)
$\Delta\pi_{t-1}$	-.578 (3.338)	-1.242 (5.166)	-1.261 (4.356)	-.548 (2.905)	-1.321 (5.156)	-1.233 (4.196)	-.590 (3.363)	-1.274 (5.354)	-1.344 (3.388)
$\Delta\pi_{t-2}$	-	-1.193 (3.385)	-.894 (2.214)	-	-1.326 (3.557)	-1.105 (2.717)	-	-1.231 (3.537)	-.908 (2.058)
$\Delta\pi_{t-3}$	-	-.731 (2.067)	-.584 (1.809)	-	-.833 (2.207)	-.713 (1.879)	-	-.775 (2.218)	-.629 (1.783)
$\Delta\pi_{t-4}$	-	-.270 (1.106)	-.202 (.978)	-	-.333 (1.276)	-.276 (1.086)	-	-.298 (1.235)	-.246 (1.126)
Regr. stat.									
Adjusted R^2	.362	.632	.762	.238	.582	.628	.350	.644	.742
F	6.951	7.174	8.201	4.282	6.005	4.798	4.762	6.423	5.320

***Notes*: The top entry represents a coefficient, absolute t-values are given in parenthesis. The dependent variable is the change of the implicit GDP deflator. Source: authors' calculations using data from the Eurostat and Central statistical Bureau of Latvia.**

Preliminary OLS Estimates of the P-star Model for Latvia using M3 as a proxy for money supply

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Constant	.020 (1.366)	.042 (2.480)	.028 (1.844)	.015 (.909)	.039 (2.043)	.027 (1.488)	.018 (1.280)	.040 (2.086)	.026 (1.561)
$\left(p_t^* - p_t\right)_t$	-.532 (2.544)	-.266 (1.153)	-.479 (2.104)	-	-	-	-.544 (2.746)	-.278 (1.150)	-.611 (2.072
$\left(p_t^* - p_t\right)_{t-1}$	-	-	-.077 (.309)	-	-	-	-	-	.088 (.164)
$\left(p_t^* - p_t\right)_{t-2}$	-	-	.728 (2.912)	-	-	-	-	-	.714 (1.302)
$\left(p_t^* - p_t\right)_{t-3}$	-	-	-.480 (1.790)	-	-	-	-	-	-.327 (.988)
$\left(p_t^{d*} - p_t^d\right)_t$	-	-	-	-.364 (1.466)	-.033 (.135)	-.164 (.681)	-.384 (1.791)	-.080 (.320)	.024 (.069)
$\left(p_t^{d*} - p_t^d\right)_{t-1}$	-	-	-	-	-	-.389 (1.625)	-	-	-.442 (1.140)
$\left(p_t^{d*} - p_t^d\right)_{t-2}$	-	-	-	-	-	.518 (2.036)	-	-	.095 (.222)
$\left(p_t^{d*} - p_t^d\right)_{t-3}$	-	-	-	-	-	.018 (.058)	-	-	.482 (.987)
$\Delta\pi_{t-1}$	-.659 (3.906)	-1.266 (5.204)	-.843 (2.755)	-.604 (3.303)	-1.295 (4.923)	-1.153 (3.415)	-.719 (4.406)	-1.241 (4.705)	-1.076 (2.973)
$\Delta\pi_{t-2}$	-	-1.142 (3.033)	-.350 (.751)	-	-1.276 (3.101)	-.864 (1.862)	-	-1.075 (2.432)	-.319 (.606)
$\Delta\pi_{t-3}$	-	-.707 (1.928)	-.193 (.506)	-	-.789 (1.954)	-.295 (.732)	-	-.653 (1.571)	.081 (.159)
$\Delta\pi_{t-4}$	-	-.279 (1.120)	-.341 (1.406)	-	-.308 (1.146)	-.116 (.471)	-	-.254 (.939)	-.053 (.170
Regr. stat.									
Adjusted R^2	.430	.617	.748	.313	.578	.691	.489	.588	.763
F	8.907	6.792	7.677	5.782	5.932	6.041	7.697	5.286	5.823

***Notes*: The top entry represents a coefficient; absolute t-values are given in parenthesis. The dependent variable is the change of the implicit GDP deflator. Source: authors' calculations using data from the Eurostat and Central statistical Bureau of Latvia.**

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