MODELLING INFLATION IN CROATIA

Maruška Vizek
Institute of Economics, Zagreb
10000 Zagreb, Trg J. F. Kennedya 7
e-mail: mvizek@eizg.hr

Tanja Broz
Institute of Economics, Zagreb
10000 Zagreb, Trg J. F. Kennedya 7
e-mail: tbroz@eizg.hr

ABSTRACT

This aim of this paper is to construct a quarterly inflation model for Croatia. In order to model inflation dynamics we use the general-to-specific approach. The advantage of this approach is its ability to deliver results based on underlying economic theories of inflation, which are also consistent with the properties of the data. A two step procedure is followed. In the first step the long run sectoral analysis of inflation sources is conducted, yielding long run determinants of inflation (mark-up, excess money, nominal effective exchange rate and the output gap). In the second step we estimate an equilibrium error correction model of inflation deploying, among other variables of interest, long run solutions derived in the first step. The derived model of inflation suggests that mark-up and excess money relationships are very important for explaining short run behaviour of inflation, as well as the output gap and nominal effective exchange rate, import prices, interest rates and narrow money. Comparing the results of the model suggests that short run inflation is much more responsive to supply side and exchange rate changes than to monetary conditions.

Key words: inflation modelling, cointegration, general-to-specific, Croatia

JEL CLASSIFICATION: C51, C53, E31, E37

1. Introduction

The aim of this paper is to formulate a structural model of inflation in order to explain its short run behaviour in Croatia. The paper uses quarterly data from the period of 1995-2006, relying on the general-to-specific approach and structural-based modelling.

Exploring the behaviour of inflation is necessary because it allows for a better understanding of the role that monetary policymakers play in controlling inflation behaviour. Moreover, in-depth knowledge of how inflation behaves is needed because monetary policy efficiency is challenged by the fact that its effects are often lagged. Given these time lags, a pre-emptive strike strategy seems like a reasonable choice for monetary authorities. However, the strategy requires a suite of inflation models in order to obtain reliable inflation forecasts. In the Croatian case, one more motive for modelling inflation emerges. In light of Croatian efforts to join the EU, knowing the determinants of inflation is of essential importance for fulfilment of the Maastricht convergence criteria, which is necessary for entering the euro area.

In terms of the determinants investigating inflation in Croatia, this paper will attempt to explore inflation behaviour in Croatia in an integral and systematic way. Related research on the subject is very obscure, which is quite surprising knowing how important the inflation process is for monetary policy. On the other hand, since Croatian monetary policy has been quite passive, i.e. reduced to preserving exchange rate movements within an implicit band it does not surprise that much more attention has been given to analyzing the exchange rate. Besides two papers modelling specific aspects of inflation - exchange rate pass-trough (Billmeier and Bonato, 2002; Kraft, 2003), three remaining inflation-related papers focus exclusively on modelling inflation using VARs (Payne, 2002; Botrić and Cota, 2006,) or forecasting inflation with an ARIMA model (Pufnik and Kunovac, 2006).

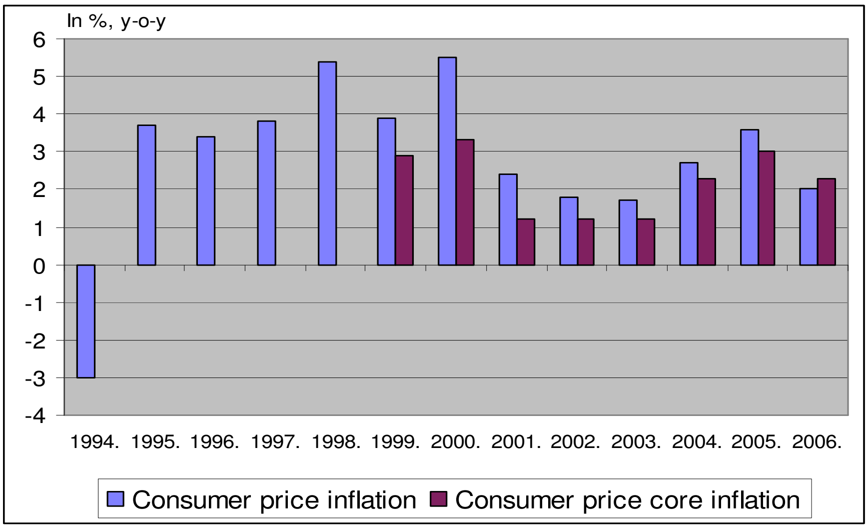
In this paper we focus on modelling inflation, i.e. we construct a theoretically plausible structural model of inflation which includes the relevant sectors of the economy and theories of inflation. We use the general-to-specific modelling approach in order to obtain a single equation model for explaining short run inflationary dynamics.

The paper starts with a short overview of past inflation behaviour, followed by a review of related work on modelling inflation in Croatia. In the fourth section, long run determinants of inflation are derived in order to establish a structural inflation function in the form of an equilibrium error correction model. In the fifth section, using the general-to-specific approach we derive a structural inflation model and present its diagnostic tests. The last section presents the main findings of our research.

2. Background

For Croatia, the early 1990s were quite dramatic. On the political front, Croatia gained independence from Yugoslavia, but also faced a situation of war. On the economic front, Croatia experienced macroeconomic instability in terms of significant output loss and hyperinflation. War, the transition process, but also monetary instability inherited from Yugoslavia contributed to such developments; output fell 36% from 1990 to 1993 while the annual rate of inflation reached 1616% in 1993. In late 1993 the Stabilization program based on a nominal exchange rate anchor was introduced. The Program successfully achieved its main aim: in the last 13 years (from 1994 to 2006) Croatia has enjoyed a stable inflation rate, which can be observed in Figure 1. Controlling the exchange rate of national currency to the deutschemark / euro became the key for maintaining price stability since pegging the nominal exchange rate meant anchoring domestic inflation expectations. However, stable inflation does not mean that one should not be interested in its main determinants. Quite the opposite, since stable inflation rates in line with those in the EU are one of the preconditions for joining euro area, it is of utmost importance to understand what drives inflation. Hence, it is not surprising that inflation-related research increased in other transition countries as the date of EU joining approached (Botrić and Cota, 2006).

Figure 1. Consumer Price inflation Developments



Source: Central Bureau of Statistics and Croatian National Bank.
Note: Consumer price core inflation is available from 1999.

3. Related literature

As we already mentioned in the introduction there are three papers investigating the inflation process in Croatia. Payne (2002) and Botrić and Cota (2006) focused on modelling inflation, while Pufnik and Kunovac (2006) are more interested in forecasting inflation.

Payne (2002) explores the inflationary dynamics in Croatia using vector autoregression over the period January 1992-December 1999. The VAR incorporated four variables: broad money supply, the retail price index[1], nominal net wage per employee and the nominal effective exchange rate. The model results suggest that wage increases and currency depreciation are positively correlated with inflation rates. Quite surprisingly, no evidence of inflation inertia was found, although the data sample covers the period of the hyperinflation.

Building on Payne's model Botrić and Cota (2006) model Croatian inflation dynamics using a structural vector autoregression model. They found that terms of trade and balance of payment shocks have the strongest impact on prices. The authors find justification for such a result in Croatia being a small open economy with high import dependency and uncompetitive economic structure. In order to contrast these findings, the authors also re-estimated Payne's model. While Payne's conclusion on the influence of wages and currency

[1] At that time, consumer price index was not calculated.

depreciation on prices still holds, in the newly estimated four-variable VAR, a positive correlation between broad money and prices and some inflation inertia also emerged.

Pufnik and Kunovac (2006) used a seasonal ARIMA model for forecasting future inflation dynamics. Besides directly forecasting future inflation, this paper also establishes a framework for forecasting the main components of the CPI in order to better understand sources of inflation and to calculate an aggregate inflation forecast. Their analysis shows that aggregating the CPI component forecasts outperforms both aggregate ARIMA and random walk inflation forecasts.

4. The block structure of the inflation model

The main objective of this section is to estimate a number of long-term relationships that govern or help explain inflation in Croatia. The variables in the long run relationships will be specified and grouped in sector VARs in a way that is a priori based on economic theory. Also, additional restrictions will be imposed on the long run models in order to maintain consistency with the underlying theory.

It is well known that inflation can be an outcome of various economic factors. On the demand side, factors like excess output cause demand-push inflation. Monetary factors like excess money supply can also induce inflationary pressures. Supply side factors come from cost-push or mark-up relationships. In addition, factors inherent to open economies, such as the deviation from the real effective exchange rate and the Balassa-Samuelson effect may also cause inflationary pressures.

In order to capture these various determinants of inflation, we will apply and combine the methodology developed in Juselius (1992) and Sekine (2001). Thus, section 4.1 of the paper measures the mark-up relationship, section 4.2 analyses the nominal effective exchange rate and Samuelson-Balassa effect, section 4.3 is devoted to monetary sources of inflation and section 4.4 examines excess output. After these relationships are determined, they will be imposed on an inflation function as equilibrium correction terms in the remainder of the paper.

4.1. Mark-up

Following de Brouwer and Ericsson (1998) and Sekine (2001), we examine a mark-up relationship for Croatian inflation. A simple mark-up model can be specified as[2]:

$$Lcpi = \delta * (Lulc)^{\gamma} * (Limport\_prices)^{1-\gamma} \qquad (1)$$

where *Lcpi* is the logarithm of the consumer price index, *Lulc* is the logarithm of the unit labor cost, *Limport_prices* is the logarithm of the import deflator and δ - *1* corresponds to a mark-up[3]. The equation assumes that linear homogeneity holds in the long run. To estimate this relationship, a cointegration analysis is applied, using a trivariate VAR that consists of

[2] See de Brouwer and Ericsson (1998) and Sekine (2001).
[3] Where δ represents share of labour and input cost in CPI and 1 represents CPI. For details on deriving the mark-up see de Brouwer and Ericsson (1998).

(*Lcpi*, *Lulc*, *Limport_prices*). It must be noted that the unit labour costs and import prices series are not calculated by the national statistical office. Since these series are unavailable, they were calculated from available. A more detailed description of the variables can be found in the appendix.

Table 1 and Table 2 summarise the main features of the cointegration analysis. The Johansen λ trace statistics support the existence of one cointegrating vector, while various tests on residuals imply a congruent VAR, as shown in Table 3.

Assuming one cointegrating vector and linear homogeneity, the derived long run mark-up relationship becomes[4]:

$$Lmarkup = Lcpi - 0.54 * Lulc - 0.46 * Limport\_prices \quad (2)$$

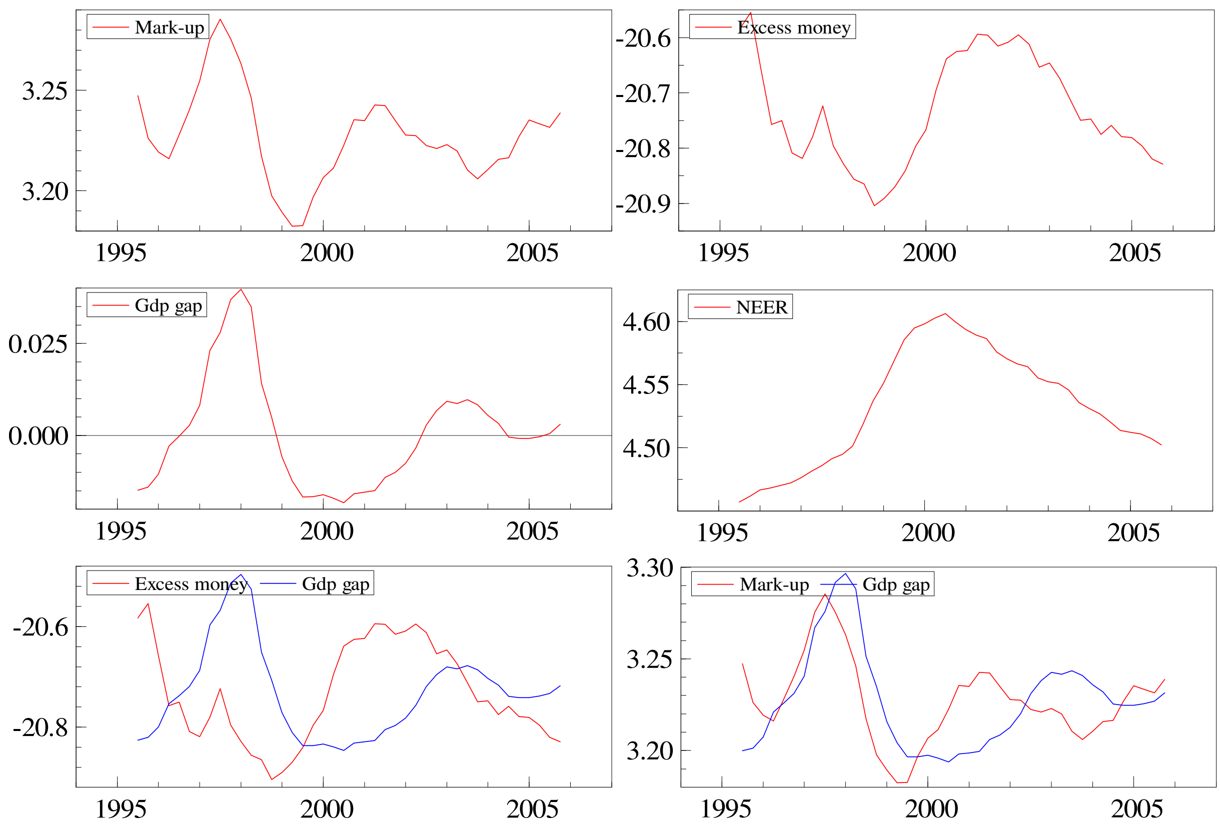
The linear homogeneity restriction is accepted ($\chi^2(1) = 0.166(0.69)$). The corresponding α vector is:

$$\begin{array}{lll} Lcpi & ... & -0.22 \\ Limport\_price & ... & -0.12 \\ Lulc & ... & 0.48 \end{array} \quad (3)$$

The share of unit labour cost in total unit cost (0.54) seems reasonable considering that the Croatian economy is highly dominated by the service sector. The share of unit labour costs in total unit cost is higher then in Australia - 0.43, but much lower than Japan - 0.90 (de Brouwer and Ericsson, 1998; Sekine, 2001). The relatively large share of import prices in total unit cost is due to the high import dependency of the Croatian economy. If we replace import prices with the producer prices index, one cointegrating vector can also be found, but the size and sign of the long run coefficients contradict the theory. Moreover, for *Lcpi*, *Lulc* and *Lppi* the long run homogeneity condition does not hold.

[4] Coefficients in this equation represent normalised and restricted cointegrating vector, while the coefficients in Table 2 come from normalised cointegrating vector.

Figure 2. Long Run Sectoral Relationships



Source: authors' calculation.
Note: all variables are represented by their moving averages; the series means and scales in the two lower panels are adjusted.

As expected, the observed mark-up (upper left and lower right panel in Figure 2) highly correlates with the movement of the business cycle, i.e. it is pro-cyclical. It peaked in 1998 during the short-lived economic expansion and slumped during the recession in 1999. Since 2000, the mark-up has been on the rise reflecting favourable economic conditions in the past six years.

Table 1. Rank of Cointegrating Vector

Rank	eigenvalue	λtrace	p-value
0	-	30.8	0.037**
1	0.357	10.9	0.22
2	0.150	3.6	0.06
3	0.077	-	-

Source: authors´ calculation.
Note: all variables are seasonally adjusted; corresponding VAR included 1 lag of each variable, unrestricted constant and dummy variables for war, bank crises dummies and a dummy for introduction of value added tax; VAR was estimated over the sample period 1995Q1 – 2006Q2; * - the null hypothesis of no cointegration rejected at 1%; ** - the null hypothesis of no cointegration rejected at 5%.

Table 2. Estimated Coefficients

Variables	Standardized eigenvectors β'	Standardized adjustment coefficients α
Lcpi	1.000	-0.213
Limport_prices	-0.519	-0.104
Lulc	-0.538	0.491

Source: authors´ calculation.

Table 3. Properties of VAR Residuals

Variables	AR 1-4 test F(4,34)	Normality test Chi^2(2)	ARCH 1-4 test F(4,30)	hetero test F(9,28)
Lcpi	0.703 [0.59]	3.389 [0.18]	0.123 [0.97]	0.416 [0.92]
Limport_prices	1.729 [0.17]	0.689 [0.71]	1.295 [0.29]	0.490 [0.87]
Lulc	1.036 [0.41]	0.562 [0.75]	0.621 [0.65]	2.024 [0.07]

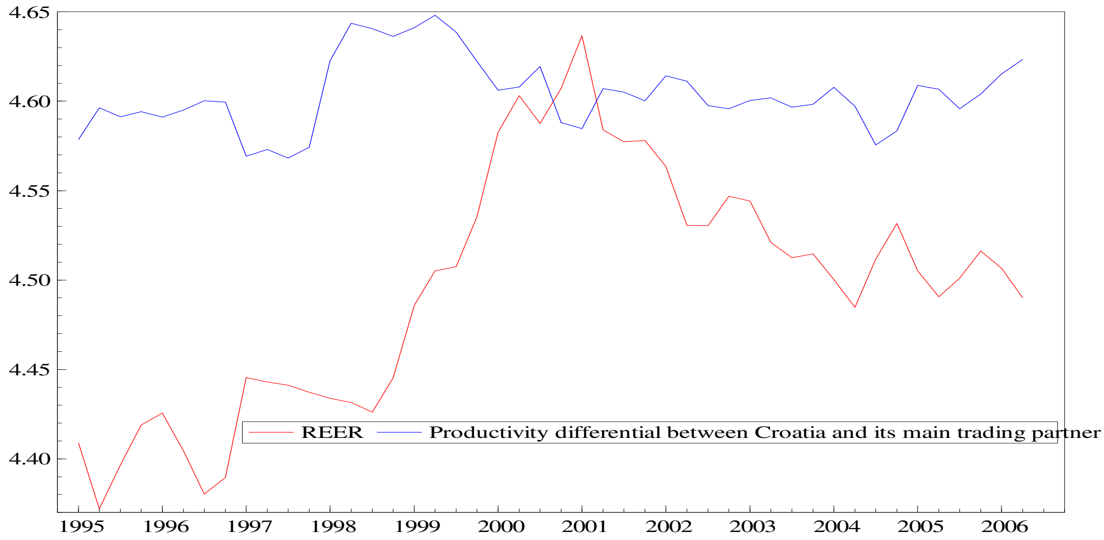
Source: authors´ calculation.

4.2. Purchasing power parity

Since Croatia is a small, open and highly euroised economy, exchange rate behaviour is very important to understanding not just inflation, but the overall macroeconomic developments. As far as inflation is concerned, purchasing power parity (PPP) and deviations from it are found to be significant for inflation functions in Juselius (1992) and Hendry (2000). However, PPP theory can be further expanded to encompass the Balassa –Samuelson effect (as in Golinelli and Orsi, 2001) because, on the one hand, in most CEE countries real effective exchange rates have been appreciating and, on the other hand, the time span is too short to test the PPP hypothesis. However, if we were to judge on the presence of the Balassa – Samuelson effect in Croatia according to graphical analysis only (Figure 3), the Balassa – Samuelson could not have been present since Croatia did not achieve significant productivity gains in the tradable sector when compared to its main trading partners in the given time period. Since we were not convinced that the Balassa – Samuelson effect could be a long run explanation of the inflation process in Croatia, we did not estimate its long run relationship and consequently impose it on the inflation function as in Golinelli and Orsi (2001). Instead, for the short run inflation function only the kuna nominal effective exchange rate (shown in Figure 2) will be used, since we assume that, due to high unofficial euroization of the Croatian economy, economic agents in the country are more interested in nominal, rather than real exchange rate movements.[5]

[5] From a purely statistical point of view, using either the real effective exchange rate or nominal effective exchange rate would probably yield quite similar results since the correlation coefficient between the first differences in logarithms of the real and nominal effective exchange rate (used for estimating the short-run inflation model) is 0.82.

Figure 3. Labour Productivity Differential and Real Effective Exchange Rate



Source: Eurostat, Croatian National Bank, Central Bureau of Statistics and authors' calculation.

4.3. Excess money

After defining the mark-up and nominal effective exchange rate, we turn to monetary determinants of inflation. In order to measure the excess money that eventually leads to inflationary pressures, we need to examine the long run relationship between narrow money supply, CPI inflation, real GDP, the real price of real estate, the own rate of money and interest rate on rival assets. A more detailed description of the variables can be found in the appendix. The estimated VAR corresponds to Juselius (1992) and Sekine (2001).

Tables 4-6 summarise the residual properties and a system cointegrating analysis of the VAR. The Johansen test supports the existence of one cointegrating vector. There are indications of autocorrelation in the residuals (indicated by the AR test), but otherwise the VAR seems satisfactory. The occurrence of autocorrelation can be attributed to the spike in the GDP series in 1997. When the first three years of data are excluded from the sample, all diagnostic tests are satisfactory. The resulting excess money can be expressed as:

$$Lexcess\_money = Lm1 + 4.07 * Lcpi - 2.97 * Lgdp + 0.39 * Lp\_estate + 2.67 * Lzibor - 8.55 * Lr\_forex - 0.04 * Trend \tag{4}$$

The excess money represented by the above equation indicates a sharp spike in the beginning of the sample followed by sharp decline in 1996 due to the expansion of the economy (Figure 2). The second spike can be observed just before the recession in 1999. From the lower left panel in Figure 2 one can conclude that, unlike the mark-up, excess money exhibits counter-cyclical behaviour, i.e. it contracts during periods when the economy is overheating, and it expands during economic recessions.

Table 4. Rank of Cointegrating Vector

Rank	eigenvalue	λtrace	p-value
0	-	120.49	0.031**
1	0.582	82.1	0.137
2	0.541	47.8	0.519
3	0.400	25.3	0.775
4	0.245	12.9	0.746
5	0.151	5.7	0.507
6	0.122	-	-

Source: authors´ calculation.

Note: all variables are seasonally adjusted; corresponding VAR includes 2 lags of each variable, unrestricted constant and restricted trend; the VAR was estimated over the sample period 1995Q1 – 2006Q2; * - the null hypothesis of no cointegration rejected at 1%; ** - the null hypothesis of no cointegration rejected at 5%.

Table 5. Estimated Coefficients

Variables	Standardized eigenvectors β'	Standardized adjustment coefficients α
Lm1	1.000	0.087
Lcpi	4.069	-0.045
Lgdp	-2.971	0.057
Lp_estate	0.394	-0.061
Lzibor	2.673	0.007
Lr_forex	-8.549	0.045
trend	-0.035	-

Source: authors´ calculation.

Table 6. Properties of VAR Residuals

Variables	AR 1-4 test F(4,34)	Normality test Chi^2(2)	ARCH 1-4 test F(4,30)	hetero test F(9,28)
Lm1	0.184 [0.90]	1.166 [0.55]	1.486 [0.26]	28.55 [0.33]
Lcpi	0.662 [0.58]	0.101 [0.95]	0.163 [0.91]	28.89 [0.32]
Lgdp	5.49 [0.008]**	0.654 [0.72]	0.909 [0.46]	32.14 [0.18]
Lp_estate	1.854 [0.17]	0.0068 [0.99]	0.108 [0.95]	28.33 [0.34]
Lzibor	1.582 [0.23]	0.891 [0.64]	0.427 [0.73]	27.80 [0.36]
Lr_forex	1.835 [0.17]	0.679 [0.71]	0.334 [0.80]	27.86 [0.36]

Source: authors´ calculation. ** Null hypothesis of no autocorrelation in residuals is rejected at the 5 percent level.

4.4. Excess demand

The final component that needs to be represented in the short-term inflation function is excess demand. It is expressed in terms of the output gap, where the output gap equals actual GDP minus potential GDP. In order to calculate the output gap we used the Hodrick – Prescott (HP) filter with λ=1600. Although the disadvantage of the HP filter is that it may create spurious cycles, in the Croatian case the validity of the HP filter can be verified by applying a production function approach to estimate the output gap (Vrbanc, 2006). Since both output gaps exhibit very similar cyclical movement, we proceed with our analysis using the output gap obtained with the HP filter. The behaviour of the output gap is presented in the middle left panel in Figure 2. One can observe the overheating of the economy during the economic expansion in 1997 and 1998, followed by the cooling that began in 1999 during the short-lived economic recession. The output gap turned positive again in 2002, with one more slowdown in late 2004 and early 2005 when more moderate rates of GDP growth were recorded.

5. Inflation model

After we found the long run relationships, we developed a single equation inflation model which is described bellow. We followed a general-to-specific approach.

At the beginning, we estimated a general model in which we regressed *DLcpi* (first difference in logarithm of consumer price index) on the above mentioned long run structural relationships – $Lmarkup_{t-i}$, and $Lexcessmoney_{t-i}$, two other sectoral sources of inflation - $DLNeer_{t-i}$ and $DLgdp\_gap_{t-i}$ and short run dynamics $DLppi_{t-i}$, $DLtrading\_partners\_cpi_{t-i}$, $DLm1_{t-i}$, $DLimport\_prices_{t-i}$, DLr_forex_{t-i}, where *i* takes values 1, 2 and 3 for all variables. A more detailed description of the variables can be found in the appendix. Our sample covers the period from 1995Q1 until 2006Q2 and for that sample period our unrestricted general model yields sigma = 1.1 percent for 28 regressors and 42 observations (Schwarz criterion = -7.22). The next step was to eliminate statistically insignificant terms from the model which led to the derivation of the following model:

$$\begin{aligned} DLcpi \;=\; & \underset{(0.00)}{-0.30*Lmarkup_1} \underset{(0.00)}{-0.05*Lexcess\_money_2} \underset{(0.07)}{+0.07*DLm1_2} \underset{(0.001)}{-0.41*DLNeer_2} \\ & \underset{(0.04)}{+0.18*DLimport\_prices_2} \underset{(0.002)}{+0.33*DLgdp\_gap_1} \underset{(0.06)}{-0.25*DLr\_forex_3} \end{aligned} \qquad (5)$$

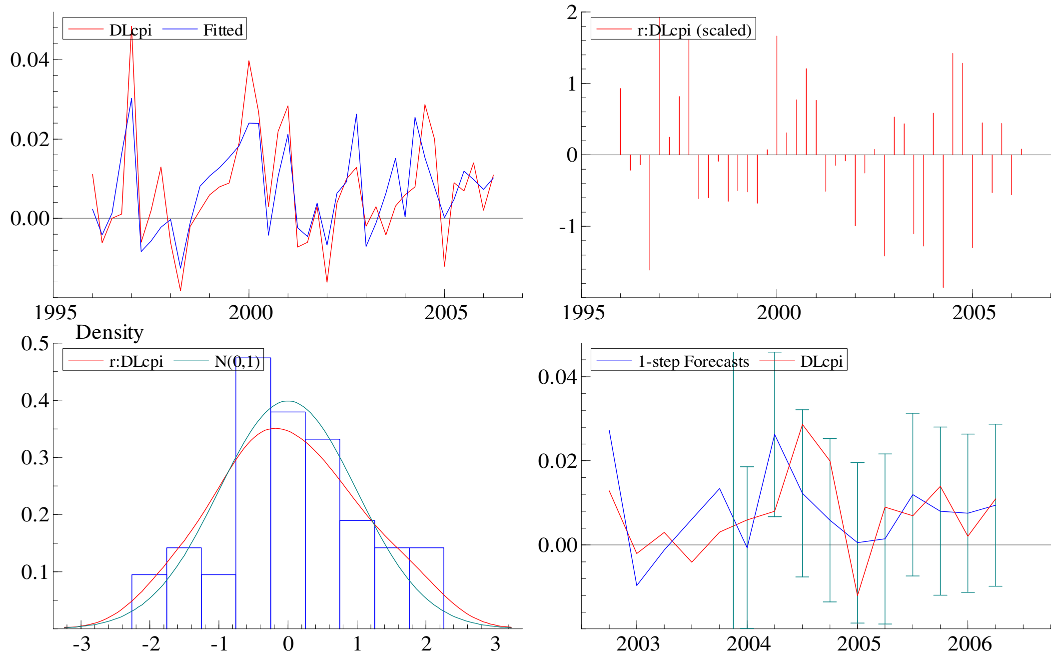
$T = 1995Q1 - 2006Q2, R^2 = 0.60, sigma = 0.009, Schwarz\ criterion = -8.89, AR = 0.72\,(0.58),$
$ARCH = 0.79\,(0.54), Normality = 0.26, (0.88)\ Chow = 0.18\,(0.94), RESET = 0.32\,(0.57)$
p–values in parenthesis.

The model proved its adequacy in terms of various diagnostic tests and also encompasses the unrestricted general model (F ~ [0.763], null hypothesis of encompassing). All variables are statistically significant and have theoretically plausible signs except the nominal effective exchange rate.

As can be seen, both error correction terms are included in the short run inflation model and have the expected (negative) sign. However, consumer price inflation reacts much more strongly and quickly to deviations from the long run mark-up relationship than to deviations from the long run excess money relationship. The weaker and slower reaction of prices to monetary developments can also be observed from the coefficient and the lag of narrow money. The reaction of consumer prices to changes in the GDP gap and interest rates, on the other hand, is quite strong with one difference; it takes 1 quarter for the GDP gap to affect inflation, while changes in interest rates affect inflation after 3 quarters. Changes in import prices are also important for explaining short run inflation behaviour, as is the nominal effective exchange rate of the Croatian currency, although its sign contradicts theory. One could, of course, argue that although it is not usual for a nominal effective exchange rate depreciation to cause lower consumer price inflation, in the Croatian "fear of floating" context it may mean that monetary policy reacts excessively to depreciation pressures thus causing price contractions.

Figures 4, 5 and 6 present the basic diagnostic features of the model. The model fits the data very well, residuals are normally distributed and do not appear correlated, as shown by panels in Figure 4. Moreover, besides the fact that the model fits the Croatian inflation generating process quite well, it could be used for forecasting inflation since, as can be seen from the lower right panel in Figure 4, it successfully forecasts the last 10 inflation observations, with actual outcomes being within approximately 2 standard errors of the forecasts.

Figure 4. Fit and One-Step Head Forecasts of the Inflation Model

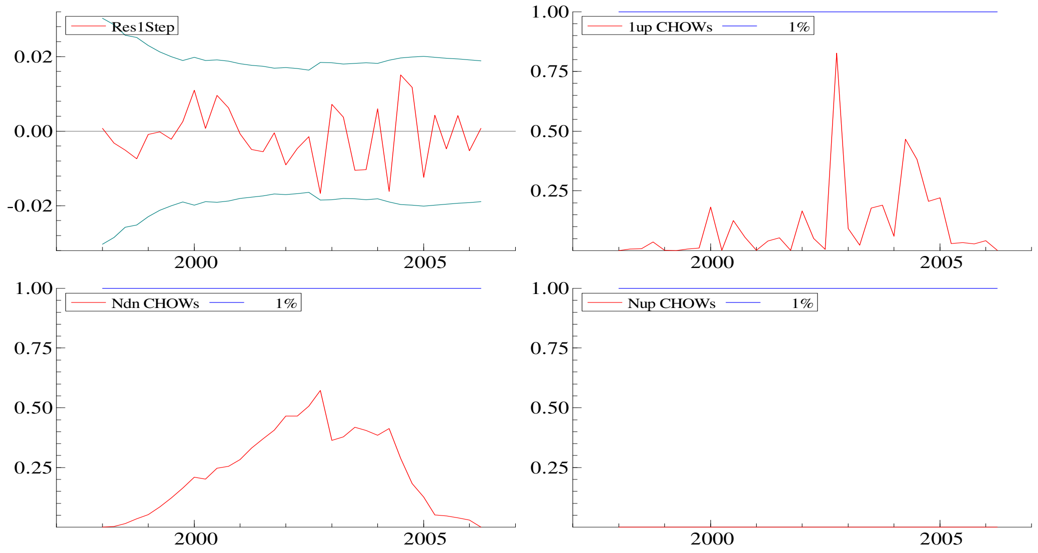


Source: authors´ calculation.

Figure 5 displays recursive statistics, more precisely one-step ahead forecasted residuals and 1-step, breakpoint and forecast Chow tests. Both, one-step forecasted residuals, which are within 2 standard error confidence bands and Chow tests confirm the stability of the model. In other words, the model's parameters are constant and there are no structural breaks inherent to the model.

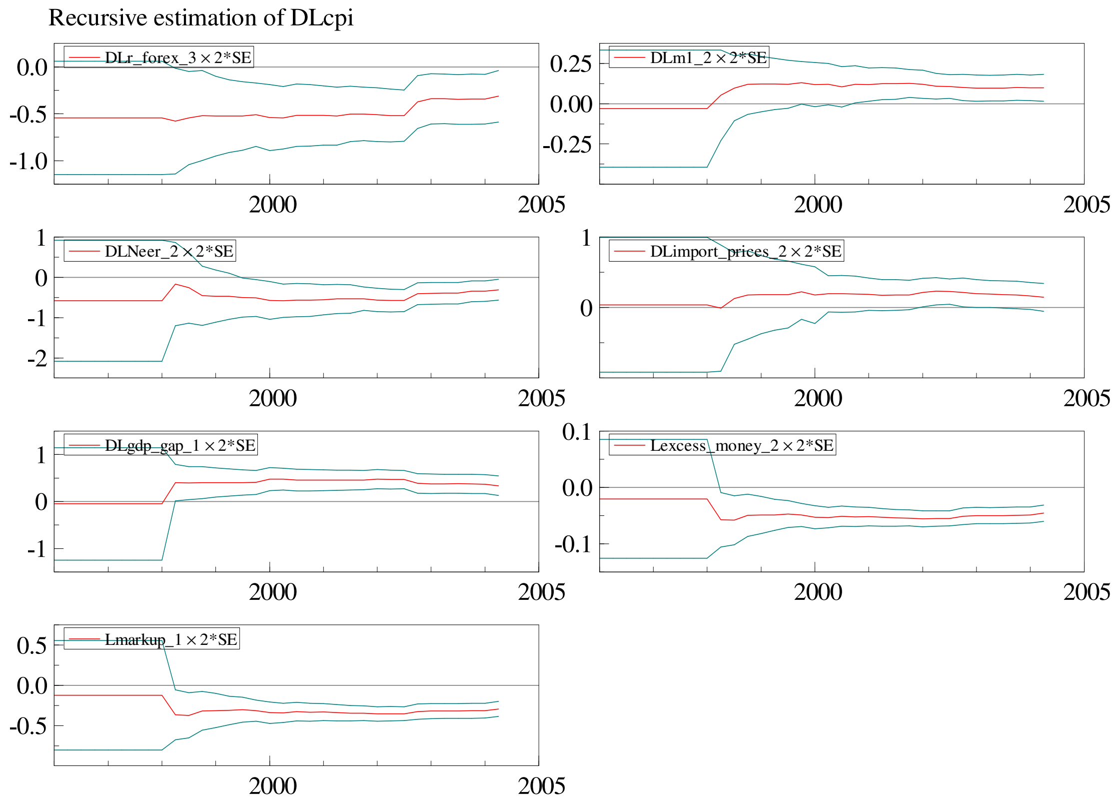
Finally, Figure 6 presents the recursively estimated coefficients of the model. It is clear that the coefficient estimates are stable and almost always significantly different from zero. This conclusion however does not apply for narrow money, the nominal effective exchange rate and import prices, whose coefficients are not significantly different from zero before year 2000.

Figure 5. Recursive Analysis of Inflation Model



Source: authors´ calculation.

Figure 6. Recursive Analysis of Inflation Model



Source: authors´ calculation.

Given the diagnostic features of the model, we can conclude that the short run model of inflation could be used for forecasting inflation. However, assessing its forecasting performance and comparing it to the other, preferably purely statistical models, is beyond the scope of this paper.

6. Conclusion

In this paper we wanted to analyse the driving forces of the inflation process in a transition economy, such as Croatia. First we derived, according to the theory, the long run sectoral relationship affecting inflation (mark-up, excess money, nominal effective exchange rate and GDP gap). Then we estimated the short run structural inflation function by imposing the above-mentioned long run relationships together with various short run variables which contribute to explaining the inflation process in general and in Croatia. The derived model of inflation suggests that mark-up and excess money relationships, imposed as error correction terms, are the most significant variables for explaining the short run behaviour of inflation. Two other sectoral variables, i.e. the GDP gap and nominal effective exchange rate are also significant for explaining short run inflation dynamics. However, according to the results of the model, it turns out that Croatian inflation is much more responsive to deviations from the equilibrium on the supply side and to changes in the nominal effective exchange rate than to deviations from equilibrium in the monetary sector. We also find Croatian consumer price inflation to be affected by changes in interest rates and import prices. Presented diagnostic tests suggest that the model could be used for forecasting purposes.

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Appendix:

Table A1. Data description

cpi	Consumer price index – CPI data can only to be obtained from 1998, so for the previous period we used the retail price index.
excess_money	Excess money supply
gdp	Gross domestic product
gdp_gap	GDP gap
import_prices	Import prices – a deflator of nominal volume of total imports of goods and services from the national accounts.
m1	Narrow money
mark-up	Mark-up
neer	Nominal effective exchange rate – calculated as a weighted geometric mean using weights for main trading partners and the nominal exchange rate at the end of the month.
p_estate	Real price of real estate
ppi	Producer price index
reer	Real effective exchange rate
r_forex	Interest rate on foreign deposits
trading_partners_cpi	CPI of Croatia's main trading partners – This includes Germany, Italy, Slovenia, USA, Austria, UK, Switzerland and France. Weights are determined on the basis of average foreign trade structure in the period from 1999 until 2004.
ulc	Unit labour cost – separate series on the number of employed persons in legal entities, agriculture and crafts had to be estimated and corrected since official statistics either has methodological issues (employment in legal persons) or is unavailable (before 1998, for agriculture and crafts). Total labour cost for legal entities was obtained by multiplying average net wage and the number of employed persons in legal entities. Total labour cost in agriculture was obtained by multiplying the average net wage in agriculture with the number of employed persons in agriculture, while total labour cost for crafts was obtained by multiplying the number of employed persons in crafts in each category of activity by the respective average net wage in that activity. Cumulative labour cost was then divided by real GDP.
zibor	Zagreb inter-bank offer rate – ZIBOR started being calculated only in 2000, so before that period we used interest rates from the Zagreb Money and Short Term Securities Market
Dummies	In deriving mark-up we used 3 dummies (bank – for bank crises in 1995 and 1997 and the first half of 1998; PDV – after introduction of the VAT in 1998; war – until 1996).

Quarterly data are used in the analysis. For data with higher frequencies, we used quarter averages. L implies data in logarithms and D implies differenced data.