STOPPING HIGH INFLATION IN AN EX-SOCIALIST COUNTRY: THE CASE OF CROATIA 1993/1994*

Velimir Šonje and Danijel Nestić

Introduction

Croatian disinflation started in November 1993[1], after the October monthly rate of inflation reached more than 30%. The official measurement of prices 45 days after the announcement of the programme showed that the economy is in deflation. Deflation continued for 8 months up to now, with no significant impact on real output. In this paper we explain these events.

By estimating the short-run (monthly) inflation equation which captures only rates of change effects, we show the hysteresis effect, i.e. the effect which pushed the economy out of it's equilibrium path. We show how it was posible for the economy to be in a permanent excess supply state, although in high inflation. So we explain post-stabilization deflation: we present evidence on relative price variability, and we show that the deflation and it's magnitude can be explained by the high degree of synchronization in price contracts in a period of appreciating domestic currency. We emphasise the role of demand factors which influence inflation with a considerable time-lag, and which make effects of the post-stabilization monetary policy very uncertain.

The paper is organized as follows. Brief history of inflation, behavior of the main aggregates and main features of the programme, are described in section 1. A special emphasis is given to the role of budget deficit. In section 2 we put things together into a short-run

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[1] *The Government publicly announced the begining of the stabilization programme on October 4th 1993.*

inflation function. First we develop a simple model which describes the international reserves maximization behavior of the Central Bank, and than we discuss the estimation procedure. In section 3 we investigate the role of price contracts and price rigidities. In section 4 we discuss two striking problems for policy makers in the post-stabilization period: changes in the demand for money and the level of the real echange rate. In section 5 we derive conclusions with special emphasis given to the nature of the post-socialist economy.

1. The history of Croatian inflation: behavior of main aggregates and main features of the programme

History of inflation 1990:1 - 1993:10

Figure 1 depicts aggregate price behavior during 53 months, from January 1990 to May 1994. In December 1989 last ex-Yugoslav Government launched a stabilization programme. Prices stabilized in April 1990, but inflation reemerged in September and October the same year. Dynamics of real money balances and households' sector real incomes, depicted in figures 2 and 4, indicates that this was a period of excess demand created by loose monetary and incomes policy.[2]

Real money balances and real incomes started to decline in the second half of 1990 due to increase in prices. Figure 2 shows that real money deflated by domestic prices declined gradually, whereas real money deflated by the exchange rate declined in descrete steps during 1990 and most of 1991, due to Government's attempt to retain fixed exchange rate policy. But Government was forced to adjust the nominal exchange rate by devaluating the official rate. That happened twice - in January and April 1991.

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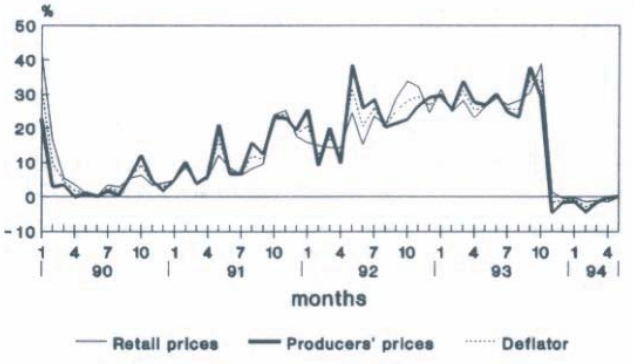
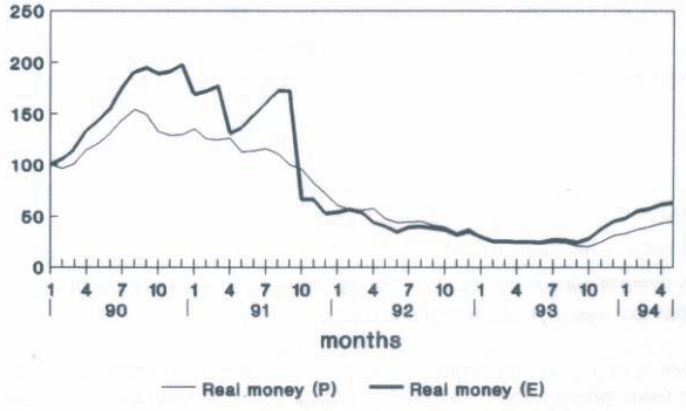
[2] Note That variables have been measured relatively to the January 1990, the base month. For more details on calculations see the Data Appendix.

Fig. 1 MONTHLY RATES OF CHANGE IN RETAIL PRICES PRODUCERS' PRICES AND DEFLATOR 1990:1 - 1994:5



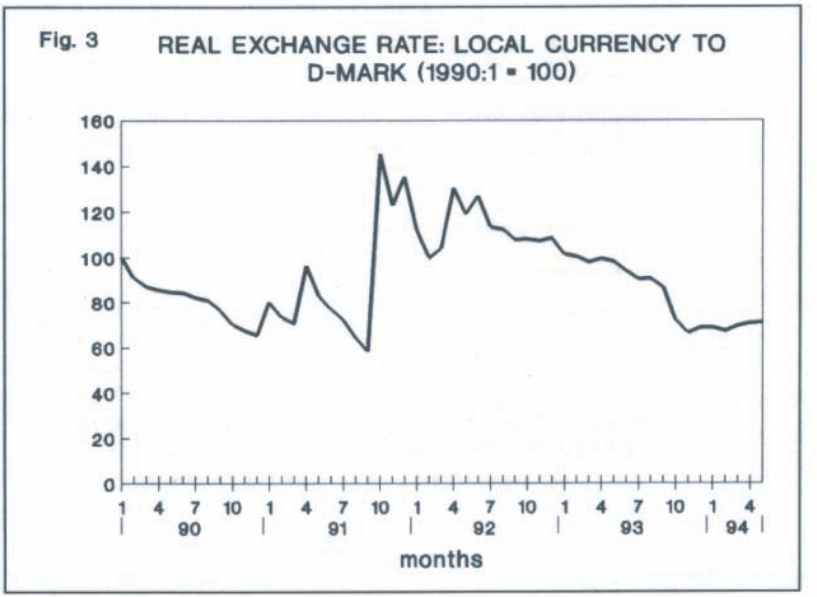
Deflator is a simple average of two indicies.

Fig. 2 REAL MONEY BALANCES IN CROATIA 1990-1994 DEFLATED BY DOMESTIC PRICES (P) AND BY THE EXCHANGE RATE (E) (1990:1=100)



This policy influenced the real exchange rate which also moved in descrete steps (figure 3) due to gradual growth of domestic prices and discrete devaluations of the nominal exchange rate. That is why real exchange rate reached it's minimum in September 1991.[3] And that was the month when open Serbian agression culminated.

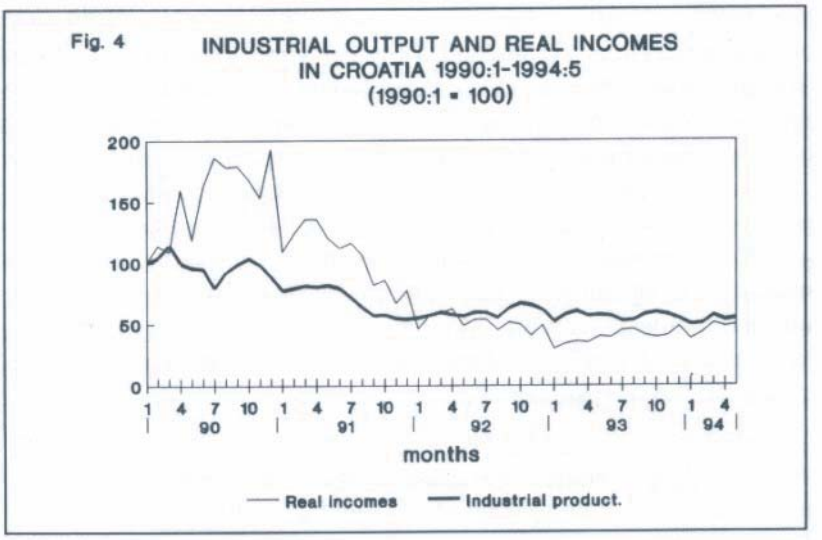
Fig. 3 REAL EXCHANGE RATE: LOCAL CURRENCY TO D-MARK (1990:1 = 100)



[3] *We used a simple calculation for the real exchange rate. Changes in the real exchange rate (re) are calculated as:*

$$re_t = e_t / p_t$$

where $e_t = E_t / E_{t-1}$ is depreciation of local currency to D-mark expressed in the ratio form, and $p_t = P_t / P_{t-1}$ is inflafion (deflator) in the ratio form. This expression is sensitive neither to German inflation, nor to exchange rates and inflations in other countries, but it approximates more sofisticated calculations of real efective exchange rates very well.

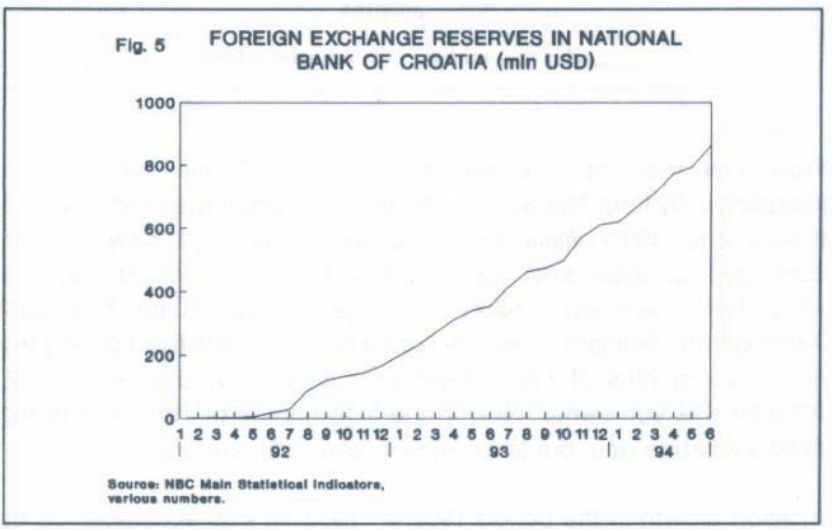


From that moment, The National Bank of Croatia (NBC) acted independently from The National Bank of ex-Yugoslavia, and therefore it allowed for 300% official devaluation in October 1991. New Croatian currency - Croatian dinar was introduced in December. At that time NBC didn't have any foreign exchange reserves at the disposal.[4] Although the C-dinar/D-mark exchange rate was held fixed during the first three months of 1992, devaluation was allowed in April 1992. Inflation was somewhat lower in the first months of 1992 due to the fixed exchange rate, but since April inflation started to rise.

Inflation growth in the period 1992:4 - 1993:10 was accompanied by the growth of the foreign excchange reserves. The growth of reserves is depicted in figure 5. Maximizing the reserves was the objective function of the NBC decision-makers. This kind of behavior was perfectly logical for monetary authorities in a newly emerging independent country. Since price of the foreign exchange was more or

[4] *Substantial foreign reserves of ex-Yugoslavia were blocked by the Serbian regime in Belgrade.*

less regulated by the NBC at that time, the monetary authorities enjoyed **discretion** in planning both nominal money growth and rates of depreciation. Their reserves maximization problem was constrained only by price and output reactions by other economic agents. So, the reserves were maximized subject to some level of inflation which policy-makers perceived as "acceptable". Nowadays, looking backward, we can speculate that it was the monthly inflation rate between 25% and 30%. This was the level inflation actually never broke up. From the middle 1992 till October 1993 monthly inflation rates were oscilating arround that level, and the inflation trend didn't show any propensity to increase. We will put these considerations into a more formal context in the next section.[5]



[5] *It may seem that depreciation is not compatible to the reserves maximization hypothesis because the central bank has to pay more for a unit of foreign currency. However, fixing the exchange rate or even apreciating it in the middle of inflation process without announcement of the overall change in the economic policy regime, is not credible. The black market rate depreciaties more than the official rate and the agents do not want to sell foreign currency to comercial banks any more. That is why central bank had to depreciate the currency in order to maximize reserves.*

Now it is important to notice that the inflation constraint on money and exchange rate decisions created pressure for excess demand to decrease. Figures clearly show the decrease in real money balances, real incomes and real exchange rate till October 1993. The explanation is that in this kind of high inflation process, which is independent of the GDP level effect, current change in prices depends on past changes in prices and, in some way, on current depreciations[6] or/and the rate of growth of money supply. Within such a setting, real demand variables tend not to grow, and under certain informational assumptions, they even tend to fall. We will also put these considerations into a more formal context in the next section. It is important to note that in the kind of inflation process where monetary authoroties maximize reserves subject to inflation constraint, decrease in real money is stronger than decrease in demand for money. We elaborate this further after the review of the main features of the
stabilization programme.

The main features of the stabilization programme

On the 4th of October Government announced a heterodox programme which contained following measures:

1. Upper intervention point" for the exchange rate was announced to be 4444 C-dinars per DEM in October (21 higher rate than the rate on the 1 st of October), 4650 C-dinars per Dem in November and 4800 C-dinars per DEM in December.
2. Money supply rule was announced to be 21 % increase in October (same percent as the initial devaluation), and 3% per month till the end of the year.
3. The NBC discount rate was set at 7% per month initially (during October it was revised and set to 3% per month).

[6] Depreciation plays a role because buildinig the foreign exchange clause into price contracts is the cheapeast way to protect from losses due to drops in relative prices.

4. Incomes policy rule was announced to be 22% net wage increase for October, and 3% for November and December. Government had enough bargaining power to stop backward looking wage indexation, and the rates were applied to the payroll at the enterprise level, but only for the state enterprises.
5. A new foreign exchange law was passed to the Parliament (and adopted in the middle of October). It contained liberalization of the foreign exchange market and introduction of the internal convertibility.

The measures were mutually consistent and their nature was foreward-looking. All of them interrupted backward-looking behavior (inertia) and turned it into the foreward-looking one. One might ask why was the 3% per month chosen to be the critical foreward-looking information? The answer lies in the policy-makers' beliefs. They were not sure about the nature of the inflation. Although they knew it was mainly expectations driven inflation, they suspected that there is some (positive) inflation level consistent with the budget deficit. They even used the figure of 3% in their public statements, and they proclaimed it to be a policy target within six months (till March 1994). However, the private economic agents reacted much faster.

The demand for money increased at the very begining of the programme, and from the middle of October till the end of the year 1993, the nominal exchange rate appreciated from 4444 to 3800 C-dinars per DEM. During the first half of 1994 it stabilized at the level of 3650-3700 C-dinars per DEM. The new Croatian currency, Kuna, was introduced in May 1994, and the rate was 3.7 per DEM. The path of appreciation was convex, and the path of the real exchange rate (figure 3) shows that the cost of disinflation measured in terms of loss in international competitiveness (real apreciation), was paid at the very begining of the programme - prior to November 1993. Since then, real exchange rate depreciatied slightly because prices followed the exchange rate path, and they started to decrease in nominal terms.

This scenario calls for more carefull elaboration of the role of the budget deficit. Even policy makers believed that the level of budget deficit would require some positive rate of inflation after disinflation.

The role of budget deficit

It is well known that budget deficits accompany high inflations. In the last three years Croatia had a budget deficit due to the war and the burden of refugees, but it's size is subject to speculations due to lack of reliable data. That is why we tried to estimate it indirectly, by analysing the degree of it's monetization.

Real money holdings (M/P) are taxed by the rate of inflation (π), so that inflation tax revenue (R) can be written as:

$$R = \pi(M/P) \qquad (1)$$

This equation, however, holds only in equilibrium conditions when the rate of inflation equals the rate of growth of monetary base. So, for empirical purposes we use alternative formula for seigniorage. Seigniorage is, simply, a real value of the new money in period t[7]:

$$S_t = (dM/dt)/P \qquad (2)$$

Multiplying eq. 2 by M/M gives:

$$S_t = ((dM/dt)/M)(M/P) \qquad (3)$$

Seigniorage is a budget revenue, because the state is a monopolist supplier of money. And that is why M in eq. 2 and 3 stands for high

[7] *According to Fischer (1982), seigniorage made 1% of GDP in 14 industrialized countries 1960-1978. And according to Cagan, in European hyperinflations in 1920's it made nearly 10% of GDP.*

powered money. In the following analysis we will use simbol H instead of M.

In order to estimate the importance of seigniorage for budget revenue in high inflation, we have to take into account the impact of inflation on regular public revenues. Tanzi (1978) had shown that the optimal rate of inflation for maximization of tax revenues is much lower than the optimal rate of inflation for maximization of the inflation tax. That is why we have measured the seigniorage rate in two ways. First, we estimated shares of monthly nominal increases of high powered money in nominal monthly GDP, which is the same as seigniorage/real GDP ratio:

$$SSHARE1 = ((dH/dt)/P)/(GDP/P) = (dH/dt)/GDP \qquad (4)$$

Second, we have measured shares of monthly changes of high powered money in total public revenues which include seigniorage itself:

$$SSHARE2 = (dH/dt)/(T + (dH/dt)) \qquad (5)$$

Table below shows quarterly results which are obtained as simple averages of monthly results within a quarter. Basic data and monthly results are presented in the data appendix.

Table 1

SEIGNIORAGE RATES AND RELATED VARIABLES

(quarterly averages of monthly data, only inflation given as a quarterly cumulative)

Year and quarter	M1/GDP* (%)	T/GDP** (%)	SSHARE1	SSHARE2	Velocity*	Quarterly infla (%)
1991:I	15.62	31.95			6.40	19.4
1991:II	13.72	25.95			7.29	32.4
1991:III	16.61	25.55			6.02	32.4
1991:IV	16.45	27.80			6.08	81.8
1992:I	13.58	36.64	0.07	0.14	7.36	58.4
1992:II	10.46	34.01	0.06	0.16	9.56	77.3
1992:III	9.46	38.30	0.10	0.21	10.57	90.0
1992:IV	8.31	36.26	0.10	0.20	12.04	108.4
1993:I	7.23	42.53	0.05	0.11	13.82	113.6
1993:II	6.09	36.70	0.08	0.17	16.41	105.4
1993:III	5.37	34.11	0.09	0.21	18.62	112.0
1993:IV	7.28	42.34	0.09	0.17	13.74	30.4
1994:I	9.91	46.09	0.04	0.08	10.09	-4.8
1994:II				0.11		-1.2

** Values at the annual level*

*** Also at the annual level: T stands for other government revenue*

The first column shows quarterly decreases of shares of M1 in GDP. The second column shows shares of total government revenue in GDP. Maximum shares in the last quarter of 1993 and the first quarter of 1994 show the inverse Tanzi-Oliveira effect, and reflect increased financial discipline which accompanied stabilization programme. Third and fourth column show seigniorage rates (SSHAREI and SSHARE2). Seigniorage share in GDP increased during 1992, after Croatia introduced it's own currency, and it reached it's maximum of 10% in GDP (21% in total public revenue respectively). After that, high inflation continued, and the shares declined. Average share of seigniorage in GDP for the whole period was 7.7%, and the average share in total government revenue was 15.5%.

There are two errors that prevent jumping into the conclusions at this stage of analysis. The first is a measurement error regarding monthly GDP estimates. These estimates are heavily biased downwards[8]. That makes ratios which contain GDP in denumerator biased upwards. Second error is due to assumption regarding the structure of high powered money. Up to now we assumed that the budget deficit is the only reason for creation of the high powered money. However, the budget deficit (DEF) can be financed by borrowing at the domestic or foreign financial markets (D), by borrowing from the central bank (H), or by decrease in international reserves (B):

$$DEF = dD/dt + dH/dt - E(dB/dt) \qquad (6)$$

where E is the exchange rate. So, by looking at eq. (6), we can interpret the assumption as: dD/dt=0 and E(dB/dt)=0. While dD/dt=0 is a reasonable assumption because of underdeveloped domestic capital markets and closed doors of international financial institutions for Croatia, the second assumption cannot hold at all. The international reserves were growing fast from the begining of 1992, and so we have to rewrite eq. (6) as:

$$DEF_t = dH/dt - E_t(dB/dt) \qquad (7)$$

or

$$dH/dt = DEF_t + E_t(dB/dt) \qquad (8)$$

In words, changes in high powered money were induced by budget deficit and changes in international reserves.

Our final analysis starts from eq. (7). DEF_t is the size of monetized deficit in month t. E_t is the average monthly local currency/USD exchange rate, and dB/dt is monthly change in dolar value of the

[8] *For more about it see the comments bellow tables in the appendix.*

international reserves at the disposal of NBC. Quarterly averages are given in the table below, and original monthly results are presented in the appendix.

Table 2
SEIGNIORAGE RATES CORRECTED FOR CHANGES IN INTERNATIONAL RESERVES
(quarterly averages of monthly data)

Year and quarter	SSHARE1	SSHARE2
1992:I	0.07	0.13
1992:II	0.05	0.13
1992:III	0.04	0.10
1992:IV	0.07	0.16
1993:I	-0.02	-0.04
1993:II	0.02	0.06
1993:III	0.03	0.07
1993:IV	0.01	0.02
1994:I	-0.01	-0.02

These data obviously suggest much lower monetized budget deficit. During 1992 the average share of monetized deficit in total governement revenues was 13.1 %, and 6% in GDP. During 1993 the average share of monetized deficit in total government revenues was 2.6%, and only 1.1 % in GDP. In some quarters the data have negative values, meaning current budget suficit. These results suggest that the budget deficit might be one of the main reasons for inflation to jump to a higher level in the first half of 1992. However, from the middle 1992 inflation was driven by other mechanisms. Data for the first quarter of 1994 prove the existence of inverse Tanzi effect, and indicate that one of the reasons for stabilization success can be found in good fiscal policy.

2. Putting things together: a simple model and estimation of the inflation equation

A simple model

The descriptive part of the paper clearly points to the fact that we are dealing with an economy in which the inflation was going on at extremely high rates, inspite of the difference between levels of actual and potential output and inspite of the questionable role of monetized part of budget deficit. Such behavior of the inflation is what is named as hysteresis effect in the new keynesian literature (Gordon, 1990). Prices are driven exclusively by inertia and rates of change effects. Let us now briefly show that effect using Gordon's notation.

Let $x = p + q$ be the rate of change of nominal GDP which is expressed as the sum of rates of change of aggregate price level and aggregate real output. By subtracting the long-run equilibrium growth rate q' from both sides of the rate of growth equation, we get:

$$X - q^{*} = p + (q - q^{*}) \qquad (9)$$

The expression shows that the excess of nominal GDP growth rate can be decomposed into the inflation rate component (p) and real output deviation rate component $(q - q^{*})$. Taking it another way, and stating that the inflation rate is equal to some (constant) part of the excess nominal GDP, we can write:

$$p = \alpha (X - q^{*}) \qquad (10)$$

Furthermore, inflation reacts to supply shocks which we put in the error term ε, and inflation is subject to inertia, i.e. it depends on it's own lagged value. So, finally we write the general form of the inflation rate equation which captures only inertia, and rates of change effects:

$$p_t = \lambda p_{t-1} + \alpha(x - q^{*})_t + \varepsilon_t \qquad (11)$$

In order to estimate the equation for Croatia, we have to give a real meaning to the second variable on the right hand side of the equation (3). So we need to: (a) construct the variables for estimation, and (b) theoreticaly prove how is it posible for real values of demand variables to decline. We do both things simultaneously.

Since we are building a theoretical model, we omit the error term for now. Second, assume that we are dealing with the small, open economy and decompose the nominal excess demand rates of change into nominal excess domestic demand (superscript d) and foreign (superscript f) demand rates of change. Write then:

$$\alpha\ (x - q^{*}) = \alpha\ ((x^{d}-q^{*d}) + (x^{f}-q^{*f}) \qquad (12)$$

Furthermore, assume $(x^{d}q^{*d}) = 0$, so that $\alpha(x - q^{*})= \alpha(x^{f}-q^{*f})$. Nominal excess demand that comes entirely from the foreign sector depends on the rate of nominal depreciation (e):

$$(x^{f}–q^{*f}) = \beta e \qquad (13)$$

Substituting (13) into (12), (12) into (11), and taking into account the assumption of zero domestic excess demand, gives the expression:

$$p_t = \lambda p_{t-1} + \gamma e_t \qquad (14)$$

where $y=\alpha\beta$. We use eq. (14) to analyse the behavior of real demand variables under different informational assumptions.

Interpret eq. (14) as a price rule which says that the current inflation is some combination of past inflation and current depreciation. Furthermore, we impose an additional parametar constraint which states that current inflation rate is a linear combination of past inflation rate and current nominal depreciation.

This restriction on parameters allowed us to assume that eq. (6) is expressed in ratio form, so that $p_t = p_t/p_{t-1}$, etc. Devide eq. (14) through by pt in order to obtain the expression for the change in the real exchange rate:

$$e_t/p_t = (1 - (\lambda p_{t-1}/p_t))/\gamma \qquad (15)$$

Obviously, we have to assume $\gamma>0$. If $\gamma=0$ would be the case, eq. (15) would equal plus infinity. That is, since $\gamma=0$ implies $\lambda=1$, current inflation is always equal to past inflation, and it is posible to increase the nominal exchange rate without any impact on prices. Stationary price equilibrium is not linked to the exchange rate then. This contradicts both real world events and theory, so we assume $\gamma>0$.

Now we investigate the behavior of the model for possible λ, and γ, and we introduce a crucial behavioral restriction into the model. In the first section we argued that the policy makers wanted to maximize the international reserves level (which positively depends on nominal money supply and exchange rate growth, given capital inflow), subject to the inflation constraint, i.e. subject to the reactions of private economic agents. Namely, policy makers wanted to keep the monthly inflation rate below some threshold which they perceived to be the upper boundary of inflation tolerance interval. They simply wanted to avoid explosion of expectations which would lead to accomodation of monetary aggregates to much higher inflation level. Analysis of the structure of changes in high powered money strongly supports this behavioral assumption.

Having in mind this behavioral constraint, the model works as follows. Assume that we start from the zero rate of inflation ($p_{t-1}=1$). Monetary authorities control nominal depreciation, and private economic agents induce inflation by their reactions to new informations. Monetary authorities maximize the present value of reserves with a discount factor high enough to induce them to depreciate in the first period as much as posible. The maximum rate of depreciation in the first period

is constrained only by induced inflation. Since monetary authorities know parameters λ and γ, they can calculate the rate of nominal depreciation which produces inflation rate equal to the given upper limit of the inflation tolerance interval. Given $p_{t-1} = 1$, and $p_t=p_t^*$, where p_t^* is a predetermined upper limit of the inflation rate, monetary authorities can derive maximum rate of nominal depreciation written as:

$$e_t = (p_t^*-\lambda p_{t-1})/\gamma \qquad (16)$$

Even without sophisticated algebra, a reader can verify that the real exchange rate (or any other real demand variable) cannot grow in the long run. Investigate first the case where $\gamma=1$, $\lambda=0$. From eq. (15) it follows that (p_{t-1}/p_t) term can be disregarded, and eq. (15) equals one; the real exchange rate would be constant, because changes in the nominal exchange rate would be directly transmitted into prices, without time lag. In terms of eq. (16), this parameter combination leads to $e_t=p_t^*$ which clearly implies a constant real exchange rate.

For other combinations of parameters, it is easy to see that after the initial (nominal and real) depreciation, which brings inflation rate to the upper limit, real exchange rate stays constant at the new level as long as $(p_{t-1}/p_t) = 1$ is valid. Values of parameters determine the real depreciation. Stronger inertia makes higher levels of real exchange rate attainable, and vice versa. Generally, for high values of λ, and low values of γ, real depreciation will be higher than for inverse combinations of parameter values.

However, the real exchange rate can even decline if we allow for slightly diferent set of informations influencing the inflation process. Assume that producers taking price decisions decide, for whatever reason, to take into account the average of past and current depreciation, so that eq. (14) now becomes:

$$p_t = \lambda p_{t-1} + \gamma(e_t+e_{t-1})/2 \qquad (17)$$

and eq. (15) becomes:

$$e_t/p_t = (2-2\lambda(p_{t-1}/p_t))/\gamma - e_{t-1}/p_t \qquad (18)$$

By multiplying eq. (18) with p_t, we obtain expression monetary authorities use for determination of the nominal depreciation:

$$e_t = 2(p_t^* - \lambda p_{t-1})/\gamma - e_{t-1} \qquad (19)$$

In the same manner we can derive equations of the type (19) for other exchange rate depreciation lag structures. For example, if private economic agents take two lags into account, eq. (19) becomes:

$$e_t = 3(p_t^* - \lambda p_{t-1})/\gamma - e_{t-1} - e_{t-2} \qquad (20)$$

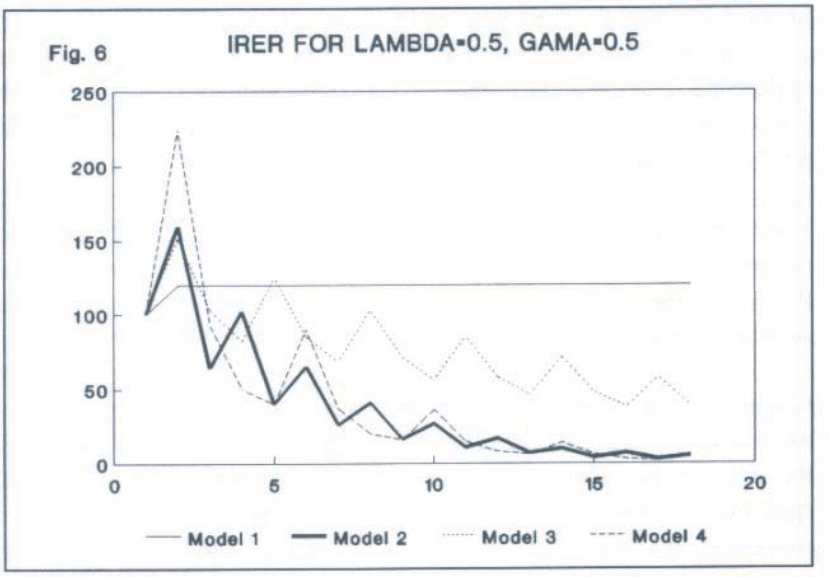
If they take three lagged values into account, equation becomes:

$$e_t = 4(p_t^* - \lambda p_{t-1})/\gamma - e_{t-1} - e_{t-2} - e_{t-3} \qquad (21)$$

Figures 6 and 7 present simulation results for real exchange rate index (IRER), for different parameter combinations and different lag structures. Equation (16) is used for obtaining the results for model 1 in both figures. Equation (19) is used for obtaining model 2 results, eq. (20) for model 3 results, and eq. (21) for model 4 results. Simulations were executed for 18 time periods, the first period beefing a base one (=100), and for two parameter combinations. The first combination (fig. 6) is λ=0.5, γ=0.5, and a second one (fig. 7) is λ=0.3, γ=0.7. In both cases we assumed upper limit inflation for monetary authorities to be 25% per period (p_t^* =1.25).

There are three important results. First, model 1 results in both cases indicate an increase in the real exchange rate which happens in the first period. In all subsequent periods the real exchange rate remains unchanged. Real exchange rate increase is possible because inflation lagged one period is lower than the upper limit inflation, and nominal

Fig. 6


IRER FOR LAMBDA=0.5, GAMA=0.5
250
200
150
100
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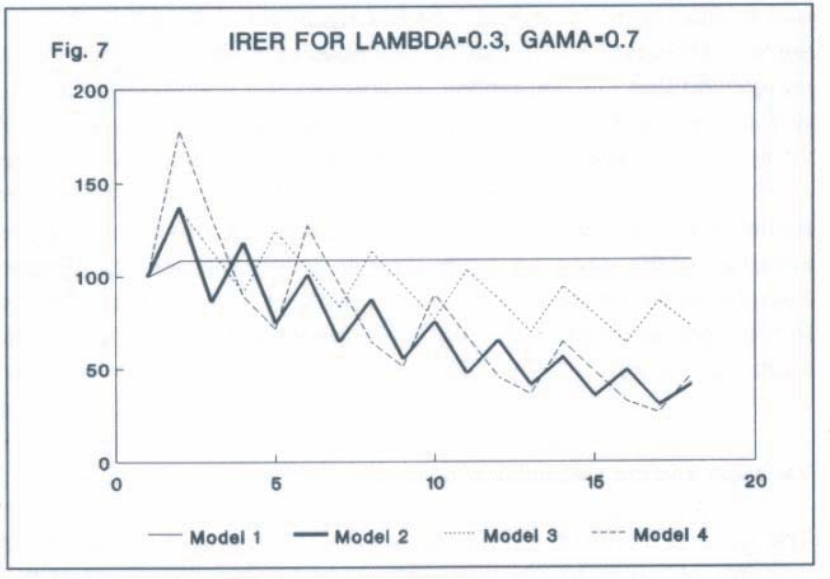
0
0
5
10
15
20
Model 1
Model 2
Model 3
Model 4

Fig. 7


IRER FOR LAMBDA=0.3, GAMA=0.7
200
150
100
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5
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15
20
Model 1
Model 2
Model 3
Model 4

depreciation can be higher than that limit. The magnitude of real depreciation depends on strenght of inertia. Stronger inertia (fig.6) allows for higher initial real depreciation.

Second, the introduction of lagged nominal depreciations into inflation equation, produces a downward trend. Real exchange rate tends to appreciate after initial depreciation, with oscillations arround the trend. Oscillations are strong at the begining, but as the time passes, they tend to be weaker.

Third, oscillations tend to be stronger for higher values of the inertial parameter. Higher inertia opens room for bigger initial real depreciations, but later it leads to stronger apreciation of the real exchange rate.

Generally, the model justifies the use of lags in construction of explanatory variables. And what is the most important result, it predicts that in an economy with strong inertia (high λ), and reserve maximization behavior subject to inflation constraint, we can expect real demand variables to increase in the shorter time period, and then to decrease during longer period, decrease beefing more intensive than the increase. This kind of real demand variables behavior fits well to real exchange rate and real incomes dynamics depicted in the first section. Moreover, this behavior describes real money changes well, suggesting that the real money decline has two components. One is well known, and is due to decrease in demand for money in high inflation. The second component is due to reserves maximization subject to inflation constraint. Monetary authorities adjust rates of money supply to rates of nominal depreciation, but when they perceive a danger of the upward jump in the rate of inflation, they slow down the rates of depreciation and money growth. The structure of changes in the high powered money during high inflation in Croatia strongly supports this view.

Variables and the estimation procedure

The general form of the model was estimated using monthly data. A possible objection to this approach could be based on the fact that monthly series almoust inevitably exhibit inertia, which leads to the upward bias in the inertial parameter. That objection is valid, but we emphasise that we are not trying to test the theory. We are using the theory as a leading idea, and we are leaving level effects which maybe work at the quarterly or annual level, outside the model. Our referent period is a month, a very short term period which is relevant for policy making in disinflation. This constraint will lead to very careful interpretation of results.

Excess rate of growth of nominal demand was decomposed into a foreign and a domestic component. The foreign component was constructed following previous analysis, with one modification. Namely, there are two mechanisms which transmit exchange rate changes into prices. The first is a standard one and is well elaborated in the literature (Dornbusch, 1976). Depreciation creates excess demand coming from the foreign sector, because domestic prices react slowly in comparison with the asset prices, especialy in comparison to the price of the foreign currency. The second mechanism is, however, specific for high inflation countries and it tends to impede the first mechanism due to foreign exchange indexation in the price contracts. In order to avoid inflation losses, producers introduce foreign exchange clause into price contracts, so that the exchange rate changes can be transmitted into domestic prices much faster. However, indexation is never pertect in the real world, as we will show in the third section.

In order to capture this considerations, we made a test of the hypothesis about the influence of the difference between the expected and actual depreciation on prices. Lagged depreciations play a role in the expectations forming mechanism which is adaptive on the monthly level. Denote expected depreciation in period t as:

$$e_t^e/e_{t-1} = 1/3(e_t/e_{t-1} + e_{t-1}/e_{t-2} + e_{t-2}/e_{t-3})$$

The explanatory variable is named DEXP and can be written as:

$$DEXP_t = (e_t^e/e_{t-1})/(e_t/e_{t-1}) = e_t^e/e_t$$

We assume that current prices react to the current difference (ratio) between expected and actual depreciation, because in high inflation, producers are able to perceive the changes in speed of depreciation at the begining of the month. That is also a reason why current depreciation enters expectations formula. However, the perception of current depreciation at the begining of the month is not perfect, and that is the reason why producers form expectations in an adaptive way, taking into account the simple average of currently perceived and two lagged depreciations. Since actual depreciation is in the denominator, increasing difference has to decrease the inflation, and the expected sign of variable DEXP is negative.

The second explanatory variable that captures the rate of change of excess demand is a domestic one. We named that variable DOMDEM (domestic demand), and it captures the effect of differences between the rates of change in marginal productivity of labor and rates of growth in real incomes. Both series are presented in section 1, and details on construction of these variables can be found in the appendix. Denote marginal productivity of labor as MPL = dy/dL, and real incomes as I/P, so:

$$DOMDEM_t = ((I/P)_t / (I/P)_{t-1}) / (MPL_t / MPL_{t-1})$$

Since rise of real incomes above marginal productivity increases the value of DOMDEM, we expect it to have a positive sign. Finally, the dependent variable is inflation measured as a simple average of the retail price and producers' price inflation.

Estimation results are shown in table 1. Two equations have been estimated for the same period and by the same method. The difference between these equations arises because of introduction of credibility dummy variable (DUMCRED) in November 1993-. This dummy captures announcement effect of the stabilization programme. Both equations contain additional dummy in May 1992. The outlier in May 1992 may occur due to supply shocks which are hidden in the error term, or due to other demand variables which are also hidden in the error term (the role of budget deficit other than public sector wages). Constant is omitted in the estimation procedure, because underlying theory suggests to do so.

Inflation lagged one period performs very well in both equations, with similar coefficients approximately equal to one. This indicates high inflation inertia during the period. Proxy for the rate of change of domestic excess demand (DOMDEM) performed well only with a considerable time lag of five months. In the first equation parameter is significant at the .05 level, and in the second equation at the .02 level of the two-tail t-test. In the fourth section we discuss the implications of the lagged influence of domestic demand.

Difference between actual and expected depreciation plays an important imediate role, but is significant only at the 0.20 level in the first, and at the .05 level in the second equation. Values of parameters in both equations indicate that it's influence is stronger than the lagged influence of excess domestic demand.

Monthly inflation equation does not capture the kink in the inflation series in November 1993 well. The prime reason is inertia which was broken by the announcement (credibility) effect of the stabilization programme.[9] Variable DUMCRED, which is equal to 1 in November,

[9] *Recall the discussion in the first section. There we argued that the programme was very well designed in order to turn backward-looking into the foreward-looking behavior. Therefore, inflationary expectations reduced prior to the disinflation (for more about it, see: Agenor and Taylor, 1992).*

captures that effect. It obviously raises both R2 and adjusted R2 in the second equation, and it also raises significance of all explanatory variables. However, after introduction of that dummy, we had to reject the nul hypothesis about no autocorelation (see t-test for RHO in the second equation and the value of Durbin's h test).

Table 3
ESTIMATION RESULTS

	Equation 1	Equation 2
Period	1990:8-1994:5	1990:8-1994:5
Method	Cohrane-Orcutt	Cohrane-Orcutt
No. of observations (df)	46 (42)	46 (41)
Dependent var.	Inflation	Inflation
Explanatory vars.	Parameters (t-tests)	Parameters (t-tests)
$INFLA_{t-1}$	1.005625 (17.84)	1.015493 (33.81)
$DOMDEM_{t-5}$	0.097218 (2.21)	0.0672195 (2.52)
$DEXP_t$	-0.1076556 (-1.565)	-0.0796269 (-2.03)
$DUM592_t$	0.180188 (2.61)	0.1311309 (3.36)
$DUMCRED_t$	/	-0.354781 (-9.13)
R^2 adj. R^2	0.6823 0.6596	0.8845 0.8732
F-test	30.068	78.46
DW	2.0395	2.1490
Durbin's h	-0.9520	-3.2496
RHO	-0.129823 (-0.78)	-0.469078 (-3.04)
Heteroscedasticity tests	for DEXP	for DEXP
Spearman's test	t=0.7674	t=1.0755
Goldfield-Quandt	λ=2.5634	λ=1.5768

Finaly, we examined heteroscedasticity problem, because we suspected there might be a positive link between values of DEXP and the variance. Use of Spearman's rank correlation test shows insignificant t-values in both equations, and confirms no heteroscedasticity. Goldfield-Quandt's test shows no heteroscedasticity at the significance levels of .10 and .01 respectively.

There are four main conclusions arising from this analysis:

1. Croatian inflation was driven by the hysteresis effect, i.e. only by inertia and the rates of change effects. Thus it was posible for it to go through the high inflation regardless to the GDP and unemployment level.
2. In a situation when monetary authorities control both the exchange rate and money supply in order to maximize reserves subject to the upper inflation limit, and when an economy in high inflation is driven by the hysteresis effect, it is perfectly possible for: (a) real money and real exchange rate to move along the downvard trend in the long period of time, and consequently (b) for an economy to be in a state of the excess aggregate supply. This fact is a possible explanation for the rather long deflation period after the announcement of the stabilization programme.
3. In the case when the second conclusion holds, cost of disinflation will be smaller, if the prices are less rigid downwards. If an economy enters the stabilization programme regime in a state of excess aggregate supply, either deflation or/and real output adjustment can drive such an economy into macroeconomic equilibrium. Croatian deflation explains why there were no signs of significant real output costs up to now.
4. Since the rate of change of excess domestic demand influences the inflation rate with a considerable time lag, monetary authorities are faced to high uncertainity regarding effects of their policy in the post-stabilization period. On the one hand, demand for money surely increases during disinflation

(especially during deflation), but on the other hand, it is imposible to make a precise estimate of the demand for money in an economy like the Croatian one. In addition to this, the economy after disinflation is still sensitive to rates of change, and not yet to level effects, so it is posible to induce new inflation cycle even if the economy is still in the excess supply state.

We elaborate conclusions 2,3 and 4 further in the next two sections, and we emphasise the overall conclusion once more. The Croatian economy was in the excess supply state for some time in the pre-disinflation period. Prices were the fastest moving macroeconomic variable at least for a year prior to October 1993.

3. The role of price contracts: relative price variability

It is not only real money, incomes and real exchange rate decline which drove the economy into the excess supply state, that explain deflation in Croatia. If prices can fall, that does not mean that they would fall. An economy can adjust by output reaction if nominal prices are rigid downwards. So, there has to be some initial motive or reason for nominal prices to change downwards.

Clearly, it is reasonable to assume that the exchange rate indexation in price contracts is widespread in a country with a long history of high inflation, and it is therefore reasonable to expect deflation when nominal exchange rate apreciates. However, we have to prove these arguments. Therefore, a natural way to proceede is to investigate the relative price variability. If previous arguments are valid, we expect to see a fall, or at least a stagnation in relative price variability when inflation reaches high level, and especialy when it oscilates arround the upper limit level of 25% for a long time. Calming of the relative price variability would mean that those producers who change their prices within a given period of time, do it in a similar manner by looking at

the same leading information (exchange rate depreciation). Of course, relative price variability doesn't have to fall to zero then, because high inflation does not necesseraly mean that all producers change their prices in the same period (Lack and Tsiddon, 1992). Although indexation reduces menu costs of price changes, these costs are still present, and there are always some producers who don't change their prices within a month. There is a stream of new keynesian literature which attempts to explain such pricing behavior (Sheshinski and Weiss, 1977, 1982; Rotemberg, 1982, 1983; Danziger, 1987; Caplin and Spulber, 1987).

Relative price variability is measured as suggested elswhere in the literature, by standard deviation of individual price changes arround a mean price change (Domberger, 1987):

$$\lambda_t \left((1/m)\ \Sigma(\Delta P_{it} - \Delta P_t)^2\right)^{1/2}$$

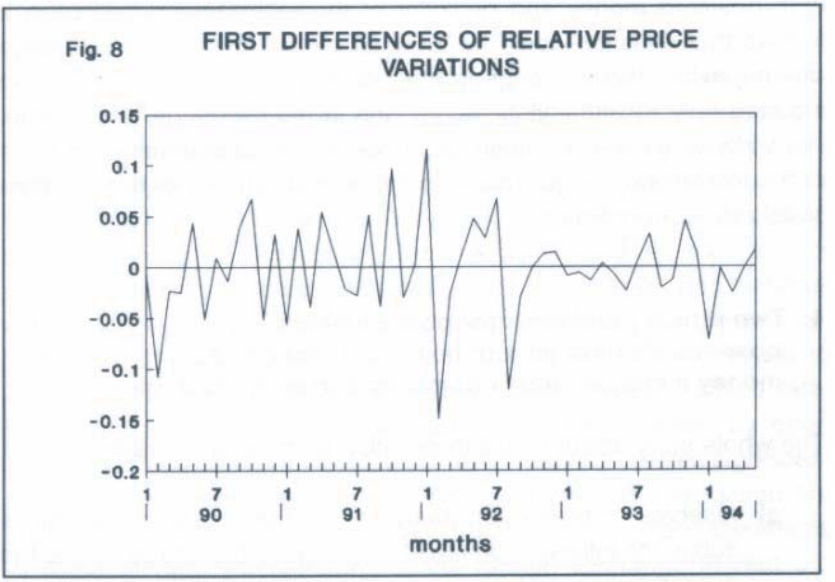
where m denotes the number of individual prices if we measure intramarket relative price variability, or the number of individual market price indicies if we measure intermarket relative price variability. Price changes are expressed in logs:

$$\Delta P_{it} = \log(P_{it} / P_{i,t-1})$$

$$\Delta P_t = (1/m)\Sigma\log(P_{it}/P_{i,t-1})$$

For the purpose of this paper we have measured intermarket relative price variability using a sample of 33 individual indices for 33 manufacturing industries in Croatia.

Figure 8 shows changes in relative price variability on a month to month level. Changes in variations are substantial till September 1992. Then, for the whole year before stabilization programme was announced, changes in variations tend to oscillate closely arround zero.



This descriptive fact confirms the hypothesis about the higher degree of synchronization between prices before the announcement of the programme.

The exchange rate depreciation was a crucial information that led to higher tacit coordination of individual price changes. In addition to this, during this period of small changes in variations, Government allowed traditionally regulated prices of energy to be indexed. Moreover, indexation coefficients to the depreciation were higher than one. This fact allowed relative (real) prices of energy to increase without discrete jumps and without significant impact on changes in variations of relative prices. Side effect of these developments was a decline in the budget deficit.

Having in mind our findings regarding the structure of changes in the high powered money and behavior of the real demand variables, it follows that deflation could be induced by the kink in the exchange rate behavior. And a change in the exchange rate behavior could be induced only by an institutional change in the exchange rate regime,

i.e by allowing the free foreign exchange market to determine the price of the foreign exchange. That was the crucial element of the Croatian stabilization programme.

4. Two striking problems for policy makers in the post-stabilization period: how much did the demand for money increase, and is domestic currency "overvalued"?

The whole story about Croatian deflation rests on three facts:

a) reserves maximization behavior of the monetary autorities subject to inflation constraint which drove the economy into the excess supply state,
b) high degree of exchange rate indexation in price contracts, and
c) announcement effect of the credible programme which turned backward looking into the foreward looking behavior, and which was supported by an institutional change in the foreign exchange regime.

A story like this crucially depends on permanent capital inflow. Croatia didn't enjoy any support from the international financial institutions. Political and war events in the region made a high risk barrier for private capital inflow. Supply of foreign currency came exclusively from the household sector. This sector is a net seller at the foreign exchange market both in pre-stabilization and post-stabilization period. Supply comes from two sources: workers remittances from abroad, and shaddow cash (mostly D-mark) savings which were accumulated during 70's and 80's and held mostly at home. These are the reasons why disposable income in Croatia is much higher than GDP. Current outlays of household sector are financed by tranfers and by decrease in savings held outside the domestic banking system. Any decrease in foreign exchange savings outside domestic banking sector should be regarded as capital inflow.

These permanent sources of capital inflow created pressure for exchange rate to appreciate, and immediately after the change in the

exchange rate regime, they started to play their role. In an economy with developed capital markets for open market operations, this wouldn't cause problems for monetary authoroties in the post-stabilization period. A National Bank would be able to act, more or less, as a currency board. Exchange rate can be fixed, and National Bank can buy all excess supply of foreign currency at a given price. High powered money thus increases only because of increase in international reserves, and any excess money supply which later occurs in higher monetary aggregates, can be sterilized by open market operations. However, lack of capital markets creates significant problems for policy makers. Possibilities for ex post sterilization are imperfect, oscillations in money multiplier are uncertain, and the effects of National Bank interventions at the foreign exchange market are uncertain, too.

Some intervention is, however, unavoidable. The level of the real money at the begining of the programme was extremely low because, as we have shown, there have been two components that had influenced it's decrease. In the post-stabilization period there are also two components which influence increase in the real money balances. One is the regular one, and another occurs due to currency substitution and is specific for an economy where savings were kept in foreign exchange cash. So, any increase in M1 in the poststabilization period can contain two components: (a) remonetization component which adjusts money supply to higher money demand with no inflationary impact, and (b) an excess money supply component which may have significant inflationary impact due to underdeveloped sterilization instruments. Since policy makers cannot distinguish these two components perfectly, i.e. they can do it only with a considerable time lag, when inflationary component already influences prices, the conduct of monetary policy becomes extremely difficult. With imperfect informations regarding two components, policy makers have to rely on indirect informations. One way how to do it is to rely on econometric estimates like the one we presented in the second section.

How can an equation help? At least in three ways.

First, the equation shows that the rate of inflation is sensitive only on inertia and rates of change effects. This conclusion holds, at least in the short run, for a long time after disinflation. And this fact is a warning for policy makers not to think in level terms: don't set policy targets such as the share of M1 in GDP comparable to moderate inflation times, because the rate of change effect can induce inflation at low levels of aggregates, even if the economy is still in the excess supply state.

Second, the equation points to the important role of incomes policy. It has to prevent discrete jumps in real wages and incomes which can push the economy into the spiral after a considerable time lag. However, since the economy entered stabilization programme in the state of excess supply, a slight increase in the real wages and incomes doesn't have to induce inflation. It can only slow down the deflation.

The equation allows us to look at the rates of change in domestic and foreign excess demand as substitutes regarding effects on the rate of inflation. Possible impact of increased real incomes can be offset by nominal appreciation after five periods. Or: posible impact of nominal depreciation can be offset by tight incomes policy. We present simulation results in order to show possible developments.

We assume zero inflation in the first period, and we assume marginal productivity of labor to be constant. We also assume expected and actual change in the nominal exchange rate to be equal in the first and first minus one period. Variable DOMDEM equals one in five periods preceeding first simulation period. Simulations are worked out using estimated equation 1. Results for inflation and the real exchange rate index are shown in the table below for the period of 12 months.

Simulation 1 shows the results when variables don't change (all are equal to 1). These results are crucial because they show that the real

exchange rate increases due to continuing deflation. Pressures for devaluation and arguments about "overvaluation" of the domestic currency are simply misspecified, because they do not take into account dynamic effects of price adjustment on a path from excess supply state towards equilibrium. As Dornbusch (1976) had shown, prices of goods do not adjust as fast as financial assets prices, so after initial real apreciation, real exchange rate can depreciate due to price adjustment.

The model is, of course, highly artificial, and in reality we expect to see changes in variables. What actualy happened in Croatia during the post-stabilization period is an increase in real incomes. We worked out simulation no.2 under the assumption of doubling real incomes in the first month. This highly artificial number is used to ilustrate a case where there is no incomes policy, and where post-stabilization monetary expansion (which policy makers perceive as remonetization) allows significant increase in real incomes. We see that in the first five months deflation continues, but after a time lag inflation suddenly raises to very high level of almoust 7% per month. Although model values of monthly inflation rates slowly decrease after the discrete jump, this shock would probably be strong enough to push the economy into a new spiral. Real exchange rate decreases, too.

Simulation 3 ilustrates the importance of incomes policy. Doubling of real incomes is spread within a year by applying equal monthly rates of growth. Obviously, deflation continues, inflation is expected somewhere in the second year of the programme, and real exchange rate depreciates during the first year, although the depreciation is slower than in simulation 1. However, it's not reasonable to expect that the rates of growth of real incomes close to 6% won't induce inflation in the first year. The equation captures only the rates of change effects, and with so high rates economy would enter into excess demand state which would pull the prices up much earlier. This effect is, however, determined outside the model. Simulation illustrates only

the principle which policy makers have to apply: use of smoth rates, without discrete shocks.

Table 4
SIMULATION RESULTS

	Simulation 1		Simulation 2		Simulation 3	
Month	Infla*	IRER*	Infla	IRER	Infla	IRER
1	0.996	100.5	0.996	100.5	0.996	100.5
2	0.991	101.5	0.991	101.5	0.991	101.5
3	0.986	103.0	0.986	103.0	0.986	103.0
4	0.981	105.0	0.981	105.0	0.981	105.0
5	0.976	107.6	0.976	107.6	0.976	107.6
6	0.971	110.9	1.068	100.8	0.977	110.2
7	0.966	114.8	1.064	94.8	0.977	112.8
8	0.961	119.5	1.059	89.5	0.978	115.3
9	0.956	125.0	1.055	84.8	0.979	117.7
10	0.951	131.5	1.050	80.8	0.980	120.1
11	0.946	139.1	1.046	77.3	0.981	122.5
12	0.941	147.9	1.041	74.2	0.982	124.8

The most important result simulations point to, concerns the exchange rate policy. International competitiveness should be gained by price adjustment, not by manipulating the nominal exchange rate which has to be determined at the market. Even further apreciations due to seasonal variations in supply of foreign currency won't impede the growth trend of the real exchange rate. This is what was actually going on during the post-stabilization period in Croatia (see fig. 3). Furthermore, it is imposible to apply economic calculus in order to calculate the precise level of non-inflationary remonetization in the post-stabilization period. Policy makers can distinguish two components of the money supply only imperfectly and ex post, after a considerable time lag. That is why monetary authorities should use other informations, such as liquidity indicators of the banking system,

in order to estimate the optimal level of the money supply. The wrong monetary policy would be to look only at the exchange rate in order to keep it fixed. This implies endogenous adjustment of the money supply. However, in a situation with underdeveloped capital markets and imperfect sterilization instruments, this policy is too risky. Money supply can overshoot the optimal level and induce new inflation which can, due to long inflation history of the country, be caught in the new inertial process accompanied by accomodative monetary policy.

5. Conclusions

Croatian post-stabilization deflation is a unique story because of unique historical circumstances: gaining independency, and building the market economy. Independency was gained after a violent dissolution of former Yugoslavia, when the Serbian regime attempted to create a centralist state using military force. The young country started it's life without any international reserves and after severe war damages. All of the ex-Yugoslavia foreign exchange reserves were blocked in Belgrade. So, monetary authorities decided to permanently adjust all control variables in order to build up the reserves. However, price reactions of private economic agents constrained that kind of behavior, because policy makers didn't want to induce inflation higher than 25%-30% per month. That is why from time to time they had to slow down the rates of growth of the nominal exchange rate and money stock in order to prevent explosion of expectations and hyperinflationary spiral trap. And that is why the economy entered the state of excess supply during 1992. Occasional slowdowns in money growth and depreciation were not credible enough to induce any change in pricing behavior. Monthly inflation rates were running on high levels, driven exclusively by inertia and rates of change effects. Even a change in the structure of creation of the high powered money from monetization of deficit towards building up the reserves, didn't have any impact on inflation. Prices were the fastest moving aggregate at least for a year prior to announcement of the stabilization programme. A heterodox programme was needed in order to make credible disinflation.

Unlike usual monetarists' view, money demand and velocity proved to be very sensitive in the short run. However, unlike usual keynesian view, prices proved not to be perfectly rigid downvards. In this kind of economic environment, no "pure" monetarist or keynesian policy recommendation can stand in the middle run. Since nominal prices can move downvards in Croatia, policy makers have to exhaust this adjustment mechanism before even thinking about some other kind of policy, more keynesian in it's nature. However, since money demand can significantly change in the very short run, any monetarist preannounced money supply rule won't be credible.[10] If policy makers try to stick to the very restrictive rule from the very begining of the programme, they can unnecesarily push the economy deeper into the depression. Conclusion holds, of course, if and only if the economy enters the stabilization programme regime in the state of the excess supply.

Post-stabilization policy making in this kind of economy becomes a sort of art. Policy makers' beliefs, attitudes, organizational capabilities, educational background and ability to resist lobbying preassures, become main determinants of the long run succes of the programme. These non-scientific or, more precisely, non-economic factors start to play a role instead of missing markets. Missing capital markets for open market operations is a strikingly clear example for a situation where discretionary decisions based on imperfect informations play a role instead of markets. It follows that market developement, especialy capital markets development which stands beyond the scope of this paper, is a primary task for policy makers in order to reduce the high degree of uncertanity in the system and to ease the burden of tough choices which make the probability of policy errors much higher.

Although the Croatian disinflation experience is quite specific and can be usefull only for countries which enter the stabilization programme in the state of the excess supply (which is probably quite rare), the last conclusion holds for all ex-socialist countries.

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[10] Money supply rule which was announced in October 1993 was not obeyed at all. Compare 3% per month rule to the real data in Table A-1, Data Appendix.

DATA APPENDIX
TABLE A-1: BASIC DATA

MONTH	1	2	3	4	5	6	7	8	9
1991-Jan.	34.27	17.7	16.13	3.92	22.15	5.1			
Feb.	34.88	17.5	16.61	6.99	39.94	9.4			
Mar.	35.91	21.2	14.12	7.16	33.77	4.0			
Apr.	38.45	23.7	13.52	6.23	26.29	5.7			
May	39.98	25.1	13.27	6.17	24.58	16.5			
Jun	43.46	25.2	14.37	6.80	26.98	7.6			
July	47.06	27.9	14.06	7.59	27.20	6.5			
Aug.	50.53	26.9	15.65	6.07	22.57	12.1			
Sep.	50.48	20.9	20.13	5.62	26.89	11.0			
Oct.	59.82	26.3	18.95	7.76	29.51	23.6			
Nov.	63.09	32.4	16.23	8.31	25.65	24.2			
Dec.	65.26	38.4	14.16	10.85	28.26	34.1	0.0	18.5	
1992-Jan 66.82	35.2	15.82	13.84	39.32	32.2	-5.6	0.0	20.7	
Feb.	70.18	44.1	13.26	14.34	32.52	39.3	22.0	3.5	12.1
Mar.	81.11	57.9	11.67	22.05	38.08	46.1	17.3	4.0	17.2
Apr.	93.07	72.1	10.76	28.91	40.10	49.1	6.5	4.0	12.0
May	101.84	77.9	10.89	23.46	30.12	53.2	8.4	7.0	31.4
Jun	112.79	96.5	9.74	30.69	31.80	62.1	16.7	18.6	20.5
July	143.93	130.0	9.23	54.90	42.23	74.5	20.0	30.8	25.9
Aug.	175.10	150.8	9.68	58.06	38.50	89.8	20.5	89.0	20.7
Sep.	201.97	177.6	9.48	60.69	34.17	110.2	22.7	122.2	25.1
Oct.	248.85	243.0	8.53	88.92	36.59	134.8	22.3	135.7	28.2
Nov.	275.41	266.1	8.62	101.01	37.96	145.3	7.8	143.9	29.4
Dec.	390.32	419.3	7.76	143.50	34.22	206.8	42.3	166.8	25.8
1993-Jan.	403.27	428.1	7.85	181.55	42.41	216.5	4.7	200.2	30.4
Feb.	428.89	483.8	7.39	202.90	41.94	245.5	13.4	231.0	25.1
Mar.	550.52	709.4	6.47	306.68	43.23	303.9	23.8	271.6	31.0
Apr.	674.78	912.2	6.16	335.02	36.73	364.1	19.8	312.7	25.3
May	852.12	1129.3	6.29	420.50	37.24	493.5	35.5	342.4	26.7
Jun	1029.50	1471.1	5.83	531.74	36.15	562.7	14.0	354.9	29.5
July	1396.91	2137.2	5.45	745.96	34.90	814.7	44.8	416.2	25.7
Aug.	1698.27	2622.2	5.40	883.16	33.68	1034.8	29.5	465.7	25.7
Sep.	2003.29	3169.7	5.27	1069.96	33.76	1283.1	21.6	476.3	34.2
Oct.	2606.18	3594.7	6.04	1495.84	41.61	1508.9	17.6	500.1	33.9
Nov.	3177.67	3442.2	7.69	1433.83	41.65	2012.5	33.4	573.9	-1.6
Dec.	3859.19	3966.9	8.11	1735.21	43.74	2257.8	12.2	612.4	-1.0
1994-Jan.	4073.17	3290.0	10.32	1552.16	47.18	2225.4	-1.4	620.8	-0.8
Feb.	4439.83	3495.6	10.58	1711.89	48.97	2480.4	11.5	669.4	-2.8
Mar.	4723.50	4458.0	8.83	1877.03	42.10	2799.8	12.9	712.9	-1.3
Apr.	5112.60			2434.17		3098.7	10.7	773.6	-0.8
May	5292.50			1828.38		3320.5	7.2	795.0	0.0
Jun	5814.90					3418.6	3.0	861.6	-0.5

1 - M1 in current prices, milions of HRK. Source: National Bank of Croatia.
2 - Monthly GDP estimated by using data on sectoral receipts and outlays data. Source: Payments System. These data underestimate GDP according to SNA concept between 15 and 25%.
3 - M1/GDP at the annual level (%)
4 - Monthly receipts of the public sector (T). Source: Payments System.
5 - T/GDP (%)
6 - High powered money in current prices, milions of HRK. Source: National Bank of Croatia. Estimates are reported for 1991.
7 - Rate of change in high powered money.
8 - NBC international reserves in milions of USD. Source: National bank of Croatia.
9 - Monthly inflation rate measured as a simple average of the retail prices and producers' prices inflation.

DATA APPENDIX
TABLE A-1: BASIC DATA

MONTH	1	2	3	4	5	6	7	8	9
1991-Jan.	34.27	17.7	16.13	3.92	22.15	5.1			
Feb.	34.88	17.5	16.61	6.99	39.94	9.4			
Mar.	35.91	21.2	14.12	7.16	33.77	4.0			
Apr.	38.45	23.7	13.52	6.23	26.29	5.7			
May	39.98	25.1	13.27	6.17	24.58	16.5			
Jun	43.46	25.2	14.37	6.80	26.98	7.6			
July	47.06	27.9	14.06	7.59	27.20	6.5			
Aug.	50.53	26.9	15.65	6.07	22.57	12.1			
Sep.	50.48	20.9	20.13	5.62	26.89	11.0			
Oct.	59.82	26.3	18.95	7.76	29.51	23.6			
Nov.	63.09	32.4	16.23	8.31	25.65	24.2			
Dec.	65.26	38.4	14.16	10.85	28.26	34.1	0.0	18.5	
1992-Jan 66.82	35.2	15.82	13.84	39.32	32.2	-5.6	0.0	20.7	
Feb.	70.18	44.1	13.26	14.34	32.52	39.3	22.0	3.5	12.1
Mar.	81.11	57.9	11.67	22.05	38.08	46.1	17.3	4.0	17.2
Apr.	93.07	72.1	10.76	28.91	40.10	49.1	6.5	4.0	12.0
May	101.84	77.9	10.89	23.46	30.12	53.2	8.4	7.0	31.4
Jun	112.79	96.5	9.74	30.69	31.80	62.1	16.7	18.6	20.5
July	143.93	130.0	9.23	54.90	42.23	74.5	20.0	30.8	25.9
Aug.	175.10	150.8	9.68	58.06	38.50	89.8	20.5	89.0	20.7
Sep.	201.97	177.6	9.48	60.69	34.17	110.2	22.7	122.2	25.1
Oct.	248.85	243.0	8.53	88.92	36.59	134.8	22.3	135.7	28.2
Nov.	275.41	266.1	8.62	101.01	37.96	145.3	7.8	143.9	29.4
Dec.	390.32	419.3	7.76	143.50	34.22	206.8	42.3	166.8	25.8
1993-Jan.	403.27	428.1	7.85	181.55	42.41	216.5	4.7	200.2	30.4
Feb.	428.89	483.8	7.39	202.90	41.94	245.5	13.4	231.0	25.1
Mar.	550.52	709.4	6.47	306.68	43.23	303.9	23.8	271.6	31.0
Apr.	674.78	912.2	6.16	335.02	36.73	364.1	19.8	312.7	25.3
May	852.12	1129.3	6.29	420.50	37.24	493.5	35.5	342.4	26.7
Jun	1029.50	1471.1	5.83	531.74	36.15	562.7	14.0	354.9	29.5
July	1396.91	2137.2	5.45	745.96	34.90	814.7	44.8	416.2	25.7
Aug.	1698.27	2622.2	5.40	883.16	33.68	1034.8	29.5	465.7	25.7
Sep.	2003.29	3169.7	5.27	1069.96	33.76	1283.1	21.6	476.3	34.2
Oct.	2606.18	3594.7	6.04	1495.84	41.61	1508.9	17.6	500.1	33.9
Nov.	3177.67	3442.2	7.69	1433.83	41.65	2012.5	33.4	573.9	-1.6
Dec.	3859.19	3966.9	8.11	1735.21	43.74	2257.8	12.2	612.4	-1.0
1994-Jan.	4073.17	3290.0	10.32	1552.16	47.18	2225.4	-1.4	620.8	-0.8
Feb.	4439.83	3495.6	10.58	1711.89	48.97	2480.4	11.5	669.4	-2.8
Mar.	4723.50	4458.0	8.83	1877.03	42.10	2799.8	12.9	712.9	-1.3
Apr.	5112.60			2434.17		3098.7	10.7	773.6	-0.8
May	5292.50			1828.38		3320.5	7.2	795.0	0.0
Jun	5814.90					3418.6	3.0	861.6	-0.5

1 - M1 in current prices, milions of HRK. Source: National Bank of Croatia.
2 - Monthly GDP estimated by using data on sectoral receipts and outlays data. Source: Payments System. These data underestimate GDP according to SNA concept between 15 and 25%.
3 - M1/GDP at the annual level (%)
4 - Monthly receipts of the public sector (T). Source: Payments System.
5 - T/GDP (%)
6 - High powered money in current prices, milions of HRK. Source: National Bank of Croatia. Estimates are reported for 1991.
7 - Rate of change in high powered money.
8 - NBC international reserves in milions of USD. Source: National bank of Croatia.
9 - Monthly inflation rate measured as a simple average of the retail prices and producers' prices inflation.

TABLE A-3: MONTHLY RESULTS FOR SIGNIORAGE RATES TAKING INTO ACCOUNT CHANGES IN INTERNATIONAL RESERVES

MONTHS	1	2	3
1992-Jan	-1.900	-0.05	-0.16
Feb.	6.788	0.15	0.32
Mar.	6.746	0.12	0.23
Apr.	3.000	0.04	0.09
May	3.602	0.05	0.13
Jun	6.552	0.07	0.18
July	9.644	0.07	0.15
Aug.	0.261	0.00	0.00
Sep.	10.291	0.06	0.14
Oct.	19.417	0.08	0.18
Nov.	6.138	0.02	0.06
Dec.	45.816	0.11	0.24
1993-Jan.	-19.31	-0.05	-0.12
Feb.	-4.215	-0.01	-0.02
Mar.	2.697	0.00	0.01
Apr.	-8.338	-0.01	-0.03
May	65.789	0.06	0.14
Jun	34.538	0.02	0.06
July	35.642	0.02	0.05
Aug.	27.176	0.01	0.03
Sep.	172.22	0.05	0.14
Oct.	59.498	0.02	0.04
Nov.	24.763	0.01	0.02
Dec.	-2.359	0.00	0.00
1994-Jan.	-87.81	-0.03	-0.06
Feb.	-57.69	-0.02	-0.03
Mar.	51.057	0.01	0.03
Apr.	-79.19		-0.03
May	98.380		0.05
Jun	-306.3		

1 - Change in high powered money minus change in international reserves, current prices, milions of HRK.
2 - SSHARE1 corrected for changes in international reserves
3 - SSHARE2 corrected for changes in international reserves

TABLE A-4: DATA USED FOR ESTIMATION

	1	2	3(N)	4(dN)	5	6(dy)	7(6/4)	8
1990-1	100	100	1545		100			100
2	113.8014	103.8910	1532	0.991585	99.15857	1.038910	1.047726	104.7726
3	108.6581	114.2996	1529	0.998041	98.96440	1.100187	1.102345	115.4956
4	159.7157	99.31906	1527	0.998691	98.83495	0.868936	0.870074	100.4898
5	118.4432	95.52529	1526	1.000854	98.89967	0.961802	0.961172	96.56807
6	162.3010	94.74708	1527	0.999345	98.83495	0.991853	0.992502	95.86394
7	186.3922	78.79377	1525	0.998690	98.70550	0.831622	0.832712	79.82713
8	178.3746	92.12062	1507	0.988196	97.54045	1.169135	1.183100	94.44350
9	179.1538	98.83268	1490	0.988719	96.44012	1.072861	1.085102	102.4808
10	168.3521	103.3073	1474	0.989261	95.40453	1.045275	1.056821	108.2835
11	153.0464	98.15175	1457	0.988466	94.30420	0.950094	0.961179	104.0799
12	192.6711	88.32684	1438	0.986959	93.07443	0.899900	0.911791	94.89915
1991-1	108.6300	77.14007	1418	0.986091	91.77993	0.873348	0.885668	84.04895
2	123.4724	78.98832	1381	0.973906	89.38511	1.023859	1.051393	88.36854
3	135.8392	81.12840	1364	0.987690	88.28478	1.027093	1.039894	91.89397
4	135.9518	80.15564	1350	0.989736	87.37864	0.988009	0.998255	91.73367
5	120.2698	81.32295	1334	0.988148	86.34304	1.014563	1.026731	94.18588
6	111.7178	78.98832	1319	0.988755	85.37216	0.971291	0.982337	92.52233
7	115.9445	71.59533	1309	0.992418	84.72491	0.906403	0.913328	84.50327
8	106.3991	63.52140	1292	0.987012	83.62459	0.887228	0.898902	75.96018
9	81.75049	56.80933	1244	0.962848	80.51779	0.894333	0.928841	70.55500
10	85.56831	57.10118	1222	0.982315	79.09385	1.005136	1.023232	72.19419
11	66.46991	54.28015	1206	0.986906	78.05825	0.950596	0.963207	69.53801
12	77.20075	53.79377	1187	0.984245	76.82847	0.991039	1.006902	70.01801
1992-1	45.25691	54.76653	1172	0.987363	75.85760	1.018083	1.031113	72.19650
2	56.44092	56.80933	1181	1.007679	76.44012	1.037300	1.029395	74.31873
3	58.47848	59.33852	1159	0.981371	75.01618	1.044520	1.064347	79.10096
4	62.15581	57.19844	1152	0.993960	74.56310	0.963934	0.969791	76.71145
5	48.57234	56.22568	1146	0.994791	74.17475	0.982993	0.988139	75.80163
6	53.55681	59.33852	1138	0.993019	73.65695	1.055363	1.062782	80.56064
7	53.34184	58.94941	1133	0.995606	73.33333	0.993442	0.997826	80.38556
8	45.00771	54.96108	1137	1.003530	73.59223	0.932343	0.929063	74.68327
9	51.23123	62.64591	1117	0.982409	72.29773	1.139623	1.160231	86.64989
10	49.38860	66.63424	1111	0.994628	71.90938	1.063664	1.069408	92.66417
11	40.30806	65.27237	1105	0.994599	71.52103	0.979562	0.984680	91.26318
12	49.02068	61.38132	1098	0.993665	71.06796	0.940387	0.946382	86.36989
1993-1	29.40611	51.55642	1092	0.994535	70.67961	0.839936	0.844551	72.94383
2	33.72859	57.29571	1086	0.994505	70.29126	1.111320	1.117480	81.51186
3	35.66708	60.11673	1082	0.996316	70.03236	1.049235	1.053114	85.84135
4	34.53551	56.30295	1077	0.995378	69.70873	0.936893	0.941242	80.79755
5	39.61234	57.00389	1073	0.996265	69.44983	1.012089	1.015862	82.07922
6	38.93104	56.22568	1071	0.998136	69.32038	0.986348	0.988190	81.10987
7	44.85518	52.14007	1068	0.997198	69.12621	0.927335	0.929940	75.42735
8	45.05056	52.62645	1062	0.994382	68.73786	1.009328	1.015030	76.56109
9	40.88771	57.29571	1054	0.992467	68.22006	1.088724	1.096988	83.98661
10	38.88162	59.14396	1048	0.994307	67.83171	1.032258	1.038187	87.19220
11	40.08521	57.39299	1043	0.995229	67.50809	0.970394	0.975046	85.01647
12	47.59959	54.08560	1034	0.991371	66.92556	0.942372	0.950575	80.81456
1994-1	37.62118	49.31906	1027	0.993230	66.47249	0.911870	0.918085	74.19470
2	42.65753	49.80544	1022	0.995131	66.14866	1.009861	1.014802	75.29297
3	50.20851	56.42023	1019	0.997064	65.95469	1.132612	1.136147	85.54392
4	47.48197	52.82101	1016	0.997055	65.76051	0.936206	0.938971	80.32329
5	48.95969	54.28015	1013	0.997047	65.56634	1.027624	1.030667	82.78661

1 - Index of the real incomes of the household sector. Nominal receipts are reported by the Payments System. These receipts include net wages, fringe monetary benefits such as workers' allowances for food and transportation, incomes from copyrights, and current budgetary transfers towards household sector. Nominal receipts are deflated by deflator.

2 - Physical index of manufacturing production (y), original data. Source: Croatian Statistical Office.

3(N) - Average number of employed persons within a month in thousands. Source: Croatian Statistical Office. Defence and part of the newly emerging private sector not included.

4 - N_t/N_{t-1}

5 - Base index of N

6 - y_t/y_{t-1}

7 - Change in industrial production divided by change in employment is used as a proxy for change in the marginal productivity of labor.

8 - Base index for data in column 7

Note: Data in column 1 were used to calculate monthly changes in real incomes. These changes were devided by data in column 7 in order to get a proxy for change effects of domestic demand (variable DOMDEM in estimation procedure).

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