

## The Challenge of Application of Phillips Curve: The Case of Croatia

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**Abstract:** In this paper hypothesis of relation between unemployment and the rate of change in prices is tested in Croatia with data spanning from 1962 to 2004. Empirical test is designed with a goal of testing the original Phillips curve developed by A. W. Phillips and adaptive expectation augmented Phillips curve designed by Edmund S. Phelps. Since both these versions of the relationship were designed for the US economy, authors suggest a new theory of accommodation through insolvency for the Croatian economy.

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**Keywords:** the Phillips curve, insolvency, transition, Croatia

### Introduction

The goal of this paper is to analyze applicability of Phillips curve in the Croatian economy. In the first part of paper, original theories of Phillips curves and expectation-augmented Phillips curves are surveyed. Analysis is based on the presentation of basic framework and major conclusions of the theory.

In the second part original Phillips curve and expectation-augmented Phillips curve are empirically tested on the data for Croatia during 1962-2003. The results have shown that there is not much empirical evidence for any kind of the relationship between unemployment and inflation in Croatia.

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In the third part, the theory of accommodation through insolvency is represented. The theory explains the reasons why there is not any relationship between prices and unemployment in self-management economy. It explains the political reasons and economical mechanisms which have created and maintained economic system in which economy did not accommodate its activity to the economic fluctuation.

In the fourth part, papers which have analyzed Phillips curve relationship in the post-transitional period are surveyed. The goal of this part was to investigate possibility that Phillips curve mechanism has been created in the transitional reforms.

In the last part, the price setting relationship is tested within the framework of small open economy. Due to the fact that current account to GDP ratio is quite high in Croatia, it is possible that nominal exchange rate movements have strong role in price formation mechanism.

### **The Phillips Curve Theory**

In the original Phillips curve developed by A. W. Phillips in 1958 two important economic variables were placed into relation. The impact of this relation spread through the decades and engulfed the thoughts of economists worldwide. Since than many modifications and revisions were made, but the basic idea of manipulating the labor market through economic policy, more precisely, by using price policies still ponders in the minds of economists everywhere. The variables that Phillips used were the rate of unemployment and the rate of change of money wage rates, but in this paper the relationship between the rate of unemployment and the change in prices will be used. This transition was explained through P. Samuelson's and R. Solow's work, where they noticed that the rate of the inflation is equal to the difference between the rate of change of money wage rates and the rate of change in labor productivity (inflation arithmetic's). When Phillips used his theory on statistical data he obtained for the UK, ranging from 1861 to 1957, he came to the following conclusion:

‘The statistical evidence seems in general to support the hypothesis stated, that the rate of money wage rates can be explained by the level of unemployment and the rate of change of unemployment, except in or immediately after those years in which there is a sufficiently rapid rise in import prices to offset the tendency for increasing productivity to reduce the cost of living’ (Phillips, 1958).

Perhaps the most important modification of the Phillips curve was one made by Edmund S. Phelps in 1967. In his work Phelps came to the conclusion that the period

which Phillips observed had the average rate of inflation equal to zero, something that changed quite abruptly in the last fifty or so years. Knowing this Phillips could have simply assumed in his equations that the expected inflation was equal to zero. During the stagflation Phelps couldn't take that for granted. Putting a lot of effort in to it, Phelps actually found a new relation, one between the unemployment rate and the change in the inflation rate, which is today known as expectations-augmented Phillips curve:

‘It is reasonable to suppose that the participants in product and labor markets will learn to expect inflation and that, as a consequence of their rational, anticipatory behavior, the Phillips curve will gradually shift upward by the full amount of the newly expected and previously actual rate of inflation’ (Blanchard, 2003).

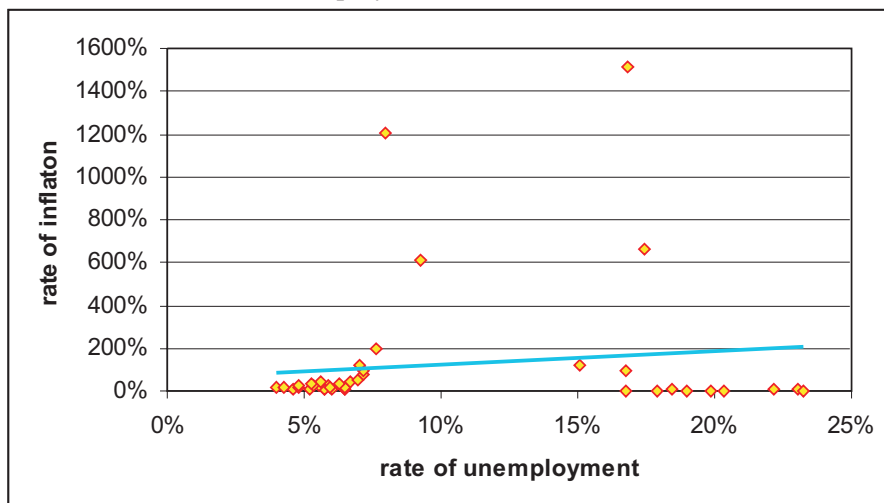
In his later work Edmund Phelps, together with Milton Friedman, created the basics for a concept known as the natural rate of unemployment. A notion accepted by most economists today, which imposes limitations to how low can the rate of unemployment go without creating distortions on the labor market. To sum up the theory of the Phillips curve, the explanation of the mechanism behind the curve is given by Phillips himself:

‘In a year of falling business activity, with the demand for labor decreasing and the percentage unemployment increasing, employers will be less inclined to grant wage increases, and workers will be in weaker position to press for them, than they would be in a year during which the average percentage unemployment was the same but the demand for labor was not decreasing’ (Phillips, 1958).

### **Empirical Results**

Taking into consideration the original Phillips curve and the expectations-augmented one, we now proceed to their implementation on statistical data obtained for Croatian economy. By looking to the Figure 1 first conclusions on the behavior of the original Phillips Curve in Croatia can be made. Unfortunately, it seems that for the period from 1962 to 2003 the fitted curve which represents the Phillips curve has a positive angle, which would suggest that the Phillips relation does not exist for Croatian economy.

Figure 1: Inflation versus Unemployment in Croatia, 1962-2003



Source: Author's calculations based on the data gathered from: see literature

The above statement could be much soundly proved with the OLS estimated slope of the original Phillips curve relationship based on Croatian data. The following equation represents exactly the same relation Phillips used for UK:

$$\pi_t = (\mu + z) - \alpha u_t \quad (1)$$

Average annual inflation is represented by  $\pi$ ,  $u$  represents annual unemployment,  $\mu$  is the mark up and  $z$  represents the factors that affect wage determination. The results for the OLS estimated slope on Croatian data are even more disappointing. Given the low value of r-squared, and the positive connection between the two economic variables, only one conclusion can be made and it states that the implementation of the original Phillips curve on Croatian economy, and deriving Croatian economic policies from it, is not advisable, not even possible. Relationship between unemployment and inflation is not a constraint in the economic policy of the Republic of Croatia.

Table 1: Parameter estimation of the original Phillips curve based on Croatian data

Dependent Variable: I				
Method: Least Squares				
Date: 11/24/05 Time: 14:18				
Sample: 1963 2003				
Included observations: 41				
I=C(1)-C(2)*U				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	63.42277	94.91589	0.668200	0.5079
C(2)	-6.232169	7.957671	-0.783165	0.4383
R-squared	0.015483	Mean dependent var	126.770	
Adjusted R-squared	-0.009761	S.D. dependent var	316.4536	
S.E. of regression	317.9942	Akaike info criterion	14.40949	
Sum squared resid	3943692.	Schwarz criterion	14.49308	
Log likelihood	-293.3946	Durbin-Watson stat	1.184770	

Source: Author's calculations based on the data gathered from: see literature

The analysis of the expectations-augmented Phillips curve for Croatia, as can be seen in Figure 2, has resulted with small, but negative slope. A negative slope is consistent with a theory and therefore this result can be seen as certain, although weak, evidence of a very small and questionable relationship.

The following equation represents expectations-augmented Phillips curve, which is estimated for Croatia:

$$\pi_t = h\pi_t^e + (\mu + z) - \alpha u_t \quad (2)$$

The expected rate of inflation ( $\pi^e$ ) has been calculated from the annual inflation rate using the following method:

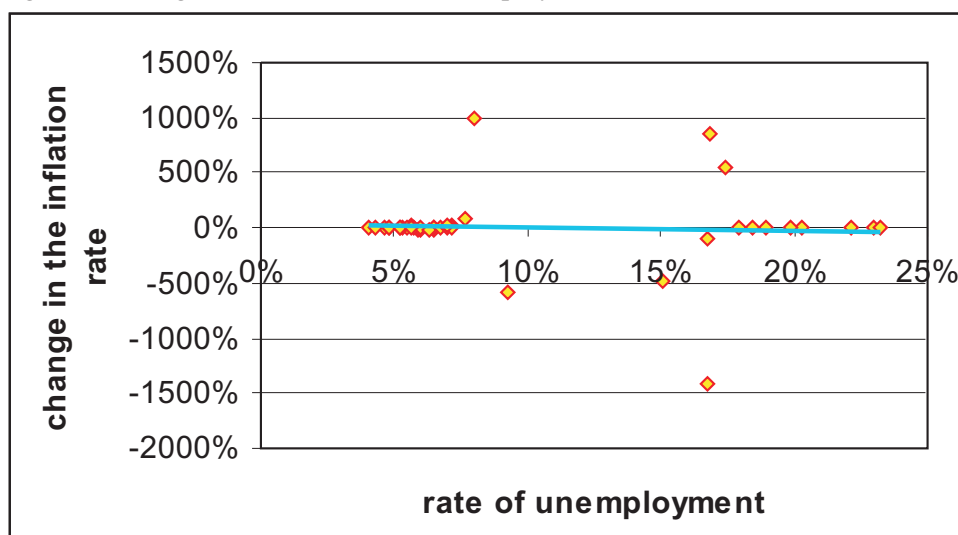
$$\pi_t^e - \pi_{t-1} = \pi_{t-1} - \pi_{t-2} \quad (3)$$

Adaptive expectations are the simplest form of the expectation formation and assumption of the adaptive expectations does not reflect our conviction that backward-looking expectations depict reality the best. Our assumption is rather

simplest way of depicting one of the extreme ways in which expectations can be formed:

‘Inflation expectations are assumed to be backward-looking. In the simplest case, the period’s rate of price inflation is expected to equal last period’s rate. Given that workers can presumably observe last period’s price level, it is hard to see why they would instead use their previous (potentially incorrect) expectation of this variable in formulating an expectation of this period’s price level’ (Whelan, 1999).

Figure 2: Change in Inflation versus Unemployment in Croatia, 1962-2003



Source: Author’s calculations based on the data gathered from: see literature

The estimate of the equation (2.2) based on Croatian data, ranging from 1962-2003, has shown that even the modified Phillips curve in Croatia has a positive angle:

Table 2: Parameter estimation of the expectation augmented Phillips curve based on Croatian data

Dependent Variable: I		
Method: Least Squares		
Date: 11/25/05 Time: 10:45		

Sample: 1963 2003				
Included observations: 41				
$I=C(1)+C(2)*E-C(3)*U$				
	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	58.05114	87.75739	0.661496	0.5123
C(2)	0.239820	0.086739	2.764860	0.0087
C(3)	-1.694197	7.536595	-0.224796	0.8233
R-squared	0.180368	Mean dependent var	126.7705	
Adjusted R-squared	0.137230	S.D. dependent var	316.4536	
S.E. of regression	293.9392	Akaike info criterion	14.27498	
Sum squared resid	3283210.	Schwarz criterion	14.40036	
Log likelihood	-289.6371	Durbin-Watson stat	1.730775	

Source: Author's calculations based on the data gathered from: see literature

Table 2 generates a conclusion that an expectation-augmented Phillips curve can not be used on long series data in Croatia, because the last forty years of Croatian economic history have been corrupted by hyper-inflation and parallel stagnation in late 80s and early 90s.

### The Theory of Accommodation through Insolvency

Understanding of the Phillips relation and its failure to be implemented on Croatian statistical data is the cornerstone of this paper. To give a better explanation why the economic fluctuations which disturbed this relation happened, a brief overview of the 1980-1990 stagnation is needed. This was the period of the first stabilization program, which was implemented in 1981. Its agenda was concentrated on aggregate demand constraints, focusing especially on state budget expenditure control. Unfortunately instead of theoretically-intended stabilization, the Croatian economy experienced stagflation in 1980s. But did anything good come out of it?

'Professional correctness requires that tremendous restructuring efforts at the expense of real wage and pension decreases, social services reduction, and falling living standards of that time should be also recognized. Stabilization restructuring policy has had some notably positive outcomes, the most

prominent being an unquestionably adopted outward orientation. Export-oriented policy combined with real exchange rate policy resulted in weighty increased exports and substantially improved the export to import ratio, which was 80% on average in the 1980s. It is interesting to observe that employment grew slightly in the whole period at an annual rate of 1%. Increasing employment in a macroeconomic environment of a GDP zero/negative growth rate and high inflation had an unavoidably unfavorable impact on labor productivity, which fell by an average annual growth rate of approximately -2%' (Družić, 2006).

It is obvious that an unfavorable trade-off between employment, growth and inflation took place and the results were devastating for the Croatian economy and for its population:

'The Croatian economy met with an unusual occurrence while undergoing the stabilization program of the 1980s. It lived to see export expansion in an environment of a zero/negative GDP growth rate and diminishing competitiveness measured by falling labor productivity. Increasing exports while domestic output stagnated and labor productivity decreased was enabled by a 'joint operation' of simultaneously reducing the export prices of domestic producers and contracting domestic demand. An 'elegant' way was found to decrease export prices that would encourage exports and at the same time increase domestic prices that would discourage domestic demand. The 'innovation' was to create a spiral of a continued 'race' between devaluation and inflation' (Družić, 2006).

In the above mentioned environment it was obvious that Croatian economy was going down the path of recession, with a depression looming on the horizon. Deranged structure of the economy, general and sector disequilibria, high losses and insolvency, and unavoidable accelerated inflation were Croatian reality. In a socialist economic system where bankrupted companies were not allowed to be liquidated, a new 'original invention' was needed:

'Insolvency as an 'original invention' of a socialist economic system in fact defined the state in which actually bankrupted companies were not allowed to be liquidated.'

'Why wasn't company liquidation a possible option? There were two main intermingled issues. On the one hand, company disappearance and resulting job losses in an environment of proclaimed employees' self-management would have contradicted the doctrinaire system's very foundations. On the



other hand, laying off workers and closing down factories would have compromised the authorities' very existence ...'

'... If there is bankruptcy and unemployment plaguing socialism as it does capitalism, then why go to such an extreme as a (revolutionary) socialism introduction?...

'...At any rate, the euphemism generally applied for the clearly visible overall recession was insolvency, because admitting to a recession or depression, especially its implication for employees as the proclaimed backbone of the system, was not possible by definition...'

'...Insolvency was 'conflict-free' because insolvent companies' accumulated losses had been 'socialized' by money and credit policy measures that re-melted individual losses into publicly-owned debt, burdening all taxpayers. Company recovery was conducted by monetary expansion; by selective primary emission loans that were just another name for money printing; by signing off public (tax) commitments, by budget transferred subventions; in other words, by inflation' (Družić, 2006).

Laying off workers and closing down factories would bring down the whole regime and without this option, the implementation of the Phillips relation wouldn't really have any sense. Prolonging and avoiding payments, thus creating an overall insolvency was the only solution that socialist company management could do. Without significant unemployment the pressure to decrease wages, which is the basis for the Phillips curve relation, doesn't exist. It means that when a company falls into crisis it won't sack workers, instead a company would not pay its bills or it will at least prolong their payment. This way a recession results in insolvency and not in unemployment, thus the existence of inflation has no connection to the prior.

Furthermore, Družić's theory implies reverse relationship, instead of a high unemployment and deflation inducing recession, there is insolvency inducing recession. Insolvency results with an accumulation of a debt that is monetized and therefore induces inflation. Instead of recession-unemployment-deflation relationship there is a recession-insolvency-debt-monetization-inflation relationship.

### **The Post-Transitional Period**

After going through an intense restructuring and stabilization process which was marked with hyperinflation, the Croatian economy emerged in 1994 as a stable market economy fueled by low inertial inflation and pressured by the needs of a quarter of unemployed workforce, which was searching for jobs. In such environment one doesn't need to perform miracles to jumpstart the economy, but

something went wrong and today after over a decade of efforts to reduce unemployment, miracles are needed because the unemployment rate hums steadily around 20 percent (Družić and Sirotković 2002). It could prove quite interesting to see how the Phillips' relation fits into this post-transitional data. Two papers were made on this subject. An older one made by Šergo and Tomčić (2003) analyzed the monthly period from January, 1994 to September, 2001 and used the rate of change in wage rates that were then put into relation with the rate of unemployment. They came to the following conclusion:

'In this paper it is proved that the rate of change of the average real wage will drop on average for about 4% when the total unemployment above the natural rate of unemployment grows for 1% with an assumption that the bottom line is absent till where the real wages can fall when the unemployment grows above the actual rate, with an expected and significant coefficient of direction. But there is no stable long-run trade-off between real wage inflation and unemployment and we can conclude that the policy-makers cannot, in the long run, in our case 'pay' for lower unemployment with a little bit of inflation' (Šergo and Tomčić, 2003).

A newer work and more thorough was made by Botrić (2005) where she used the same start date as Šergo and Tomčić (2003), but a later end date, December 2003. Many analysis and conclusions were given since the subject is tremendously complex, but due to the needed compression of this paper only the most interesting ones are stated:

'The empirical results in the analyzed period have shown that there is a negative connection between unemployment and inflation, but because the strength of the link in the regression equation is weak, the rate of unemployment as an explanation variable doesn't really determine the inflation process in Croatia. In the long run the empirical evidence has shown that the expected inflation coefficient has the value of (around) one, which could confirm the hypothesis of a vertical Phillips curve in the long run. Different methods of analysis were applied and as a rule they have all shown that there is a connection between these two variables, but the dominant effects on the process of forming inflation are coming from outside the real sector' (Botrić, 2005).

Table 3: Regression Summary

Author	Measure of inflation	Period	Coefficient (rate of unemployment)	R <sup>2</sup>	Adjusted R <sup>2</sup>	Durbin - Watson
Šergo – Tomčić	%Δwage	01.1994 - 09.2001.	-71.90764	0.035	0.024	1.9456
Botrić	CPI	01.1994. - 12.2003.	-0.524	0.26	0.23	1.99

Source: Botrić, 2005; Šergo and Tomčić, 2003.

Both papers, Botrić (2005) and Šergo and Tomčić (2003) have obviously confirmed that there is not a negative connection between unemployment and inflation in Croatia. Obviously, process of transition reforms and labor market reform have not created environment in which bargaining power of labor unions depends negatively on the level of unemployment.

Therefore, it is possible to draw a conclusion that mechanism of insolvency still depicts Croatian reality much better than Phillips curve theory. The only difference compared to self-management system is that, due to stabilization, 'dirty float' and independent monetary policy, it is not possible to monetize induced debt any more. Instead of monetization of accumulated debt that accelerates inflation, the process stops at accumulation of debt. Due to privatization process, government does not intervene as it used to in the self-management system, and due to independence of monetary policy, even if intervention occurs, it is not possible to borrow money from the central bank. The insolvency phenomenon in the transition period accelerates public and private debt instead of accelerating inflation. It is clear that the process of transition did not establish relationship between unemployment and nominal wages and/or prices, but only to substitute hyperinflation with accelerating public and/or private debt.

### Small Open Economy Approach to Price Setting Relationship

Besides the insolvency problem there might be another possibility for the lack of the relationship between unemployment and inflation in Croatian economy. Having in mind the fact that current account to GDP ratio in Croatia is approximately 50%, it is possible that nominal exchange rates are dominant factor in determination of prices.

Under assumption that current account to GDP ratio is 50%, movements of exchange rate determine 50% of price movements. Expressed in the term of Phillips curve our assumption means that unemployment and mark-ups have equal ponder as nominal exchange rates in determination of inflation:

$$\pi_t = (1 - \beta) \left[ h\pi_t^e + (\mu + z) - \alpha u_t \right] + \beta E \quad (4)$$

The term  $\beta$  reflects the current account to GDP ratio, while the term in the bracket  $(1 - \beta)$  reflects the share of price movements that might be explained by labor market within the country. Nominal exchange rate is  $E$ , all the other variables are the same as in the original Phillips equation (Soskice and Carlin 1990).

According to our equation (4) increase in nominal exchange rate of 1% (depreciation) induces increase of price level by  $1 * \beta$ , which is 0.5% in our case. This assumption is much more realistic for a small open economy such as Croatia, and it depicts rather simply the complex phenomenon that was named as ‘continued ‘race’ between devaluation and inflation’ by Družić (2006).

The estimate of the equation (4) based on Croatian data, ranging from 1965-2004, has shown that log difference of the nominal exchange rate of German Mark enters the equation quite significantly. According to this quite simple model it is possible to conclude that 1% of nominal exchange rate change, affects inflation rate by 0.86%. Expected rate of inflation is also significant and equation reflects the fact that 1% increase in expected inflation (adaptive expectation assumption) affects inflation by 0.1%. Unfortunately, Phillips curve relationship between unemployment and inflation is once more insignificant and with a wrong sign. Autoregressive term reflects the fact that deviations in the model die out quite slowly. Half-life time of the deviation is almost three years.

Table 4: Estimation of Phillips curve in the small open economy framework

Dependent Variable: INF				
Method: Least Squares				
Date: 01/25/06 Time: 14:31				
Sample(adjusted): 1968 2004				
Included observations: 37 after adjusting endpoints				
Convergence achieved after 17 iterations				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.058629	0.155363	-0.377371	0.7084
UNEM	0.885962	1.031567	0.858850	0.3968
DDM	0.864718	0.041625	20.77416	0.0000
DINF	0.101368	0.026539	3.819551	0.0006
AR(1)	0.781522	0.124548	6.274885	0.0000
R-squared	0.976119	Mean dependent var		0.477153

Adjusted R-squared	0.973133	S.D. dependent var	0.709140
S.E. of regression	0.116235	Akaike info criterion	-1.341310
Sum squared resid	0.432341	Schwarz criterion	-1.123619
Log likelihood	29.81424	F-statistic	326.9886
Durbin-Watson stat	2.089386	Prob(F-statistic)	0.000000
Inverted AR Roots	.78		

Source: Author's calculations based on the data gathered from: see literature

Although the result of the econometrical test of the equation (4) is rather interesting it must be interpreted with care. Dickey-Fuller (1979) and Phillips-Perron (1988) have rejected null hypothesis of the unit root, but it was not possible to say with high level of significance is the unemployment stationary or trend-stationary series.

## Conclusion

The idea of the Phillips curve that there is a negative relationship between unemployment and inflation, as well as an idea of expectation-augmented Phillips curve, has been tested in Croatian economy on the yearly data spanning fifty years.

The results for Croatia show that there is not any significant relationship between two variables in simple model and expectation-augmented model between 1963 and 2004. The coefficient is either insignificant and/or with a wrong sign.

Having in mind that this might be the case due to the fact that model was tested on the predominantly pre-transitional data, post-transitional tests of Phillips curve in Croatia have been surveyed. Both empirical tests of the theory have shown that there is not any relationship between two variables and that there is not any relationship between inflation and labor market in general.

The relationship between inflation and unemployment was tested even in the small open economy environment and results have shown that expected inflation and depreciation of the nominal exchange rate are quite significant factors in determination of prices, while unemployment is insignificant with a wrong sign.

Therefore, according to our findings, it is obvious, that there is not any signs of the existence of any kind of statistically significant relationship between unemployment and inflation in Croatian economy in pre-transitional, as well as in the post-transitional period.

The explanation of accommodation of economy to recession and slumps through insolvency is still valid in Croatia as well as it was during pre-transitional period.

While industrialized economies accommodate to recession through increased unemployment, Croatia accommodates to slowdown in economic activity through increased insolvency. Usually government initiates a domino effect of insolvency. After that, companies in Croatia simply delay payments even more, creating increasing insolvency and accumulating debt in the face of economic slowdown. At the end a cumulative effect of insolvency is even deeper economic slowdown. Adjustments in number of employees are not politically questionable any more, but still it is rare and 'unpopular' way of doing business.

Although 600000 people out of 1.6 million employed lost their job at the beginning of the transition, it is quite reasonable to claim that surge in unemployment was not created through the normal economic bargaining, as much as it was by the new institutional environment of hard budget constraint, privatization, deregulation and liberalization. It was discrete adjustment in labor force which did not reflect accommodation of existing companies to the recession, but rather a massive shutting down of all companies which were not considered rentable and/or profitable by the new private owners or public sector decision makers.

The only difference between insolvency based theory of pre-transitional and post-transitional period is in the fact that accumulated debt is not any more automatically socialized through monetization. Given that monetization of the public debt is not an option, insolvency phenomenon culminates in the accumulation of debt, until at the end companies collapse or/and are nationalized again by the government. In each case, insolvency based accommodation creates ever growing public and private sector external debt.

Therefore it is possible to conclude that during recessions, companies in Croatia simple does not lay off people. Due to insolvency based adjustment, factually unemployed are not fired, but subsidized through insolvency by future generations which are going to pay back debts accumulated during recession.

The mayor consequence of the model of insolvency based accommodation to economic slowdown is the fact that ultimate indicator of recession is not unemployment rate, but amount of insolvency (and/or external debt as hidden inflation). In industrialized countries unemployment increase during slumps, but in Croatia unemployment stays unchanged and insolvency increase. Therefore the theory might be proposed that any sign of increase in insolvency might be interpreted as an economic slowdown.

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