

## UNDERGROUND ECONOMY IN CROATIA

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### *Abstract*

*The subject of this paper is to estimate the size of underground economy in the period 2001-2007 using labour approach. Two types of data are used: administrative and survey. The main questions are: How did the activity rates move? What is the relationship between activity rates and the size of shadow economy? Is there correlation between official employment, official unemployment and unofficial employment (shadow economy) and what is it like? What is the position of Croatia considering the members of the European Union? It is presumed that the increase of activity rates causes decrease of underground economy. However, this assumption is valid only for administrative data. Correlation analysis is based on regression models and given results are quite logical. If Croatian and European underground economy is compared, it can be confirmed that the position of Croatia is extremely poor. Given results are approximative and show the level of Croatian underground economy which is presumably underestimated. These phenomena occur because of available statistics and method limitations.*

*Key words: shadow economy, unofficial economy, measuring shadow economy, labour approach, Croatia, European Union.*

### **1 Introduction**

Underground economy can be found in all countries in the world. What is it that makes an individual participate in unofficial economy<sup>1</sup>? For undeveloped countries, the motif is obviously low income and low quality of life.

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<sup>1</sup> One of the synonyms for underground economy is unofficial economy. If we talk about the labour force method, underground economy represents employment in unofficial economy (unofficial employment).

In this research, we attempt to estimate the size of Croatian unofficial economy using the labour approach based on administrative and survey data. We will try to give answers to the following questions: How did the activity rates move? What is the relation between activity rates and the size of underground economy? Is there correlation between official employment, official unemployment and unofficial employment and what is it like? What is the position of Croatia considering the members of the European Union?

The use of labour approach algorithm for administrative data shows an inversely proportionate relation between activity rates and unofficial employment. Survey data indicate the opposite conclusion, i.e. the relation is proportionate in this case. That means that a segment of the population participates in both official and unofficial economy at the same time. The task of the state is to create a legal, tax and pension system that would stimulate individuals and companies to operate in official economy, i.e. not to participate in unofficial economy. Correlation coefficients give the expected results: negative relationship between official employment and official unemployment, negative relationship between official employment and unofficial employment and positive relationship between official unemployment and unofficial employment.

Comparison of Croatian and European underground economy is very alarming. The shares of underground economy for the period 2001-2007 are four times bigger than in Croatia. Thus, the state must start taking more radical combat measures aimed at: narrowing of the government role, reduction of the tax burden, creating conditions for employment stimulation and fight against corruption.

Following Introduction, there are basic methods for estimating underground economy together with the definition this work refers to. Chapter 3 offers empirical addressing of the labour approach. Unemployment in unofficial economy in Croatia is estimated using administrative and survey data, and compared at the national and European level. Conclusion and References can be found at the end of the paper.

*Table 1 Underground economy evaluation methods*

<b>Method</b>	<b>Description</b>
Tighter control of tax payers and tax returns	Tax evasion appears in two forms: reporting income lower than the actually earned and increasing costs to reduce the tax base. Both ways are used to avoid tax. The method involves detailed analysis of tax returns and persons who do not file tax returns (whether they truly do not work).
Expert survey	The method involves a survey of experts in different fields of economy who should be familiar with the situation and structure of underground economy for the branches they are engaged in.
Sampling method	The method examines causes which lead the individual to take part in underground economy. The following indicators are used: tax burden, degree of tax ethics, official working hours, rate of population activity, presence/absence of foreign workers.

Method of maladjustment of tax statistics and national accounts	The method is based on comparing adjusted data from tax statistics and income registered in national accounts. In the first phase income from national accounts is adjusted for the items tax payers are not obliged to report to tax administration. Adjustment for the items reported to tax authorities which are not part of income according to the national accounts concept is also made. In this way conceptually identical items are obtained, and possible difference represents the level of unofficial economy.
Difference between realized income and realised consumption	The method falls under methods of maladjustment (indirect method). If the income is lower than the expenses, the realized difference represents unofficial economy. It is used at micro and macro level (households and total economy). The main idea is to find out the share of unregistered consumption within total consumption.
Data obtained from national accounts	The method analyzes national accounts items in detail to find out underestimated GDP and its categories. The idea is to measure added value not registered in national accounts. The size is obtained using one of the indirect methods of evaluation of unofficial economy - by estimation of discrepancies between the amounts of income and expenses of GDP. The method is not used for obtaining the absolute level of unofficial economy, but only the difference between independent estimates of income and expense of GDP.
Monetary approach	The monetary approach estimates the share of cash in total assets in circulation, and based on changes of the share within a period of time leads to conclusions on increase or reduction of the size of unofficial economy. The main assumptions used in this approach are: <ul style="list-style-type: none"> <li>• The majority of payments in underground economy is made in cash, i.e. vary rarely by cheque or payment order, which, of course, is not entirely true;</li> <li>• There is no underground economy within the accounting (base) period;</li> <li>• The relationship between cash covers and sight deposits, i.e. the bank note share in the total volume of assets would be constant if there were no underground economy;</li> <li>• Velocity of circulation is equal to official and unofficial economy.</li> </ul>
Population activity rates	There are two subtypes of this method. One uses historical activity rates and the other labour force survey. The main idea is to take over data on total population and the number of employed and unemployed. Based on these data, active and hypothetical active population is calculated, and total estimation of underground economy is defined by these parameters.
Input method (electric power consumption)	It is assumed that the increase of electric power consumption is an indicator that also describes movements of total GDP, as short term elasticity is 1. Thus, the difference between the growth rate of total electric power consumption and recorded (official) GDP growth rate is attributed to the rise of underground economy.

*Source: Author based on Bejaković (1997), Mikulić (2000), Easton (2001), Madžarević and Mikulić (1997), Schneider (2000, 2003), Crnković-Pozaić (1997), Lovrinčević, Marić and Mikulić (2006).*

## 2 Definitions and methods of underground economy

Underground economy is a very broad term defined in numerous ways. It is difficult to give an exact definition which would answer all the questions. Academic circles studying it provide new definitions based on new insights over time.

The most important authors studying the subject are: Tanzi, Smith, Feige, Thomas, Schneider, Bagachwa, etc. The author of this paper refers to Feige's definition. According to Feige (1990), underground economy is divided in four types:

- *illegal economy* – Production and distribution of goods and services forbidden by law such as narcotics, prostitution, smuggling, organized crime, usurious trade, theft.
- *undeclared economy* – Activities undertaken with the aim of avoiding established fiscal rules included in tax laws, tax and contribution evasion, and fraud for gain. Cumulative measure of undeclared income is the amount of income which should have been declared to tax authorities but was not.
- *unregistered (unrecorded) economy* – Activities not registered by the official statistics although they should be. This type of economy is measured using income not registered in the System of National Accounts. Unregistered income represents the difference between the total realized income and income registered in the system of accounts.
- *informal economy* – Activities which reduce company costs and break administrative rules that regulate property rights, works agreements, credit agreements, social security system.

Analysing the above methods, the author decided on the labour approach because of its simple calculation and available data. All necessary data are available at Central Bureau of Statistics web sites so that no additional sources were needed. The author also believes that consistency during data collecting is necessary, i.e. one source only must be used so that the end results would be exact.

## 3 Underground economy evaluation based on labour approach

### 3.1 Introduction

The main idea is to calculate the value of underground economy using labour approach. We will observe the Republic of Croatia and the period 2001-2007.

We will use two types of data for our estimate: administrative and survey data<sup>2</sup>. The basic difference in the data is their application and comparability. Evaluations based on administrative data are impossible to compare with other countries as they represent a typically Croatian way of data collecting as opposed to survey data.

The whole idea of empirical approach is based on Crnković-Pozaić (1997). It is important here to point out the similarities and differences between this paper and Crnković-Pozaić (1997) who, based on administrative data for the period 1991-1996, calculated

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<sup>2</sup> For a detailed description of administrative and survey data, see Central Bureau of Statistics (2008).

the activity rates (alternative definition) and values of underground economy using the labour approach and specified the correlation coefficients (assuming the simple linear regression model). In addition to the stated components, the author additionally checked the representative quality of model, tested the hypotheses on the importance of the explanatory variables and compared the obtained results with those obtained by Crnković-Pozaić (1997).

Except with administrative data, the same procedure was used for survey data for the period 2001-2007 (calculation of activity rate, unofficial employment estimate, correlations) so that the data obtained could be compared with those of the member states of the European Union. Crnković-Pozaić did not use survey data (as such data have not been collected prior to 1996) and did not draw a comparison with European countries.

There follows methodology used in this paper (a detailed description of labour approach).

### **3.2 Detailed description of labour approach**

According to Bejaković (1997), the basic idea underlying this method is activity rates follow-up in a certain country and comparison of the results with those in other countries. The method is one of indirect methods and is meaningful only if the changes in official population activity rates are caused by factors related to the underground economy.

Its advantages are availability of data on rates and the simple calculation, but the disadvantage is the fact that the data are collected every ten years when the census is taken so that we can only make estimates for the years between two censuses. Besides, using the method can reveal the number of unemployed who work in unofficial economy, but the number of those employed in both unofficial and official economy remains unknown. The reduction of the rate can indicate the retreat of population from official and participation in unofficial economy.

The labour approach is rather rough and limited. One of the main disadvantages is the fact that the initial value of unofficial employment is always zero. The assumption is not realistic, but the method algorithm itself gives such value. The method was more important for the 90-ies, but today other methods are more credible.

According to Crnković-Pozaić (1997), the activity rate can be defined as a ratio of persons who either are or wish to be economically active to all persons of working-age:

$$\text{activity rate} = (\text{the employed} + \text{the unemployed}) / \text{persons of working-age} \quad (1)$$

$$\begin{aligned} \text{the employed} + \text{the unemployed} = & \text{labour force (total labour supply, total} \\ & \text{working population, de facto economically active population)} \end{aligned} \quad (2)$$

Alternative definition:

$$\text{activity rate} = (\text{the employed} + \text{the unemployed}) / \text{total population} \quad (3)$$

The same author differentiates between two methods of employment estimate in unofficial economy. One is based on historical activity rates, and the other on labour force survey.

*Method based on historical activity rates*

The basic assumption underlying this method is that there are long-term trends in the stated rates which depend on the changes in the level of economy development and the type of economy structure. The two elements are closely related, as the structural changes induced by the differential technology advancements stimulate growth thereby gradually encouraging economic development. Poorly developed countries have typically high activity rates and almost all individuals capable of working are involved in economic activity. Economic development and greater productivity make it possible for a part of population capable of working not to work, so that they devote themselves to other activities which improve the quality of life and are not regarded as economic activities.

In the historical context, this period corresponds with the period of industrialization, when activities such as industry and mining, construction, transport and communication showed the biggest expansion, while the share of agriculture was becoming ever more modest. With the reduction of agriculture share, the activity rate is also significantly reduced, and even today countries with relatively higher share of agriculture have, under same circumstances, higher activity rates. In the post-industrial era the share of industrial activities as well as development of service and quarterly industries is declining. Higher activity rate corresponds with these structural changes occurring even at the highest level of development.

The author also specifies the algorithm for estimating the number of employed in unofficial economy. It can be used for the estimation of the number of employed in the unofficial economy according to the activities (sectors) as well.

The main steps are:

- Data on the employed and unemployed (for certain time periods) should be obtained from the Central Bureau of Statistics, Croatian Pension Insurance Institute or some other source of statistical data and de facto active population calculated according to the formula (2).
- Activity rate is to be calculated using the formula (1) or (3).
- Zero activity rate is defined according to the formula (1) or (3), in the process of which initial data of the given time series are used. Hypothetically active population for the time period  $t$  is equal to the product of multiplication of the zero activity rate and total population in year  $t$ .
- After the values from step 1), 2) and 3) have been calculated, it is possible to calculate the value of the employed in unofficial economy according to the formula (4).

$$\text{share of employed in the unofficial economy} = (\text{hypothetically active} - \text{de facto active}) / \text{de facto active} \quad (4)$$

*Method based on labour force survey*

Labour force survey is one of good sources of data on employment in unofficial economy, since the unit of observation is a household and all individuals in it. The household is an ideal source for research of all processes not only at the labour market but also in all areas affecting the life of an individual.

The survey offers insight in the behaviour of some population categories which are never a subject of research within administrative sources of statistical data. Their participation at the labour market became more significant in the period of a drop in the standard of living, and these categories mostly attempt to become self-employed. International standards, which define employment as an hour of work within the reference week, and their application in the survey surely put these, up to now, invisible categories into the limelight. There are many reasons why it is precisely them who became the focus, because at the same time these are the categories at the margins of the formal sector, whose hours of work and effort are longer than usual and whose income, despite their work, is often insufficient for normal life. This is only one dimension of such work. Simultaneously we find here individuals who achieve high living standard with their multiple activities and do not belong to marginal social classes.

**3.3 Administrative data**

The following data are necessary for the calculation of unofficial employment: population size and the number of unemployed. Based on these and an algorithm (section 3.2), activity rates, hypothetically active population and unofficial employment for certain time series are calculated. The results obtained are shown in Table 2.

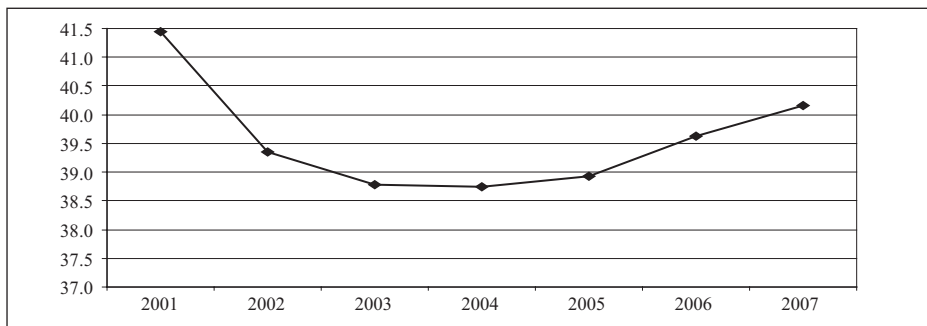
*Table 2 Administrative data 2001–2007 (in 000)*

	2001	2002	2003	2004	2005	2006	2007
total population	4,440.0	4,443.0	4,442.0	4,439.0	4,442.0	4,440.0	4,436.0
total employed	1,460.0	1,359.0	1,392.5	1,409.7	1,420.5	1,467.9	1,516.9
the unemployed	380.2	389.7	329.8	309.9	308.7	291.6	264.4
de facto active population	1,840.2	1,748.7	1,722.3	1,719.6	1,729.2	1,759.5	1,781.3
activity rate, %	41.45	39.36	38.77	38.74	38.93	39.63	40.16
hypothetically active population	1,840.2	1,841.6	1,841.2	1,839.9	1,841.2	1,840.4	1,838.7
unofficial employment, %	0.00	5.31	6.90	7.01	6.47	4.60	3.22

*Source: Author, based on data from the Central Bureau of Statistics (DZS). For the period 2002-2007, data have been taken from Statistical Informations 2005-2008, and for 2001, from The Monthly Statistical Report 01/2007 and 01/2008 are used.*

Figure 1 shows activity rates trends in Croatia from 2001 to 2007. It needs emphasizing that alternative definition (activity rate is equal to ratio of de facto active population to total population) was used in the calculation, because data on economically active population are not available.

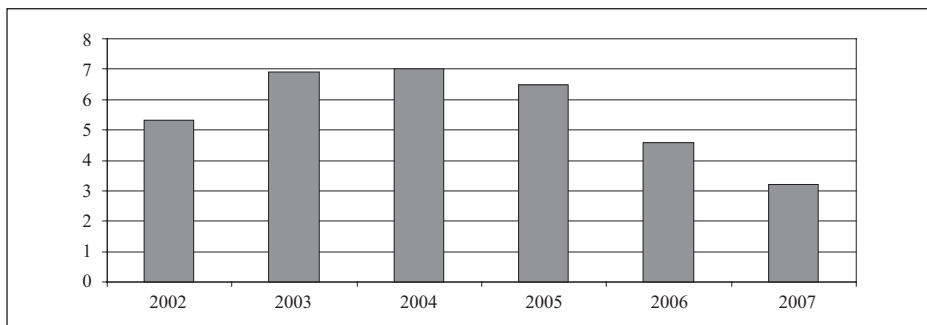
Figure 1 Activity rates 2001-2007 (administrative data)



Source: Author, based on data shown in Table 2.

There is a significant drop in activity rate until 2004, after which growth is achieved. In the period 2002-2004 de facto active population declines much faster than the total population grows. This phenomenon results in the drop in the activity rate. After 2004 de facto active population grows and thus, grows the rate. The values of the rates vary between 38.7 and 41.5%.

Figure 2 Estimate of employment in unofficial economy 2002-2007 (administrative data)



Source: Author, based on data shown in Table 2.

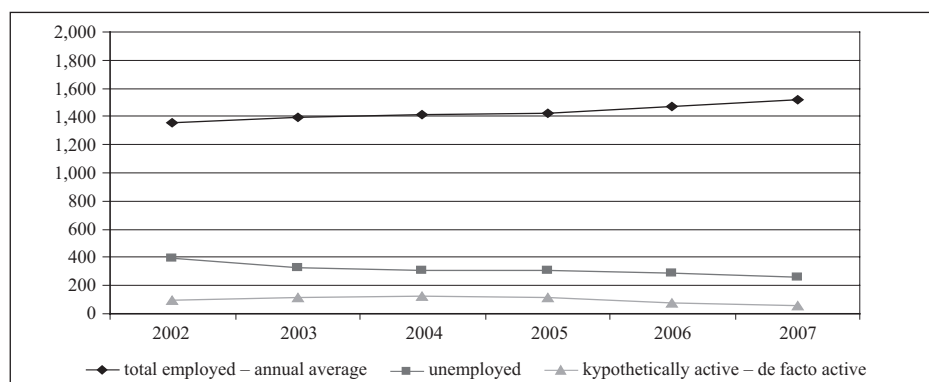
By comparing Figure 1 and 2 we find out that activity rate is inversely proportional to estimate of people employed in unofficial economy. As the activity rate falls, the unofficial employment grows. The obtained result is meaningful as the population switches



from official to unofficial economy. One of the reasons for switching can be aspiration for higher earnings (black labour brings higher earnings).

However, the assumption that everybody who leaves labour force enters unofficial economy is not entirely correct. Naturally, there is always a share of active population that becomes inactive, but this method cannot calculate its percentage.

*Figure 3 Trends in employment, unemployment and unofficial economy 2002-2007 (administrative data)*



Source: Author, based on data shown in Table 2.

Figure 3 shows interesting correlations between the employed in the official economy, unemployed in official economy and employed in unofficial economy. In order to have consistent data comparable with the previous calculations (Crnković-Pozaić, 1997), the author used data from 2002 to 2007 for the calculation of correlation coefficients and believes that pointing this out is extremely important. Thus, six data are used, not seven.

The main reason lies in the labour approach itself. If we observe Table 2, we can notice that for 2002, the difference between hypothetically active and de facto active population is zero, which is obviously why the initial year is ignored. This way of calculation will be used in further analysis of work to enable comparison.

*Table 3 Pearson's correlation coefficients for the period 2002-2007 (administrative data)*

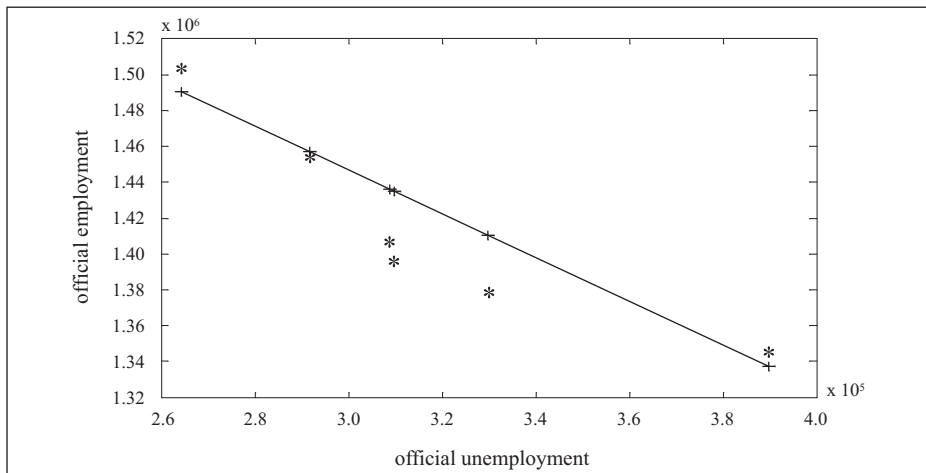
Variable	Correlation coefficient
official unemployment and official employment	-0.92
unofficial employment and official employment	-0.74
unofficial employment and official unemployment	0.41

Source: Author

Correlation coefficients in Table 3 are calculated assuming a simple linear regression model. However, the question arises whether the models are of such type indeed. In the following sections, we will try to determine if the simple linear model approximates the data well enough or multiple regression model is needed.

### 3.3.1 Correlation of official unemployment with official employment

Figure 4 Scatter diagram of official unemployment and official employment, a line



Source: Author

Scatter diagram shows negative statistical relationship. The points marked with \* represent exact values  $(x_i, y_i)$ , and points marked with + regression values  $(x_i, \hat{y}_i)$ . Regression line is:  $\hat{y} = 1813721 - 1,2226x$ .

Table 4 Representation indicators, a line

Representation indicators	Sample realization
SSR (sum squares due to regression)	$1.3407 \times 10^{10}$
SSE (residual sum of squares)	$2.4979 \times 10^9$
SST (total sum of squares)	$1.5905 \times 10^{10}$
variation coefficient (%), $V$	1.4291
determination coefficient, $R^2$	0.8429

Source: Author

Table 5 Hypotesis testing, a line

Hypothesis	Test statistics	Realization of test statistics	p-value
testing hypothesis on the significance of parameter $\beta$	$T = \frac{\hat{\beta}}{\sqrt{\frac{\sigma^2}{S_{xx}}}}$		
$H_0 : \beta = 0$		-5.6749	0.0048*
$H_1 : \beta \neq 0$			0.0024**
$H_1 : \beta < 0$			

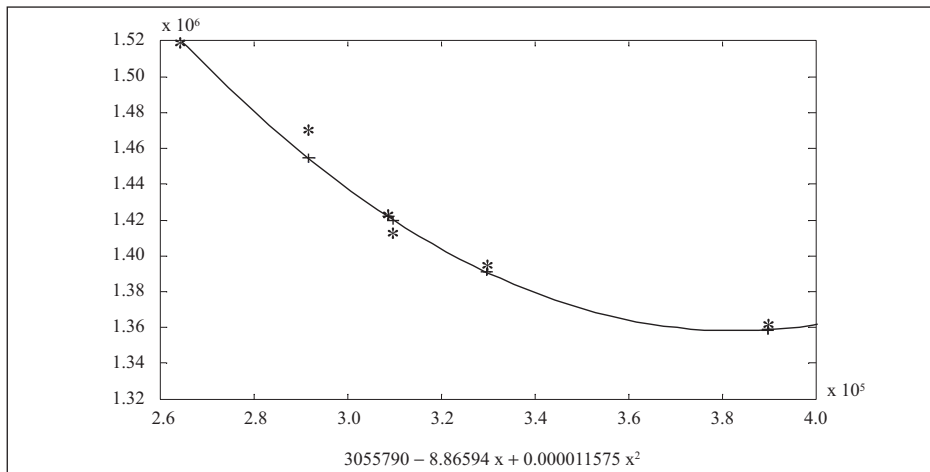
\* p value for two-sided test

\*\* p value for one-sided test

Source: Author

Based on representation indicators and hypothesis testing (Table 4 and Table 5) we conclude that the model is quite good, although we suppose the multiple regression model will be more appropriate after all.

Figure 5 Scatter diagram of official unemployment and official employment, quadratic polynomial



Source: Author

It can be noticed from the diagram (Figure 5) that the quadratic polynomial approximates the data much better than the line. Regression polynomial is:  $\hat{y} = 3055790 - 8.86594x + 0.000011575x^2$ .

Table 6 Representation factors, quadratic polynomial

Representation indicators	Sample realization
SSR (sum squares due to regression)	1.5606*10 <sup>10</sup>
SSE (residual sum of squares)	2.9898*10 <sup>8</sup>
SST (total sum of squares)	1.5905*10 <sup>10</sup>
variation coefficient (%), <i>V</i>	0.4944
determination coefficient, <i>R</i> <sup>2</sup>	0.9812

Source: Author

We can note from Table 6 that representation factors for a quadratic polynomial are much better than for a line (Table 4).

Table 7 Hypotheses testing, quadratic polynomial

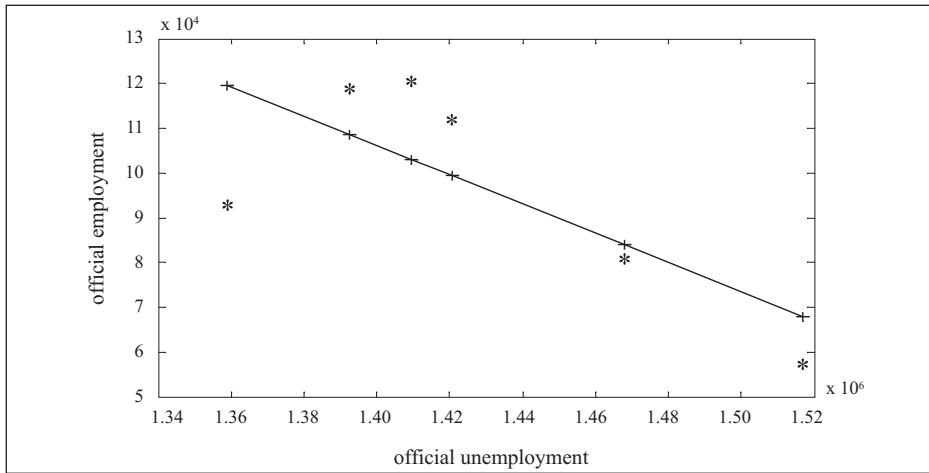
Hypothesis	Test statistics	Realization of test statistics	p-value
Testing the hypothesis on the significance of parameter $\beta_j$ $H_0: \beta_j = 0$ $H_1: \beta_j \neq 0$ $H_1: \beta_1 < 0$ ili $\beta_2 > 0$	$T = \frac{\hat{\beta}_j}{\sigma_{\hat{\beta}_j}}$	T1 = -7.6893 T2 = 6.6429	0.0046* 0.0023** 0.0070* 0.0035**
Testing the hypothesis on the significance of a part of variables $H_0$ : reduced model is sufficient (m=1) $H_1$ : complete model is required (K=2)	$F = \frac{SSE_m - SSE_K / K - m}{SSE_K / n - K - 1}$	44.1285	0.0070

Source: Author

Based on hypotheses testing (Table 7) we conclude that the data poorly support simple linear model and that quadratic model is much better indeed.

### 3.3.2 Correlation of unofficial employment with official employment

Figure 6 Scatter diagram of official employment and unofficial employment, a line



Source: Author

$$\hat{y} = 563820 - 0.3269x$$

Table 8: Representation indicators, a line

Representation indicators	Sample realization
SSR (sum squares due to regression)	1.6999*10 <sup>9</sup>
SSE (residual sum of squares)	1.3993*10 <sup>9</sup>
SST (total sum of squares)	3.0992*10 <sup>9</sup>
variation coefficient (%), $V$	15.7337
determination coefficient, $R^2$	0.5485

Source: Author

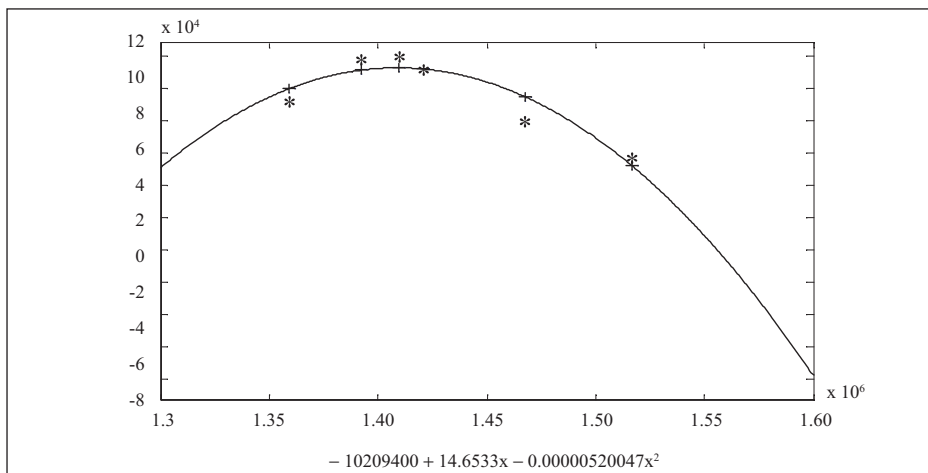
Based on the diagram (Figure 6) and representation indicators (Table 8) we conclude that approximation of data by a line is not a good choice in this case. The fact is confirmed by the hypothesis testing result (Table 9).

Table 9 Hypothesis testing, a line

Hypothesis	Test statistics	Realization of test statistics	p-value
Testing the hypothesis on the significance of parameter $\beta$	$T = \frac{\hat{\beta}}{\sqrt{\frac{\sigma^2}{S_{xx}}}}$	-2.6998	0.0541*
$H_0: \beta = 0$			0.0271**
$H_1: \beta \neq 0$			
$H_1: \beta < 0$			

Source: Author

Figure 7 Scatter diagram of official employment and unofficial employment, quadratic polynomial



Source: Author

$$\hat{y} = -10209400 + 14.6533x - 0.00000520047x^2$$

Table 10 Representation factors, quadratic polynomial

Representation indicators	Sample realization
SSR (sum squares due to regression)	$2.7173 \cdot 10^9$
SSE (residual sum of squares)	$3.8213 \cdot 10^8$
SST (total sum of squares)	$3.0994 \cdot 10^9$
variation coefficient (%), $V$	8.2221
determination coefficient, $R^2$	0.8767

Source: Author

Figure 7 and Table 8 confirm that the quadratic model is more representative. This is supported by the hypotheses testing results (Table 11).

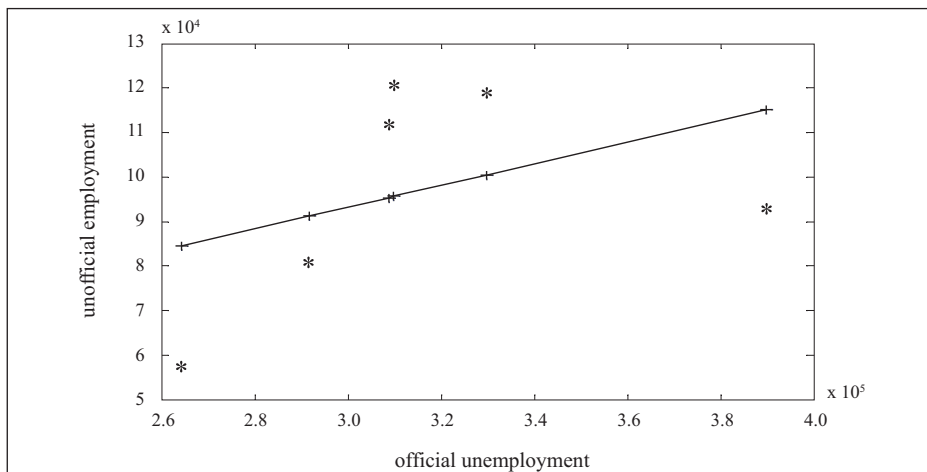
Table 11 Hypotheses testing, quadratic polynomial

Hypothesis	Test statistics	Realization of test statistics	p-value
Testing the hypothesis on the significance of parameter $\beta_j$	$T = \frac{\hat{\beta}_j}{\sigma \hat{\beta}_j}$	T1 = 3.9086	0.0298*
$H_0 : \beta_j = 0$			0.0149**
$H_1 : \beta_j \neq 0$		T2 = -3.9964	0.0281*
$H_1 : \beta_1 > 0$ ili $\beta_2 < 0$			0.0140**
Testing the hypothesis on the significance of a part of variables	$F = \frac{SSE_m - SSE_K / K - m}{SSE_K / n - K - 1}$	15.9709	0.0281
$H_0$ : reduced model is sufficient (m = 1)			
$H_1$ : complete model is required (K = 2)			

Source: Author

### 3.3.3 Correlation of unofficial employment with official unemployment

Figure 8 Scatter diagram of official unemployment and unofficial employment, a line



Source: Author

$$\hat{y} = 20272 + 0.2432x$$

Table 12 Representation factors, a line

Representation indicators	Sample realization
SSR (sum squares due to regression)	5.3070*10 <sup>8</sup>
SSE (residual sum of squares)	2.5685*10 <sup>9</sup>
SST (total sum of squares)	3.0992*10 <sup>9</sup>
variation coefficient (%), <i>V</i>	21.3163
determination coefficient, <i>R</i> <sup>2</sup>	0.1712

Source: Author

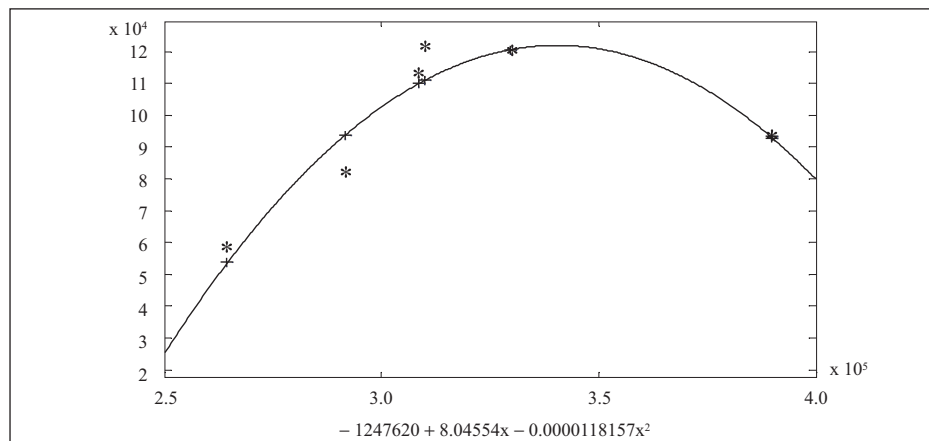
Scatter diagram (Figure 8), representation factors (Table 12) and results of the hypotheses testing (Table 13) indicate that simple linear model is a very bad choice in this case. Hence, it is necessary to approximate the data by a quadratic polynomial.

Table 13 Hypothesis testing, a line

Hypothesis	Test statistics	Realization of test statistics	p-value
Testing the hypothesis on the significance of parameter $\beta$	$T = \frac{\hat{\beta}}{\sqrt{\frac{\sigma^2}{S_{xx}}}}$	1.1134	0.3279*
$H_0 : \beta = 0$			0.1640**
$H_1 : \beta \neq 0$			
$H_1 : \beta > 0$			

Source: Author

Figure 9 Scatter diagram of official unemployment and unofficial employment, quadratic polynomial



Source: Author

$$\hat{y} = -1247620 + 8.04554x - 0.0000118157x^2$$



Table 14 Representation factors, quadratic polynomial

Representation indicators	Sample realization
SSR (sum squares due to regression)	2.8220*10 <sup>9</sup>
SSE (residual sum of squares)	2.7712*10 <sup>8</sup>
SST (total sum of squares)	3.0991*10 <sup>9</sup>
variation coefficient (%), $V$	7.0018
determination coefficient, $R^2$	0.9106

Source: Author

As assumed, scatter diagram (Figure 9) and representation factors (Table 14) support the quadratic model. Low p values (Table 15) indicate that total (quadratic) model is really necessary.

Table 15 Hypotheses testing, quadratic polynomial

Hypothesis	Test statistics	Realization of test statistics	p-value
Testing the hypothesis on the significance of parameter $\beta_j$ $H_0: \beta_j = 0$ $H_1: \beta_j \neq 0$ $H_1: \beta_1 > 0$ ili $\beta_2 < 0$	$T = \frac{\hat{\beta}_j}{\sigma \hat{\beta}_j}$	T1 = 7.2478  T2 = -7.0434	0.0054* 0.0027** 0.0059* 0.0029**
Testing the hypothesis on the significance of a part of variables $H_0$ : reduced model is sufficient (m = 1) $H_1$ : complete model is required (K = 2)	$F = \frac{SSE_m - SSE_K / K - m}{SSE_K / n - K - 1}$	49.6098	0.0059

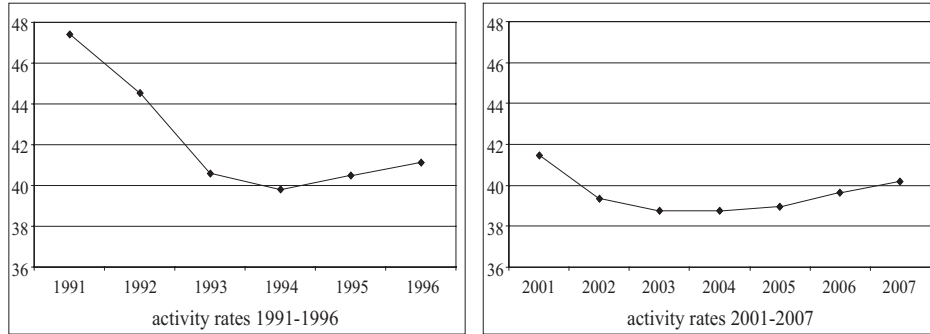
Source: Author

Final conclusion: the results obtained show that it is better to approximate the data by a quadratic polynomial than a line in all three cases.

### 3.4 Comparison of administrative data for the periods 1991-1996 and 2001-2007

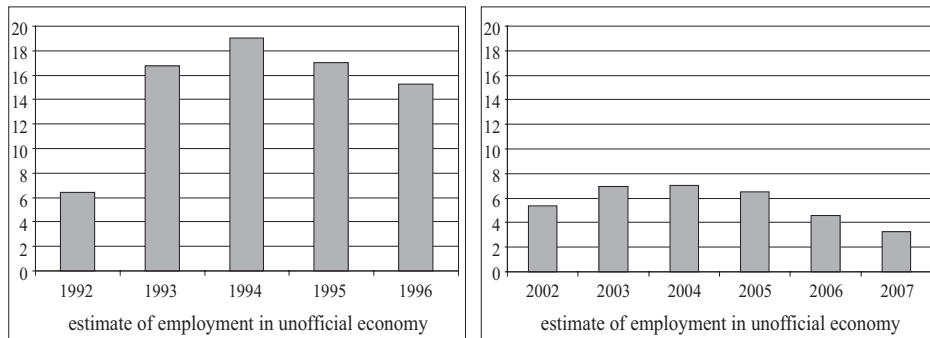
Based on the article by Crnković-Pozaić (1997) and our own estimates, we will try to compare the results obtained for the periods 1991-1996 and 2001-2007 and draw conclusions.

Figure 10 Comparison of activity rates for the periods 1991-1996 and 2001-2007 (administrative data) (%)



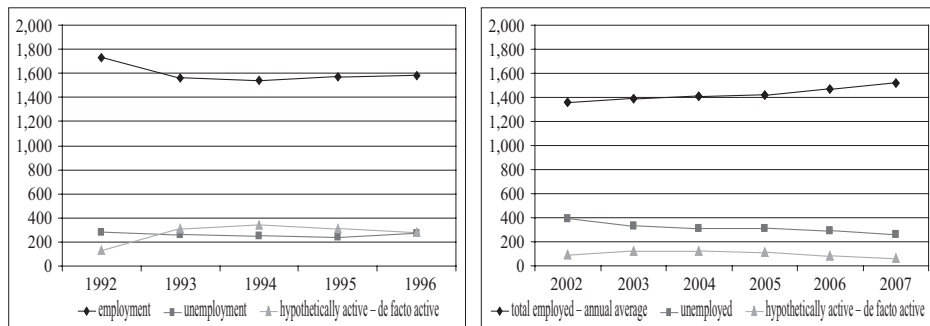
Source: Author, based on data from the article by Crnković-Pozaić (1997) and Figure 1.

Figure 11 Comparison of unofficial employment for the periods 1992-1996 and 2002-2007 (administrative data) (%)



Source: Author, based on data from the article by Crnković-Pozaić (1997) and Figure 2.

Figure 12 Comparison of variables' trends for the periods 1992-1996 and 2002-2007 (administrative data)



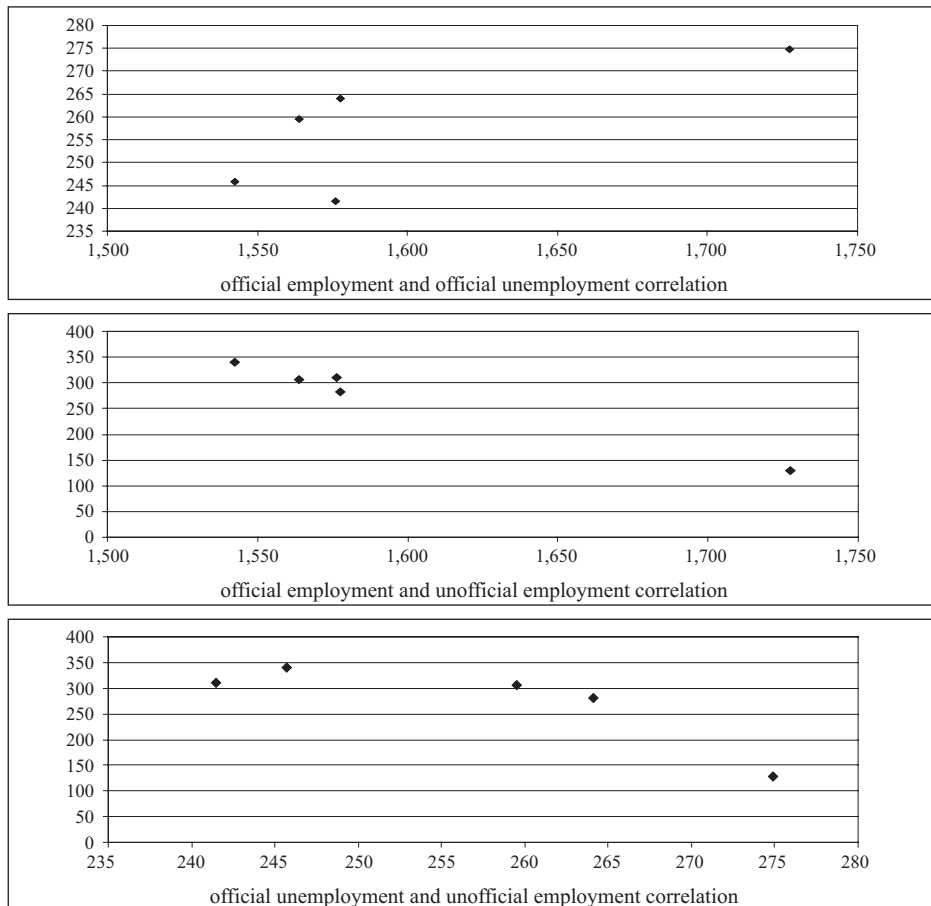
Source: Author, based on data from the article by Crnković-Pozaić (1997) and Figure 3.

It is apparent from Figure 10 and 11 that in both periods there is the same trend in activity rates and unofficial employment. For the period 1991-1996, there is a drop in rates until 1994 followed by a slow growth (the curve is U-shaped), also applicable for the period 2001-2007.

If we observe the relationship between activity rate and unofficial unemployment in both periods, we come to the conclusion it is inversely proportional. This phenomenon can be explained by an assumption that a share of active population moves from official to unofficial economy.

In addition to this, we will compare the correlations between variables (official employment and official unemployment, official employment and unofficial employment, official unemployment and unofficial employment) and correlation coefficients for both periods.

Figure 13 Correlations between variables, 1992-1996 (administrative data) (in 000)



Source: Author, based on data from the article by Crnković-Požaić (1997).

Crnković-Pozaić (1997) calculated correlation coefficients in all three cases assuming the linear interdependency between the variables, although scatter diagrams (Figure 13) show that in the first and third case assuming a curved-line correlation would have been more correct (in which case the use of linear correlation coefficient is not very appropriate).

This is the reason why the author did the same, to have the results which can be compared, although in the above specified cases, approximation by a quadratic polynomial is a better choice.

*Table 16 Pearson's correlation coefficients for the period 1992-1996 and 2002-2007 (administrative data)*

Period	Variables	Correlation coefficient
1992-1996	official unemployment and official employment	0.75
	unofficial employment and official employment	-0.991
	unofficial employment and official unemployment	-0.82
2002-2007	official unemployment and official employment	-0.92
	unofficial employment and official employment	-0.74
	unofficial employment and official unemployment	0.41

*Source: 1992-1996: Crnković-Pozaić (1997); 2002-2007: author*

*Table 17 Survey data 2001 – 2007 (in 000)*

	2001	2002	2003	2004	2005	2006	2007
total population	4,437.5	4,443.0	4,442.0	4,439.0	4,442.0	4,440.0	4,436.0
employed	1,460.0	1,521.0	1,538.0	1,583.0	1,566.0	1,548.0	1,563.0
unemployed	264.0	273.0	253.0	253.0	236.0	206.0	197.0
de facto active population	1,724.0	1,794.0	1,791.0	1,836.0	1,802.0	1,754.0	1,760.0
activity rate, %	38.85	40.38	40.32	41.36	40.57	39.50	39.68
hypothetically active population	1,724.0	1,726.1	1,725.7	1,724.6	1,725.7	1,724.9	1,723.4
estimate of employment in UE*, %	0.00	3.78	3.65	6.07	4.23	1.66	2.08

*Source: Author, based on data from the Central Bureau of Statistics (DZS). For the period 2002-2007, data have been taken from Statistical Informations 2005-2008, and for 2001, from The Monthly Statistical Report 01/2007 and 01/2008 are used.*

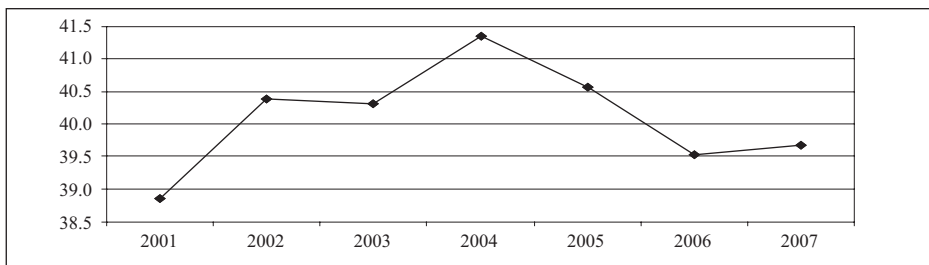
It is realistic to assume that the increase in the number of employed persons in official economy at the same time decreases the number of the unemployed. The assumption is valid for the period 2002-2007 (statistically proved in Section 3.3.1), but for the period

1992-1996, positive correlation is unusual. According to Crnković-Pozaić (1997), the reasons are: recession and statistics (data collecting and the way of their processing). The correlation is meaningful since the persons employed in official economy, satisfied with their jobs and income, do not think about moving to underground economy. The latter correlation (unofficial employment and official unemployment) for the period 2002-2007 is also logical. If the labourers lose their jobs in official economy, they attempt to participate in unofficial economy.

### 3.5 Survey data

Table 17 shows values of activity rates and unofficial employment calculated using algorithm (Section 3.2). The same was done with the administrative data.

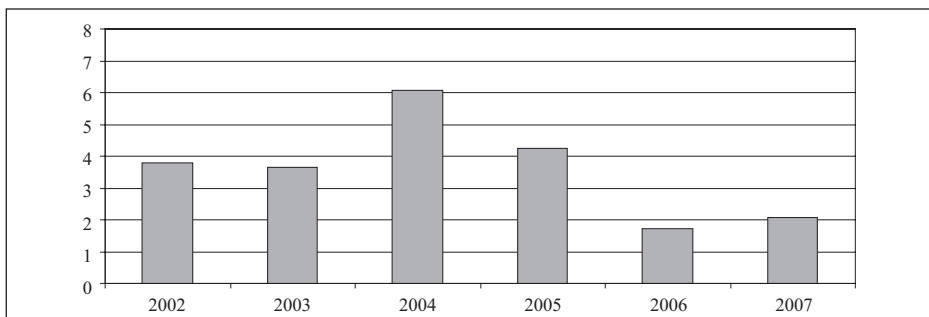
Figure 14 Activity rates 2001-2007 (survey data) (%)



Source: Author, based on data from Table 17.

Figure 14 shows a completely different situation. For administrative data, the rate was dropping at the beginning and rising later. For survey data, there was a growth until 2004 followed by a decline. As the activity rate is defined as a ratio of active to total population, this is not an error; Figure 14 simply arises from data on active population given in Table 17.

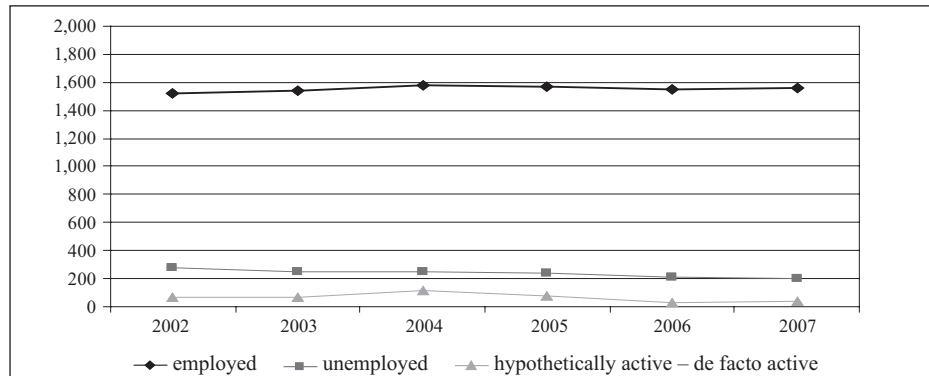
Figure 15 Estimate of employment in unofficial economy 2002-2007 (survey data)



Source: Author, based on data from Table 17.

We can observe from Figure 14 and 15 that the growth in activity rate is followed by the growth in the number of employed in unofficial economy (proportional relationship), which cannot be applied to administrative data. The reason for this can be the fact that a certain share of population works in both official and unofficial economy at the same time, but this method cannot identify these values. Correlation between certain variables looks as follows:

Figure 16 Trends in employment, unemployment and unofficial economy 2002-2007 (survey data)



Source: Author, based on data from Table 17.

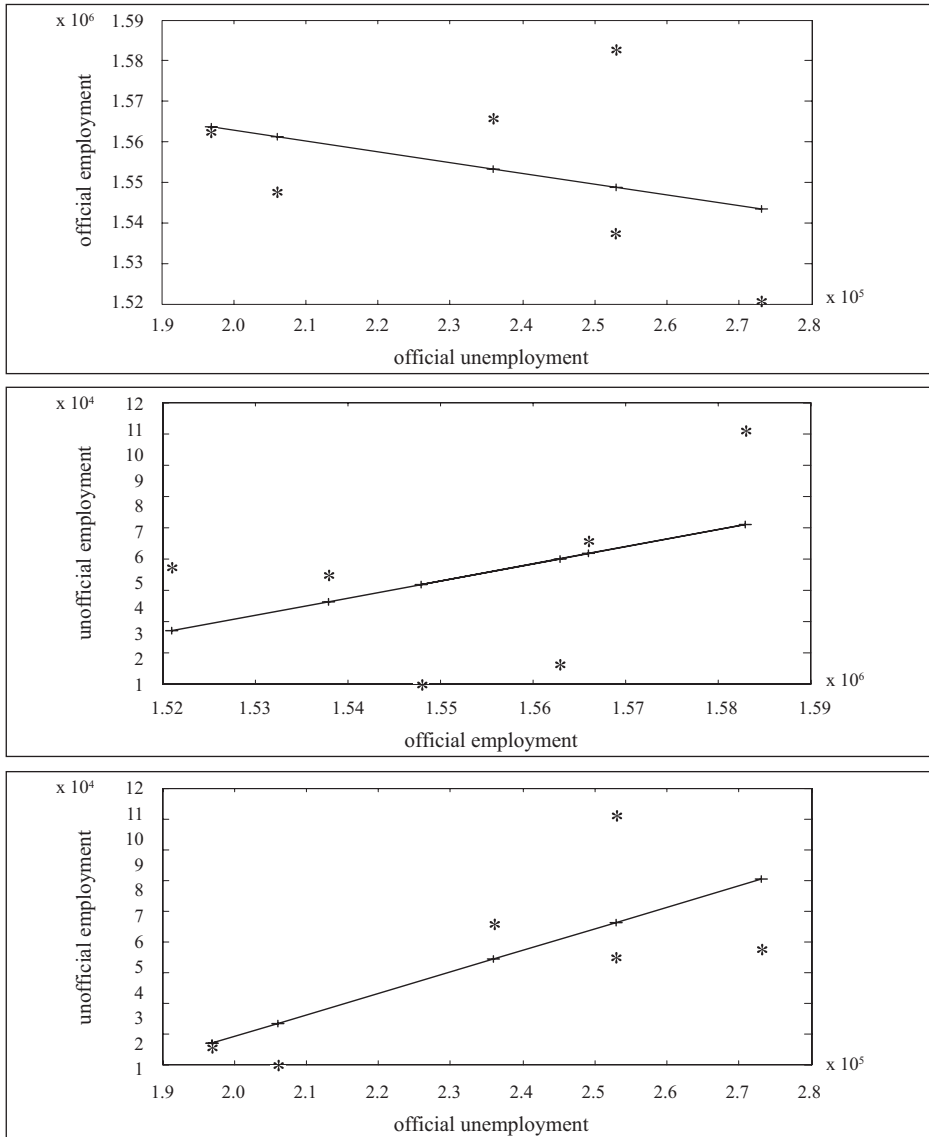
Scatter diagrams are as follows:

By observing Figure 17 we draw a conclusion that data are rather dispersed in all three cases and finding the curves which would approximate the data well is not simple. For this reason we will make approximations by a line and calculate the correlation coefficients based on six data which will, naturally, not be representative for the total population. The coefficients are (in accordance with the diagrams): -0.3580, 0.4109, 0.7040 respectively. The values for administrative data are: -0.92, 0.41 and 0.7. Again, we notice the contradiction between the obtained data due to different ways of their collecting.

### 3.6 Comparison between Croatia and the European Union

In this Section, we will attempt to calculate the activity rates and unofficial employment for the European Union. The results obtained (Table 18) will be compared to Croatia (survey data) to observe the position of Croatia with regard to the member states of the European Union.

Figure 17 Scatter diagrams for the period 2002-2007 (survey data)



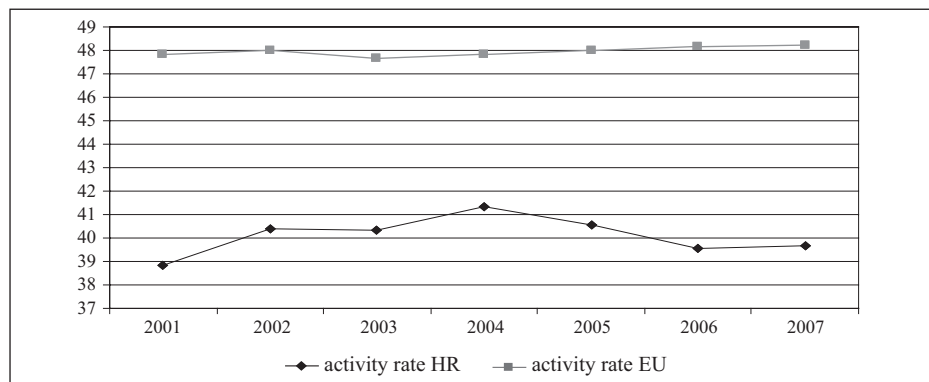
Source: Author

Table 18 Survey data 2001-2007 for EU (in 000 000)

	2001	2002	2003	2004	2005	2006	2007
total population	484.0	485.7	487.7	489.8	491.9	493.9	495.9
employed	212.5	213.1	212.2	213.5	215.5	218.9	222.5
unemployed	19.1	20.0	20.3	20.9	20.5	19.0	16.7
de facto active population	231.6	233.1	232.5	234.4	236.0	238.0	239.2
activity rate,%	47.85	47.99	47.67	47.84	47.98	48.18	48.24
hypothetically active population	231.6	232.4	233.4	234.4	235.4	236.3	237.3
unofficial employment, %	0.00	0.30	0.38	0.02	0.26	0.69	0.81

Source: Author, based on internet source [www.unec.org](http://www.unec.org) (links: *Statistical Data On-Line* → *Labour Force & Wages* → *Population and Employment By Variable, Measurement, Country and Year*; and *Statistical Data On-Line* → *Work & the Economy* → *Unemployment by Age, Sex, Measurement, Country and Year*).

Figure 18 Comparison between activity rates for Croatia and the European Union 2001-2007

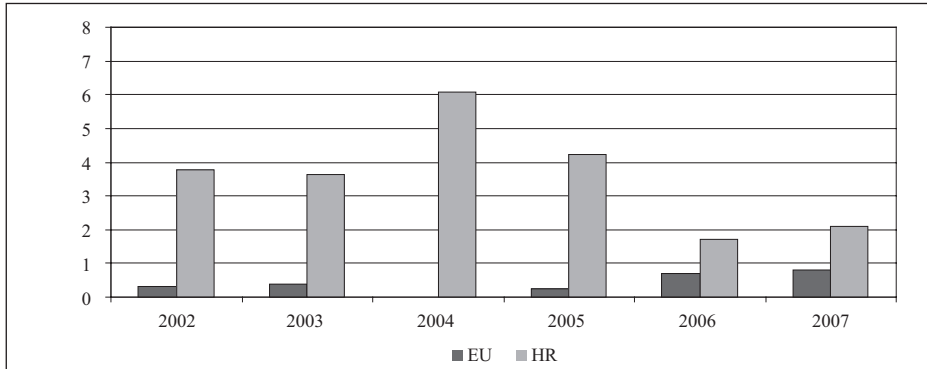


Source: Author, based on Figure 14 and data from Table 18.

Activity rates for the European Union fluctuate between 47.9 and 48.2%, which is rather high compared to Croatia where the rate does not exceed 42%. Such results are meaningful and expected since the Union has higher living standard, more developed industry and generally better organization of labour than Croatia.



Figure 19 Comparison between the estimate of unofficial employment for Croatia and the European Union, 2001-2007



Source: Author, based on Table 17 and 18.

From Figure 18 and 19, it can be noticed that the relationship between activity rate and unofficial employment is proportional, i.e. when activity rate grows, unofficial employment increases as well. Hence, when the number of people employed in official economy grows, the number of those employed in unofficial economy grows too, i.e. there is a certain number of people who take part in both economies at the same time. But we can also notice that a high level of activity rate in the European Union leads to extremely low unofficial employment (max. 49% → max. 1%), unlike Croatia where the spread of final values is narrower (max. 41% → max. 6%).

In further analysis, we will calculate the values of unofficial employment (algorithm from Section 3.2) for every member state of the European Union (period 2002-2007) and based on these values (6 data for every country) we will calculate the mean. Using means, we will sort the countries in the ascending order and see where Croatia is.

*Table 19 Values of unofficial employment for member states of the EU and Croatia*

<b>Country</b>	<b>Unofficial employment, 2002-2007</b>						<b>Mean</b>
Austria	0.32	0.15	0.43	1.11	1.17	2.33	0.92
Belgium	0.18	0.62	0.67	2.61	3.06	3.30	1.74
Bulgaria	0.31	1.50	0.06	1.00	3.48	4.38	1.17
Cyprus	0.03	2.89	4.41	6.21	5.46	6.13	4.19
Czech R.	0.17	0.96	0.03	0.51	0.95	1.18	0.24
Denmark	0.17	0.37	1.33	1.21	0.88	0.19	0.63
Estonia	1.20	1.70	1.86	1.63	4.72	4.86	2.26
Finland	0.79	0.67	0.54	0.63	0.02	0.77	0.35
France	0.03	0.51	0.31	0.64	0.35	0.51	0.38
Germany	0.02	0.31	1.54	2.22	2.16	2.34	1.43
Greece	1.29	1.47	4.16	4.33	4.94	5.17	3.56
Hungary	0.25	2.01	1.62	3.24	4.30	4.22	2.61
Ireland	0.61	1.17	2.48	4.71	6.37	7.59	3.82
Italy	0.99	1.34	0.08	0.42	0.04	0.17	0.28
Latvia	2.49	1.78	2.68	3.80	6.51	9.30	4.43
Lithuania	0.68	1.96	0.35	0.08	0.51	0.57	0.29
Luxemburg	2.78	4.12	5.68	6.64	8.38	10.54	6.36
Malta	0.28	0.44	1.25	0.40	0.03	1.72	0.03
Netherlands	0.31	0.40	0.31	0.61	1.44	2.90	1.00
Poland	0.26	12.56	13.20	13.52	16.68	19.62	12.64
Portugal	0.58	1.01	0.59	1.19	1.43	1.56	1.06
Rumania	2.54	3.85	3.25	3.65	1.24	1.27	2.63
Slovakia	0.83	1.50	0.01	1.39	2.55	3.28	1.59
Slovenia	1.58	1.54	1.63	1.89	2.41	3.53	2.10
Spain	1.91	3.44	5.02	5.47	7.00	7.82	5.11
Sweden	0.03	0.32	0.24	0.51	1.19	1.71	0.47
UK	0.75	1.06	1.41	1.93	2.78	3.05	1.83
Croatia	3.78	3.65	6.07	4.23	1.66	2.08	3.59

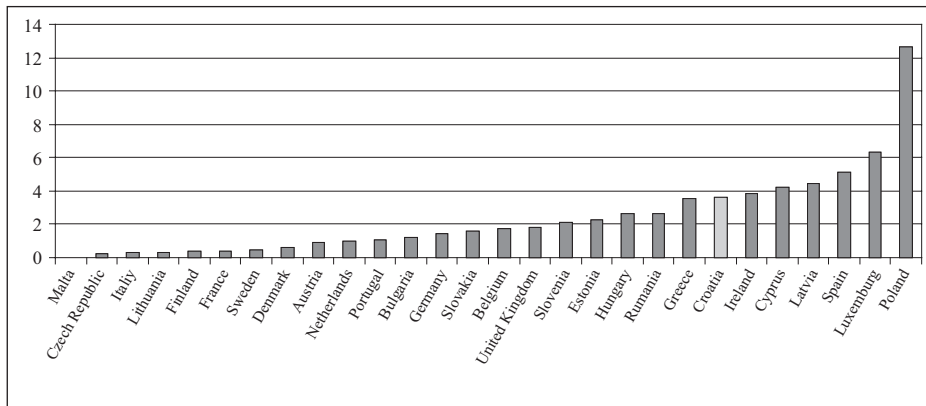
*Source: Author, based on internet source [www.unece.org](http://www.unece.org)*

Table 20 Member states of the EU and Croatia sorted in the ascending order based on means of unofficial employment

No.	Country	Mean	No.	Country	Mean
1	Malta	0.03	15	Belgium	1.74
2	Czech Republic	0.24	16	United Kingdom	1.83
3	Italy	0.28	17	Slovenia	2.10
4	Lithuania	0.29	18	Estonia	2.26
5	Finland	0.35	19	Hungary	2.61
6	France	0.38	20	Rumania	2.63
7	Sweden	0.47	21	Greece	3.56
8	Denmark	0.63	22	Croatia	3.59
9	Austria	0.92	23	Ireland	3.82
10	Netherlands	1.00	24	Cyprus	4.19
11	Portugal	1.06	25	Latvia	4.43
12	Bulgaria	1.17	26	Spain	5.11
13	Germany	1.43	27	Luxemburg	6.36
14	Slovakia	1.59	28	Poland	12.64

Source: Author based on Table 19.

Figure 20 Position of Croatia based on unofficial employment with respect to member states of the EU



Source: Author based on Table 20.

If we observe Croatia among the members of the EU (Figure 20), we can see that it has the seventh largest underground economy. Most countries have better results than Croatia. This could mean that they have better government, policy, tax system and developed economy which contribute to having a smaller share of underground economy in the official economy.

Nevertheless, it is surprising that certain countries such as Ireland, Cyprus and Spain have higher unofficial employment than Croatia. Thus, there is underground economy in both undeveloped and developed countries. Poland is in somewhat worse situation than Croatia as it has recently joined the European Union and it takes some time for the situation to improve by means of adequate measures. It is to assume Croatia will follow the same path. To become a member, it has a lot to improve and use stronger measures for fighting underground economy, but it also has to continue at this rate after becoming a member.

In order for the measures to be effective, all causes of underground economy need to be affected and not just the consequences which is what the government usually does. According to Ott (2002), it is necessary to improve laws and regulations, strengthen the independence of courts and the quality of their equipment, improve statistics, organization, efficiency, competence and cooperation among the government bodies, reduce the role of the government, rationalise public expenditure, improve quality of the public sector, reduce the tax burden, provide a flexible labour market and offer greater possibilities of education.

#### **4 Conclusion**

The primary aim of this paper was to estimate the size of underground economy for the period 2001-2007 using labour approach. While the data were being collected we noticed two types of data: administrative and survey data. Therefore, the calculation was applied to both types to establish the possible difference.

Comparing the two periods (1991-1996 and 2001-2007) based on administrative data we observed negative relation between activity rates and the estimated value of underground economy as expected. The value of underground economy in the 90s was over 20%, while the value for the period 2001-2007 decreased drastically. Hence, we can assume that the measures of fighting underground economy became more drastic and are implemented. But there still remain certain doubts. Are these measures responsible for the decrease or is this just the case of better statistical analysis?

Correlation analysis showed logical but surprising results. Correlation coefficients for the period 2002-2007 are in accordance with the assumptions, but the main surprise was a positive correlation coefficient between official employment and official unemployment for the period 1992-1996.

The analysis of the data for the period 2001-2007 indicates a substantial difference in the results obtained. Here, the relation between the activity rates and estimated values of underground economy is proportional although the numerical figures remained within the same range. The reason for this is first of all different ways of data collecting for the same time series.

At the end of the paper, the European Union is studied as well as certain member states to establish the position of Croatia. The results showed the majority of European countries have a far smaller share of underground economy in the official economy than

Croatia. Although there has been a decrease in underground economy if compared with the 90s, it is still necessary to work on fighting it.

The main problem of this paper is the heterogeneousness of data. The difference in administrative and survey data leads to contradictory conclusions, so that it is questionable which results to rely on. The solution would be using only survey data for the time after 1996, as the Labour Force Survey has been conducted since 1996. It needs emphasizing that only survey data make comparison of Croatia with other countries possible.

Moreover, the results obtained would certainly be more reliable if the longer time series had been taken, e.g. 1991-2007. But administrative data for 1997, 1998, 1999 and 2000 were not available from the Central Bureau of Statistics web site and survey data were not collected then.

Therefore, research of underground economy using labour approach might offer far better results in future as it is expected that state statistics, homogeneousness and availability of larger quantity of data will improve.

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