The Estimation of 1910-1989 Per Capita GDP in Croatia

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Abstract: In Croatia, the record of national income is rather poor in the nineteenth century as well as in the twentieth century. Therefore the goal of this paper is to estimate GDP per capita in Croatia during 1910-1989. The methodology is based on 'backcasting' technique that has resulted in ten statistically significant estimates of GDP per capita of Croatia during 1910-1989. Furthermore, obtained data is combined with Good's and Maddison's data for the purpose of cross-country comparison of GDP per capita throughout 1870-2000.

JEL Classification: N30

Key words: GDP estimate, cross-country analysis, convergence, development gap

Introduction

The record of national income in nineteenth century Europe is often poor. Therefore, both economic historians and development economists have employed short-cut methods in deriving indirect estimates of national income and product. Some of the methods rely on a wide range of socioeconomic data that are readily available compared to that required for standard national-income type estimates (Good 1994); other methods rely on alternative measurements of national income (Balke and Gordon 1989).

Because of poor record of national income in Croatia, in this paper we will try to estimate levels of GDP per capita in 1910-1989.

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The Methodology

The methodology applied in this paper is partially based on the 'backcasting' technique that was used for estimation of the US GNP during 1870-1929 (Balke and Gordon 1989). Variables used for the 'backcasting' are the growth rates of alternative measurements of national income, growth rates of various sectors and the socioeconomic data.

The estimation starts with data of the Croatian GDP per capita in Geary-Khamis 1990 international dollars that were published for the period between 1990-2000 (Maddison 2003). Although the Penn World Table version 6.1 provides data in more recent 1996 international dollars, Maddison's data set is chosen in this paper due to the fact that it covers a longer period of time. While the Penn World Table 6.1 includes GDP per capita data for 1950-2000 (Summers Heston and Aten 2002), Maddison covers GDP per capita for 1500-2001 (2003). Therefore, estimates for 1910-1989 which we are focusing on, are much more consistent if the Geary-Khamis international dollars are used for the entire period.

The starting ground for further estimations is the GDP per capita data of former Yugoslavia (Maddison 2003). The data set is used for the two estimates of Croatian GDP per capita: **the simple approach (SA)** estimate and **the regression approach (RA)** estimate.

In the **SA** estimate, the growth rates of GDP per capita of former Yugoslavia are multiplied by the ratio of growth rates of former Yugoslav social product per capita and the growth rates of Croatian social product per capita.[1] However, this is a very primitive and simple way of estimation and it is used only as a starting point for further analysis. The GDP per capita growth rates are estimated for the years 1952-1990 and the levels of GDP per capita of Croatia in 1990 are 'backcasted' all the way to the year 1952. Further 'backcasting' is not possible, since the data for social product of Croatia in the pre-1952 period is not available.

The **RA** estimate is based on the regression analysis. The growth rates of various sectors (Industry, Agriculture, Forestry, Services…) of former Yugoslavia are the independent variables in the model and the growth rates of GDP per capita of former Yugoslavia (Maddison 2003) is the dependant variable. Furthermore, the GDP per capita of Croatia is estimated by inserting the growth rates of the above mentioned sectors of Croatia into the regression equation. The **RA** estimate is then used to estimate GDP per capita in Croatia for 1958-1990, since the sector data is not available for the pre-1958 period.

The data for economic performance of Croatia is not available for 1913-1952. Therefore, three estimates of the economic activity of former Yugoslavia are used for further 'backcasting'. The first estimate was published by Stajić (1957) and Čobeljić (1959), and were used in Bićanić and Škreb (1991). It is the estimate of the national

income of former Yugoslavia for 1923-1956 in 1938 prices. The second estimate was published by Vinski, who constructed data series for the national income per capita of former Yugoslavia for 1909-1959 (1967, p.163). The data has been estimated for the real national income per capita at 1958 prices and published as the base index 1909-1912=100. The third estimate was published by Maddison (2003) in Geary-Khamis 1990 international dollars for the benchmark years 1870, 1890, 1900, 1910, 1913 and consecutively for 1920-2001.

All three, Stajić's, Vinski's and Maddison's estimates were then used for the estimation of GDP per capita growth rates of Croatia in 1910-1958. Firstly, the **SA** and the **RA** estimates were 'backcasted' with the original growth rates of Stajić's, Vinski's and Maddison's estimates. Secondly, a regression analysis with growth rates of former Yugoslavia as an independent variable and the growth rates of Croatia as a dependent variable was constructed for 1952-1989. The Croatian GDP per capita growth rates for 1910-1958 were extrapolated by inserting Stajić's, Vinski's and Maddison's growth rates in the regression equation. The **SA** estimate data was used as a dependant variable in regression analysis for the further 'backcasting' of the **SA** estimate, and the **RA** estimate was used for the further 'backcasting' of the **RA** estimate. The social product of former Yugoslavia per capita was included as an independent variable in the regression analysis that was used for the extrapolation with Stajić's and Vinski's growth rates and the estimated GDP per capita of former Yugoslavia was used for extrapolation with Maddison's growth rates.

In total, the methodology of the 'backcasting' resulted in ten statistically significant estimates of the GDP per capita of Croatia in 1910-1989. The level of GDP per capita of Croatia in 1990 was 'backcasted' with the **SA** and the **RA** estimate. Subsequently, the **SA** estimate was 'backcasted' with the original and extrapolated growth rates of Stajić, Vinski and Maddison, while the **RA** estimate was 'backcasted' with the original growth rates of Stajić, Vinski and the original and extrapolated growth rates of Maddison.

Having in mind that one of the goals of this study is a cross-country analysis, it was required to select one of the estimates for the purpose of comparison. Therefore, Good's (1994: 879)[2] level of GDP per capita in of 1910 was used as a test of rejection of our estimate. The logic behind this is that Good's methodology is based on socioeconomic proxy variables and the fact that the methodology in this study is based on correlating growth rates of social product, national income and GDP. Therefore, if two different methodologies result in similar levels of GDP per capita, then both estimates may be considered more reliable.

Limitations

There are several issues connected with methodology used in this paper and all of them need to be addressed. The short-cut methodology is definitively controversial, but David F. Good (1994) rather eloquently describes the need for it:

> *Despite their widespread use, approaches using proxy measures remain controversial. A fundamental problem is that choosing indicators and weighting them in a single index can be quite arbitrary. Different indicators and different weights may lead to significantly different rankings. These deficiencies have led some, such as Maddison, to argue strongly in favor of the Kuznetsian national-income approach as the most reliable means of filling in the gaps in our historical knowledge.*
> *In principle, of course, Maddison is correct. In practice, however, it is not always feasible to work within the Kuznetsian tradition. The required data may be either completely lacking or prohibitively costly to generate* (Good 1994, p.872).

The 'backcasting' methodology is also partially controversial. The most significant problems in the usage of social product or any other indicator to 'backcast' a GDP estimate are the 'borderline' problem and the 'base year' phenomenon. Balke and Gordon (1989) have described the 'borderline' problem and have given the methodological solution to the problem:

> *As we go backward in time, the quality of available data deteriorates. Our discussion ignores the continuous nature of the deterioration and simplifies by treating the deterioration as occurring at a discrete point in time, called the 'borderline' year. Before the borderline year some crucial data are missing but are available after the borderline year. Any method of estimating or 'backcasting' aggregate economic activity before the borderline year must infer the level of output in the sectors lacking data* (Balke and Gordon 1989, p.41).

The 'base year' phenomenon is sometimes also referred to as 'Gerschenkron effect'. Gerschenkron (1951) used 1939 U.S. prices to compute the value of the U.S.S.R. machinery output. While his figures showed a 400 percent increase between 1927-28 and 1937, the official Soviet series, which used 1926-27 ruble prices, indicated that machinery output had increased by 1,500 percent. When Gerschenkron investigated this vast difference in reported growth rates, he discovered that the U.S.

data behaved similarly if prices from different eras were used. Gerschenkron concluded:

> *The selection of a relatively early year as weighting period will, as a rule, result in a higher rate of growth during the subsequent years than would be true of an index based on weights pertaining to a later pointing time* (Gerschenkron 1951, p. 1)

He reasoned that, if the relative price of a good fell, its output would expand more rapidly than those of other goods. Using a later base year assigns these goods low relative prices and gives them less weight in the index. Thus, an index with a later base year assigns less importance to the most rapidly expanding sectors of the economy, and it would exhibit less growth (Nuxoll 1994, p. 1425).

The problem that the growth rates vary, when the base year is changed, is usually solved with a chained index. Unfortunately, such a chain index has neither been used in Croatian official statistics nor in Vinski's, Stajić's and Maddison's data sets. Even today, the official GDP figures are published in 1990 constant prices only.

The social product of Croatia has been calculated and published for period 1952-1990 in 1972 constant dinars, the national income of former Yugoslavia has been published in 1938 constant dinars (Stajić 1957) and the national income of former Yugoslavia has been published in 1958 constant dinars (Vinski 1967). According to Gerschenkron (1951, p. 1), there is a proportional relationship between the distance of the base year and the overstatement in the growth rates. A data set with later base year should have a smaller growth rate for the same period than a data set with an earlier base year. According to that, Stajić's data should result in the biggest growth rates, Vinski's data with smaller growth rates than Stajić's and Maddison's data with the smallest growth rates for the same period of time. Unfortunately, the data shows an opposite relationships. During 1923-1952 the aggregate economic activity of former Yugoslavia increased by 10.45% according to Stajić, 24.76% according to Vinski and 32.15% according to Maddison.

Therefore, it is rather questionable in which way the Gerschenkron phenomenon has altered the growth rates and in which way Maddison's methodology avoided problems resulting from this phenomenon. Having all these issues in mind the Gerschenkron phenomenon will be willingly omitted in our analysis.

Analysis

The only period in which official statistics have used the GDP as a measure of the economic activity in Croatia is 1990-2000. Accordingly, GDP per capita in

international dollars has been published. The series for 1990-2001 is available in Maddison's latest publication (Maddison 2003) and the series for 1990-1998 is available in Maddison's previous publication (2002, p. 338). However, there is a significant difference between these data sets. The latest has a much higher level of GDP per capita. In this paper, the later data set is chosen for the purpose of further 'backcasting'.[3]

Table 1: The GDP Per Capita of Croatia 1990-2000

Year	Maddison GDPpc of Croatia 1990 Geary-Khamis int. $*	Maddison GDPpc of Croatia 1990 Geary-Khamis int. $**
1990	6971	7351
1991	5452	5758
1992	4896	5209
1993	4528	4805
1994	4758	5012
1995	5107	5392
1996	5457	5818
1997	5827	6290
1998	5963	6530
1999	n.a.	6487
2000	n.a.	6632
2001	n.a.	6802

* The old Maddison's data set
** The new Maddison's data set
Source: Maddison 2002, p. 338; Maddison 2003

Backcasting of 1952(58)-1990 Per Capita GDP

The Croatian GDP in Croatia during this period has not been a part of any official statistics. The social product of Croatia, as a measure of economic activity, has been published for 1952-1990 in aggregate and for 1958-1990 for different sectors of economy. The only available GDP data for this period is the GDP per capita of former Yugoslavia (Maddison 2003). Therefore, the level of GDP per capita in 1990 has been 'backcasted' with two different methodologies.

Table 2: The estimation of GDP Per Capita of Croatia (the simple approach) 1952-1990

Year	Maddison YU GDPpc 1990 G-K int $	Maddison growth rates YU GDPpc	SP Croatia constant prices dinars 1972	Pop. Croatia (000)	Growth rates CRO SPpc	SP former YUG constant prices dinars 1972	Pop. former YUG (000)	Growth rates YU SPpc	Growth rates CRO SPpc / Growth rates YU SPpc	Growth rates SIMPLE HR GDPpc	SIMPLE 1990 G-K int. $
1952	1448	-0.0897	1594	3913		5974	16708				1655
1953	1643	0.1342	1851	3946	0.1515	6924	16937	0.1434	1.0568	0.1418	1890
1954	1712	0.0421	1993	3978	0.0681	7142	17151	0.0186	3.6571	0.1541	2181
1955	1797	0.0499	2274	4013	0.1310	8109	17364	0.1215	1.0786	0.0538	2298
1956	1742	-0.0309	2177	4040	-0.0491	7700	17508	-0.0582	0.8422	-0.0260	2238
1957	2014	0.1565	2584	4067	0.1791	9278	17659	0.1946	0.9202	0.1440	2561
1958	2080	0.0325	2648	4089	0.0193	9453	17796	0.0111	1.7420	0.0567	2706
1959	2314	0.1124	2886	4115	0.0830	10991	17968	0.1515	0.5477	0.0616	2872
1960	2437	0.0533	3171	4140	0.0921	11828	18133	0.0664	1.3873	0.0739	3085
1961	2522	0.0347	3405	4169	0.0663	12509	18318	0.0469	1.4155	0.0491	3236
1962	2544	0.0087	3498	4200	0.0197	12938	18500	0.0241	0.8182	0.0072	3259
1963	2781	0.0934	3875	4232	0.0994	14503	18685	0.1099	0.9046	0.0845	3535
1964	3019	0.0856	4241	4246	0.0908	16161	18852	0.1044	0.8700	0.0744	3798
1965	3071	0.0170	4369	4273	0.0237	16466	19038	0.0089	2.6489	0.0451	3969
1966	3205	0.0438	4691	4300	0.0670	17751	19221	0.0678	0.9881	0.0433	4141
1967	3232	0.0084	4852	4326	0.0281	18152	19390	0.0137	2.0554	0.0172	4212
1968	3272	0.0125	5071	4353	0.0387	18817	19552	0.0281	1.3778	0.0173	4285
1969	3610	0.1031	5455	4379	0.0693	20634	19705	0.0881	0.7874	0.0812	4633
1970	3755	0.0401	5834	4406	0.0629	21795	19840	0.0491	1.2818	0.0514	4871
1971	4151	0.1056	6307	4430	0.0752	23554	20015	0.0713	1.0555	0.1114	5413

1972	4255	0.0251	6481	4447	0.0237	24555	20197	0.0331	0.7157	0.0180	5511
1973	4361	0.0247	6739	4465	0.0356	25768	20367	0.0406	0.8752	0.0217	5630
1974	4879	0.1190	7328	4482	0.0833	27968	20550	0.0757	1.0991	0.1308	6366
1975	4836	-0.0088	7541	4500	0.0250	28989	20732	0.0274	0.9133	-0.0080	6315
1976	4939	0.0212	7864	4517	0.0389	30119	20930	0.0292	1.3318	0.0283	6494
1977	5250	0.0628	8535	4535	0.0810	32532	21126	0.0701	1.1560	0.0726	6965
1978	5491	0.0460	9183	4553	0.0717	34780	21309	0.0599	1.1971	0.0551	7349
1979	5819	0.0596	9732	4570	0.0559	37233	21490	0.0615	0.9088	0.0542	7748
1980	6063	0.0421	9853	4588	0.0084	38086	21615	0.0170	0.4957	0.0208	7909
1981	6134	0.0117	9997	4606	0.0106	38637	21707	0.0102	1.0487	0.0123	8006
1982	6146	0.0020	9866	4621	-0.0163	38817	21860	-0.0024	6.9289	0.0138	8117
1983	6172	0.0041	9714	4636	-0.0186	38427	21968	-0.0149	1.2460	0.0051	8158
1984	6300	0.0209	9921	4646	0.0191	39184	22012	0.0177	1.0809	0.0226	8342
1985	6325	0.0039	9935	4657	-0.0010	39374	22115	0.0001	-6.7996	-0.0268	8118
1986	6559	0.0369	10210	4667	0.0255	40775	22213	0.0310	0.8208	0.0303	8364
1987	6462	-0.0147	10200	4674	-0.0025	40312	22283	-0.0145	0.1712	-0.0025	8343
1988	6351	-0.0173	10105	4681	-0.0108	39625	22358	-0.0203	0.5308	-0.0092	8266
1989	6250	-0.0159	9950	4685	-0.0162	38996	22429	-0.0190	0.8510	-0.0135	8155
1990	5779	-0.0754	9100	4770	-0.1017	36058	22488	-0.0778	1.3080	-0.0986	7351

Source: SYC-93, p.136; Družić Sirotković 2002, p.39; SYY-90, p.164-5; SYY-82, p.156-7; SYY-76, p.134-5; Maddison 2003

The Simple Approach

The growth rates of the social product of Croatia are divided by the growth rate of social product of former Yugoslavia and multiplied by the growth rate of GDP per capita of former Yugoslavia in 1990 international dollars (Table 2 and Equation 1).

$$\text{Equation 1: } grGDPpc_{CRO} = grGDPpc_{YU} * \frac{grSPpc_{CRO}}{grSPpc_{YU}} \text{ 4}$$

The Regression Approach

In the second approach, regression analysis is used to estimate the GDP per capita for the years 1958-1990. A structural equation is formed, in which the growth rate of the GDP per capita of former Yugoslavia is the dependent variable and the growth rates of sectors are the independent variables (Table 3).

Table 3: Regression Results Growth Rates of GDP Per Capita of Former Yugoslavia vs. the Growth Rates of Sectors of Former Yugoslavia

Constant	Industry	Agriculture	Forestry	Construction	Transportation	Trade	Hotels...	Craft...	Utilities...	The rest	DF	R^2	SEE
-0.02	0.76	0.25	-0.12	-0.09	0.32	-0.06	0.00	0.04	0.18	-0.04	13	0.88	0.02
-1.60**	3.25*	3.00*	-0.75	-0.94	1.62**	-0.18	0.01	0.24	0.92	-0.34			

*Significant at 0.05 level; **Significant at 0.10 level
Notes: second row = coefficients, third row = t statistics, DF = degree of freedom, R^2 = adjusted coefficient of determination, SEE = standard error of the estimate.

The estimated equation has only three variables which are statistically significant. All of them have a positive sign, which means that they can be used for estimation of the GDP growth rates.

$$\text{Equation 2: } grGDPpc_{CRO} = -0.02 + 0.76grINDpc + 0.25grAGRpc + 0.32grTRApc$$

The growth rates of Croatia for the period 1959-1990 are extrapolated with the regression equation (Equation 2) and the level of GDP per capita in 1990 is 'backcasted' with the extrapolated growth rates. The result are shown in Table 5.

Table 4: Growth Rates of GDP Per Capita in Former Yugoslavia and Growth Rates of Sectors of the Economy 1965-1988 (in %)

Year	Growth rates of GDP per capita of former yugoslavia 1990 G-K int. $	Industry	Agriculture	Forestry	Construction	Transp ortation	Trade	Hotels...	Craft...	Utilities...	The rest
1965	1.7	6.3	-8.7	2.8	-5.7	5.0	1.9	6.7	12.6	-2.1	2.5
1966	4.4	2.4	17.5	1.0	5.1	4.5	5.7	6.4	5.8	-1.1	2.6
1967	0.8	-0.8	-1.7	-2.2	6.2	7.6	4.7	-1.2	4.5	1.1	-6.0
1968	1.3	4.4	-4.8	-3.4	6.3	5.2	3.8	12.2	4.1	1.1	5.1
1969	10.3	9.0	8.6	0.4	8.0	7.2	10.9	10.7	5.4	7.3	6.0
1970	4.0	7.3	-6.9	3.4	8.3	8.1	9.9	5.1	5.5	9.6	3.3
1971	10.6	8.7	5.7	0.6	0.4	7.5	10.8	3.8	5.6	3.3	3.4
1972	2.5	6.1	-3.0	1.0	2.7	2.1	5.4	2.2	6.2	4.8	-3.2
1973	2.5	4.4	8.2	1.4	-2.7	5.9	2.6	1.4	4.6	1.4	7.3
1974	11.9	10.0	4.5	3.6	5.1	8.7	6.4	3.7	6.6	4.3	14.6
1975	-0.9	5.4	-3.8	1.6	9.7	-0.7	0.4	2.0	5.6	-3.8	8.6
1976	2.1	2.6	5.9	-2.4	3.9	1.2	0.0	1.7	2.7	2.0	12.7
1977	6.3	8.5	4.5	7.9	8.2	5.2	6.9	5.9	4.4	2.6	6.4
1978	4.6	7.7	-6.5	-2.2	10.3	9.2	9.4	5.2	4.8	9.5	10.0
1979	6.0	7.2	4.7	1.8	8.6	3.2	5.1	5.1	4.1	6.7	9.1
1980	4.2	3.5	-0.4	-3.8	-0.4	3.4	0.4	0.7	3.2	0.6	-0.6
1981	1.2	3.4	1.8	3.6	-5.6	-0.4	-2.3	0.8	1.5	1.6	6.9
1982	0.2	-0.7	6.7	5.6	-8.0	-2.7	-0.8	1.6	3.9	2.6	-2.6
1983	0.4	0.7	-1.5	-0.4	-13.7	0.6	-2.9	1.3	1.0	0.4	-2.9
1984	2.1	4.4	1.4	3.2	-4.8	3.2	-3.2	1.2	2.4	-7.2	-5.8
1985	0.4	2.0	-7.9	-0.4	-2.4	2.7	-1.1	1.5	2.6	2.2	3.4
1986	3.7	3.2	10.4	-1.2	-2.0	3.9	1.8	-6.8	-6.3	2.7	1.5
1987	-1.5	0.2	-5.0	0.0	-1.5	2.8	-6.4	-5.9	-5.2	-0.6	3.0
1988	-1.7	-1.3	-4.2	-1.2	-7.1	-0.3	-4.8	2.3	0.9	-1.2	0.8

Source: SYY-90, p.164-5; SYY-82, p.156-7; SYY-76, p.134-5; Maddison 2003

The Simple Approach and Regression Approach Comparison

The **SA** and the **RA** estimates results in a similar growth performance, but with completely different level of volatility of estimated GDP per capita during the period

Table 5: Sectorvise Growth rates and Estimated per Capita GDP Growth Rate in Croatia (in %)

Year	Industry	Agriculture	Forestry	Construction	Transport	Trade	Hotels…	Craft…	Utilities…	The rest	Estimated growth rate of GDP pc	Estimated GDP pc 1990 G-K int. $
1958												2349
1959	13.3	1.7	9.4	19.2	5.1	12.7	8.5	-1.5	0.0	8.8	10.6	2598
1960	14.9	-1.5	-5.8	22.9	10.7	14.3	20.3	-0.6	0.0	3.7	12.9	2932
1961	5.8	0.1	-4.8	16.9	3.9	17.1	-8.3	2.8	0.0	1.4	4.1	3051
1962	8.1	-1.1	-2.2	-6.1	4.2	3.0	-6.7	-7.4	11.7	3.3	5.7	3225
1963	12.1	3.5	6.5	22.0	9.3	9.4	12.7	-4.3	4.8	21.6	11.5	3595
1964	14.5	-0.6	-0.3	7.2	7.3	15.2	6.7	9.9	-0.3	14.0	11.7	4014
1965	6.8	-9.3	2.1	5.6	3.4	2.1	9.8	12.0	-5.9	3.5	2.3	4107
1966	5.3	16.4	2.0	6.6	4.4	5.9	6.5	4.6	-0.6	-11.3	7.9	4430
1967	-0.3	-0.5	-1.9	9.5	9.3	5.5	-1.2	8.6	2.2	0.9	1.0	4476
1968	4.4	0.5	-1.9	4.7	3.7	2.7	17.7	3.9	2.1	8.9	3.1	4613
1969	7.0	3.6	-0.6	5.7	7.1	11.2	13.9	5.6	7.3	1.4	6.9	4930
1970	7.2	-1.1	3.4	8.4	7.9	10.1	7.6	5.2	6.7	4.0	6.1	5233
1971	7.5	3.4	2.0	7.6	8.1	11.6	7.8	6.1	4.0	7.0	7.6	5631
1972	6.4	-10.2	0.9	1.2	2.4	6.0	4.9	6.9	10.4	-5.1	1.5	5717
1973	1.8	13.0	2.1	-5.2	6.6	3.1	2.3	4.9	1.5	5.7	5.1	6009
1974	10.8	7.7	4.4	3.4	8.9	8.3	0.9	7.4	5.4	13.5	11.4	6694
1975	5.1	-6.8	1.9	7.2	-0.3	1.1	1.2	11.9	-16.7	20.9	0.5	6726
1976	2.8	6.7	-1.5	10.3	1.6	1.1	-0.7	4.9	4.0	15.5	2.7	6905
1977	9.3	6.9	8.7	10.2	5.7	7.8	6.5	5.4	1.7	8.6	9.0	7527
1978	7.3	-1.0	-1.4	9.1	9.6	10.2	6.4	8.8	9.8	10.5	6.8	8037

1979	6.2	6.4	2.8	8.8	3.7	2.5	6.5	6.5	8.9	7.1	5.9	8509
1980	1.4	-5.5	-3.4	-2.7	14.8	-1.3	2.7	5.1	-5.5	-4.6	2.8	8751
1981	3.2	4.4	4.9	-2.1	-1.9	-3.1	1.9	2.1	1.4	6.8	1.2	8859
1982	-3.0	4.6	8.6	-10.1	-4.3	0.7	2.4	5.1	1.4	-1.4	-4.2	8489
1983	-2.1	0.5	0.6	-7.5	1.0	-3.7	2.5	1.7	-0.3	-3.6	-2.7	8256
1984	4.9	3.8	4.3	-5.3	3.5	-2.7	6.3	2.5	-14.0	-3.0	4.1	8598
1985	1.7	-8.5	-1.1	-3.7	3.0	-1.2	7.8	4.4	-2.2	2.1	-1.5	8471
1986	4.4	9.3	0.7	-7.4	5.7	2.6	-5.7	-9.3	10.0	-2.5	5.8	8966
1987	1.6	-1.8	4.2	-8.3	8.2	-5.6	-3.4	-0.7	-7.5	2.2	1.8	9123
1988	-1.6	-6.7	2.3	1.3	3.4	-4.3	7.6	0.6	1.8	3.3	-3.4	8813
1989	-0.5	5.6	-2.5	-5.1	-4.4	-0.4	-26.3	6.1	-2.0	-0.1	-2.1	8631
1990	-13.2	-3.8	-14.1	-8.8	-6.7	-11.0	-7.5	-10.8	-7.7	-14.0	-14.8	7351

Source: SYC-93, p.136, Calculation by author

(Figure 1). Also, the regression approach gives slightly higher growth rates than the simple approach.

Figure 1: The Comparison of the GDP Per Capita 'Backcasted' by the Simple and Regression Approach (Geary-Khamis 1990 international dollars)
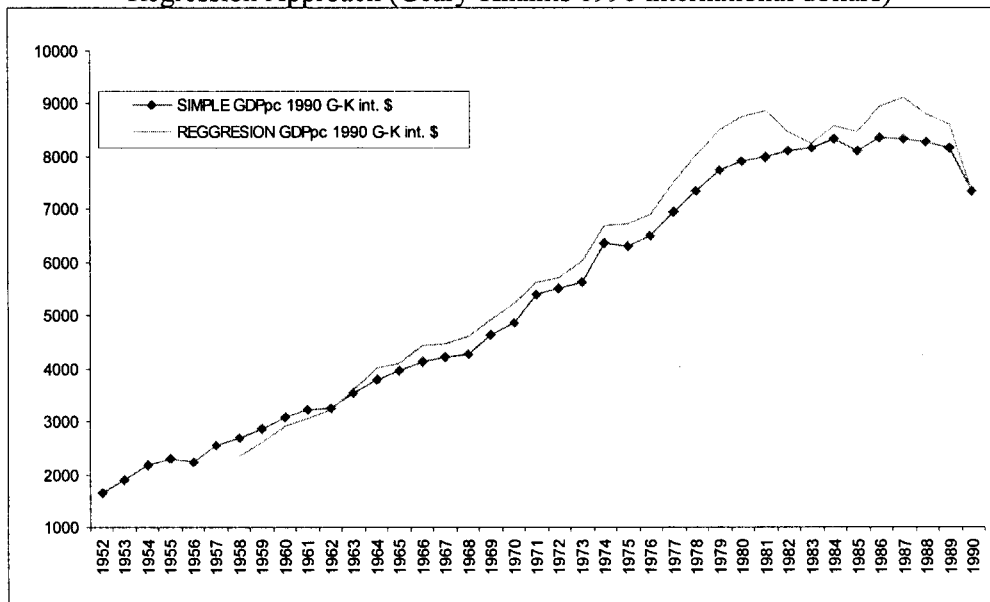
Source: Table 4 and Table5

Backcasting 1910-1952 Per Capita GDP

The data for economic performance of Croatia is not available for years 1913-1952. Therefore, three estimates of economic activity of former Yugoslavia mentioned above are used for further 'backcasting'.

Backcasting of the SA Data with the Estimated Growth Rates of Croatia

The data on GDP or any other measure of the economic activity of Croatia during 1910-1952 is not available. Therefore, growth rates of GDP per capita of Croatia were extrapolated based upon the growth rates of GDP per capita of former Yugoslavia.

The extrapolation was based on the regression analysis for the growth data during 1952-1989. Since the regression analyses were used for the SA data, the dependent variable in both regression analyses was the SA estimate. The growth rates of the social product of former Yugoslavia were used as the independent variable in the regression analysis for 'backcasting' with Stajić's and Vinski's figures (Table 6 and Equation 3).

Table 6: The Growth Rates of GDP Per Capita in Croatia (SA) vs. the Growth Rates of Social Product Per Capita of Former Yugoslavia

Growth rates of social product per capita of former Yugoslavia	DF	R^2	SEE
0.801258	35	0.450849	0.042003
9.7011836*			

*Significant at 0.05 level

Notes: second row = coefficient, third row = t statistics, DF = degree of freedom, R2 = adjusted coefficient of determination, SEE = standard error of the estimate.

Equation 3: $grGDPpc_{CRO} = 0.801258 grSPpc_{YUG}$

The GDP of former Yugoslavia was used as the independent variable in the regression analysis for 'backcasting' with Maddison's data (Table 7 and Equation 4).

Table 7: The Growth Rates of GDP Per Capita in Croatia (SA) vs. the Growth Rates of GDP Per Capita of Former Yugoslavia

Growth rates of social product per capita of former Yugoslavia	DF	R^2	SEE
0.98972	35	0.731113	0.020567
15.1233*			

*Significant at 0.05 level

Notes: second row = coefficient, third row = t statistics, DF = degree of freedom, R^2 = adjusted coefficient of determination, SEE = standard error of the estimate.

Equation 4: $grGDPpc_{CRO} = 0.98972 grGDPpc_{YUG}$

The SA data were 'backcasted' with extrapolated growth rates of Vinski, Stajić and Maddison (Table 8).

Table 8: The Estimates of GDP Per Capita in Croatia During 1910-1952 (the SA estimate with the extrapolated growth rates)

Year	Extrapolated Vinski+SA GDPpc 1990 G-K int. $	Extrapolated Čobeljić+SA GDPpc 1990 G-K int. $	Extrapolated Maddison+SA GDPpc 1990 G-K int. $
1910	1319		1211
1911	1356		1245
1912	1395		1280
1913	1434		1316
1920	1288		1182
1921	1288		1193
1922	1319		1211
1923	1372	1512	1255
1924	1404	1565	1326
1925	1456	1670	1371
1926	1528	1603	1445
1927	1477	1548	1402
1928	1559	1642	1502
1929	1641	1699	1559
1930	1590	1666	1507
1931	1530	1616	1442
1932	1407	1485	1291
1933	1428	1488	1313
1934	1459	1516	1343
1935	1408	1465	1305
1936	1533	1615	1453
1937	1533	1593	1457
1938	1645	1681	1550
1939	1696	1732	1613
1947	1566	1584	1504
1948	1800	1809	1768
1949	1929	1937	1915
1950	1803	1792	1771
1951	1832	1848	1816
1952	1655	1655	1655

Source: Calculation by author

Backcasting of the RA Data with the Estimated Growth Rates of Croatia

Just like before with the **SA** data, a regression analysis of the growth rates of GDP per capita was done with the **RA** estimate as dependant variable. The regression with

growth rates of the social product per capita was constructed for extrapolation based on the Stajić's and Vinski's growth rates. The regression with growth rates of GDP per capita of former Yugoslavia as an independent variable was constructed for the extrapolation with the Maddison's growth rates.

Table 9: The Growth Rates of GDP Per Capita in Croatia (RA) vs. the Growth Rates of Social Product Per Capita of Former Yugoslavia

Growth rates of social product per capita of former Yugoslavia	DF	R^2	SEE
0.897311	28	0.1455	0.062192
5.246738*			

*Significant at 0.05 level

Notes: second row = coefficient, third row = t statistics, DF = degree of freedom, R^2 = adjusted coefficient of determination, SEE = standard error of the estimate.

Unfortunately, the regression with the social product of former Yugoslavia as an independent variable resulted in comparatively low adjusted coefficient of determination (Table 9). Therefore, the RA estimate was 'backcasted' only with the extrapolated growth rates of Maddison (Table 10 and Equation 5).

Table 10: The Growth Rates of GDP Per Capita in Croatia (RA) vs. the Growth Rates of GDP Per Capita of Former Yugoslavia

Growth rates of social product per capita of former Yugoslavia	DF	R^2	SEE
0.786885	28	0.40733	0.076407
4.146966*			

*Significant at 0.05 level

Notes: second row = coefficient, third row = t statistics, DF = degree of freedom, R^2 = adjusted coefficient of determination, SEE = standard error of the estimate.

Equation 5: $grGDPpc_{CRO} = 0.786885 grGDPpc_{YUG}$

Table 11: The Estimates of GDP Per Capita in Croatia During 1910-1952 (The RA Estimate 'backcasted' with the Extrapolated Growth Rates)

Year	Extrapolated Maddison+RA GDPpc 1990 G-K int. $
1910	1362
1911	1401
1912	1440
1913	1481
1920	1336
1921	1346

1922	1362
1923	1402
1924	1464
1925	1504
1926	1569
1927	1531
1928	1619
1929	1667
1930	1623
1931	1567
1932	1437
1933	1457
1934	1483
1935	1450
1936	1580
1937	1583
1938	1664
1939	1718
1947	1626
1948	1852
1949	1975
1950	1857
1951	1894
1952	1761
1953	1947
1954	2011
1955	2090
1956	2039
1957	2290
1958	2349

Source: Calculation by author

Sirotković's Proposal

According to Sirotković (2002), during 1910-1952 the aggregate social product in Croatia grew more slowly, but the population growth was also smaller, which resulted in the fact that the per capita values have grown at the same pace as in former Yugoslavia (Družić and Sirotković 2002, p.162). Therefore, the SA and the RA data were 'backcasted' with the original growth rates of the economic activity published by Stajić (1957), Vinski (1967, p.163) and Maddison (2003).

Table 12: The Estimates of GDP Per Capita in Croatia During 1910-1958 (The SA and the RA Data 'Backcasted' with the Non-Extrapolated Growth Rates)

Year	Original Vinski+SA GDPpc 1990 G-K int. $	Original Stajić+SA GDPpc 1990 G-K int. $	Original Maddison+SA GDPpc 1990 G-K int. $	Original Vinski+RA GDPpc 1990 G-K int. $	Original Stajić+RA GDPpc 1990 G-K int. $	Original Maddison+RA GDPpc 1990 G-K int. $
1910	1263		1208	1119		1194
1911	1299		1242	1150		1227
1912	1336		1277	1183		1262
1913	1373		1313	1216		1298
1920	1225		1178	1085		1165
1921	1225		1190	1085		1176
1922	1263		1207	1119		1193
1923	1326	1498	1252	1175	1428	1238
1924	1364	1564	1323	1208	1490	1308
1925	1428	1694	1369	1264	1614	1353
1926	1516	1610	1444	1342	1534	1427
1927	1453	1541	1400	1286	1468	1384
1928	1554	1658	1502	1376	1580	1484
1929	1655	1729	1559	1465	1647	1541
1930	1592	1687	1506	1409	1608	1489
1931	1516	1625	1441	1342	1548	1424
1932	1364	1461	1289	1208	1392	1274
1933	1390	1463	1310	1230	1394	1295
1934	1428	1498	1341	1264	1427	1325
1935	1364	1436	1302	1208	1368	1287
1936	1516	1619	1451	1342	1542	1434
1937	1516	1591	1455	1342	1516	1438
1938	1655	1701	1550	1465	1621	1532
1939	1718	1765	1613	1521	1682	1594
1947	1554	1577	1503	1376	1503	1486
1948	1844	1857	1769	1633	1769	1749
1949	2009	2021	1918	1779	1926	1896
1950	1844	1832	1772	1633	1746	1752
1951	1882	1903	1818	1667	1813	1797
1952	1655	1655	1655	1465	1577	1636
1953				1723	1854	1855
1954				1779	1878	1933
1955				2002	2118	2030
1956				1946	2040	1967
1957				2349	2335	2275
1958				2349	2349	2349

Source: Calculation by author

Comparison and Selection of 1910-1989 Estimates

The obtained estimates were validated through a comparison with the GDP per capita level reported by David F. Good (1994) for Croatia during 1870-1913. Good made structural equitation using the GDP per capita as a dependent variable and five socioeconomic proxies as an independent variable. GDP per capita was for 12 European countries[5] which had available statistical data on GDP per capita during 1870-1910. The socioeconomic proxies, used by Good were the volume of mail per capita, the death rate, the percentage of the labour force outside agriculture, the level of real savings and the ratio of school enrollments to total population.

Three of these proxies were statistically significant: the death rate, the percentage of the labour force outside agriculture and the volume of mail per capita.. Good used them to estimate GDP per capita for the regions of Austria-Hungary Empire (Equation 6).

Equation 6: $LYP = 5.1775 - 0.26779 LCDR + 0.60893 LNAGR + 0.14225 LLET$

After GDP per capita levels for the regions of the Empire were estimated, Good estimated data for the present day boundaries of countries which were totally or partially included in the Empire (Table 13).[6]

Table 13: GDP Per Capita in Regions of Austria-Hungary Empire which are Part of Present Day Boundaries of Croatia in 1985 International Dollars

Region	1870	1880	1890	1900	1910
Littoral	745	861	966	1134	1476
Dalmatia	348	389	443	493	622
Croatia-Slavonia	312	408	448	514	697
Croatia*	**377**	**446**	**506**	**595**	**786**
Croatia/UK	18,9%	20,5%	20,3%	21,3%	27,4%
UK**	3190	3477	4009	4492	4611
Croatia* ***	**603**	**713**	**814**	**957**	**1263**

* Present day boundaries 1985 international dollars
** Maddison data in 1990 Geary-Khamis international dollars
*** Calculation by author in 1990 Geary-Khamis international dollars
Source: Good 1994, p.875-886; Maddison 2003

For the purpose of this article, GDP per capita of Croatia was converted into the 1990 Geary-Khamis international dollars through the ratio of the Croatia/UK GDP per capita that was published by Good (1994, p. 886)[7] and Good's level of GDP per capita in 1910 was used as a rejection test for ten obtained estimates. The reason for

this approach is the fact that Good's methodology is based on the socioeconomic proxy variables and the methodology in this work is based on extrapolating growth rates out of the social product, the national income and GDP data sets and estimates.

The 1910 level of the **SA** data 'backcasted' with Vinski's growth rates was the closest to Good's level (Table 14). Therefore, in an attempt to select the most reliable estimate, the logical choice would be to use Good's data for the 1870-1913, Vinski's data for the national product per capita for the 1920-1952, the **SA** estimate for the 1952-1990 and Maddison's data for the 1990-2000. This combined estimate in further text will be referred to as the GVSM estimate.

Table 14: Comparison of 1910 Level of GDP Per Capita in Croatia in Geary-Khamis 1990 International Dollars

Year	Good	Extrapolated Vinski+SA GDPpc 1990 G-K int. $	Extrapolated Maddison+SA GDPpc 1990 G-K int. $	Extrapolated Maddison+RA GDPpc 1990 G-K int. $	Original Vinski+SA GDPpc 1990 G-K int. $	Original Maddison+SA GDPpc 1990 G-K int. $	Original Vinski+R A GDPpc 1990 G-K int. $	Original Maddison +RA GDPpc 1990 G-K int. $
1910	**1263**	1319	1211	1362	**1263**	1208	1119	1194

Source: Good 1994, p. 886; Calculation by author

Figure 2: The Comparison of the Simple and the Regression Approach GDP Per Capita 'Backcasted' with the Original and the Extrapolated Growth Rates of Stajić, Vinski and Maddison (Geary-Khamis 1990 international dollars)
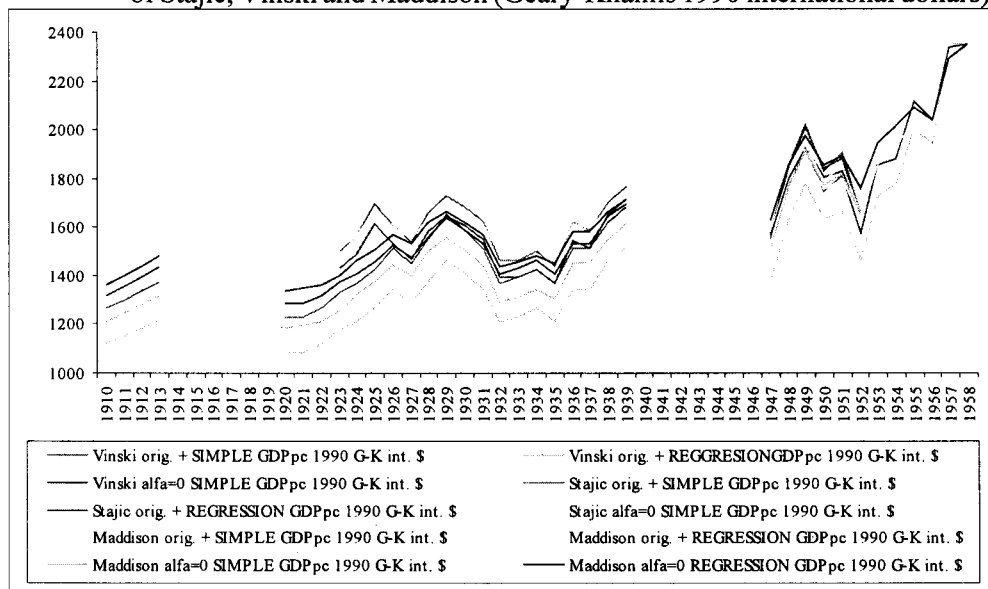
Source: Calculation by author

Comparing the GVSM Estimate with Existing Estimates

Two estimates of GDP per capita in Croatia have been published recently in Croatia (Stipetić 1999; Družić Tica 2002; Stipetić 2002; Stipetić 2003). The GVSM estimate is compared with both of them (Table 15 and Figure 3).

Table 15: Comparison of Various Estimates of GDP per capita in Croatia

Year	GVSM ESTIMATE GDPpc 1990 Geary-Khamis int. $	Stipetić GDPpc 1990 Geary-Khamis int. $	Družić/Tica GDPpc 1990 Geary-Khamis int. $
1870	603	596	n.a.
1880	713	709	n.a.
1890	814	821	n.a.
1900	957	1026	1100
1910	1263	1282	1374
1913	1373	1371	1469
1929	1655	1632	1818
1938	1655	1667	1842
1940	n.a.	1737	2323
1950	1844	1838	2052
1975	6315	5547	6457
1980	7909	7246	8275
1989	8155	7278	8183
2000	6632	6347	6632

Source: Stipetić 1999, p.119; Družić Tica 2002, p.112-113; Stipetić 2002, p.73; Stipetić 2003, p.152

During the pre-1952 period the Družić and Tica estimate is constantly at a higher GDP per capita level (Družić Tica 2002, p.112-113). The reason is difference in the recession of 1952. Družić and Tica growth rate in 1952 is also negative but much higher than in GVSM estimate, therefore in the pre-1952 period there is a higher level of GDP per capita and in the post-1952 period there is a lower level. Due to stronger slump in 1952, the Družić and Tica estimate has higher growth rates after 1952. Also, in the late seventies there is a much stronger growth and stagnation after 1980, while the **GVSM** estimate has smaller growth rates during the late seventies and slowdown in growth rates in the early eighties. The late eighties and nineties are practically identical.

Stipetić's estimation is more or less the same as the **GVSM** estimate for the 1870-1974 and rather lower in the late seventies, eighties and nineties. Difference between the two estimates is probably due to the fact that Stipetić used much older data than the one used in this paper (Stipetić 2002, p.72). At the time of the estimate,

Maddison did not publish data for the year 2000; therefore Stipetić calculated the level of GDP per capita in Croatia out of data published by "the Economist" and the OECD. Also, Stipetić's estimate was based on Maddison's previous books which contained data that were later revised and updated twice (Table 1 and Stipetić 2002, p. 73.).

Figure 3: Comparison of GDP Per Capita in Croatia in 1870-2000 by Various Authors in 1990 Geary-Khamis International Dollars
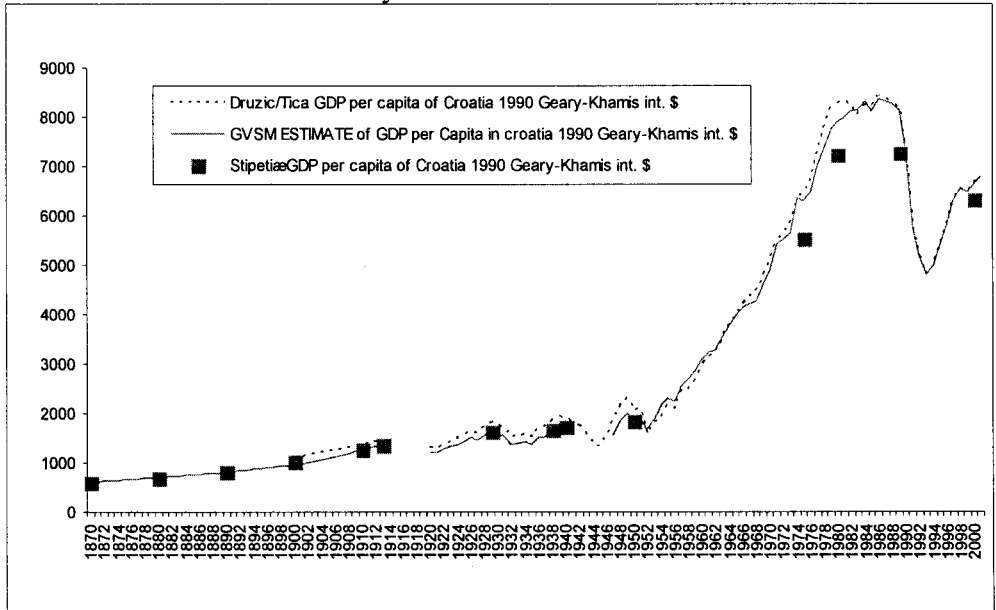
Note: Družić and Tica's estimate was recalculated in 1990 Geary-Khamis international dollars for the purposes of comparison.
Source: Stipetić 1999, p.119; Družić Tica 2002, p.112-113; Stipetić 2002, p.73; Stipetić 2003, p.152

Implication

To summarise, the 'methodology' of 'backcasting' employed in this paper used various measures of economic activity of Croatia and former Yugoslavia to estimate GDP per capita of Croatia. Two estimates of GDP per capita in 1952(8)-1990 and ten statistically significant estimates for 1910-1952(8) were obtained.

Good's data for GDP per capita of Croatia for the year 1910 was used as a selection criterion for the estimates. The logic behind this approach is the fact that Good used socioeconomic data to estimate GDP per capita of Croatia and therefore if

two different methodologies result in the same result, then they may be considered more reliable than other estimate. The official 1990 level of GDP per capita 'backcasted' to 1952 with the simple approach estimate and further 'backcasted' from 1952 to 1910 with original Vinski's growth rate resulted in the same level of 1910 GDP per capita as Good's methodology.

The selected estimate combined with Good's and Maddison's data contributes significantly to our eagerness to fill the gap in our knowledge about GDP per capita levels of Croatia and offers insight on several key issues concerning the relative backwardness of the Croatia.

According to our estimate, GDP per capita of Croatia increased by 40.2% during 1920-1939, from 1225 to 1718 Geary-Khamis 1990 international dollars. The average growth rate of Croatia during this period was 1.79%. It was bigger than in nearly all Mediterranean countries at the time, but smaller than in most of continental and north European countries. Nevertheless, the relative growth performance of Europe was rather small during the period. Compared to the US this was a period of slow convergence, and throughout the period GDP per capita of Croatia increased from 22 to 26% of US GDP per capita (Table 16).

In the post-WWII era, GDP per capita increased by 452% during 1950-1987, from 1844 to 8343 Geary-Khamis 1990 international dollars. The average growth rate of GDP per capita of Croatia during 1950-1987 was 4.16%. In Europe, only Greece and Spain grew faster than Croatia during the period. Compared to the US, Croatia converged rather fast. The ratio of Croatian/USA GDP per capita increased from 19 to 38% during the period. Croatia managed to overtake most of the central European countries, while eastern European countries lagged behind even more. Only the Mediterranean countries, Greece, Spain and Portugal kept the pace with Croatian growing performance throughout the period and reported the similar values (Table 16).

Throughout the entire period of 1870-2000, the average growth rate of GDP per capita of Croatia was 1.86%. Compared to the majority of European countries, this may be considered as an average growing performance and compared to the eastern European countries, it was even above the average growing performance. The estimate clearly confirms that after a long period of convergence, during the independence war and transition between 1987 and 1995, Croatia has rendered its converging performance (Table 16). The current economic lag of Croatia in comparison to the most of the developed countries is equally entrenched as it was in the nineteenth century (Good, 1994, p. 883). After 130 years of growth, Croatia is equally backward, when compared to the developed countries of the world.

A graphical analysis of this cross country comparison reveals much clearer notion of the Croatian growing performance. Due to the large number of countries originally compared, grouping according to similar growth patterns has been made. Grouping

resulted with some form of 'back of the envelope' formation of convergence clubs (Solow 1956; Solow 1957; , Romer and Weil 1992). Countries were grouped in six convergence clubs: Mediterranean (Greece, Spain, Portugal and Ireland[8]), Central European (Czech Republic, Slovakia, Hungary and Poland), East European (Bulgaria, Romania, Former USSR and Albania), G7, small continental (Belgium, Netherlands, Austria and Switzerland) and Nordic (Sweden, Norway, Denmark and Finland).

According to analysis, it is rather obvious that Portugal and Croatia have almost identical GDP per capita levels during 1910-1987 (Figure 4)[9]. Spain, after the stagnation during 1900-1950, has also grown at the same pace. Greece is also showing similar growth performance during 1947-1987. Ireland grew just like the Mediterranean countries during 1965-1987 and converged back to the group of countries where it was prior to 1965.

After 1987, Croatia experienced a transitional slump, while Greece, Portugal and Spain continued to grow at the same pace as before 1987, whereas Ireland became a growth miracle. It is even more appropriate to say that Ireland came back where it was prior to 1965. The growth pattern of Croatia in post-transitional period is rather similar to Hungary or Poland.

Compared to the Eastern European countries, it is obvious that Croatia has a much higher level and growth rate throughout most of the 1870-2000 (Figure 6). G7 countries (Figure 7), 'Nordic' countries (Figure 8) and small European continental countries (Figure 9) obviously do not share the common growth pattern with Croatia.

Therefore, we can conclude that there is a substantial amount of evidence that Croatia has belonged to the 'Mediterranean' convergence club before 1987 and that after the transition, Croatia converged to the a growth path of Hungary, Poland and former Czechoslovakia[10] (Figure 5).

Therefore, findings of the cross country analysis can be summarized into three major findings. Firstly, Croatia has lagged behind in comparison to North and Western Europe during 1920-1939, but in the post WWII era, development gap decreased and Croatia overtook Central European countries and left Eastern European countries behind. Secondly, before the transition the Croatian growth pattern was much closer to the growth performance of the Mediterranean countries, but during the transition, Croatia diverged away from Mediterranean countries and converged to group of lesser developed Central European countries such as Hungary, Poland, the Czech Republic and Slovakia. Thirdly, although the relative economic backwardness of Croatia is today at the same level it was in 1870, during this period Croatia was constantly converging in peace and diverging in wars, political turmoil and economic blockades. Unfortunately for Croatia, its relative growth performance throughout 1870-2000 showed a symmetry of relative progress and regress. The magnitude of destruction during these numerous periods of divergence is even more

shocking, if we have in mind the fact that compared to the set of countries in Table 16, Croatia had second highest average growth rate during 1870-1910 and third highest average growth rate during 1950-1987 and 1993-2000.

Table : GDP Per Capita (USA=100) and Average Growth Rates for Various Periods[11]

Year	1870	1913	1870-1913	1920	1939	1920-1939	1950	1987	1950-1987	1993	2000	1993-2000	1870-2000
Austria	76	65	1.45	43	62	2.83	39	70	3.91	73	71	2.23	1.85
Belgium	110	80	1.05	71	78	1.39	57	71	2.87	74	74	2.58	1.58
Denmark	82	74	1.57	72	91	2.16	73	83	2.61	81	82	2.83	1.90
Finland	47	40	1.44	33	52	3.28	44	71	3.54	63	72	4.49	2.24
France	77	66	1.45	58	73	2.10	55	76	3.14	77	74	2.05	1.87
Germany	75	69	1.61	50	82	3.53	41	72	3.85	71	66	1.68	1.80
Italy	61	48	1.26	47	54	1.64	37	69	4.00	70	67	1.89	1.96
Netherlands	113	76	0.90	76	85	1.45	63	72	2.64	76	77	2.83	1.60
Norway	59	47	1.30	50	69	2.59	57	84	3.31	85	87	2.95	2.20
Sweden	68	58	1.46	50	77	3.13	70	78	2.53	70	72	2.98	1.94
Switzerland	86	80	1.66	78	97	2.06	95	91	2.13	87	78	1.03	1.82
United Kingdom	131	93	1.01	82	95	1.70	73	71	2.18	70	70	2.73	1.41
Ireland	73	52	1.01	48	47	1.04	36	45	2.83	53	78	8.37	1.96
Greece	36	30	1.39	36	40	1.79	20	43	4.38	42	43	2.76	2.03
Portugal	40	24	0.58	22	27	1.87	22	42	4.09	47	50	3.35	2.07
Spain	49	39	1.25	39	29	-0.67	23	48	4.33	52	54	3.28	1.97
Australia	134	97	1.06	86	89	1.08	78	74	2.13	74	77	3.11	1.46
New Zealand	127	97	1.19	102	98	0.72	88	64	1.38	60	57	1.93	1.27
Canada	69	84	2.27	70	73	1.12	76	84	2.53	78	79	2.75	2.00
United States	100	100	1.82	100	100	0.88	100	100	2.25	100	100	2.62	1.90
Fmr Czechoslovakia	48	40	1.38	35	n.a.	n.a.	37	39	2.44	31	31	2.69	1.55
Hungary	45	40	1.53	31	43	2.71	26	31	2.77	23	25	3.77	1.45
Poland	39	33	1.43	n.a.	n.a.	n.a.	26	26	2.30	21	26	5.35	1.58
Fmr Yugoslavia	25	20	1.33	19	22	1.67	16	30	3.93	14	15	3.49	1.52
Fmr USSR	39	28	1.06	n.a.	34	n.a.	30	32	2.44	21	15	-1.69	1.18
Croatia	25	26	1.93	22	26	1.79	19	38	4.16	20	24	4.71	1.86
Bulgaria	34	29	1.41	n.a.	24	n.a.	17	29	3.72	21	19	1.21	1.44
Romania	38	33	1.47	n.a.	n.a.	n.a.	12	19	3.43	12	11	0.78	0.90

Average growth rates: fourth, seventh, tenth, thirteenth, fourteenth column

GDP per capita USA=100: second, third, fifth, sixth, eighth, ninth, eleventh, twelfth column

Source: Maddison 2003; Calculation by author

Figure 4: log GDP per capita of Ireland, Greece, Portugal, Spain and Croatia in 1990 international dollars
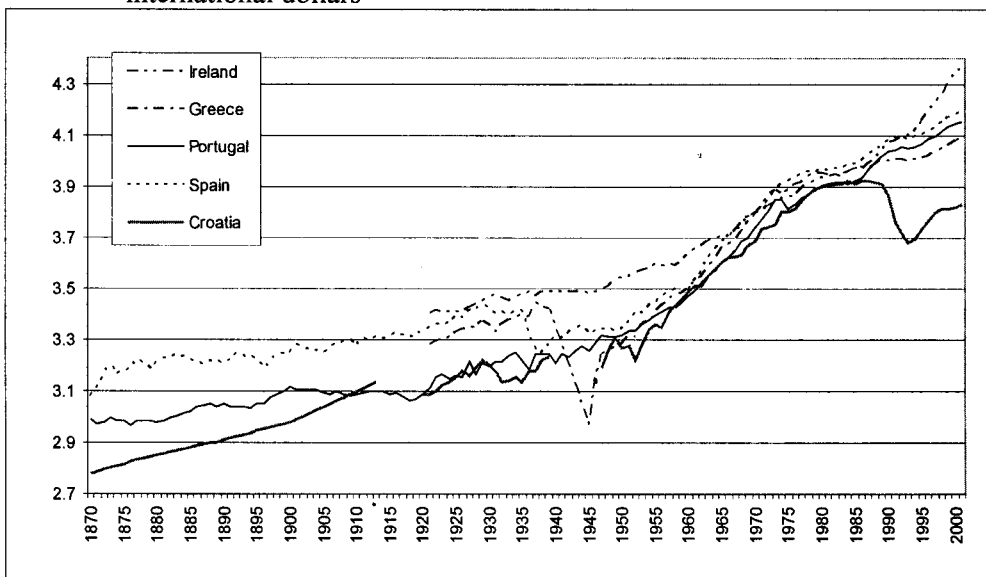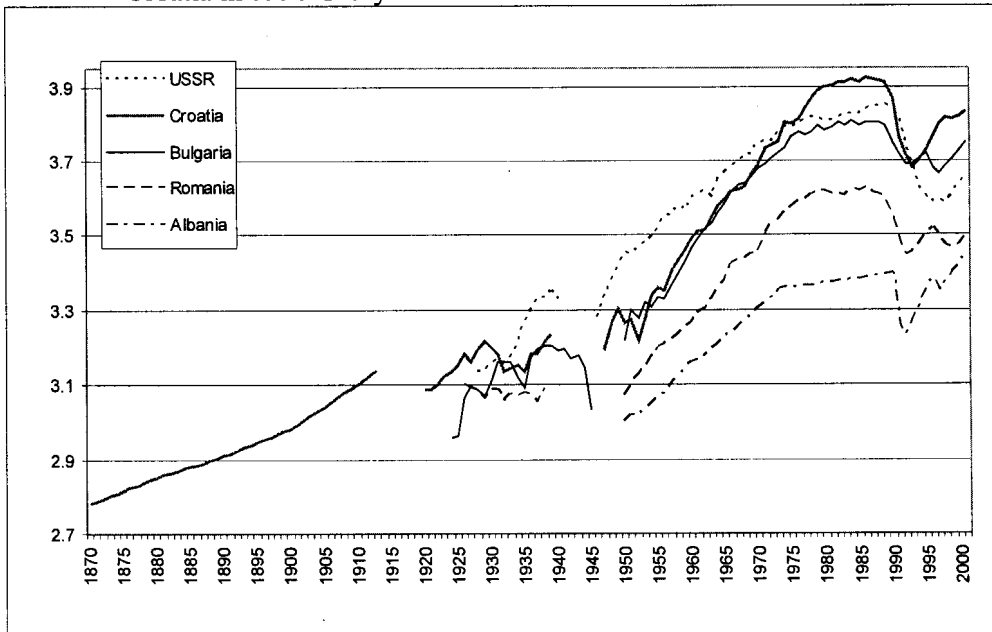

Source: Maddison 2003, Calculation by author

Figure 5: log GDP Per Capita of Former Czechoslovakia, Hungary, Poland and Croatia in 1990 Geary-Khamis International Dollars
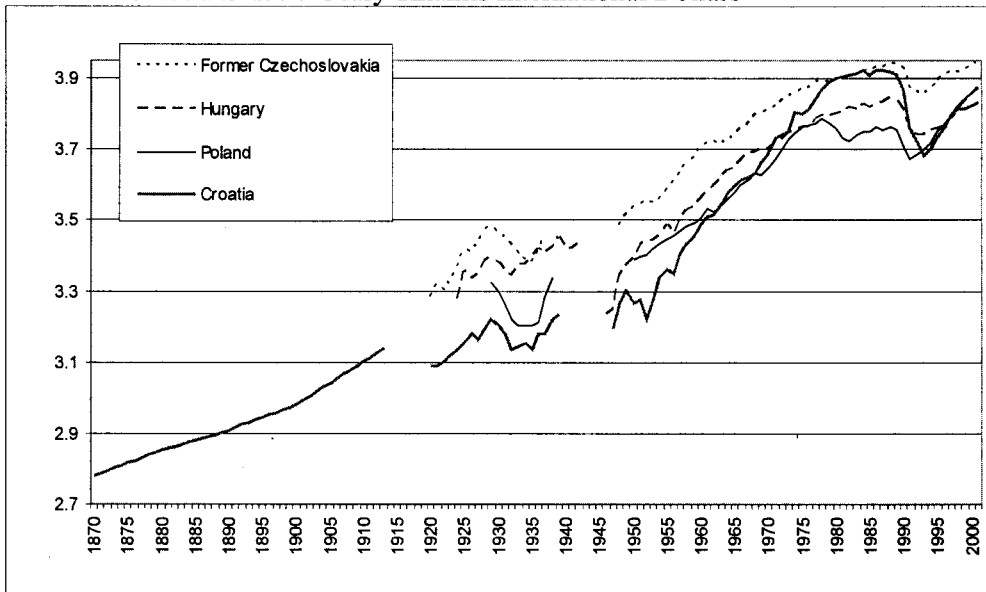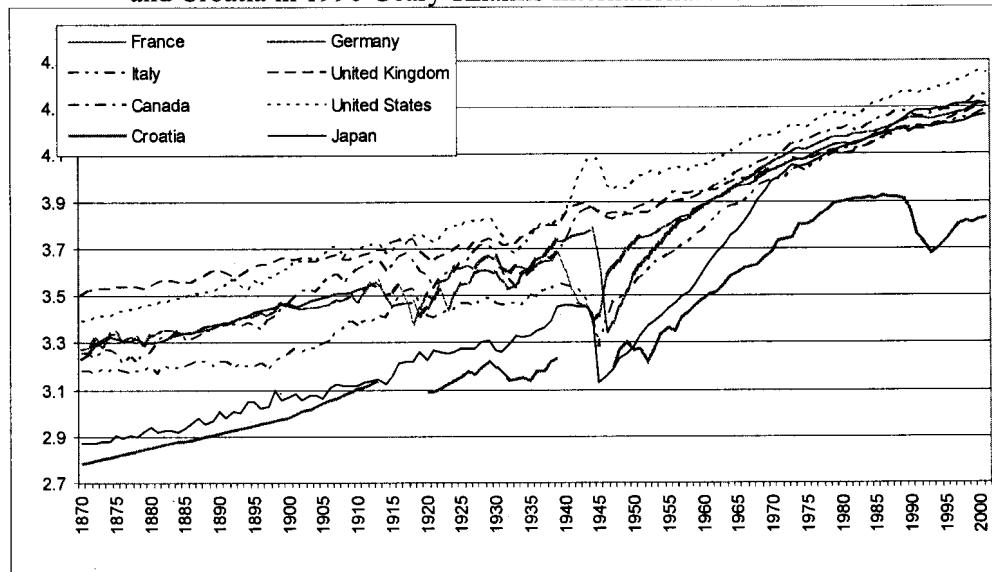

Source: Maddison 2003, Calculation by author

Figure 6: log GDP Per Capita of Former USSR, Bulgaria, Romania, Albania and Croatia in 1990 Geary-Khamis International Dollars
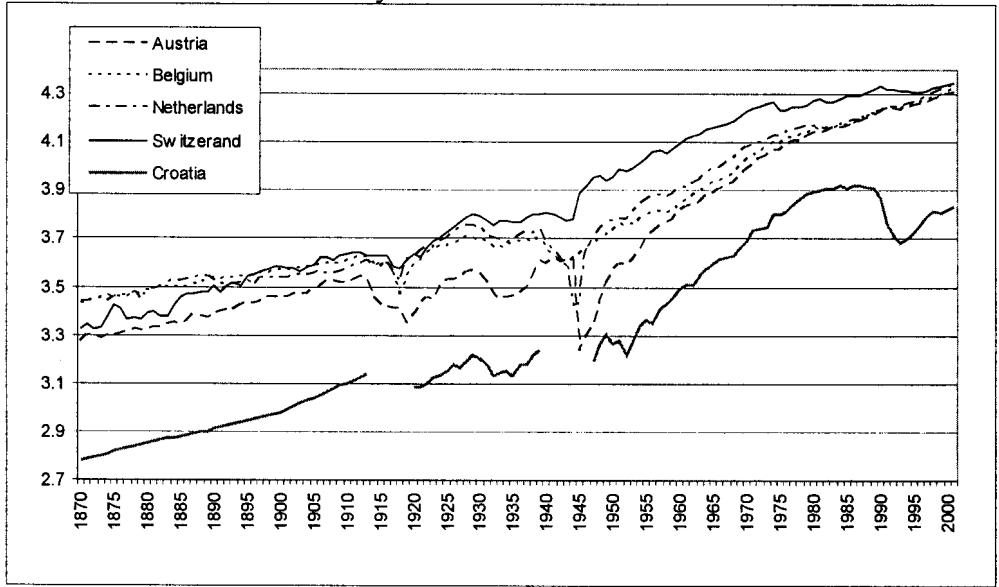

Source: Maddison 2003, Calculation by author

Figure 7: log GDP Per Capita of France, Italy, Canada, Germany, UK, USA, Japan and Croatia in 1990 Geary-Khamis International Dollars

Source: Maddison 2003, Calculation by author

Figure 8: log GDP Per Capita of Austria, Belgium, Netherlands, Switzerland and Croatia in 1990 Geary-Khamis International Dollars

Source: Maddison 2003, Calculation by author

Figure 9: log GDP Per Capita of Denmark, Finland, Norway, Sweden and Croatia in 1990 International Dollars
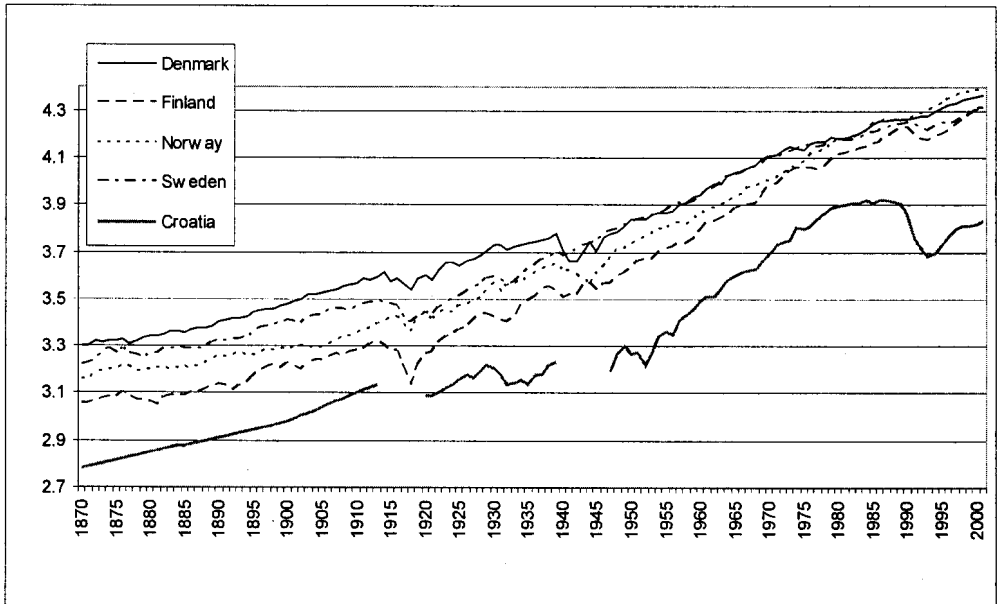
Source: 2003, Calculation by author

At the end it should be highlighted, once more, that the GVSM estimate of GDP per capita of Croatia during 1920-1990 has several limitations. The methodology used in this paper has willingly ignored three issues in order to make this estimate possible. Firstly, due to the fact that the national income data are completely lacking and prohibitively costly to generate, alternative measures of the economic activity had to be used for the estimation of GDP per capita. Since Maddison applied a similar methodology in estimating GDP per capita of former Yugoslavia and former USSR, our decision did not deteriorate the quality of estimate or the cross-country analysis. Secondly, the 'backcasting' technique ignores the fact that the quality of the data deteriorates through time. Unfortunately, this problem is unavoidable in any estimate that covers such a long span of time. The quality of the data simply deteriorates as we go further back into time. Thirdly, the Gerschenkron phenomenon was excluded in our 'backcasting' technique. In which way has the phenomenon deteriorated the quality of our estimate is impossible to predict, while the fact that deterioration increased with the distance in time is certain.

Despite of the above mentioned limitations, we believe that this study will be useful for other researchers of economic history and economic development attempting to shed light on the economic backwardness of Croatia and this region of Europe throughout the period. Furthermore, growth economists may find this estimate useful for further empirical research in the framework of growth models, conditional convergence and the prospects of growth in Croatia.

NOTES

[1] In this study the growth rate of former Yugoslavia was adjusted with the ratio of growth rates, while in my previous estimate (Tica 2003) level of GDP of former Yugoslavia was adjusted with ratio of GDP levels.

[2] David F. Good conducted structural equation in which he used pre-1914 levels of GDP per capita of the 12 European countries as an independent variable and five socioeconomic variables as dependant variables to extrapolate 1870-1910 GDP per capita estimates for the countries that were in the Austria-Hungary Empire at the time (Good, 1994: 879).

[3] In this study we have 'backcasted' the new Maddison's data set, while in our previous estimates only the old data set was published at the time (Tica 2003).

[4] In our previous estimate SA levels of GDP per capita were estimated by multiplying the level of former Yugoslav GDP per capita and the ratio of Croatian and former Yugoslav social product per capita (Tica 2003).

[5] Belgium, Denmark, Finland, France, Germany, Italy, Norway, Russia, Sweden, United Kingdom, Netherlands, and Switzerland

[6] GDP per capita levels for the years between the benchmark years in the remainder of this paper are linearly estimated by the author.

[7] This is much simpler approach than conversion with US implicit deflator (1999, p. 116)

[8] The fact that Ireland belongs to the Mediterranean convergence club do not imply that Ireland is Mediterranean country. It represents the fact that Ireland has growth pattern similar to the Mediterranean countries (Maddison 2003).

[9] In the graphical analysis of log GDP per capita data, the logarithm scale is not used due to the fact that it is creating optical illusion that everything is converging, even two parallel lines! (Under condition that lines are not horizontal or decreasing)

[10] Former Czechoslovakia is used due to the fact that Czech Republic and Slovakia don't have pre-1990 growth data as well.

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